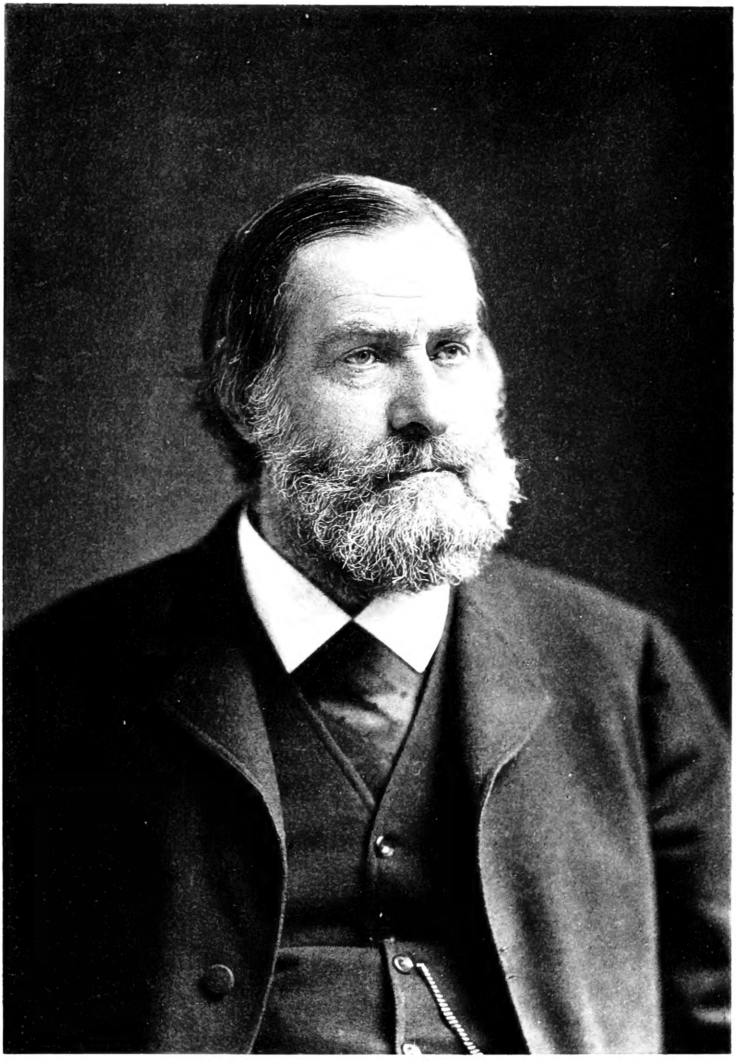

Joseph Leidy

F. GUTEKUNST, PRINT

PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1891.

JANUARY 1.

Mr. CHARLES MORRIS in the chair.

Thirty-three persons present.

A paper entitled "Basanite from Crawford Co., Ind.," by Edward Goldsmith was presented for publication.

The death of John B. Trevor, a member, December 20, 1890, was announced.

The Council reported the appointment of the following Standing Committees to serve during the current year:—

ON LIBRARY.—Joseph Leidy, W. S. W. Ruschenberger, Gavin W. Hart, Charles P. Perot and J. Bernard Brinton.

ON PUBLICATIONS.—Joseph Leidy, Angelo Heilprin, Thomas Meehan, Edward J. Nolan and John H. Redfield.

ON INSTRUCTION AND LECTURES.—Isaac C. Martindale, Harold Wingate, George A. Rex, Charles Morris and J. Bernard Brinton.

On Two New and Undescribed Methods of Contractility Manifested by Filaments of Protoplasm.—PROF. J. A. RYDER presented the results of his recent investigations of the peculiar phenomena of contractility presented by the stalk of *Vorticella* and of the body of *Trypanosoma balbiani.* The speaker pointed out that all the accounts of the mode of contraction of the stalk of *Vorticella* hitherto offered were either inadequate to account for the facts or else wholly inaccurate. No figures yet published give a correct picture of the relations of the muscular filament in a spiral, and the outer tubular sheath which invests that muscular filament. Neither has there been any correct account given of the way in which the spiral condition of the stalk of *Vorticella* is generated as a consequence of the contraction of the muscular filament.

The true state of affairs is as follows:—The muscular filament of *Vorticella* passes downward through its sheath in a spiral manner and is only in contact along a spiral line with the inside of the transparent investing sheath. The filament thus makes eight or nine complete turns within its sheath which is itself not in contact with the spiral muscular filament except along the spiral line already mentioned. It follows from this, that if this spiral line of contact is in turn traced upon the muscular filament, it will be found to describe a spiral around the latter.

In a condition of contraction it will be found that the inner faces of the spirally coiled muscular filament are in a state of greater compression than the outer ones and that therefore the inner side of the muscular filament has suffered a greater contraction of its substance than the outer. This face of the filament again is found to correspond to the face which is in spiral contact with the sheath in the uncontracted condition. But to fully satisfy the mechanical conditions of the problem, it is necessary to assume that the contractile filament of *Vorticella* is composed, as are ordinary striated muscular fibers in higher forms, of alternating and superposed disks of singly and doubly refractive plasma, or at least of a series of disks whose most contractile margins are permanently arranged in conformity with the spiral line which can be traced along the surface of the filament where it is in contact with the investing sheath. In this way alone is it possible to account for the way in which the spiral coil in the contractile stalk of *Vorticella* is generated. In this way only can it be supposed that a muscular fibre may contract at a uniform rate so as to bend continuously and constantly in two directions so as to generate a spiral in accordance with the well-known laws which preside over the generation of uniformly coiled spirals in space. After this conclusion had been deduced from an attempt at a diagrammatic construction of the spiral stalk and analysis of its components, observation of mounted preparations of *Carchesium polypinum* showed that the coiled parts of the muscular filament are actually composed of discoidal elements such as are met with in ordinary muscular fibre alternating apparently as singly and doubly refractive elements. Further study disclosed the remarkable fact that the disks of anisotropic matter are in contact along the concave or inner side of the coils and not in contact on the outer or convex sides or faces of the coils, where a wedge-shaped mass of isotropic material seems to be interposed between the outer edge of the successive anisotropic disks. This is, in fact, the condition which should have existed, *per hypothesis.*

The torsion into a spiral of the muscular stalk of *Vorticella* may have been due to the constant torsional strain of the crown of cilia vibrating constantly in a cyclical manner in one direction setting up a vortex movement, such a vortex tending constantly to maintain the torsional strain and thus add the additional spirals or twists to the new parts of the muscular stalk as the latter is lengthened by growth next to the animalcules' body. This hypothesis of torsion the speaker had not yet verified, but he had no doubt that the facts when ascertained would countenance it.

The development of a progressive spiral in either direction may be caused by rotating the wave of contraction around the center of each one of the successive disks of contractile matter, here hypothetically assumed and actually found to exist in some forms of *Vorticella.* This is of great importance in acquiring a comprehension of the generation of the spiral in *Trypanosoma balbiani*, the parasite of the alimentary canal of the oyster, as well as in the case of many spiral *Schizomycetes* and long flagella, many of which have spiral rather than a simple undulatory movement. If the contraction wave for each successive disk is a little behind or a little ahead of its next neighbor, or, what amounts to the same thing, if the revolution of these contraction waves follows a spiral line turning to the right or left, then will the spiral be generated in a sinistral or dextral manner so as to determine the direction of movement either forwards or backwards or alternately as happens in *Trypanosoma balbiani*, in which the revolutions of the organism so caused, occur with the greatest velocity. In this connection it is interesting to mention the extraordinary behavior of a string of gyrostats when set rotating in a connected series suspended one to the other. If they then be disturbed there will be generated a curious progressive cork-screw motion which will travel along the series, as pointed out by Sir William Thomson, or, as suggested to the speaker by his colleague, Prof. G. F. Barker, the analogies with some of the phenomena of the polarization of light are also interesting.

In conclusion, the speaker insisted that the type of muscular contractility presented by the muscular filament of *Vorticella* had no analogue amongst the muscular elements of higher animals, and it, therefore, constituted a type by itself, where unequally contracting disks were fixed in a spiral order.

The second form was typified by the filamentous *Trypanosoma balbiani* in which there is a rapid reversal of the spiral in a dextral or a sinistral direction and in which the contractile disks (here hypothetical) are not fixed but in which waves of contraction may be supposed to revolve, as described above, either in a sinistral or dextral direction, in order to continuously maintain the spiral condition, and also at the same time cause the spiral to apparently travel from one end of a filamentous organism or flagellum to the other. Two very distinct and constant types of filamentous muscular or plasmic contractility the speaker believed might be thus characterized with *Vorticella* and *Trypanosoma* as their types, in addition to the single ordinary form presented by the usual types of smooth and transversely striated muscular fibres.

The following was ordered to be printed:—

RESEARCHES UPON RESPIRATION.

BY HENRY C. CHAPMAN, M. D. AND ALBERT P. BRUBAKER, M. D.

No. 1.

ON THE CONSUMPTION OF OXYGEN AND THE PRODUCTION OF CARBON DIOXIDE IN ANIMALS.

Of all subjects of biological enquiry there is none, perhaps, that has attracted more attention or exceeds in importance that of the accurate determination of the consumption of oxygen and production of carbon dioxide and water in man and animals. Not only is the proper ventilation of our dwellings, lecture rooms, theatres, halls of justice, based upon such knowledge but all estimates as to the amount of radiant energy set free through the combustion of food, as determined by calorimetrical experiments, are dependent upon the same. Passing over the early observations of Boyle, Hales, Cigna, Black and Priestley which showed that the air becomes so materially modified by animals breathing it as to soon render it irrespirable unless renewed, it may be said that Lavoisier, by his classical researches, first established (1785) the modern theory of respiration and calorification, namely, that the carbon dioxide and water produced during respiration and the heat thereby set free are due to the oxidation of the carbon and hydrogen of the food. While subsequent investigations, such as those of Allen and Pepys, Milne Edwards, Despretz, Dulong, Valentin and Brunner, Boussingault and Barral, confirmed in the main the profound views announced by Lavoisier, nevertheless the differences in the results obtained were such as to induce Regnault and Reiset[1] to undertake an extended series of researches upon the respiration of different animals, more particularly with the view of determining the amount of oxygen consumed and carbon dioxide produced. The results of this elaborate investigation, it may be added, have never, in the main, been questioned. Inasmuch, however, as the water exhaled by an animal is not determined by the Regnault-Reiset apparatus, and in so far as known to the authors they are the only experimenters who have ever had the opportunity of comparing the amount of oxygen con-

[1] Recherches Chimiques sur la Respiration des animaux des diverses classes. Par MM. V. Regnault et J. Reiset, Annales de Chimie et de Physique, 3me Ser., tome XXVI, 1849.

sumed as so determined directly, with the amount absorbed as determined indirectly from the carbon dioxide and water produced, as obtained by means of a Voit respiration apparatus, it does not appear superfluous to submit the results of experimenting with the two kinds of respiration apparatus.[1]

Description of Apparatus.

The Regnault-Reiset respiration apparatus in the fulfilment of the physical and chemical requirements incidental to the construction of such apparatus, remains to this day unsurpassed. It consists essentially of the following three parts:

A central glass bell-jar or chamber for the reception of the animal, communicates on the one side with two glass pipettes containing an alkaline solution for the absorption of the carbon dioxide produced by the animal, and on the other side with a glass pipette filled with oxygen to replace that absorbed by the animal in the bell-jar.

The central glass bell-jar or chamber A, Pl. I, tubulated above and having a capacity of about 47.6 litres,[2] is cemented through its lower open portion into the inner of two grooves with which the iron-plate upon which it rests is provided. The metal plate itself presents a central opening sufficiently large for the introduction of the animal into the chamber and is hermetically closed (the animal having been introduced) by means of a circular-metal lid, the latter being tightly screwed up to the under surface of the plate by means of bolts. The inner circular portion of the metal plate and upper surface of the metal lid closing the inferior opening of the central bell-jar are painted with red lead so as to avoid any absorption of oxygen through oxidation of the metal. In order that the animal should not stand directly on the circular metal disk closing the inferior opening of the central bell-jar (which would cool it too much) a movable bottom consisting of a circular wooden disk pierced with holes upon which the animal is placed is passed up

[1] The results obtained by Voit's respiration apparatus will be presented in a subsequent communication.

[2] The absolute capacity of the jar or that of the tubes connecting it with the pipettes need not be determined since the investigation, is based upon a comparison of the composition of a given amount of the air within the jar at the beginning and at the end of the experiment and any extra amount of air within the jar as well as that in the connecting tubes can be neglected, as they are on both sides of the equation.

through the inferior opening of the bell-jar. This can be easily done as the wooden disk is somewhat smaller than the inferior opening of the jar. The circular wooden disk with the animal placed upon it, after being introduced through the inferior opening of the chamber is, slightly rotated and then lowered and comes to rest upon three pivots projecting inwardly over which the disk glides, it being sufficiently notched upon its sides for that purpose. If it be desired to preserve the urine and feces this can be accomplished by placing a circular metal pan within the space between the under surface of the wooden disk and upper surface of the iron lid closing the inferior opening of the jar into which space the excreta would otherwise fall. The central glass bell-jar or chamber, A Pl. I, with a thermometer suspended within it and containing the animal resting upon the wooden disk, the inferior opening of the jar being closed by the iron lid, is surrounded by water, the latter being held by four rectangular glass plates fitting into the outer of the two grooves with which the iron plate is provided. As it is essential that the temperature of the central bell-jar containing the animal should be maintained as constant as possible, that of the water surrounding it must be maintained equally so.

Through the upper superior portion of the central bell-jar, A Pl. I, pass four tubes L M N O. Through the tube L the jar communicates directly with the flask P containing a solution of soda or potash and indirectly with the pipette F containing the oxygen to be respired. By means of the tube M and the small mercurial manometer connected with it the pressure of the gas within the jar A can be determined from moment to moment. Through the two connecting tubes N O the jar A communicates with the two pipettes R S containing the alkaline solution for the absorption of the carbon dioxide. The accessory tube T given off from the main tube O and leading to the large mercurial manometer enables us, as we shall see presently, to draw out of the jar A a sample of gas for analysis. The iron plate with the bell-jar A is firmly supported by a heavy frame-work resting upon the floor. The two glass pipettes, Pl. I, R S, serving for the absorption of the carbon dioxide, connected through their lower extremities by an india-rubber tube and having a capacity of about three litres, are filled with a solution of caustic soda or potash whose weight and composition have been previously determined. The two glass pipettes R S are firmly attached to two metal supports. The supports are suspended by chains from the beam V and with the movement of the latter alternately ascends and descends uniformly in a vertical manner the supports moving in a frame. The beam V is moved by the eccentric X which in turn is moved by the rotation of a number of interlocking toothed wheels W the movement of the latter being due to the fallof 150 kilogrammes, through 10 metres and regulated by a fan. The relations of the wheels, weight, etc. are such as to necessitate the winding up of the weight once only in fifteen hours. The vertical movement of the pipettes just described is such that as the pipette R, for example, ascends, the solution of soda within it passes into the pipette S which descends; the air in the latter freed of its carbon dioxide passing into the jar A while the air of A loaded with carbon dioxide passes into the pipette R. On the other hand, as the pipette S ascends and R descends, the solution of soda passing from S to R, the air of the pipette R, freed of its carbon-dioxide, passes back to the jar A and the air of the latter, loaded with carbon dioxide, passes into the pipette S. In order that the absorption of the carbon dioxide by the soda be as thorough has possible a number of glass tubes, open at both ends, are placed within the pipettes, the walls of these tubes remaining moistened with soda when the pipettes have emptied themselves of the alkaline solution. They present consequently a large absorbing surface. It will be observed that as the pipette S takes air from the upper portion of the jar A and the pipette R from the lower portion, the play of the pipettes not only ensures the absorption of the carbon-dioxide in proportion as it is produced by the animal but keeps up a continual agitation of the air within the jar A which tends to maintain its composition uniform. The frames in which the glass pipettes move, together with the wheels etc. moving them, are firmly supported by a heavy metal frame-work resting upon the floor. The pipette,[1] F Pl. I, filled with oxygen by means of the tube *d*, replacing that of the jar A absorbed by the animal, has a capacity of 19,440 c. c. between the marks *b* and *c* and it communicates through its upper opening and with the flask P which in turn communicates with the jar A and, through its lower opening with a vessel *e* which receives the liquid that flows out of the pipette

[1] In the original experiments as performed by Regnault and Reiset three oxygen pipettes similar to the one described above were successively used, the experiment lasting until the last pipette was exhausted. It was found, however, by the authors, though provided with the three pipettes, that it was easier on account of the connections to refill the same pipette when necessary than to substitute for it a second pipette previously filled.

F, when the latter is filled with oxygen, and with the tube *f* into which the liquid flows that drives the oxygen out of the pipette over into the jar A. The oxygen made use of by the authors was obtained by heating in an iron retort a mixture of chlorate of potassium and black oxide of manganese and passing the gas so developed through a solution of caustic potassa. The gas so purified and further tested by explosion with hydrogen, appeared to be pure. In order to introduce the oxygen into the pipette previously filled with a concentrated solution of calcium chloride, little or no oxygen being absorbed by that liquid, the stop cock on the upper tube *d* putting the oxygen reservoir in communication with the pipette and that on the inferior tube *j* conducting the fluid away, must be opened, and as the oxygen passes into the pipette the solution of the calcium chloride flows out into the vessel *e*. The pipette should be filled under a little higher pressure than that of the atmosphere and the gas allowed to acquire the same temperature as that of the latter. By allowing a little oxygen to escape and so making its elastic force equal to that of the atmosphere, the level of the solution of calcium chloride can be brought to that of the lower mark *c*. The height of the barometer and the temperature of the oxygen must now be noted, the latter being ascertained by means of a thermometer suspended within the pipette.

After this somewhat detailed description of our respiration apparatus let us endeavor to describe the manner of conducting the experiments.

Method of Experimentation.

The oxygen pipette being filled under the atmospheric pressure H and a temperature t let V represent the capacity in litres of the pipette between the upper and lower marks and *f* the pressure of the aqueous vapor abandoned to the oxygen by the solution of calcium chloride, then the weight W of the oxygen delivered to the bell-jar supposing the pipette to be emptied to the lower mark,[1] will be given by the equation

[1] In order to be able, if necessary, to stop the experiment at any moment the pipette was graduated in litres and demilitres Owing, however, to the uncertainty as to the accuracy of the graduation incidental to the globular form and large size of the pipette it is undesirable to terminate the experiment before the pipette has emptied itself to the upper mark.

$$W = 1{\cdot}4298\ V \frac{1}{1 + 0{\cdot}00367\ t} \times \frac{H - f}{760}$$ [1]

The pressure of the vapor from the calcium chloride solution to be deducted from the barometric pressure, was accepted by the authors as being from 0·47 to 0·55 of the pressure of aqueous vapor at corresponding temperatures according as the temperatures of the oxygen varied from 16° C to 21° C, the experiments being made in winter or summer.

The pipettes for absorbing the carbon dioxide are now weighed and then filled with a solution of caustic potash or soda and then again weighed, the difference giving the weight of the solution, the amount of carbon dioxide present in the soda having been previously determined by analysis, the method of which will be described presently. The animal is now introduced, with food and drink if necessary, into the bell-jar, the walls of which have been previously moistened. In order to maintain the temperature of the water surrounding the bell-jar as constant as possible, the experiment should begin with the temperature of the water a little higher than that of the surrounding atmosphere, the heat given off by the animal compensating for that given off by the water. The lid closing the inferior opening of the jar is now screwed up and the two-way stop cocks so turned that the interior of the bell-jar is put in communication with the interior of the oxygen pipette through the intermediation of the flask P but cut off from the atmosphere, and the carbon dioxide pipettes put in motion through the descent of the weight. Let us suppose that the respiration of the animal consists simply in the consumption of oxygen and production of carbon dioxide. It is evident that in proportion as the oxygen of the chamber is consumed by the animal and the carbon dioxide produced is absorbed by the soda of the pipettes, the elastic force of the gas within the chamber is diminished and, if the chamber communicates with the oxygen pipette, the oxygen absorbed will be at once replaced by an equivalent amount of oxygen, provided that the solution of calcium chloride be added through the tube *f* to that in the oxygen pipette in quantity sufficient to maintain the elastic force of the gas equal to that of the

[1] The number 1·4298=weight of 1 litre of oxygen at standard pressure and temperature.

0·00367=coefficient of expansion for each deg. C.

760.=standard barometric pressure in millimetres of mercury.

atmosphere. This successive addition of the solution of calcium chloride is accomplished by putting the tube of the oxygen pipette in communication with the reservoir G containing a concentrated solution of calcium chloride, the level of which is maintained very nearly constant by means of the three glass flasks 1, 2, 3 filled with the same solution and which empty themselves successively as the level of the fluid in the reservoir falls, the flasks differing slightly from each other in the length of their necks. In proportion as the oxygen in the pipette becomes rarefied the liquid column in the tube falls and the elastic force of the air in the tube diminishes, the consequence of which is that the solution of calcium chloride flows from the reservoir into the tube and thence into the pipette. Nevertheless the elastic force in the chamber does not remain constant during the time that the pipette furnishes oxygen. It diminishes in proportion as the pipette becomes filled with the solution of calcium chloride, that is if such solution was at the same level in the tube and the pipette at the moment that the former was cemented to the tube leading from the reservoir, the pressure of the air within opposing the flow from the reservoir[1]. As a matter of fact, however, the variations due to the cause just mentioned may be restricted to very narrow limits by simply raising the level of the solution in the tube a few inches higher than that of the solution in the pipette before joining the tube to that leading from the reservoir. By so doing an excess of pressure of the gas within the chamber of about 1 centimeter is maintained which is of advantage in compensating for the small amount of carbon dioxide 1 to 2 per cent always present in the chamber notwithstanding the constant play of the pipettes for the absorption of the latter. It should be mentioned, however, in this connection that absolute constancy of pressure can not be maintained since variations in barometric pressure modify that of the gas within the chamber. Towards the end of the experiment, when there only remains about 300 cubic centimeters of oxygen in the pipette, the tubes are disconnected and the solution of calcium chloride poured into the tube until the solution in the pipette rises to the level of the upper mark when the stop cock on the tube is turned off. By this time there is an excess of pressure within the chamber of about 2 to 3 per cent and while the oxygen corresponding to this ex-

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[1] That such is the case is shown by disconnecting the tubes for a moment after the flow from the reservoir has ceased, for in connecting them again the flow at once begins.

cess is consumed by the animal, plenty of time is afforded for making the temperature of the water and therefore of the chamber the same as at the beginning. By observing the fall of the mercury in the gauge the requisite number of millimetres of mercury is obtained which, if added to or subtracted from the observed barometric pressure, makes the final equal to the initial pressure.[1]

During this time also a sample of the gas of the chamber is drawn off for analysis.

In order to draw off a sample of gas from the chamber for analysis the tube already referred to as being given off from the tube T is put in communication with the large mercurial manometer. In this case as the mercury flows out the gas flows into the manometer whence, as will be presently described, it is transferred for analysis to the Hempel burettes. It is indispensable that the sample of gas should be drawn from the chamber as the pipette R ascends, inasmuch as at that moment the gas of the chamber loaded with carbon dioxide passes into that pipette and consequently into the manometer. If the sample was drawn as the pipette descends, the gas so obtained being freed of its carbon dioxide would not represent the composition of the gas within the chamber. The sample of gas having been drawn from the chamber at the moment that the pressure of the gas was the same as at the beginning of experiment the movement of the pipettes for the absorption of the carbon dioxide is stopped. The animal is removed and weighed together with food and excreta and the pipettes at once also weighed. The increase in weight of the pipettes at the end of the experiment as compared with their weight at the beginning represents both the carbon dioxide absorbed and the hygrometric water fixed by the concentrated solution of soda. The weight of the carbon dioxide contained in the solution of soda is then determined by analysis and deducting therefrom the the weight of the carbon dioxide that the solution contained at the beginning of the experiment as previously determined, the difference will be the weight of the carbon dioxide absorbed during the experiment by the solution of soda. This weight added to that of the carbon dioxide remaining in the chamber at the end of the experiment as determined by analysis of the sample drawn from the cham-

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[1] If for convenience it be necessary to terminate an experiment at any moment, and a difference still exists between the final and initial temperatures, and between the final and initial pressures, the error so arising, due to the initial volume of the gas of the chamber being thereby increased or diminished, must be taken into consideration in the summing up of the general results.

ber will give the total weight of the carbon dioxide produced by the animal. It is evident if during the experiment, oxygen has only been consumed and carbon dioxide only produced, the latter being as rapidly absorbed as produced, that the composition of the gas of the chamber will be the same at the end as at the beginning of the experiment. That the gas of the chamber during the experiment does not differ to any great extent from that of the atmosphere is shown not only by the analysis of the air but from the fact that the animals do not experience any discomfort even after a much longer sojourn in the chamber than that to which they were subjected in the experiments by the authors. It should be added in this connection that the air of the chamber is neither altered by the food nor excreta of the animal. Let us consider now the data at our disposal by means of which the composition of the air of the chamber at the beginning and end of the experiment can be determined. The volume of air at the beginning of the experiment is equal to that which is contained in the chamber, in the pipettes for the absorbing of the carbon dioxide, and in the connecting tubes less the volume of air displaced by the animal and food which are introduced into the the chamber. The determination of both the latter volumes when the density of the food can not be determined, can only be made approximately but in taking it as equal to the volume of air displaced by an equal weight of water the error committed can be but slight. This is equally true at the end of the experiment, for apart from the oxygen consumed and carbon dioxide produced and nitrogen present being in relatively large quantities it must be remembered that by far the greatest part of the food consumed is still present either within the animal or in its excreta. Indeed the only part of the food actually disappearing and which diminishes its volume is that entering into the formation of the carbon dioxide and which must in any case occupy less volume than the water having the same weight as the carbon dioxide produced. Let V represent the volume in litres of the air of the chamber on the supposition that the animal has just been enclosed within the latter, H the elastic force of that air, at its temperature, f the pressure of the aqueous vapor at that temperature to be deducted from H, it acting in opposition to it, then the weight of the oxygen and nitrogen that the chamber contains at the beginning of the experiment can be determined by substituting in the following equations

$$\text{Weight of oxygen} = 0{\cdot}2095.\ 1^{gr.},4298.\ V.\ \frac{1}{1+0{\cdot}00367.t}.\ \frac{H-f}{760}$$

$$\text{Weight of nitrogen} = 0{\cdot}7905.\ 1^{gr.},2562.\ V.\ \frac{1}{1+0{\cdot}00367.t}.\ \frac{H-f}{760}$$

the values of V, H, t and f obtained by observation; 0·2095 and 0·7905 representing the amounts of oxygen and nitrogen per volume in 100 volumes of air and $1^{\cdot gr\cdot}4298$ and $1^{\cdot gr\cdot}2562$ the weight of a litre of oxygen and nitrogen respectively at standard pressure and temperature. At the end of the experiment H, t and f being made the same as at the beginning, the total volume of air then within the chamber will be unchanged its composition having been modified by the amount of carbon dioxide or other gases produced and remaining in the chamber. The weight of carbon dioxide oxygen and nitrogen or other gases present in the chamber at the end of the experiment is then determined by multiplying the weight of the gases obtained from the sample of gas drawn from the chamber by the ratio of the volume of air of the chamber V to that of the sample v. Let us suppose that C, O and N represent the weight of the carbon dioxide oxygen and nitrogen in the sample of air drawn from the chamber and that $\frac{V}{v}=M$; then CM, OM and NM will be the weight of the carbon dioxide, oxygen and nitrogen in the chamber at the end of the experiment. The weight of the carbon dioxide present in the chamber must be added as already mentioned to that obtained from the pipettes to obtain the total amount of carbon dioxide produced while the weight of the oxygen remaining in the chamber must be deducted from the sum of the weight of oxygen present in the chamber at the beginning of the experiment and that delivered to the chamber during the experiment to obtain the total weight of oxygen consumed. Finally the increase or diminution in the weight of the nitrogen within the chamber at the beginning and end of the experiment amounting to perhaps the 0·02 of a gramm the authors regard as being due to errors in the eudiometrical readings rather than as nitrogen exhaled or inhaled by the animal, the amount of nitrogen in the chamber present being the same at the end as at the beginning of the experiments.

Method of Determining the Weight of the Carbon Dioxide Absorbed by the Solution of Soda in the Pipettes.

The method made use of by the authors in determining the weight of the carbon dioxide absorbed by the soda solution in the pipettes was essentially that recommended by Regnault. It depends upon the decomposition of the sodium carbonate in the solution through the addition of sulphuric acid and the reabsorbing of the carbon dioxide so set free by passing the latter through bulbs, etc. containing soda, the increase in the weight of the bulbs giving the weight of the carbon dioxide absorbed. The apparatus represented in F Plate II consists of a litre flask B into which is poured a sample of the soda solution from the pipettes to be analyzed. Through the cork closing the flask pass three tubes, the first tube communicates with the U shaped tube A containing soda and pumice stone for the absorption of the carbon dioxide in the air that passes through the apparatus at the end of the experiment. The second tube serves for the introduction of the sulphuric acid which should be a little less dense than the alkaline solution and added gradually to the latter, the mixture being slowly heated by gas jets to boiling. The third tube communicates with the narrow flask C containing concentrated sulphuric acid, the latter communicating in turn with the tube D containing pumice stone and sulphuric acid for drying the air and through which the carbon dioxide developed passes on its way to the Liebig bulbs E containing a concentrated solution of soda and the tube F containing pumice stone and small pieces of caustic soda. The remaining tubes G and H contain pumice stone and concentrated sulphuric acid. The increase in weight of the three tubes E F and G at the end of the experiment, the tubes having been previously weighed at the beginning, gives the weight of the carbon dioxide absorbed. To ensure accuracy in the weighing of the tubes E, F, G three similar tubes disposed in the same manner and displacing an equal volume of air should be used as counter weights.

The tube H containing pumice stone and sulphuric acid serves to prevent the moist air depositing water in the tube G. Finally by means of the aspirating jar I a current of air is made to pass through the apparatus and of so carrying the last traces of carbon dioxide to the soda solution absorbing it. In order to maintain the tubes firmly bound together and to facilitate their connection and disconnection they are all clamped to a solid wooden framework by means of which they can all be removed together and in position when desirable. The weight of the carbon dioxide previously existing in the soda solution placed in the pipettes at the beginning of the experiment for absorption of the carbon dioxide produced by the animal is determined by means of the same apparatus and must of course be deducted from the weight of the carbon dioxide absorbed, present in the soda solution at the end of the experiment.

It has already been mentioned, that by means of the accessory tube T Pl. I given off by the tube leading from the chamber, to the carbon dioxide pipette R, that a sample of gas can be drawn into the large mercurial manometer. By so turning its three-way stop cock, as to let the mercury flow out, the sample so obtained is afterwards driven over to the absorbing or explosion apparatus for analysis. This is accomplished by pouring mercury into the limb of the manometer opposite that containing the sample, the three-way stop cock being so turned as to put both limbs in communication and then of retransferring to the manometer for determination of volume of gases absorbed. The method made use of by the authors, however, in order to expedite the analysis is to draw the sample of gas from the chamber directly into a Hempel graduated burette B[1] filled with mercury, the latter, Plate III, Fig. 1, flowing out of the burette as the mercurial reservoir A with which the burette communicates is lowered by means of the wheel work C attached to the solid wooden frame fastened to the table. The sample of gas so obtained reduced to standard temperature and pressure is then driven out of the burette B by elevating the mercurial reservoir into a Hempel pipettte F containing a concentrated solution of soda and after remaining there long enough for the absorption of any carbon dioxide present is driven back into the graduated burette by lowering the mercurial reservoir, the diminution in volume, the latter reduced to standard temperature and pressure, representing the carbon dioxide absorbed. The pipette for the absorption of the carbon dioxide being removed, the burette is connected with one containing pyrogallic acid into which the sample of gas just freed of its carbon dioxide is driven by elevating the reservoir and in which it is allowed to remain until the oxygen present is absorbed. The sample of gas being then driven back into the graduated burette by lowering the reservoir the diminution in volume, reduced to standard temperature and pressure, represents the volume of oxygen absorbed. The volume of gas now remaining in the burette the authors regarded as consisting of nitrogen. At least the volume of residual gas in the burette was

[1] Neue Methoden für Analyse der Gase, von Dr. W. Hempel, Braunschweig, 1880.

usually such as it ought to be on the supposition that it was nitrogen, and as can be shown experimentally by transferring the gas to the Explosion Apparatus Plate III, Fig. 2. The connection with the burette containing the gas is made with that limb of the apparatus A which has been previously filled with a solution of soda the latter being forced up by the mouth applied at the end of the other limb F and the latter then clamped. A known volume of oxygen being then introduced, and a sufficient volume of detonating gas developed electrolytically by means of three Daniell cells connected with the platinum plates, through the binding screws H H the gaseous mixture is exploded by connecting a Ruhmkorff apparatus with the platinum terminals G G. The fact of there being no diminution in the volume of the residual air as ascertained by transferring the gas back to the graduated burette proves the absence of at least hydrogen, heavy carburetted hydrogen, C_2H_4 and light carburetted hydrogen or marsh gas, CH_4 the gases which are the most likely to be present, the two former coming from the rectum of the animal the latter from its food. That there is no free hydrogen[1] is further shown in the absence of absorption on passing the residual gas through palladium. The following tabulated actual experiment will serve to illustrate the general method and order of experimentation.

Experiment No. 17.
Oct. 29th, 8.45 *P. M.*
2 PIGEONS.

BEGINNING OF EXPERIMENT.

Weight of animal	$0^{\cdot kil.}567$
" " food	$0^{\cdot kil.}000$
Barometer	$748^{mm.}$
Temp. of Chamber	18°C
Pressure of Aq. Vap.	15°·35
Vol. of Gas of Chamber at standard temp. = and pressure	$\overset{\text{LIT.}}{47{\cdot}6 - 0{\cdot}567} \cdot \dfrac{748 - 15{\cdot}35}{760\,(1 + 00367{\cdot}18)} = \overset{\text{LIT.}}{42{\cdot}53}$

[1] Were these gases present in the residual air then after explosion with oxygen water and carbon dioxide would be formed and retained in the pipette the volume of the gas being consequently diminished. It should be mentioned, however, in this connection that it is extremely difficult whatever the kind of apparatus used, to determine such very small volumes of hydrogen or carburetted hydrogen or marsh gas as are likely to be present in the sample of gas drawn from the chamber for analysis and in neglecting to take these gases into account no very sensible error, at least in most instances, will be introduced into the result.

		GRAMMES.
Weight of Oxygen in Chamber.	= 0·2095 1·4298 gr. 42·53	= 12·739
Weight of Nitrogen in Chamber	= 0·7905 1·2562 gr. 42·53	= 42·220
Temp. of Oxygen in Pipette		19°
Pressure of Aq. Vap. aband. by Calcium Chloride sol.		7·mm·679

		GRAMMES.
Weight of Oxygen in Pipette.	= 1·4298 gr. 19·440 $\frac{748-7\cdot67}{760\,(1+00367\cdot19)}$	= 25·297
Weight of Pipettes and Soda sol.		= 7683·000
" "		= 6238·000
" Soda sol. or difference		= 1445·000
Sample of Soda sol. analyzed = 140· cc		
Weight of tubes at end		= 258·35
" " beginning		= 257·50
Carbon dioxide absorbed or difference		= 000·85
Carbon dioxide in Soda sol. used		= 8·77

End of Experiment.

Duration of experiment	21 hours.
Weight of animal	= 0·529
" excreta	= 0·038
	MM.
Barometer	758
Pressure in gauge	10
Elastic force of gas in chamber	748
Temperature of chamber	18°C
	LIT.
Vol. of gas of chamber at standard temp. and press.	= 42·53

Analysis of Sample Gas.

Barometer	762·mm·6
Temperature of laboratory	18°5

Pressure of aq. vapor		15·mm·8
Vol. of sample of gas at observed temp. and press.	=	71 cc
Vol. of sample reduced to stand. temp. and press. before absorption of carbon dioxide.	=	65·32 cc
Vol. of sample after absorption of carbon dioxide.	=	64·40 cc
Carbon dioxide absorbed.	=	00·92 cc
Vol. of sample after absorption of Oxygen.	=	51·71 cc
Oxygen absorbed.	=	12·69 cc

COMPOSITION OF GAS OF CHAMBER.

$$\frac{\text{Volume of Gas of chamber.}}{\text{Volume of Gas of sample.}} = \frac{42530}{65{\cdot}32} = 651$$

		LIT.		GRAMMES.		
0·92 651	=	0·6 1·966	=	1·179	= Carbon dioxide.	In chamber.
12·69 651	=	8·2 1·429	=	11·789	= Oxygen.	
51·71 651	=	33·6 1·256	=	42·238	= Nitrogen.	

	Composition per volume.	Composition per cent.
Carbon dioxide.	0·60	1·4
Oxygen.	8·25	19·5
Nitrogen.	33·62	79·1
	42·47	100·0

		GRAMMES.
Weight of Oxygen delivered to chamber from Pipette	=	25·297
" " in chamber at beginning of exp.	=	12·739
" " available	=	38·036
" " in chamber at end of exp.	=	11·789
" " consumed by animal	=	26·247
" " " " " per hour	=	1·249
" " " " " " " per kilo.	=	2·202
" Pipettes and Soda sol.	=	7712·000
" "	=	6238·000
" Soda sol. or difference	=	1474·000

Weight of sample of Soda. sol. analyzed 140 cc		
" Tubes at end	=	257·72
" " at beginning	=	254·20
Carbon dioxide absorbed or difference	=	003·50
1474 gr. of Soda sol. at end contained Carbon dioxide	=	37·060
1445 " " at beg. " "	=	8·770
Carbon dioxide produced by animal	=	28·280
" " absorbed by Soda sol. rem. in chamber	=	1·179
Total CO_2 produced by animal	=	29·459
Weight of Oxygen in Carbon dioxide produced	=	21·424

$$\frac{\text{Weight of Oxygen in Carbon dioxide produced}}{\text{Weight of Oxygen consumed}} = \text{Resp. Quot.} = \frac{21{\cdot}424}{26{\cdot}247} = 0{\cdot}816$$

Weight of Nitrogen in chamber at beginning	=	42·22
" " " at end	=	42·20
		00·02
W. of CO_2 produced by animal per hour	=	1·402
W. of CO_2 produced per hour per kil. of animal	=	2·472

In order to test the accuracy of the method of experimentation just described by control experiments the authors burned within the chamber a given weight of stearic acid. $6^{\cdot gr \cdot}7$ of stearic acid ($C_{18}H_{36}O_2$) when burned should theoretically produce 18·9 gr. CO_2. When burned in the chamber of the respiratory apparatus, that amount of stearic acid actually produced 18·5 gr. of CO_2. The loss $0^{\cdot gr \cdot}4$ CO_2 or 2·1. pc. was not, therefore, greater than what might been have anticipated.

The animals experimented with, rabbits, monkeys, pigeons, turtles, enjoying good health at the beginning of the experiment, did not appear to suffer in any way from their sojourn in the chamber of the respiratory apparatus. The food placed in the chamber when the animals had not been previously fed was in some instances not eaten, the animal apparently not being then hungry. The period of experimentation extended through the winter, spring and summer months of 1890. The hour of experiment selected, day or night, depended upon the convenience and the amount of time at the disposal of the experimenters.

Experiment No. 1.
Jan. 15th.
RABBIT.

Weight of animal	2.kil.5
Weight of food	0.kil.0
Duration of experiment	7 hours, day.
Difference between the initial and final temperature of the gas of the chamber	+0°.5 C.
Difference between the initial and final pressure of the gas of the chamber	1.mm.5

Composition of gas of chamber at the end of the experiment		Composition per cent	
Carbon dioxide	0·807	Carbon dioxide	2·00
Oxygen	7·331	Oxygen	18·00
Nitrogen	33·737	Nitrogen	80·00
	41·875		100·00

	GRAMMES.
Weight of oxygen consumed	15·994
Weight of carbon dioxide produced	19·762
Weight of oxygen contained in the carbon dioxide	14·372
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·898
Weight of oxygen consumed per hour . . .	2·284
Weight of oxygen consumed per hour per kilogramme of animal	0·913
Weight of carbon dioxide produced per hour .	2·823
Weight of carbon dioxide produced per hour per kilogramme of animal	1·129

Experiment No. 2.
Jan. 20th.
RABBIT.

Weight of animal	2.kil.4
Weight of food, turnips	0.kil.4
Duration of experiment	12 hrs. 45 min. night.
Difference between the initial and final temperature of the gas of the chamber	+0°.5
Difference between the final and initial pressure of the gas of the chamber	+6mm.

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	0·649	Carbon dioxide	1·6
Oxygen	7·755	Oxygen	19·0
Nitrogen	32·333	Nitrogen	79·4
	40·737		100·0

	GRAMMES.
Weight of oxygen consumed	31·53
Weight of carbon dioxide produced	35·26
Weight of oxygen contained in the carbon dioxide	25·65
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·81
Weight of oxygen consumed per hour	2·48
Weight of oxygen consumed per hour per kilogramme of animal	1·03
Weight of carbon dioxide produced per hour	2·76
Weight of carbon dioxide produced per hour per kilogramme of animal	1·15

Experiment No. 3.

Jan. 24th.

RABBIT.

Weight of animal	2.kil.3
Weight of food	0.kil.0
Duration of experiment	7·5 hrs., day.
Difference between the initial and final temperature of the gas of the chamber	0°·5 C.
Difference between the initial and final pressure of the gas of the chamber	+10mm.

Composition of gas of chamber at the end of the experiment		Composition per cent	
Carbon dioxide	0·448	Carbon dioxide	1·00
Oxygen	8·655	Oxygen	20·10
Nitrogen	34·036	Nitrogen	78·90
	43·139		100·00

	GRAMMES.
Weight of oxygen consumed	9·219
Weight of carbon dioxide produced	10·706
Weight of oxygen contained in the carbon dioxide	7·786

Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·844
Weight of oxygen consumed per hour . . .	1·229
Weight of oxygen consumed per hour per kilogramme of animal	0·534
Weight of carbon dioxide produced per hour .	1·427
Weight of carbon dioxide produced per hour per per kilogramme of animal	0·620

Experiment No. 4.
Feb. 3rd.
RABBIT.

Weight of animal	2·kil·6
Weight of food	0·kil.
Duration of experiment	7·5 hrs., day.
Difference between the initial and final temperature of the gas of the chamber . . .	+2°C.
Difference between the initial and final pressure of the gas of the chamber	1·mm·8

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	0·983	Carbon dioxide	2·3
Oxygen	7·244	Oxygen	17·3
Nitrogen	33·787	Nitrogen	80·04
	42·014		100·00

	GRAMMES.
Weight of oxygen consumed	15·00
Weight of carbon dioxide produced . . .	19·80
Weight of oxygen contained in the carbon dioxide	14·40
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·96
Weight of oxygen consumed per hour . . .	2·00
Weight of oxygen consumed per hour per kilogramme of animal	0·70
Weight of carbon dioxide produced per hour .	2·64
Weight of carbon dioxide produced per hour per kilogramme of animal	1·01

Experiment No. 5.
Feb. 5th.
RABBIT.

Weight of animal	2·kil.3
Weight of food, turnips	0·kil.2
Duration of experiment	. 11 hours, day.
Difference between the initial and final temperature of the gas of the chamber	+1° C.
Difference between the initial and final pressure of the gas of the chamber	+4·mm·4

Composition of gas of chamber at the end of the experiment			Composition per cent
Carbon dioxide	0·886	Carbon dioxide	2·1
Oxygen	7·763	Oxygen	18·7
Nitrogen	32·853	Nitrogen	79·2
	41·502		100·0

	GRAMMES.
Weight of oxygen consumed	22·534
Weight of carbon dioxide produced . . .	28·132
Weight of oxygen contained in the carbon dioxide	20·459
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·907
Weight of oxygen consumed per hour . . .	2·048
Weight of oxygen consumed per hour per kilogramme of animal	0·890
Weight of carbon dioxide produced per hour .	2·557
Weight of carbon dioxide produced per hour per kilogramme of animal	1·111

Experiment No. 6.
Feb. 7th.
RABBIT.

Weight of animal	2·kil.5
Weight of food	0·kil.0
Duration of experiment	9 hrs.
Difference between the initial and final temperature of the chamber	+1°C²
Difference between the initial and final pressure of the gas of the chamber	+8mm.

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	0·919	Carbon dioxide	2·15
Oxygen	7·849	Oxygen	18·37
Nitrogen	33·963	Nitrogen	79·48
	42·731 Lit.		100·00

	GRAMMES.
Weight of oxygen consumed	18·526
Weight of carbon dioxide produced	24·010
Weight of oxygen contained in the carbon dioxide	17·470
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·957
Weight of oxygen consumed per hour	2·058
Weight of oxygen consumed per hour per kilogramme of animal	0·823
Weight of carbon dioxide produced per hour	2·668
Weight of carbon dioxide produced per hour per kilogramme of animal	1·067

Experiment No. 7.
Feb. 10th.
RABBIT.

Weight of animal	2·kil.2
Weight of food, turnips	0·kil.2
Duration of experiment	11 hours, night.
Difference between the initial and final temperature of the gas of the chamber	0° C.
Difference between the initial and final pressure of the gas of the chamber	+5mm.

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	0·823	Carbon dioxide	2·00
Oxygen	7·279	Oxygen	17·00
Nitrogen	34·956	Nitrogen	81·00
	43·058		100·00

	GRAMMES.
Weight of oxygen consumed	20·53
Weight of carbon dioxide produced	24·60

Weight of oxygen contained in the carbon dioxide	17·90
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·87
Weight of oxygen consumed per hour . . .	1·86
Weight of oxygen consumed per hour per kilogramme of animal	0·84
Weight of carbon dioxide produced per hour . .	2·23
Weight of carbon dioxide produced per hour per kilogramme of animal	1·01

Experiment No. 8.

Feb. 14*th.*

RABBIT.

Weight of animal	$2^{\cdot kil.}5$
Weight of food, fed before experiment . . .	
Duration of experiment	1·15 hrs., night.
Difference between the initial and final temperature of the gas of the chamber . . .	0° C.
Difference between the initial and final pressure of the gas in the chamber	$+11^{mm.}$

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	0·889	Carbon dioxide	2·00
Oxygen	7·946	Oxygen	19·00
Nitrogen	32·911	Nitrogen	79·00
	41·646		100·00

	GRAMMES.
Weight of oxygen consumed	21·58
Weight of carbon dioxide produced . . .	26·75
Weight of oxygen contained in the carbon dioxide	19·45
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·90
Weight of oxygen consumed per hour . . .	1·86
Weight of oxygen consumed per hour per kilogramme of animal	0·74
Weight of carbon dioxide produced per hour . .	2·32
Weight of carbon dioxide produced per hour per kilogramme of animal	0·92

Experiment No. 9.
Feb. 18*th.*
RABBIT.

Weight of animal	2·kil·1
Weight of food, turnips	0·kil·4
Duration of experiment	12 hrs., night.
Difference between the initial and final temperature of the gas of the chamber	+4° C.
Difference between the initial and final pressure of the gas of the chamber	0·m·0

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	1·230	Carbon dioxide	3·000
Oxygen	6·033	Oxygen	14·000
Nitrogen	34·165	Nitrogen	83·000
	41·428		100·000

	GRAMMES.
Weight of oxygen consumed	24·396
Weight of carbon dioxide produced	29·310
Weight of oxygen contained in the carbon dioxide	21·316
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·873
Weight of oxygen consumed per hour	2·033
Weight of oxygen consumed per hour per kilogramme of animal	0·968
Weight of carbon dioxide produced per hour . .	2·442
Weight of carbon dioxide produced per hour per kilogramme of animal	1·162

Experiment No. 10.
March 11*th.*
RABBIT.

Weight of animal	2·kil·1
Weight of food, turnips	0·kil·4
Duration of experiment	13 hrs., night.
Difference between the initial and final temperature of the gas of the chamber	+1° C.
Difference between the initial and final pressure of the gas of the chamber	+1·mm·4

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	0·693	Carbon dioxide	1·6
Oxygen	6·672	Oxygen	15·7
Nitrogen	35·076	Nitrogen	82·7
	42·441		100·0

	GRAMMES.
Weight of oxygen consumed	27·21
Weight of carbon dioxide produced	34·12
Weight of oxygen contained in the carbon dioxide	24·81
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·91
Weight of oxygen consumed per hour	2·09
Weight of oxygen consumed per hour per kilogramme of animal	0·99
Weight of carbon dioxide produced per hour	2·62
Weight of carbon dioxide produced per hour per kilogramme of animal	1·24

Experiment No. 11.

March 20th.

RABBIT.

Weight of animal	2·kil·4
Weight of food, turnips	0·kil·4
Duration of experiment	13 hrs., night.
Difference between the initial and final temperature of the gas of the chamber	+0°·5 C.
Difference between the initial and final pressure of the gas of the chamber	0·mm·0

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	0·558	Carbon dioxide	1·40
Oxygen	6·810	Oxygen	17·00
Nitrogen	32·592	Nitrogen	81·60
	39·960		100·00

	GRAMMES.
Weight of oxygen consumed	27·939
Weight of carbon dioxide produced	37·208

Weight of oxygen contained in the carbon dioxide	27·242
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·971
Weight of oxygen consumed per hour . . .	2·141
Weight of oxygen consumed per hour per kilogramme of animal	0·892
Weight of carbon dioxide produced per hour . .	2·862
Weight of carbon dioxide produced per hour per kilogramme of animal	1·192

Experiment No. 12.

April 28th.

RABBIT.

Weight of animal	2·kil·00
Weight of food, turnips	0·kil·12
Duration of experiment	9 hrs. 45 min., day.
Difference between the initial and final temperature of gas in the chamber	+5° C.
Difference between the initial and final pressure of the gas of the chamber	+3·mm·5

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	1·194	Carbon dioxide	2·85
Oxygen	7·688	Oxygen	18·39
Nitrogen	32·927	Nitrogen	78·76
	41·809		100·00

	GRAMMES.
Weight of oxygen consumed	17·535
Weight of carbon dioxide produced . . .	21·878
Weight of oxygen contained in the carbon dioxide	15·911
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·907
Weight of oxygen consumed per hour . . .	1·807
Weight of oxygen consumed per hour per kilogramme of animal	0·903
Weight of carbon dioxide produced per hour . .	2·254
Weight of carbon dioxide produced per hour per kilogramme of animal	1·127

Experiment No. 13.
May 2nd.
RABBIT.

Weight of animal	1·kil·8
Weight of food, turnips	1·kil·13
Duration of experiment	11 hrs. 45 min., night.
Difference between the initial and final temperature of the gas of the chamber . . .	0° C
Difference between the initial and final pressure of the gas of the chamber	—10mm.

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	0·567	Carbon dioxide	1·40
Oxygen	7·479	Oxygen	18·58
Nitrogen	32·228	Nitrogen	80·02
	40·274		100·00

	GRAMMES.
Weight of oxygen consumed	27·228
Weight of carbon dioxide produced . . .	39·332
Weight of oxygen contained in the carbon dioxide	28·605
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	1·050
Weight of oxygen consumed per hour . . .	2·326
Weight of oxygen consumed per hour per kilogramme of animal	1·292
Weight of carbon dioxide produced per hour .	3·361
Weight of carbon dioxide produced per hour per kilogramme of animal	1·867

Experiment No. 14.
April 1st.
MONKEY, CEBUS CAPUCINUS.

Weight of animal	2·kil·00
Weight of food, orange	0·kil·170
Duration of experiment	5 hrs., day.
Difference between the initial and final temperature of the gas of the chamber	+0°·5 C.
Difference between the initial and final pressure of the gas of the chamber	+2mm.

Composition of gas of chamber at the end of the experiment:

			Composition per cent:
Carbon dioxide	0·855	Carbon dioxide	2·10
Oxygen	8·422	Oxygen	19·80
Nitrogen	33·117	Nitrogen	78·10
	42·394		100·00

	GRAMMES.
Weight of oxygen consumed	13·47
Weight of carbon dioxide produced . . .	16·389
Weight of oxygen contained in the carbon dioxide	11·919
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·884
Weight of oxygen consumed per hour . . .	2·694
Weight of oxygen consumed per hour per kilogramme of animal	1·347
Weight of carbon dioxide produced per hour . .	3·277
Weight of carbon dioxide produced per hour per kilogramme of animal	1·638

Experiment No. 15.
April 3rd.
MONKEY, CEBUS CAPUCINUS.

Weight of animal	1·kil.50
Weight of food, sweet potatoes	0·kil.158
Duration of experiment	6 hrs. 20 min., day.
Difference between the initial and final temperature of the gas of the chamber . . .	+3° C.
Difference between the initial and final pressure of the gas of the chamber	+1mm.

Composition of gas of chamber at the end of the experiment:

			Composition per cent:
Carbon dioxide	0·418	Carbon dioxide	0·98
Oxygen	8·759	Oxygen	20·61
Nitrogen	33·324	Nitrogen	78·41
	42·501		100·00

	GRAMMES.
Weight of oxygen consumed	14·31
Weight of carbon dioxide produced . . .	18·73

Weight of oxygen contained in the carbon dioxide	13·62
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·95
Weight of oxygen consumed per hour . . .	2·27
Weight of oxygen consumed per hour per kilogramme of animal	1·51
Weight of carbon dioxide produced per hour . .	2·97
Weight of carbon dioxide produced per hour per kilogramme of animal	1·98

Experiment No. 16.
May 26th.
2 Pigeons.

Weight of animals	0·$^{kil.}$570
Weight of food, corn	0·$^{kil.}$180
Duration of experiment	13 hrs. 15 min., day.
Difference between the initial and final temperature of the gas of the chamber . . .	+0°·5 C.
Difference between the initial and final pressure of the gas of the chamber	+19·$^{mm.}$00

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	0·630	Carbon dioxide	1·42
Oxygen	9·447	Oxygen	21·37
Nitrogen	34·131	Nitrogen	77·21
	44·208		100·00

	GRAMMES.
Weight of oxygen consumed	26·6804
Weight of carbon dioxide produced . . .	32·1564
Weight of oxygen contained in the carbon dioxide	23·1592
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·8680
Weight of oxygen consumed per hour . . .	2·0218
Weight of oxygen consumed per hour per kilogramme of animal	3·5470
Weight of carbon dioxide produced per hour . .	2·3471
Weight of carbon dioxide produced per hour per kilogramme of animal	4·1178

Experiment No. 17.
Oct. 29th.
2 PIGEONS.

Weight of animal	$0^{\cdot kil.}567$
Weight of food	$0^{\cdot kil.}0$
Duration of experiment	21 hrs.
Difference between the initial and final temperature of the gas of the chamber . . .	0°·0
Difference between the initial and final pressure of the gas of the chamber	$0^{\cdot mm.}0$

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	0·60	Carbon dioxide	1·4
Oxygen	8·25	Oxygen	19·5
Nitrogen	33·62	Nitrogen	79·1
	42·47		100·0

	GRAMMES.
Weight of oxygen consumed	26·247
Weight of carbon dioxide produced	29·459
Weight of oxygen contained in the carbon dioxide	21·424
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·816
Weight of oxygen consumed per hour . . .	1·249
Weight of oxygen consumed per hour per kilogramme of animal	2·202
Weight of carbon dioxide produced per hour . .	1·402
Weight of carbon dioxide produced per hour per kilogramme of animal	2·472

Experiment No. 18.
April 7th.
TURTLE, PSEUDEMYS MOBILENSIS.

Weight of animal	$1^{\cdot kil.}7$
Weight of food, sweet potato	$0^{\cdot kil.}1$
Duration of experiment	96 hours.
Difference between the initial and final temperature of the gas of the chamber	0·° C.
Difference between the initial and final pressure of the gas of the chamber	$+19^{\cdot mm.}00$

Composition of gas of chamber at the end of the experiment:		Composition per cent:	
Carbon dioxide	0·366	Carbon dioxide	0·85
Oxygen	9·623	Oxygen	22·41
Nitrogen	32·954	Nitrogen	76·74
	42·943		100·00

	GRAMMES.
Weight of oxygen consumed	8·612
Weight of carbon dioxide produced . . .	11·341
Weight of oxygen contained in the carbon dioxide	8·248
Ratio between the weight of the oxygen contained in the carbon dioxide produced, and the weight of the oxygen consumed	0·957
Weight of oxygen consumed per hour . . .	0·088
Weight of oxygen consumed per hour per kilogramme of animal	0·051
Weight of carbon dioxide produced per hour .	0·118
Weight of carbon dioxide produced per hour per kilogramme of animal	0·063

RESUME OF 13 EXPERIMENTS AS REGARDS THE CONSUMPTION OF OXYGEN AND PRODUCTION OF CARBON DIOXIDE BY RABBITS.

EXP.	O, consumed per hour. GRAMMES.	O, consumed per hour per kil. of animal. GRAMMES.	CO_2, produced per hour. GRAMMES.	CO_2, produced per hour per kil. of animal. GRAMMES.	Resp. Quot
No. 1.	2·28	0·91	2·82	1·12	0·89
" 2.	2·48	1·03	2·76	1·15	0·81
" 3.	1·22	0·53	1·42	0·62	0·84
" 4.	2·00	0·70	2·64	1·01	0·96
" 5.	2·04	0·89	2·55	1·11	0·90
" 6.	2·05	0·82	2·66	1·06	0·95
" 7.	1·86	0·84	2·33	1·01	0·87
" 8.	1·86	0·74	2·32	0·92	0·90
" 9.	2·03	0·96	2·44	1·16	0·87
" 10.	2·09	0·99	2·62	1·24	0·91
" 11.	2·14	0·89	2·86	1·19	0·97
" 12.	1·80	0·90	2·25	1·12	0·90
" 13.	2·32	1·29	3·36	1·86	1·05
Total,	26·17	11·49	33·03	14·57	11·82

Average $= \frac{26{\cdot}17}{13} = 2^{\cdot gr\cdot}01$ $\frac{11{\cdot}49}{13} = 0^{\cdot gr\cdot}88$ $\frac{33{\cdot}03}{13} = 2^{\cdot gr\cdot}53$

$\frac{14{\cdot}57}{13} = 1^{\cdot gr\cdot}12$ $\frac{11{\cdot}82}{13} = 0{\cdot}90$

It will be observed from the above resumé that the rabbit consumes upon the average $2^{\cdot gr\cdot}01$ of oxygen per hour and $0^{\cdot gr\cdot}8$ of oxygen per hour per kilogramme of body weight and produces $2^{\cdot gr\cdot}5$ of carbon dioxide per hour and $1^{\cdot gr\cdot}1$ of carbon dioxide per hour per kilogramme of body weight, the respiration quotient or the ratio between the weight of the oxygen contained in the carbon dioxide produced and the weight of the oxygen consumed amounting on the average to 0·9. In this connection it may be mentioned that the rabbit consumes on the average the same amount of oxygen and produces the same amount of carbon dioxide whether the gas breathed, be the atmosphere as under ordinary circumstances, or pure oxygen as in the case of the animal being placed within the chamber of the respiratory apparatus. As the respiratory process in man does not differ from that of the rabbit, at least in its chemical aspects, there is no reason to suppose that any more oxygen would be consumed by man if breathed alone than when breathed as mixed with nitrogen as obtains in the breathing of ordinary air. Notwithstanding that the experiments with the rabbits were performed at different seasons of the year, at different hours of the day or night, that food was or was not eaten, that in some instances the animals were more lively and active than in others, in a word, that the conditions in general varied considerably, nevertheless, it will be seen that the respiratory quotient varied but little in the different experiments.

It may be mentioned that the respiratory quotient as given by Regnault & Reiset, Rauber, Colosanti, Richet, Regnard and others differs but little from that obtained by the authors. Attention is also called to the fact of the consumption of oxygen and production of carbon dioxide being increased by the taking of food—example 6 as compared with example 12 offers the only exception. The animal in the former case, however, weighed more than in the latter.

Inasmuch as in their next communication the authors propose to give a detailed account of their observations upon the respiration of monkeys as studied by means of the Voit apparatus, attention is simply called to the fact that the respiratory quotient (Exps. 14, 15) differs but little, if at all, from that of the rabbit. With reference to the experiments with the pigeons (Exps. 16, 17) apart from the fact (of little significance) that one experiment was performed in May and the other in October it should be mentioned that in the first instance the pigeons were fed and were much more active than in the second which accounts for the weight of the oxygen consumed and carbon dioxide produced being so much greater in the former case than in the latter, the respiratory quotient being 0·8. The apparatus made use of by the authors in the investigations just described is not well adapted to the study of respiration as obtained in the lower vertebrata, reptilia, batrachia and invertebrata. Nevertheless, the results of an experiment (Exp. 18) with a turtle (Pseudemys mobilensis) are offered as illustrating how slowly oxygen is consumed and carbon dioxide is produced in such animals, the respiratory quotient, however, being the same as in the mammalia.

NOTES ON A COLLECTION OF SHELLS FROM SOUTHERN MEXICO.

BY FRANK C. BAKER.

The following notes are based upon collections made by the Expedition which went from the Academy of Natural Sciences under the charge of Prof. Angelo Heilprin in the early part of 1890. The geographical positions of the localities visited are as follows:

Silam, situated on the northern coast of Yucatan on the Gulf of Mexico; Progreso, on the northern coast of Yucatan about fifty miles west of Silam; Campeche, on the western coast of Yucatan on the Gulf of Campeche; and Vera Cruz, on the southeastern coast of Mexico on the Gulf of Campeche. All of these localities are situated between the 19th and 22nd degrees of north latitude.

Most of the specimens collected were beach shells, although some dredging was done at Progreso, and more or less littoral collecting was done at all the localities visited. At Vera Cruz there is a chain of large coral reefs and islands, and upon these reefs in water from four to twenty feet in depth were found living *Purpura haemastoma* var. *Floridana*, *Conus mus*, *Coralliophila abbreviata*, *Sistrum nodulosum*, *Siphonaria alternata*, *Arca Noæ*, *Arca imbricata* and *Triton tritonis* var. *nobilis*. A serpuloid reef, Punta Gorda, a few miles north of Vera Cruz was found literally paved with living *Purpura haemastoma* var. *Floridana* associated with *Siphonaria alternata*. Old logs and pieces of timber along the shore were most always found to be covered with *Littorina columellaris*, *L. ziczac* and a few specimens of *Purpura haemastoma* var. *Floridana* and *Siphonaria alternata*. Many interesting species were found in the sea-wrack thrown upon the shore. The outer reefs at Vera Cruz, as for example the Isle la Verde, were found to be very prolific in lamellibranchs, the genera *Arca* and *Lucina* being well represented. It will be seen by the following list that many species are reported from localities at a greater or lesser distance south than has previously been reported. Many species hitherto reported from Florida Keys we now know extend as far south as Silam, Campeche or Vera Cruz.

The collections from Silam were made by Prof. Angelo Heilprin and Mr. J. E. Ives; those from Progreso by Prof. Heilprin, Messrs. J. E. Ives, Witmer Stone and myself; while the shells from Vera Cruz were collected by Prof. Heilprin and myself. The Campeche collection was purchased.

The sequence of families and species is uniform with Dr. Dall's List of the Marine Mollusks of the S. E. coast of the U. S.

PELECYPODA.

OSTRÆIDÆ.

Ostrea cristata Born. Vera Cruz; Progreso.

Ostrea frons Linné. Vera Cruz.

ANOMIIDÆ.

Anomia simplex d'Orb. Progreso; Silam.

SPONDYLIDÆ.

Plicatula ramosa Lam. Progreso; Silam.

Spondylus coccineus Lam. Vera Cruz.

Spondylus longitudinalis Lam. Vera Cruz.

PECTENIDÆ.

Pecten ornatus Lam. Vera Cruz; Campeche.

Pecten medius Lam. Vera Cruz.

Pecten nucleus Born. Vera Cruz.

Pecten dislocatus Say. Vera Cruz; Campeche. Most southerly locality reported.

LIMIDÆ.

Lima scabra Born. Vera Cruz.

AVICULIDÆ.

Avicula brevicauda Desh. Vera Cruz; Progreso.

Avicula ala-perdicis Reeve. Progreso.

Perna ephippium Lam. Vera Cruz.

Pinna muricata Linné. Progreso.

MYTILIDÆ.

Mytilus hamatus Say. Vera Cruz.

Modiola tulipa Linné. Vera Cruz; Progreso.

ARCIDÆ.

Arca Noae Linné. Vera Cruz; Progreso; Silam. Living in 10 feet of water among the coral.

Arca imbricata Brug. Vera Cruz; Progreso; Silam.

Arca incongrua Say. Vera Cruz; Campeche.

Arca Floridana Conrad. Vera Cruz.

Arca Deshayesii Hanley. Progreso; Silam.

Arca Adamsi Shuttl. Vera Cruz; Progreso; Silam; Campeche, living in coral at Vera Cruz.

Arca gradata Brod. Vera Cruz.

Arca sp. nov. Vera Cruz.

CARDITIDÆ.

Cardita floridana Conrad. Progreso; Silam. Most southerly locality reported. Given in Dall's list as from Tampa to Key West.

LUCINIDÆ.

Lucina tigrina Linné. Vera Cruz; Silam.

Lucina imbricatula Adams. Vera Cruz.

Lucina Jamaicensis Spengler. Vera Cruz; Silam.

Lucina Antillarum Reeve. Progreso.

Lucina squamosa Lam. Progreso; Silam.

Lucina dentata Wood. Progreso.

Loripes edentula Linné. Vera Cruz; Silam.

CHAMIDÆ.

Chama macrophylla Chem. Vera Cruz; Progreso; Silam.

Chama arcinella Linné. Vera Cruz.

CARDIIDÆ.

Cardium magnum Born. Vera Cruz.

Cardium muricatum Linné. Vera Cruz; Progreso; Silam; Campeche, most southerly locality reported.

Cardium serratum Linné. Vera Cruz; Progreso; Campeche.

Cardium isocardia Linné. Silam.

VENERIDÆ.

Venus mercenaria Linné. Silam; Progreso.

Venus mercenaria Linné var. Mortoni Conrad. Vera Cruz. Most southerly locality yet reported. Dall says: "Hog Island, Va. to Florida Keys." The species has not before been reported south of the United States.

Venus Listeri Gray. Vera Cruz.

Venus rostrata Sowb. Vera Cruz; Silam; Progreso.

Venus cancellata Linné. Silam; Progreso.

Dosinia discus Reeve. Vera Cruz.

Dosinia elegans Conrad. Progreso.

CYRENIDÆ.

Cyrena Carolinensis Bosc. Vera Cruz.

Cyrena Floridana Conrad. Silam; Progreso. No extreme southern range is given by Dr. Dall; it has been reported from Tampa and West Florida.

DONACIDÆ.

Donax denticulatus Linné. Vera Cruz.

Donax variabilis Say. Vera Cruz.

Donax fossor Say. Vera Cruz.

Iphigenia Brasiliana Lam. Vera Cruz.

PSAMMOBIIDÆ.

Tagelus gibbus Spengler. Vera Cruz.

Asaphis deflorata Linné. Vera Cruz.

Sanguinolaria rosea Lam. Vera Cruz.

TELLINIDÆ.

Tellina fausta Solander. Vera Cruz.

Tellina lineata Turton. Silam.

Tellina polita Say. Progreso.

Tellina radiata Linné. Campeche.

Macoma constricta Brug. Vera Cruz.

Lutricola interstriata Say. Silam; Vera Cruz. (=*Tellina intastriata* Say, *Tellina gruneri* Phil.)

SEMELIDÆ.

Semele reticulata Gmelin. Vera Cruz.

Semele orbiculata Sowb. Vera Cruz.

Semele variegata Lam. Vera Cruz.

GNATHODONTIDÆ.

Gnathodon rostrata Petit. Vera Cruz. Has not before been reported so far south.

MACTRIDÆ.

Mactra Brasiliana Lam. Progreso.

LYONSIIDÆ.

Lyonsia Beana d'Orb. Progreso.

PHOLADIDÆ.

Pholas Campechiensis Gmelin. Vera Cruz.

SCAPHOPODA.

DENTALIIDÆ.

Dentalium semistriatum Guilding. Progreso.
Cadulus Carolinensis Bush. Vera Cruz.

GASTROPODA.

TORNATINIDÆ.

Tornatina Candei d'Orb. Silam.

BULLIDÆ.

Bulla striata Brug. Vera Cruz; Silam; Progreso.
Haminea succinea Conrad. Progreso.

SIPHONARIIDÆ.

Siphonaria lineolata d'Orb. Vera Cruz. Found living on coral in 10–20 feet of water.

Siphonaria alternata Say. Silam. Most southerly locality reported. Quoted by Dall from Bermuda, East and West Florida and Florida Keys.

TEREBRIDÆ.

Terebra cinerea Gmelin. Vera Cruz.

Terebra protexta Conrad. Vera Cruz. Most southerly locality reported.

CONIDÆ.

Conus proteus Hwass. Vera Cruz; Progreso.

Conus mus Hwass. Vera Cruz; Campeche. Living among the coral in Vera Cruz in 20 feet of water.

Conus Pealii Green. Silam; Progreso.

Conus verrucosus Hwass. Campeche.

PLEUROTOMIDÆ.

Drillia fuscescens Gray. Vera Cruz; Progreso.

Drillia coccinata Reeve. Silam.

Drillia leucocyma Dall. Silam.

Drillia ostrearum Stearns. Progreso.

Mangilia accincta Mont. Vera Cruz.

Mangilia plicata C. B. Adams. Silam; Progreso, (=" *plicosa* C. B. Ad." Dall's List.) Most southerly locality reported.

CANCELLARIIDÆ.

Cancellaria reticulata Linné. Vera Cruz.

OLIVIDÆ.

Oliva litterata Lam. Vera Cruz. Most southerly locality reported. Given in Dall's list as from Hatteras to Key West.

Olivella floralia Duclos. Vera Cruz.

Olivella Verreauxi Duclos. Vera Cruz.

Olivella nivea Gmelin. Silam; Progreso; Campeche.

Olivella mutica Say. Progreso.

MARGINELLIDÆ.

Marginella lactea Kiener. Verz Cruz; Campeche.

Marginella labiata Val. Silam; Progreso.

Marginella apicina Menke. Silam; Progreso; Campeche.

Marginella guttata Dillw. Progreso; Campeche.

Marginella fauna Sowb. Progreso.

Marginella succinea Conrad. Progreso. (Young.)

Marginella avena Val. Campeche.

Marginella pallida Don. Campeche.

TURBINELLIDÆ.

Turbinella scolymus Gmelin. Progreso. (young.)

MITRIDÆ.

Mitra granulosa Lam. Vera Cruz.

FASCIOLARIIDÆ.

Fasciolaria tulipa Linné. Vera Cruz; Silam; Progreso.

Fasciolaria distans Lam. Vera Cruz.

Fulgur perversa Linné. Silam; Progreso.

Fulgur pyrum Dillw. Vera Cruz; Silam; Progreso.

Melongena melongena Linné. Vera Cruz; Silam; Progreso.

Melongena corona Gmelin. Silam; Progreso.

Latirus cinguliferus Lam. Vera Cruz.

Latirus ocellatus Gmelin. Progreso.

BUCCINIDÆ.

Pisania pusio Linné. Vera Cruz.

Pisania tincta Conrad. Vera Cruz.

Engina turbinella Kiener. Vera Cruz.

NASSIDÆ.

Nassa vibex Say. Vera Cruz; Silam; Progreso.

Nassa acuta Say. Vera Cruz.

COLUMBELLIDÆ.

Columbella mercatoria Lam. Vera Cruz; Silam; Campeche.

Columbella obesa Adams. Vera Cruz; Silam; Progreso.

Columbella nitida Lam. (= *nitidula* Sowb.) Vera Cruz; Progreso; Campeche.

Columbella cribraria Lam. Vera Cruz; Campeche.

Columbella catenata Sowb. Vera Cruz.

Columbella idalina Duclos. Vera Cruz.

Columbella avara Say. Silam; Progreso.

Columbella limata Say. Silam.

Columbella lævigata Linné. Campeche

Columbella pulchella Kiener. Campeche.

MURICIDÆ.

Murex Salleanus A. Adams. Progeso.

Ocinebra cellulosa Conrad. Vera Cruz.

Ocinebra erosus Brod. Vera Cruz.

Ocinebra alveatus Kiener. Vera Cruz.

Urosalpinx Floridana Conrad. Progreso.

Purpura patula Linné. Vera Cruz. living.

Purpura hæmastoma Linné var. Floridana Conrad. Vera Cruz. On the reefs at low water in great quantities.

Purpura hæmastoma Linné var. undata Lam. Vera Cruz.

Purpura deltoidea Lam. Vera Cruz.

Ricinula nodulosa C. B. Adams. Vera Cruz. Living among coral.

Ricinula parva Reeve. Vera Cruz.

Coralliophila abbreviata Lam. Vera Cruz. (= *galea* Chem., *plicata* Wood.) Found in great quantities on the corals *Madrepora prolifera* Lam., *M. palmata* Lam. The young shell is known as *C. plicata* Wood.

SCALIDÆ.

Scala tenuis Sowb. Vera Cruz.

Scala venosa Sowb. Vera Cruz.

Scala clathrus Linné. Vera Cruz.

Scala gradatella Mörch. Vera Cruz.

Scala Humphreysii Kiener. (=*Sayana* Dall) Campeche. Most southerly locality reported.

JANTHINIDÆ.

Janthina fragilis Lam. Vera Cruz. (=*communis* Lam.)

EULIMIDÆ.

Eulima Jamaicensis C. B. Adams. Vera Cruz; Silam.

PYRAMIDELLIDÆ.

Pyramidella conica C. B. Adams. Vera Cruz.

TRITONIIDÆ.

Distorsio cancellinus Lam. Vera Cruz. (=*Distortrix reticulata* Link, of Dall's list.)

Triton tritonis Linné, var. nobilis Conrad. Vera Cruz. Living in 20–30 feet of water.

Triton tuberosus Lam. Vera Cruz.

Triton chlorostomus Lam. Vera Cruz.

Triton pileare Lam. Vera Cruz.

Ranella affinis Brod. Vera Cruz.

CASSIDIDÆ.

Cassis testiculus Linné. Vera Cruz.

Cassis sulcosa Born, var. inflata Shaw. Vera Cruz.

DOLIIDÆ.

Dolium perdix Linné. Vera Cruz.

Pyrula papyratia Say. Silam; Progreso.

CYPRÆIDÆ.

Cypræa exanthema Linné. Vera Cruz.

Cypræa cinerea Gmelin. Vera Cruz.

Cypræa spurca Linné. Vera Cruz.

Trivia suffusa Gray. Vera Cruz; Progreso; Campeche.

Trivia pediculus Linné. Progreso, Campeche.

Erato Maugeriæ Gray. Progreso; Vera Cruz.

STROMBIDÆ.

Strombus bituberculatus Lam. Vera Cruz; Silam.

Strombus pugilis Linné. Vera Cruz.

Strombus gigas Linné. Progreso.

TRIFORIDÆ.

TRIFORIS DECORATUS C. B. Ad. Vera Cruz.
TRIFORIS TURRISTHOMÆ d'Orb. Vera Cruz.

CERITHIOPSIDÆ.

SEILA TEREBRALIS C. B. Adams. Vera Cruz.
CERITHIOPSIS SUBULATA Montg. Vera Cruz.
CERITHIOPSIS PUNCTATUM Linné. Progreso.

CERITHIIDÆ.

BITTIUM VARIUM Pfr. Silam; Progreso.
CERITHIUM EBURNEUM Brug. Vera Cruz; Silam; Progreso.
CERITHIUM LITTERATUM Born. Vera Cruz; Progreso.
CERITHIUM FERRUGINEUM Say, var. VERSICOLOR C. B. Adams. Vera Cruz; Silam.
CERITHIDEA IOSTOMA Pfr. Progreso; Silam.

PLANAXIDÆ.

PLANAXIS NUCLEUS Wood. Vera Cruz.
PLANAXIS LINEATUS DaCosta. Vera Cruz.

MODULIDÆ.

MODULUS FLORIDANUS Conrad. Vera Cruz; Silam.
MODULUS LENTICULARIS Chem. Vera Cruz; Silam; Progreso.

CAECIDÆ.

CÆCUM FLORIDANUM Stimp. Silam.
CÆCUM NITIDUM Stimp. Silam; Progreso.

VERMETIDÆ.

VERMICULARIA SPIRATA Philippi, var. RADICULA Stimp. Silam; Vera Cruz; Progreso.

TURRITELLIDÆ.

TURRITELLA VIRIDARIA Dall. Vera Cruz.

LITTORINIDÆ.

LITTORINA ZICZAC Dillw. Vera Cruz.
LITTORINA COLUMELLARIS d'Orb. Vera Cruz.

LITIOPIDÆ.

LITIOPA MELANURA C. B. Ad. Silam; Vera Cruz.

SOLARIIDÆ.

Solarium granulatum Lam. Vera Cruz.
Torinia cylindrica Gmelin. Vera Cruz.
Torinia delphinuloides d'Orb. Vera Cruz.
Torinia bisulcata d'Orb. Vera Cruz.

RISSOIDÆ.

Rissoina Chesnelii Michaud. Vera Cruz; Silam; Progreso.
Rissoina fenestrata Schwartz. Vera Cruz.

TRUNCATELLIDÆ.

Truncatella Caribæensis Sowb. Silam.

CALYPTRÆIDÆ.

Crucibulum verrucosum Reeve. Progreso.
Crepidula fornicata Linné. Vera Cruz; Progreso; Silam.
Crepidula aculeata Gmelin. Vera Cruz; Silam; Progreso. Found living among coral at Vera Cruz.
Crepidula plana Say. Progreso.

XENOPHORIDÆ.

Xenophora conchyliophora Born. Vera Cruz.

NATICIDÆ.

Natica canrena Lam. Vera Cruz; Progreso; Campeche.
Natica lactea Guilding. Vera Cruz.
Natica duplicata Say. (Young) Vera Cruz.
Natica mamillaris Lam. (=*brunnea* Link). Vera Cruz. Living in the sand north of the reefs.
Sigaretus perspectivus Say. Progreso.

ACMÆIDÆ.

Acmæa confusa Guilding. Vera Cruz.

PHASIANELLIDÆ.

Phasianella tessellata P. & M. Vera Cruz; Silam.

TURBINIDÆ.

Astralium Olfersi Troschel. Vera Cruz.
Astralium longispinum Lam. Silam.

TROCHIDÆ.

Chlorostoma fasciatum Born. Vera Cruz; Progreso; Silam.
Calliostoma jujubinum. Gmelin. Vera Cruz.

NERITIDÆ.

Nerita fulgurans Gmelin. Vera Cruz.
Neritina reclivata Say. Vera Cruz.
Neritina viridis Linné. Vera Cruz ; Progreso.
Neritina virginea Linné. Silam.

FISSURELLIDÆ.

Glyphis alternata Say. Vera Cruz ; Progreso ; Silam.
Fissurella rosea Gmel. Vera Cruz.

CEPHALOPODA.

SPIRULIDÆ.

Spirula Peronii Lam. Vera Cruz.

REMARKS ON THE MURICIDÆ WITH DESCRIPTIONS OF NEW SPECIES OF SHELLS.

BY FRANK C. BAKER.

Having recently obtained for my collection several rare species belonging to the Muricidæ, and having studied their characters carefully, I take this opportunity of commenting upon them.

Murex tribulus Lam.

Murex carbonnieri Jousseaume, described in Le Naturaliste No. 44, p. 349 and figured in Nouvelles Archives du Museum, 1882, p. 31, plate 4, figures 1*a*, 1*b*, is a color variety of *M. tribulus*, characterized by chestnut dots on the spiral liræ. I have in my collection a specimen which corresponds in every respect with Jousseaume's figures. There are on the body-whorl six principal liræ, with fine lines between, all punctate with chestnut; the whorls are distinctly shouldered, and the apex is identical with that of *tribulus*. In the collection of the Academy of Natural Sciences there is a suite of *tribulus* which shows the gradations from the typical form to the variety *carbonnieri*. I do not consider it distinct even as a variety.

Murex haustellum Linné var. **longicaudus** Baker.

I propose the above name for a variety of *M. haustellum* having an exceedingly long canal and short body-whorl. In the variety the canal is two-thirds the length of the entire shell while in the typical *haustellum* the canal occupies a half of the length; besides this, the variety is much smaller than the typical form being only 52 mm. in length, while a fair sized typical *haustellum* is 100 mill. or more. I have seen three specimens of this form one of which is in the collection of the Academy of Natural Sciences and two are in my own collection. They show little or no variation. They are from the Red Sea.

Murex tumulosus Sowerby.

This curious form has been considered by Mr. Tryon and other authors to be a synonymy of *M. cornutus*. Mr. Tryon remarks in his Manual of Conchology, vol. 2, p. 98 " Is *M. tumulosus* a hybrid ? " I have recently obtained a specimen of this species and do not hesitate for a moment in considering it a synonym of *M. cornutus* Linné.

There are specimens of *cornutus* in the collection of the Academy which are almost identical with it. The sculpture, number of varices and whorls are identical in both species. Both have a straight canal differing in this respect from *M. brandaris* which has a more or less crooked canal. I do not consider *tumulosus* a hybrid but a young form of *cornutus*. The species is well figured in Sowerby's Thesaurus Conchyliorum, vol. 4, Murex, plate 18, figure 168. It was described in Proc. Zoöl. Society, 1840, p. 144, and first figured in Sowerby's Conchological Illustrations, Catalogue of Murex, figure 71. The locality, unfortunately, is unknown.

Murex brandaris Linne.

M. Locard has described, in Ann. Soc. Linn. Lyons, 1885, p. 219, two species of this group under the names *trispinosus* and *brandariformis*.

The first species, *trispinosus*, will stand as a good variety but nothing more. *Brandariformis* is founded upon specimens destitute of spines and must become a synonym of *brandaris*, as I have specimens which will at once connect it with the parent form. The variety may be described as follows:

M. brandaris L. var. **trispinosus** Locard.

Shell club-shaped as in typical *brandaris;* whorls 5–6, varices nine, three spines to a varix; one on, one above and one below the periphery; one row of spines on the canal; color yellowish running into chestnut on the canal and spines and dashed with the same color in many places.

Alt. 65 mill., diam. 40 mill. Aperture (excluding canal) alt. 25 mill., diam. 15 mill.

The principal difference of this variety from the typical *M. brandaris* is in the possession of the three rows of spines, and in its dark chestnut color. This variety has also been named *trifariospinosa* by Chemnitz whose name should have priority over *trispinosus* Locard.

Ocinebra Pilsbryana Baker.

Shell small, fusiform, solid, with about six whorls; spire rather acute, suture scarcely impressed; sculpture of longitudinal ribs and spiral liræ; there are nine longitudinal plicæ on the last whorl, somewhat strong, rounded, raised into four elongate ridges by the stronger spiral liræ. Spiral liræ twenty-seven in number, strong, scabrous; aperture elongate oval, about half the length of the entire shell, outer lip rounded, with seven strong spiral liræ within; margin slightly crenulate in some specimens and nearly simple in others; interior of aperture porcelain-white; columella arcuate, smooth with a slight tendency toward purple in some specimens; canal short, open, reflexed; umbilicus none, but there is a furrow in its place, bounded by a fasciole; color cinereous, overlaid by a reddish-brown epidermis.

Alt. 17, diam. 10 mill. Aperture (excluding canal) alt. 7, diam. 4 mill.

Habitat, Ceylon.

This species has features recalling the genera *Trophon*, *Urosalpinx* and *Sistrum*, but its right place in, I think, is in *Ocinebra*. There is no shell known to me with which to compare it. A distinguishing feature is the strong, scabrous spiral liration, and the absence of any interliral lirulæ.

Ricinula (Sistrum) rugosoplicata Baker.

Shell fusiform, rather solid, with about 5–6 whorls; spire acute, nucleus broken, suture scarcely impressed; there are twelve longitudinal costæ on the last whorl crossed by about fifteen alternating stronger and weaker spiral lines, which cut the surface of the shell into large, rough knobs or plications; aperture elongate oval, considerably less than half the length of the entire shell; outer lip rounded, with its edge scalloped by the spiral liræ and with nodules within; columella arcuate, smooth, with three small tubercles near the anterior canal; canal short, open, rather wide, a little deflected to the left; umbilicus none, but there is a little chink in its place; color of shell black under a cinereous epidermis.

Alt. 12, diam. 5 mill. Aperture (excluding canal) alt. 4, diam. 2 mill.

Habitat, Turtle Bay, Lower California.

This species is separated from *Ricinula ferruginea* Reeve, its nearest ally, by the nodules of the latter species being larger and less numerous. The aperture in *ferruginea* is much larger and more elongate; the spire is shorter and the canal more open. The longitudinal ribs of *ferruginea* are seven in number while those of *rugosoplicata* are twelve in number; the spiral liræ of *ferruginea* are more numerous and not so coarse as in *rugosoplicata*.

This pretty little shell was found in a collection recently purchased by the Conchological Section of the Academy of Natural Sciences from Mr. Henry Hemphill. It is wholly distinct from any species of *Ricinula* or *Sistrum* yet described.

Concholepas Peruvianus Lam.

In the Annales de Malacologie, vol. 2, 1884–86, p. 261, M. Mabille has published a paper entitled "Étude Monographique du Genre Concholepas," in which he describes, and in some cases figures, a number of supposed new species of this group.

The species described are as follows:

Concholepas similis.

This species is an elongate variety of *C. Peruvianus,* about three-quarters as broad as long, and very scabrous on the outer surface. The tooth is but slightly produced.

Concholepas decipiens.

This shell is a little more rounded than the typical form with the apex nearer the margin. The surface sculpture is not as strong as in *similis.*

Concholepas granosus.

Founded upon specimens with a granose texture.

Concholepas densistriatus.

Founded upon specimens with dense and squamose sculpture.

Concholepas rhombicus, splendens, verrucundus, Patagonicus.

These names are founded upon variations of form and sculpture, all of which run into the parent form *Peruvianus.*

On page 280 of the same paper M. Mabille characterizes the genus *Charonia,* the type and only species being *Concholepas Kieneri* Gay, a tertiary fossil of Chili. The species, *Kieneri,* was described by Gay in the Historia de Chile, Zoologia, vol. 8, p. 203, and figured in the large folio atlas accompanying the work, Conchyliologia, No. 3, fig. 4. The figure differs from the typical *Concholepas Peruvianus* in having the columellar region free from the spreading callus so characteristic of *Peruvianus,* and in this respect resembling young forms of the latter species. The columella is much more arcuate than in *Peruvianus* and the general form of the shell is much like a *Purpura.* I doubt, however, whether the genus will stand, the differences seeming hardly to be of generic importance. It is a fossil form.

Coralliophila galea Chemn.

Mr. Tryon, Manual of Conchology, vol. 2, p. 207, makes *C. plicata* Wood the young of *galea.* I have before me upwards of seventy specimens of this form from well authenticated West Indian localities and I am of the opinion that *plicata* is a good species. For comparison I have taken two specimens of equal size (30 mill. alt.), and placed the descriptions in parallel columns in order to show to better advantage the principal differences of the two species.

C. galea Chem.

Shell rounded, largely umbilicate, spire short; whorls four, apex eroded; sutures distinct but not impressed; sculpture of heavy, scabrous, spiral lines of which there are twenty-five with sometimes an intervening one; there are also nine scarcely visible, longitudinal folds; aperture ovate; outer lip crenulate; inner lip arcuate, smooth; umbilicus wide, deep; inner lip fifteen lirate within; aperture pinkish or yellowish within; shell yellowish-white externally. Alt. 32, diam. 25 mill. Aperture, alt. 22, diam. 10 mill.

C. plicata Wood.

Shell more or less cone-shaped, umbilicus nearly closed, spire short; whorls four, apex eroded; sutures distinct; sculpture of heavy scabrous, spiral lines, of thick there are 18–20, three of which are much larger and heavier than the rest which cut the edge of the outer lip into four scallops; there are ten longitudinal folds; aperture very elongate; outer lip crenulate and scalloped by the spiral liræ; inner lip slightly arcuate, smooth; umbilicus scarcely visible; inner lip very slightly lirate within; aperture very deep purple within sometimes shading to greenish; shell cinereous, sometimes covered with a green coating without. Alt. 28, diam. 17 mill. Aperture, alt. 20, diam. 9 mill.

I have collected *plicata* in large quantities at Vera Cruz, Mexico, from the coral reefs, and have never seen a *galea* among them, although special search was carried on for them. I have specimens of both species from the following localities: St. Thomas, W. I.; Bahamas; St. Croix; Key West, Fla.; Vera Cruz (*plicata* only); Little Cayman, W. I. (collected by C. J. Maynard). This group of shells is one in which great specific variation is likely to occur, on account of their parasitic habit, and great allowance must be made in their determination from this fact; but the species under consideration seem to me to be entirely distinct from one another and, although I have examined over seventy specimens, yet I am not able to place them together.

Engina Harveyana Baker.

Shell turbinate, solid, straw-colored with a white band just below the periphery. Whorls 4 +, (the tip in the specimen is broken off) rounded, crossed by longitudinal costæ and spiral liræ; there are seven large, rounded, strongish longitudinal costæ which are crossed by ten strong, rounded spiral liræ, with a finer line between; these spiral lines in crossing the costæ cut them into large, quadrate nodules; aperture very elongate, about half the length of the entire shell; outer lip thickened, with seven denticles upon the inside, the three central ones occupying a small callus in the center of the lip; inner lip provided with three faint tubercles near the lower end, and a single large tubercle near the posterior end of the aperture; there is a slight callus over the columella; aperture pinkish within; canal short, open; umbilicus none; tubercles lighter than the ground color; the interlinear lines reddish-brown; there is a light band just below the periphery on the last whorl.

Alt. 12, diam. 8 mill. Aperture alt. 6, diam. 2 mill.

Habitat, West Coast of Africa.

This species is separated from *Engina corallina* Kiener by the outer lip being more thickened and the three central denticles being placed upon a callus instead of directly upon the outer lip as in the first species. The coloration is entirely different from that of *corallina* being rosy with black lines over the central tubercles, the tips of the tubercles being straw colored and there is a white band below the periphery. There are longitudinal costæ crossed by thirteen spiral lines in *corallina*. The length of *corallina* is 20 mill. while that of *Harveyana* is only 12.

This species is named in honor of Prof. F. L. Harvey of Orono, Maine from whom the specimens were received.

AN ATTEMPT TO ILLUSTRATE SOME OF THE PRIMARY LAWS OF MECHANICAL EVOLUTION.

BY JOHN A. RYDER.

The object of the present communication is mainly to exhibit a piece of apparatus intended to illustrate, in a concrete form, the operation of certain physical forces in the production of a body which approximates the form of that of certain free-swimming monads. While the necessity for such experiments has been apparent to me for several years, in order to test certain *á priori* conclusions arrived at in the contemplation of the morphological data in our possession in respect to the Protozoa, the difficulty in the way of their trial was the contrivance of the proper kind of apparatus. After a number of fruitless experiments, which it is needless to describe, a very simple form of apparatus was found successful. This device is now described and figured. It serves to show some of the apparent conditions under which a heavy fluid, with a certain specific viscosity or cohesiveness, may, when made to fall through another highly viscous fluid medium, so alter the shape of the former, when in large drops, as to assume somewhat the figure of certain living monadiform organisms.

Certain *á priori* reasons had long existed in the writer's mind to suggest these experiments, and, it may be added, the remarkable experimental results obtained by Plateau, Quincke, Roux, Berthold and Bütschli, in allied fields of inquiry, only served to quicken his interest in what had always seemed worth attempting, but which, for want of the proper means, had hitherto eluded the application of direct experimental verification.

The problem may be thus stated: It was assumed that living matter is viscous, and exhibits a less prompt capacity to change its form than water, when in the form of drops. The plasmodia of Myxomycetes, and the behavior of various amœboid forms, illustrate this part of our statement. It was further assumed that the primæval forms of living things were more or less markedly monadiform, as is shown by the flagellula stage of *Protomyxa,* as well as the male or primordial condition[1] of the germs of the great majority of all multicellular types, and the shapes of the lowest existing forms. Water itself is a fluid body with a certain degree of

[1] The origin of sex through cumulative integration, etc. Proc. Am. Philos. Soc., XXVIII, 1890, pp. 109–159.

viscosity. We have, then, in the motion of the simplest of organisms, the apparent condition of a viscous body, propelled by an energy generated within its own substance, acting as a moving force, and driving it through a less viscous fluid—water.

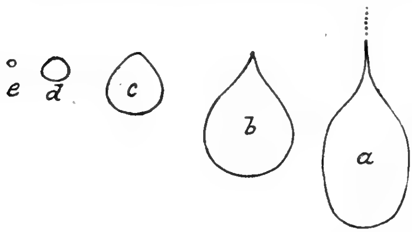
The application of energy, as a moving force to a viscous and fluid body moving through water or other fluid, was the difficulty which was confronted from the first. Even with the precautions which have been taken, it may be that in the present experiment serious defects of method may have been overlooked. However, the way in which the initial moving force was obtained was simply to use the gravity of the heavier body to propel it through the viscous medium, and to watch and see what the result would be. It was assumed that the conditions as subsisting between the lowest living matter and its medium, water, could be in a considerable degree approximated, and it was confidently expected that there would be certain definite changes of figure which could be predicted as following from the inter-action of the motion of large drops of a heavy fluid moving through a viscous medium, both being homogeneous. These expectations were realized, so far as is illustrated by the apparatus here described.

The expectation was, reasoning from cause to effect, that drops of the heavier fluid, moving under the influence of gravity, at a certain velocity, through a viscous medium, would be drawn out at least into an oval or oblong figure, such as is met with in certain protozoa. The actual experiment, however, showed in addition, that if a heavy fluid, such as mercury, was used, and allowed to drop through a very thick, syrupy solution of silicate of soda or soluble glass, enclosed in a test-tube, the drops of mercury, if large enough to fall with sufficient velocity, were not only elongated in the direction in which they fell, but were also drawn out at the upper pole, or that opposite the direction of motion, so that the whole drop rudely simulated the figure of a monad with a single posterior flagellum or tail. While such an artificial form, produced as the consequence of the definite interaction of certain forces, such as resistance, cohesion and friction, generated between two substances of known qualities, cannot, of course, fail to be suggestive, the writer does not mean to imply that the problem of the genesis of the figures or shapes of all monadiform organism is thus solved. It is only in the way of a suggestion toward rendering palpable the action of some of the forces of nature, which have had to do with giving a definite form to some of the lowest and most numerous of living beings, that the experiment was undertaken. If previous experiments of the writer had utterly failed, there was no reason why, by varying the conditions and means used, that some interesting results should not be obtained, as the sequel proves.

Berthold has conclusively shown that a mass of plasma, such as is found in an amœba, would, for physical reasons, tend to be elongated in the direction of its own motion, such as is actually observed to be the case. The experiment with the large drop of mercury falling through a thick solution of soluble glass, shows that if the friction and cohesion incident to its motion be the same on all sides, and sufficiently great, that the whole mass, instead of flattening in one direction and elongating in another, as in the case of an amœba creeping over a fixed substratum, there is a general elongation in the direction of motion, resulting in the production of an elongated or pyriform body with a short but sharply attenuated flagellum or tail. The flagellum seems to be largely, though probably not wholly, the result of friction, since at its apex the mercury is continually being pulled off in the form of almost impalpably fine globules, so that in this way the large drop may be slowly disintegrated into a vast number of minute metallic globules.

That the figures of many of the lower organisms are affected more or less by such forces as those of cohesion and friction with the circumjacent fluid media in which they live, and by surface-tension, etc., there can scarcely be any doubt. In what ways these forces tend to modify organisms can only be determined by the most laborious and difficult methods of observation and study. Such effects cannot be determined by studying the dead organisms, but must be conducted on the living material, with the help of a great array of comparative measurements taken during active movement and rest.

The experiment here described, and which is represented on a reduced scale of one-half in the accompanying figure, shows a number of interesting facts. If the drops are below a certain size they are spherical; if somewhat larger they are flattened in the direction of motion; if still larger, the drops assume the singular monadiform-shape already described. With these three forms and sizes of drops or metallic



globules there is associated a progressive acceleration of motion due to the gradually increased gravity of the individual drops, and consequently increased friction and cohesion of the larger surface of the larger drops with the viscous medium through which they fall. If the attempt were made to represent the law according to which the three forms of drops were produced, it would be necessary to determine the weight or mass of each of the three sizes of drops or globules of mercury, and their rate of motion in a given interval of time. The factors of friction and cohesion would be dependent upon the increase in the area of the surfaces of the three grades of drops. The viscosity of the medium would be the same for all three sizes. These data are measurable, and could be expressed in mathematical formulæ.

The writer is aware that this experiment does not account for flagella at both ends of a monad, such as many bacterial forms show; nor does it account for the genesis of cilia or pseudopods all over a Protozoan, or for the cilia on an epithelium lining a cavity, or covering a free surface in one of the higher Metazoa. It is presented only with a view to indicate that experiment in the direction of the artificial simulation of some of the lowest living forms was not without much that is suggestive, even though no definite conclusion could be formulated from such an experiment, except the single one, that the nature, and especially the velocity of the motions of the lowest organisms, through their fluid surroundings, has probably had a definite or determinate influence in modifying their shapes so as to develop a major axis. Or where, as in some cases, the body of the monad is attached to the side of a long vibratile flagellum, there is an evident tendency to drag out or lengthen the monad's body in the direction of motion. The resemblance of the flagellula stage of *Protomyxa* to our large artificially-produced monadiform drop of mercury moving in a solution of soluble glass is even more striking.

Furthermore, as a matter of fact, we find, as in *Paramœcium*, that a slight spiral torsion of the body causes such a form to rotate while moving in a linear direction, and conformably with its major axis or longest diameter.

There is, in fact, no evidence to disprove that the major axis of all lower forms, as well as the major axes of higher forms, may not have been at first partly or wholly the result of the direct interaction of their primitive ancestral types with their surroundings.

In this connection, I may mention the planulæ of Coelenterata, which are elongated in the direction of their own motions, as well as the gastrulæ of sponges and the lowest vertebrates, which are similarly extended in the direction of their principal motions. That such tendencies of configuration were thus, in the first instance, directly adaptive or directly acquired, there is the greatest probability. Their subsequent transmission through inheritance by unequal growth along the major and minor axes is equally probable, in that the unequal growth may have been in the first place unequally stimulated along these axes by variation of stress along them, due to the motion of the organism itself. For stress or resistance from without, along the longest axis would be less than in the direction of the minor axis, which would constantly tend to be compressed, as the experiments here described testify. There are even facts which support this conclusion in another way. For example, the wild trout has a sharper head and more slender body than the trout reared in ponds and basins under domestication, and the same rule holds in respect of gold-fishes. The correlation of a sharper head and slenderer body is evidently with greater activity and ease of motion, so that the wild form may be regarded as "clipper-built," or like the figure of the famous yacht "Puritan," as compared with an ordinary fair-sailing sloop. These correlations of figure, with proportional powers of motion, are even more marked amongst the families of fishes themselves. The swiftly-swimming sharks, mackerel and herring are the "clipper-built" fishes of the seas; while the slow *Mola*, or sun-fish, typifies the living but helpless "hulk" sometimes run down and killed by actual collision with vessels.

It also seems to be a universal law of animal motion, that its direction in free forms is in conformity with the major axis or greatest diameter of an organism, or in the direction of least resistance. A cross-section somewhere at right angles to the greatest diameter gives the minor axis. This minor axis interposes the least resistance to motion in a fluid medium. It is also true that the waves of undulatory, vermicular, or vibratory motions always conform in direction to the major axis of an organism. In the simplest form studied by the writer, viz., that occurring in the movements of *Trypanosoma Balbiani*, the intestinal parasite of the oyster, this undulatory motion is propagated alternately from opposite ends of the fusiform body of the animal. The result is that the direction of the motions of the creature are reversed as often as the direction of the vibrations or undulations of the body is reversed, as must result from the well-known laws of wave-motion.

The assumption of the undulatory or vibratory method of locomotion, according to the laws of wave-motion, as in fishes, entails the necessary conformity of the longest or major axis with the direction of motion. No other direction of progressive motion following from the undulations of an elongated body is conceivable, as seen in the case of *Trypanosoma*. The direction of the motions of a vast majority of animals is therefore determined according to the physical laws, the operations of which we have just been tracing, while it has been equally well shown in the experiment presented that an energy, generated within the organisms, and dissipated in the form of motion, must always tend to elongate such an organism moving in a fluid, in conformity with the well-known laws of friction and cohesion, to which a soft, viscous, primitive organism must have been exposed during its motions through such a fluid medium.

The energy expended in molar or mass-motion was, therefore, partly dissipated at one time in giving a figure to the organism, as follows from known and empirically demonstrable laws of the motion of viscous bodies in fluids. We may, therefore, literally assert, with Lamarck, that organisms have, through their own motions, tended to shape and modify themselves. And it may be added, there is no evidence at present to show that such laws dominating similar forces are not active at the present moment, and that mechanical evolution is now in progress. The Lamarckian and Darwinian hypotheses are therefore reconcilable with the doctrine of the conservation of energy—the so-called Neo-Darwinian doctrine is not, and is therefore false. The first-named hypotheses thus lend themselves to an explanation of the genesis of variations which the latter does not, since its most strongly-expressed tenet is that acquired characters cannot be inherited. (Acquired only as here supposed, viz., through the expenditure of energy.)

Another effect of the undulatory motion of living bodies, along their major axes, is, that if they move freely in a dense medium, such as water, they tend to be flattened, especially at the ends, and at right angles to the plane in which the undulatory or wave-motions of the body are propagated. This is seen first of all in monadiform organisms themselves, and their flagella or propelling organs, which are flattened, as is shown by successful cross-sections of such minute structures. This lateral flattening, due to lateral undulatory motion, is also illustrated by the Hydrophidæ amongst snakes, in which their marine swimming habits have developed a vertically-flattened tail in a series of types which are ancestrally allied to land forms amongst the Elapidæ. It is further illustrated in fishes in which the flattening has expressed itself in the development of vertical fin-folds and fins. In *Sagitta*, where the undulations of the body are in a vertical plane, and not lateral, as in fishes, the fins are flattened horizontally.

The further consequences of this process, under the stress of still further modifying conditions, may be traced in the origin of heterocercy in fishes, as may be illustrated by means of a paper model vibrated from side to side in a dish of water. If the lower caudal lobe is widened, as it probably was by energetic sculling strokes of the tail in struggling to get to the surface, there must result an upward flexure of the axis of the tail, resulting in the morphological complication seen to-day in diverse groups of fishes which have no possible genetic connection with each other, as is proved by the structure of the tails of these several forms. Since there cannot be any possible genetic connection between Selachians and Teleostomes, or of the latter with the sturgeons or Chimæroids, the heterocercal conditions of these forms must have arisen independently, and as a consequence of the same physical causes acting independently and in the same way for each group.[1] The fracture of the caudal rays of the Salmonoids and Clupeoids follows conformably with the laws of the undulations of the tail in a dense medium.[2]

Still other consequences of motion in differentiating structure may be traced, such as the correspondence of the number of muscle-plates with the number of vertical rows of scales, as I have lately found in certain Clupeoids. This is also true of the vertebral column and the vertebral centra, whose biconcave bodies in lower types are a marvellous expedient, rendering continuous growth and concomitant functional activity possible. Their form has not the remotest relation to any arrangement for strength to be compared with the trusses and beams of a system of cantilevers, as absurdly

[1] On the Morphology and Evolution of the Tails of Osseous Fishes. Proc. Am. Ass. Adv. of Science, XXXIII, 1884, pp. 532, 533.

[2] Proofs of the effects of habitual use in the modification of animal organisms Proc. Am. Philos. Soc., XXVI, 1889.

suggested by Prof. Bardeleben.[1] Notwithstanding their biconcavity, the vertebræ of the salmon show undoubted evidence of conforming to the shape demanded of them in executing the lateral undulatory movements of the body. In the Cetacea, where these undulations are vertical, the conformation of the caudual vertebræ is precisely the reverse of what it is in the salmon.

Farther research will undoubtedly disclose farther evidence of the forward displacement of the vertical and paired fins of fishes. This displacement may, with absolute certainty, be traced to the manner in which the vertical fins exercise their functions in certain instances, as in *Mola*, for example.[2] The continuous tension forwards on the bases of the dorsal and anal fins, acting like propeller-blades from before backwards, has conspired to produce such a result only too plainly evident in a study of the skeleton. But even this result is to be traced to antecedent modes of motion of the whole body, which were undulatory in character, but which now no longer affect the body itself of this singularly-modified fish. We may, therefore, affirm, that habits, and ultimately functions, have been superposed, leading to the superposition of structures. If this method of procedure is philosophical, the whole fabric of morphological method and speculation now rife amongst biologists must be re-cast. For my own part, I have no hesitation in declaring that some of the current methods are destined to end in disappointment. The method is overweighted with morphological details, which have nothing but a morphological significance in the eyes of this newer school of biologists. What such methods may lead to is indicated by papers which have appeared within the year on the origin of vertebrates from crabs and scorpions!

No hypothesis of the origin of the limbs yet offered is anything but purely morphological, and by so much is one-sided and defective. None of the hypotheses of the evolution of the limbs link the palpable facts of structure with the palpable facts of function, and, above all, with the mechanical and physiological laws, in the widest sense, which that function and structure illustrate. As long as they do nothing more, these hypotheses are a mere conning of data to which no significance can or will be attached by those who ask for more than mere anatomy, except as those data help to illustrate

[1] Beiträge zur Anatomie der Wirbelsäule, 4to, Jena, 1874. (Die Wirbelsäule als Fachwerk, pp. 20–27.)

[2] The Swimming Habits of the Sun-fish, Science VI, 1885, pp. 103–104.

a philosophy of that science whose barest outlines have scarcely more than been indicated. We may truly say, with Roux, that there is an anatomical discipline of the future which has scarcely yet been developed even in outline. Only here and there has any one been bold enough to declare himself. This new science will not grow as fast as morphology. It will require a different sort of mental equipment than is possessed by the majority of morphologists, most of whom seem to be lost in trivial morphological details, or in framing systems of relations and phylogenies based on purely morphological data, and which are more or less happy and valuable as aids in identifying forms. This newer discipline will demand that a structure be turned over and looked at from every conceivable standpoint of conditions which have had to do with its genesis. The method is infinitely slow, because it recognizes the fact that *structures, functions* and *conditions* are contemporaneous or superposed; and to unravel the method of the working of the energy of life as manifested to us in living creatures, through this interwoven trinity of factors, is its object.

NOTE ON THE SOFT PARTS AND DENTITION OF STOMATELLA.

BY H. A. PILSBRY.

In the course of my study of *Stomatella* for the Manual of Conchology, I was struck by the apparent diversity of the few animals of different species described by various observers. It therefore seems desirable to describe the only species seen by me in the flesh, and to figure the dentition, heretofore unknown.

The specimen (No. 60696 of the alcoholic collection of the Academy) is labelled *S. Godeffroyi* Dkr., Viti Islands. It seems to be the same as *S. Mariei* Crosse.[1]

The foot is broad and fleshy, emarginate behind, the sole divided longitudinally by an impressed median furrow. Its upper surface is granulate and tuberculate. The muzzle is rather broad, transversely wrinkled, ending in a flat, oval oral disk, the mouth in the middle. Tentacles stout but tapering. Eyes on short, stout peduncles outside and a little above the bases of the tentacles. Epipodial ridge commencing in a short triangular lobe behind the right eye-peduncle, the lateral edges of the lobe somewhat upturned, like a short trough. From this the epipodial ridge is rather fleshy and prominent along the sides of the foot, and it bears two slender cirri. It terminates posteriorly at the operculigerous lobe. In the specimen before me there is no operculum, and the edges of the lobe are upturned, probably from contraction in alcohol. There are two minute frontal lobes between the tentacles, not connected across the "forehead."

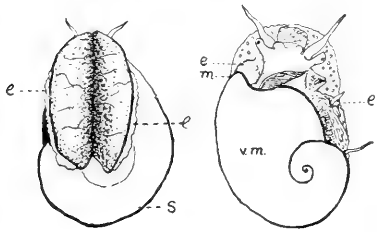


Fig. 1.

Fig. 2.

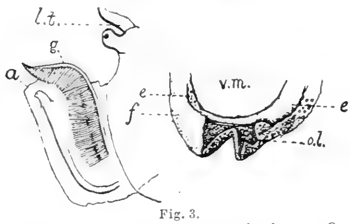


Fig. 3.

The gill is single, consisting of numerous (about 130) narrow plates, arranged in one series. Anterior third of the plume free. Anus opens on a short papilla.

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[1] *Vide* Manual of Conchology, xii, p. 16.

The radula shows a marked resemblance to the same organ in the *Trochidæ.* The rhachidian tooth has a broad body, narrowed above, with a distinct, denticulate cusp. The laterals, five on each side, are of rather complicated form, having supporting-wings on their outer edges, or as Troschel would call them, *Stützlamellæ.* They gradually change in form from the oblique shape shown by the inner one, to the more upright position of the fifth or outer lateral.

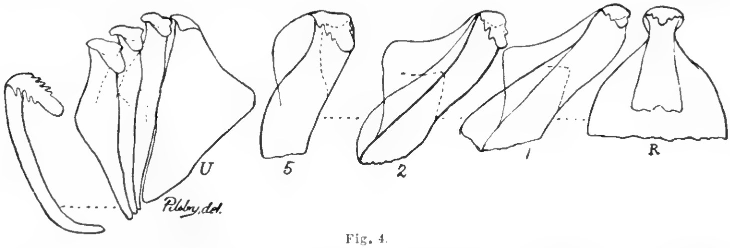

Fig. 4.

Note here that the outer lateral is of the same size and structure as the inner ones, not enlarged or reduced, or modified in form as in so many Rhipidoglossate mollusks. The inner uncinus has a very broad triangular body; the following ones have the body of the tooth narrower, and in the outer uncini it is still more slender. The cusps of the rhachidian and lateral teeth are denticulate on their edges; those of the inner uncini are smooth, but the outer ones have long serrate cusps.

Explanation of figures.

Figs. 1, 2, three views of animal, the shell removed from the dorsal and side views, showing the visceral mass (*v. m.*), the epipodial ridge (*e*), etc. Fig. 3 shows the mantle slit open to exhibit the gill (*g*), anal papilla (*a*) and left tentacle and eye-peduncle. Also showing the back of the foot (*f*), with operculigerous lobe (*o. l.*). Fig. 4, dentition. Formula *x*–5–1–5–*x*.

JANUARY 13.

Dr. GEO. H. HORN in the chair.

Twenty-three persons present.

Papers under the following titles were presented for publication:—

On the "Genus Psilorhinus Rüppell." By Witmer Stone.

"Description of a specimen of Chirolophus polyactocephalus from Vancouver Island." By Ashdown H. Green.

"Geological Researches in Yucatan." By Prof. Angelo Heilprin.

JANUARY 20.

Dr. CHARLES SCHAEFFER in the chair.

Thirty persons present.

A paper entitled "A Review of the Cretaceous Mammalia" by Henry F. Osborn was presented for publication.

An hypothesis as to the Nature and Origin of Germ Force.—DR. J. CHESTON MORRIS referred to a communication published by him in the Proceedings of the Academy about thirty years ago in which he called attention to the mode of splitting of egg-albumen in diluted solution kept at a warm temperature, giving rise to a body like creatin and a ferment possessing properties allied to pepsin. Accident, unfortunately, and press of other work, prevented the completion of the quantitative analysis. But now, in connection with the views recently propounded by Dr. McLaughlin (Texas State Med. Soc. Trans. 1890) as to the explanation of the phenomena of immunity from, and prevention of, contagious and infectious diseases by the law of interference, these views might be again referred to, as illustrations of the splitting of organic molecules and their results.

Physical forces are now generally regarded as vibrations or undulations produced in matter, but to regard vital force as also vibratory is a great step in advance. Its effects are evolution of form, growth, secretion, excretion, reproduction, maintenance of form with change of material; its conditions, the presence of liquid plasma, heat, light, oxygen, and a germ, itself the result of union of a germ-cell with a sperm cell. Without all these, we have no life-phenomena with them they always ensue. Matter in becoming part of a living body continues to possess all the vibrations which give its special character; the plasma, be it earth or organic matter, retains its chemical properties, but these are modified by other vibrations resulting from this special force. If the law of *interference* explains many of the phenomena of infectious and contagious diseases, and also the action of many drugs (as for instance that of opium inhibiting or modifying nerve-vibration), no less does that of *transference* explain the origin of the germ. If a cord be stretched between two pillars, and a weight suspended half-way between, and then two other weights similarly suspended half-way between it and the pillars, so that motions at right angles may be given to them—*e. g.* north to south to one, east to west to the other—the central weight will gradually begin to swing and evolve certain figures and curves due to the impulses transferred from the two outer weights. So the union of the contents of the germ-cell and sperm-cell results in the formation of a germ which evolves a form like that of its parents, following their evolution, transmitting in turn its form to its successors, or transmuting it into other forms of motion. Thus all the phenomena of life may be explained on the vibratory hypothesis. Nay, death itself is but the transmutation into other forms of the form so evolved, and becomes as necessary a part of tne whole series of evolutions as birth.

The permanence of cicatrices is thus explained. Also the apparent intelligence with which, from a common plasma, different plants evolve different principles (according to their special vibrations), or different organs take their special nutriment from one common blood, and, as the nerves for instance, give rise to special vibrations consonant with their special functions.

In fact we enter thus upon an entirely new field in biology, physiology, pathology and therapeutics. Already the results obtained in the study of variola, syphilis, anthrax, rabies, cholera, and as alleged lately in tuberculosis, may be seen to arrange themselves in accordance with the principles thus enunciated, as foreshadowed by Dr. McLaughlin, and by Dr. Dixon in his communication to this Academy.

In reply to a question with regard to suspended animation, convulsions, etc., Dr. Morris said that he thought these phenomena were fully in accordance with the vibratory hypothesis and that the latter also offered the only plausible explanation suggested as yet of the well-known periodicity of life phenomena both in health and disease.

January 27.

Dr. Geo. H. Horn in the chair.

Thirty-two persons present.

The death on the 22nd inst. of Charles Lennig, a member, was announced.

Rate of Coral Growth.—PROF. HEILPRIN exhibited a specimen of *Porites astrœoides* from the Caletta Reef, harbor of Vera Cruz, Mexico, which gave some interesting data regarding the rate of growth of coral structures. The specimen in question was received through Captain J. Powell, Chief of Construction of Piers of the Mexican Railway, and is said by that gentleman to have been removed from an anchor which was cast in the autumn of 1885 and drawn in November, 1890. The extreme period of growth is thus somewhat over five years, but naturally it is impossible to state how soon after the casting of the anchor attachment of the polyp was made. The coral is a mammillated sheet or crust measuring four inches in longest diameter, and somewhat less than three inches on the shorter diameter. The general thickness of the basal mass is not over $\frac{1}{5}$–$\frac{1}{4}$ inch, although through involution and secondary crustage knobs of considerable prominence have been added to the surface. Assuming the basal growth as the index of actual development then the annual accretion would be (if we allow full five years for the process) scarcely the $\frac{1}{20}$ of an inch. Observations recently made on other species of corals have yielded somewhat similar results.

The following were elected members:—Albert P. Brown, M. D., Amos Peaslee Brown, Thomas Hewson Bradford, M. D., Stewardson Brown, Edmund E. Reed Jr., George C. Evans and Mary S. Holmes.

The following were ordered to be printed:—

NEW SPECIES OF FUNGI FROM VARIOUS LOCALITIES.

BY J. B. ELLIS AND BENJAMIN M. EVERHART.

Phyllosticta Lycopodis.

On leaves of *Lycopus Canadensis*, London, Canada, Sept., 1889. J. Dearness, 727. Spots amphigenous, thin, white, mottled with dirty gray, finally deciduous and often confluent, 1–3 mm. diam. with a definite, narrow, black border. Perithecia epiphyllous, sublenticular, black, pierced above, 80–100 μ. diam. not numerous. Sporules abundant, hyaline, elliptical, with a nucleus in each end, 2½–3 x 1½ μ.

Phyllosticta Petasitidis.

On leaves of *Petasites palmata*, London, Canada, Sept., 1889. J. Dearness, 838. Spots orbicular, reddish-brown, sometimes with a whitish center, ½–1 cm. diam. concentrically wrinkled, margin subindefinite. Sporules oblong-elliptical, hyaline, 5–8 x 2½–3 μ. Possibly an imperfectly developed form of *Ascochyta microspora* Traill., but we see no septum in the sporules.

Phyllosticta minutissima.

On living leaves of *Acer glabrum*, Hot Creek Basin, Sioux Co., Nebraska, Aug., 1889. H. J. Webber, 21. Spots amphigenous irregular in outline, suborbicular, 4–9 mm. diam. reddish-brown above with a lighter colored shaded border, paler below. Perithecia hypophyllous, minute (75–85 μ.), globose, numerous, subprominent, filled with minute, subelliptical, hyaline sporules about 1½–2 μ. long and ½ μ. or less broad.

Septoria Pteleæ.

On leaves of *Ptelea trifoliata*, Racine, Wis., Oct., 1890. (Davis, 9057). Spots amphigenous, scattered, small, 1–3 mm., irregular in shape, nearly black, definite but without any distinct border. Perithecia amphigenous, scattered, minute, (100–150 μ.), prominent, papillate. Sporules cylindric-vermiform, nucleate, 1–3-septate, narrowed toward one end, hyaline, 35–65 x 3–3½ μ.

Septoria nubilosa E. & E.

On leaves of *Helenium autumnale*, Racine, Wis., October, 1890. (Davis, 9056). Differs from *S. Helenii* E. & E. (J. M. III, 87), in the absence of any definite spots, the minute, epiphyllous, prominent perithecia being collected in orbicular patches ½–1 cm. across and darker than the other parts of the leaf. Sporules 25–30 x 1½–2 μ., nucleate, narrower at one end.

Phyllosticta Staphyleæ Dearness.

On living capsules of *Staphylea trifolia*, London, Canada, Aug., 1890. Dearness, No. 16. Spots at first wine color, becoming brown, mostly limited when young by a carmine-red line. *Perithecia* scattered, 90–145 μ. diam., innate, concolorous with the spot at first, at length darker and finally well marked by a ring of raised, light cuticular cells. Sporules oblong-elliptical, hyaline, becoming pale brown, 6–7 x 2¾–3⅓ μ.

Phyllosticta Rhei.

On leaves of rhubarb (*Rheum Rhaponticum*) Newfield, N. J., Sept., 1889, and New Brunswick, N. J., Aug., 1890. (Halsted.) Spots large (1 cm. or more), reddish-brown, concentrically zoned. Sporules oblong or clavate-oblong or elliptical, 2–3 nucleate, hyaline, 7–12 x 3½–4½ μ. Some of them slightly constricted in the middle but no septum seen.

Phyllosticta Parkinsoniæ.

On living leaves of *Parkinsonia aculeata*, San Antonio, Texas, Dec., 1889–Jan., 1890. Dr. B. F. G. Egeling, No 121. Spots amphigenous, orbicular, minute (1 mm.) nearly black, with a slightly raised border, becoming reddish brown. Perithecia innate only slightly prominent, depressed-globose, dark, 80–100 μ. diam. Sporules elliptical or oblong-elliptical hyaline, 4–6 x 2 μ.

Phyllosticta Sophoræ.

On living leaves of *Sophora speciosa*, San Antonio, Texas, Dec., 1889. Dr. B. F. G. Egeling. Spots amphigenous, small (about 1mm), round, concave on both sides of the leaf, with a narrow raised border, nearly black, becoming reddish-brown, leaf not discolored around them. Perithecia innate, mostly only one on a spot partially erumpent, globose, 100–150 μ. filled with a mass of minute (1½–2½ x ¾ μ.) sporules.

Cornularia ulmicola.

On outer dead bark of Elm, London, Canada, Dec., 1889. J. Dearness, 1248. Perithecia clavate-cylindrical, black, ½–1 mm. high and about 74 μ. thick below, enlarged above and 100 μ. thick but acute at the apex, of fibrous texture, the fibres separating above into a dense brush-like head. Sporules enclosed in the swollen head, slender fusoid, pale yellowish, multinucleate becoming multiseptate, 70–80 x 3 μ., ends attenuated and mostly curved in opposite directions, borne on filiform basidia about 35 μ. long. Closely allied to *C. hispidula* Ell. but differs in its smooth stem with swollen head and rather longer and narrower sporules.

Sphaeronema sphaeropsoideum.

On dead limbs of *Fraxinus*, London, Canada, Feb., 1889. J. Dearness, 1467. Perithecia scattered, conical, ½ mm. diam., sunk in the surface of the inner bark and erumpent through the ruptured epidermis, with a subulate slender beak ½–1 mm. long crowned with a whitish globule of ejected sporules which are oblong, hyaline, 12–20 x 6–8 μ., on basidia about as long as the sporules and 2½–3 μ. thick. Among the basidia are numerous slender threads (sterile basidia) ? like paraphyses overtopping the sporules.

Schizothyrella Hippocastani.

On bark of dead *Aesculus Hippocastanum*, London, Canada, March, 1890. J. Dearness, 1571. Perithecia subseriately-erumpent, superficial, black, globose-tuberculiform, subconfluent or single, when perfect more or less distinctly quadrisulcate. Sporules fasciculate, 75–80 μ. long, separating above into cylindrical, hyaline, truncate joints 8–10 x 1½ μ. The lower part may be considered as a basidium and is of a brownish color.

Haplosporella seriata E. & E.

On bark of *Sambucus*, London, Canada, May, 1890. Dearness, 1661. Perithecia connate, forming a narrow oblong stroma 2 or more mm. long and 1–2 mm. wide, erumpent through the ruptured epidermis, often more or less continuously confluent in narrow strips for several cm. in length. Sporules brown, continuous, 20–25 x 10–12 μ.

Vermicularia Veratrina.

On half dead leaves of *Veratrum viride*, Wilmington, Del., June, 1890. Commons, 1458. Perithecia irregularly scattered, small (75 μ. diam.), mostly imperfect above, clothed around the sides with black, erect bristles 70–150 x 4–5 μ. Sporules fusoid-cylindrical, nucleate, slightly curved at each end, 15–22 x 2½–3 μ. The leaves are soon blackened and killed.

Sphaeropsis ulmicola.

On dead elm branches, London, Canada, Apr., 1890. Dearness, 1581 (b). Perithecia scattered, minute (¼–⅓ mm.), white inside, covered by the epidermis which is raised into little pustules but mostly not ruptured. Sporules, yellowish-brown, elliptical or obovate, 20–30 x 12–15 μ. on stout basidia rather shorter than the sporules. *S. ulmi* S. & R. has sporules 60–70 μ. long.

Diplodia papillosa.

On bark of dead *Cornus*, London, Canada, Feb., 1890. J. Dearness. Perithecia scattered, buried in the bark which is raised into minute papillae over them, minute (¼–⅓ mm.). Sporules oblong-elliptical, greenish-yellow, 1–septate and slightly constricted, 12–15 x 6–7 μ. Apparently the stylosporous stage of *Didymella Corni* (Sow.), which is found with it. *D. mamillana* Fr. has larger brown spores.

Diplodia Linderae.

On dead limbs of *Lindera Benzoin*, Newfield, N. J. and London, Canada. Perithecia scattered, covered by the epidermis or partially erumpent, small, sporules oblong-elliptical, brown, 1-septate and constricted, 10–12 x 3–4 μ. Possibly not distinct from *D. Harknessii*, Cke.

Diplodia Dearnessii.

On dead decorticated stem of wild currant, London, Canada, Feb., 1890. Perithecia erumpent-superficial, scattered, minute (½ mm.), subglobose, sporules narrow-elliptical, brown, 1–septate, 8–10 x 3½–4 μ. Differs from *D. ribicola* C. & E. (Grev. V., p. 55) in its much smaller sporules. *D. ribicola* C. & E. takes precedence of *D. Ribis* Sacc. which appears to be the same.

Leptostromella elastica.

On leaves of *Ficus elastica* in a green-house at Knoxville, Tenn., Jan., 1890. Prof. F. L. Scribner. Spots large, dull white, darker around the margin with a reddish-purple border. Perithecia epiphyllous, hysteriiform, ½–¾ mm. in the longer diam. opening by a longitudinal cleft along the middle. Sporules oblong, hyaline, 2–3 nucleate, 12–15 x 4–5 μ., on stout, olivaceous basidia 12–15 x 3–4 μ. Probably the spermogonial stage of some *Lophodermium.*

Septoria gummigena.

On the hardened gum of cherry trees, Wilmington, Del., Dec. 3, 1889. A. Commons, 1105. Perithecia gregarious, black, subovate, soon broadly pierced above, about ¼ mm. diam. Sporules filiform, continuous, 30–40 x 1–1¼ μ.

Septoria dolichospora.

On leaves of *Solidago latifolia*, London, Canada, Sept., 1889. Dearness, 835. Renders the leaf bullate-rugose with numerous small swellings, convex above and concave below, 1–2 mm. diam. These become white above, generally several contiguous ones becoming confluent so as to form a dirty white spot of irregular outline above and of a dark, dirty brown below, the white color spreading finally more or less and appearing also here and there below. Perithecia epiphyllous, scattered quite abundantly on the white places, 75–100 μ. diam. Sporules 70–110 x 1½ μ., continuous and not distinctly nucleate, hyaline. Differs from *S. solidaginicola*, Pk. in the bullate-rugose leaf, more abundant and larger perithecia and much longer sporules.

Septoria carnea.

On partly dead leaves of *Carex*, London, Canada, Sept., 1889. J. Dearness, 805. Perithecia hypophyllous, flesh colored, collapsed when dry, seriate between the nerves of the leaf and forming elongated patches, 1–3 cm. long and 2–4 mm. wide. Sporules fusoid, slightly curved, nucleate, acute at the apex, fasciculate, 20–30 x 1½ μ. hyaline.

Septoria Erechtitis.

On living leaves of *Erechtites hieracifolia*, Wilmington, Del., Aug., 1890. Commons, 1536. Spots light-brown, numerous, suborbicular or elliptical, or subangular and partly limited by the veinlets. Perithecia numerous epiphyllous, small, black, erumpent, subglobose, pierced above. Sporules, 20–30 x 1½ μ., with several nuclei, nearly straight or rather abruptly bent near the middle.

Septoria Canadensis Ell. & Davis.

On *Solidago Canadensis*, Racine, Wis., May, 1886. Spots amphigenous, suborbicular, 2–3 mm. diam., rusty-brown becoming paler in the center and surrounded by a shaded purplish border. Perithecia minute and inconspicuous, amphigenous but mostly epiphyllous. Sporules vermiform-cylindrical, 33–45 x 1½–2 μ., nucleate, becoming faintly about 3-septate. In the fresh specimens the septa do not appear, but finally a faint division of the contents of the spore may be discerned.

Septoria albicans.

On leaves of *Saxifraga Pennsylvanica*, Genoa Junction, Wis., May, 1890. Dr. J. J. Davis, 9022. Spots orbicular, chestnut-brown, subindefinite, 2–4 mm. diam. slightly depressed above and prominent below. Perithecia very minute, 40–50 μ. diam. epiphyllous, crowded in the center of the spots. Sporules filiform, 50–75 x 1½ μ., faintly nucleate, hyaline, nearly straight, oozing out and whitening the upper surface of the spots.

S. Saxifraga Pass. agrees with this in the character of the spots but is said to have the sporules 17–30 x 3 μ.—much shorter and thicker than in the Wisconsin specimens.

Phleospora reticulata.

On *Lathyrus palustris*, London, Canada, Aug., 1890. J. Dearness, 156. Spots subquadrate, about 1 mm. diam., mostly marginal, white with a narrow black margin, numerous and confluent in one large, oblong spot 1–2 x ½ cm., the whole surrounded by a shaded dark margin. The large spot has a checkered or recticulated look on account of the narrow black lines surrounding the smaller component spots. Sporules linear, 100–160 x 3½–4 μ., attenuated towards the ends, 3–6–septate (or more), often constricted at the septa. Perithecia very imperfectly developed, consisting merely of the more or less blackened cells of the surrounding parenchyma. The sporules are abundant and soon erumpent in short, thick, pale, flesh-colored cirrhi.

Stagonospora Petasitidis.

On living leaves of *Petasites palmata*, London, Canada, July, 1890. J. Dearness, 1767. Perithecia epiphyllous, scattered hemispherical, black, coarsely cellular, smooth, broadly perforated above, about ⅓ mm. diam. Sporules clavate-cylindrical, nucleate, becoming 3–4–septate, 55–70 x 5–6½ μ. hyaline.

Stagonospora Cyperi Ell. & Tracy.

On culms of *Cyperus cylindricus*, Starkville, Miss., July, 1890. Tracy, 1559. Perithecia minute, globose, crowded, forming pustuliform groups 1 mm. or more in diam. beneath the cuticle which becomes brown above them and finally splits open, exposing the tobacco-brown perithecia. Sporules fusoid, hyaline, 12–16 x 2½–3 μ., 2–3-nucleate.

Stagonospora Trifolii.

On living leaves of *Trifolium repens*, London, Canada, Aug., 1890. Dearness, 262. On dark brown spots (becoming paler), of considerable size and more or less limited by the veinlets of the leaf. Perithecia innate, subprominent above, pale. Sporules cylindrical, 2–4-nucleate, 12–20 x 3–4 μ., hyaline.

Coryneum Paspali.

On dead culms of *Paspalum platycaule*, St. Martinsville, La., Dec., 1859. Langlois, 2239. Acervuli scattered, erumpent, black, ½ mm. diam. Spores oblong cylindrical, brown, 6–9-septate, 50–60 x 10–12 μ., on short basidia.

Glœosporium Caryæ Ell. & Dearness.

On leaves of *Carya alba*, London, Canada, Sept., 1890. Dearness, 319. Spots suborbicular, reddish-brown above, darker below, 1–2 cm. in diam. or by confluence more, subindefinitely margined. Acervuli hypophyllous, numerous, small, 75–150 μ. superficial, brown. Spores allantoid, hyaline, continuous, 7–10 x 1½–2 μ.

Glœosporium Celtidis.

On leaves of *Celtis occidentalis*, London, Canada, Sept., 1890. J. Dearness. Spots mostly marginal, more or less continuous along the edge of the leaf, sometimes occupying and killing half the upper part of the leaf and eventually the entire leaf, the dead areas turning dirty brown and being definitely limited by a darker, narrow border, beyond which the leaf often turns yellowish. Acervuli numerous, about 200 μ. diam. Spores fusoid-oblong or ovate-oblong, continuous, 10–12 x 4–5 μ., hyaline, mostly erumpent below in small orange-colored heaps.

Glœosporium lunatum.

On large (1–3 cm.) orbicular dead spots on living leaves of *Opuntia*, with *Sphaerella Opuntiae* E. & E., San Antonio, Texas, Jan., 1889. Dr. B. F. Egeling. Acervuli erumpent, flesh color, numerous. Spores lunate-fusoid, 12–20 x 2–3 μ., mostly a little thicker at one end. Differs from *G. Opuntiae* E. & E. in its maculicolous growth and lunate spores.

Glœosporium saccharinum.

On leaves of *Acer saccharinum*, Racine, Wis., June, 1889. Dr. J. J. Davis, 1189. Killing the margin and upper part of the leaves which become brown and dry and are finally entirely destroyed.

Acervuli minute, abundant not readily seen. Spores oblong-fusoid, 6–7 x 1½–3 μ., hyaline, continuous.

Glœosporium Canadense.

J. M. V., p. 153. Dr. Davis sends from Wisconsin a variety of this on leaves of *Quercus alba* having the spots larger (1 cm. and over), of a brighter color and sometimes confluent over a large part of the leaf. The spores are about the same as in the Canada specimens.

Glœosporium ovalisporum.

On leaves of *Prunus serotinas*, London, Canada, May, 1890. Dearness, 1714. Arcervuli minute, thickly scattered over large dead areas of the leaf which becomes of an ashy-brown, erumpent on both surfaces of the leaf. Spores ovate or lemon-shaped with a slight apiculus at one end, 6–10 x 5–7 μ. Affects the leaves in the same way as *G. aridum*, E. & H.

Cylindrosporium Ziziae.

On living leaves of *Zizia cordata*. Racine, Wis., June, 1890. Davis, 9016. Spots amphigenous, subangular, mostly subelongated, small, 1–1½ x 2–3 mm., blackish, limited by the veinlets. Acervuli numerous, crowded, small, dark. Spores cylindrical-vermiform, 40–60 x 5–6 μ., nucleate, becoming 3–6–septate, slightly curved, erumpent in white cirrhi more abundantly on the lower surface of the leaf.

Cylindrosporium Dearnessii.

On leaves of *Carpinus Americana*, London, Canada, June, 1890. Dearness, 1727. Spots reddish-brown, orbicular, 2–3 mm. diam., the margin a little darker. Acervuli few, crowded in the center of the spots, 100–120 μ. diam. Spores cylindrical, granular, becoming 3–or more–septate, often curved into a semicircle, 35–40 x 2½–3 μ., erumpent on both sides of the leaf but especially above, forming a loose, white flocculent mass.

Cylindrosporium Cicutæ.

On living leaves of *Cicuta maculata*, London, Canada, Sept., 1889. J. Dearness, 567. Spots dirty brown, amphigenous 1–2 mm. diam. suborbicular, partly limited by the veinlets. Acervuli minute, innate, 70–80 μ, diam., scarcely visible. Conidia 20–30 x 1½ μ. (exceptionally 35 μ. long), nucleate, nearly straight, thicker at one end, greenish-hyaline, erumpent mostly on the upper side of the leaf in minute, white cirrhi. This is quite distinct from *Septoria Sii*, Desm. which has distinct perithecia and longer sporules.

Cylindrosporium Ceanothi.

On leaves of *Ceanothus thyrsiflorus*, Santa Cruz Mts. near Fulton, Cala., Aug., 1888. Prof. L. M. Underwood. Amphigenous. Acervuli large, on small (1–2 mm.), blackish-brown spots which are thickly scattered over the leaves and more or less confluent, paler beneath. Spores vermiform, more or less curved, 1–3–septate, 35–45 x 4 μ., issuing in compact flesh-colored cirrhi.

Marsonia nigricans.

On leaves of *Salix*, London, Canada, Sept., 1890. Dearness, 308. Spots amphigenous, nearly black above, becoming more or less whitish, reddish-brown below, indefinitely limited and more or less confluent or sometimes definitely limited, especially above, and margined by a narrow, yellow shaded border. Spots, when not confluent, about ½ cm. diam. Acervuli 100–125 μ. diam., dark-colored, not numerous. Spores clavate-ovate, curved, acute below, with a single septum near the lower end, 14–16 x 6 μ., erumpent on the lower surface of the leaf. *M. Populi* is epiphyllous and has larger spores.

Marsonia apicalis.

On living leaves of *Salix lucida*, Racine, Wis., July, 1890. Davis, 9012. Occupying the apex of the leaf which soon becomes brown, dry and dead. Acervuli, minute, numerous. Spores oblong or oblong-cylindrical, hyaline, 1–septate, 12–20 x 5–6 μ., one end often a little narrower, erumpent mostly on the lower surface of the leaf in minute white heaps.

Ramularia Canadensis

On living leaves of *Carex conoidea*, London, Canada, Aug., 1890. Dearness, No. 22. Spots black, elliptical, 1–2 mm. long or by confluence ½–1 cm. becoming white in the center. Hyphae subulate, hyaline, continuous, 30–40 x 3–4 μ., arising from the white center of the spots and bearing at their tips oblong 1-septate, nucleate, 2–3-concatenate, hyaline conidia, 15–22 x 5–6 μ.

This can hardly be referred to *Septocylindrium* on account of its well developed fertile hyphae (basidia). It bears considerable resemblance to *Septocylindrium caricinum* Sacc., but differs in its subulate basidia and broader, 1-septate conidia.

Ramularia stolonifera.

On leaves of *Cornus stolonifera*, London, Canada, Sept., 1889. J. Dearness, 707. Hypophyllous on small, pale-reddish, subindefinite spots which are rather more distinct above. Hyphae subfasciculate, hyaline, simple or sparingly branched, 20–40 x 3–4 μ., continuous, obtuse and denticulate above. Conidia cylindrical, obtusely pointed, catenulate (2–3), 10–30 x 2–3 μ.

R. angustissima Sacc. (on *Cornus sanguinea*) is said to have the hyphae 10–40 x 1–1½ μ., and conidia 10–12 x 1–1½ μ. Ours may be only a more robust form.

Ramularia arnicalis.

On *Arnica cordifolia*, Rimini, Montana, June, 1889. Rev. F. D. Kelsey, No. 88. Spots amphigenous, 3–4 mm. diam. suborbicular or partly limited by the veinlets, dark dirty-brown above, with a lighter, subindefinite, yellowish border, dull white below. Hyphae hypophyllous, subfasciculate, 12–20 x 2½–3 μ., slightly toothed above. Conidia subcylindrical, 15–20 x 3 μ., nucleate, acute at the ends and the upper end mostly slightly curved.

Ramularia repens.

On leaves of *Aralia racemosa*, London, Canada, Sept., 1889. J. Dearness, Nos. 876 and 877. Hypophyllous. Hyphae subfasciculate 12–20 x 3 μ., subdenticulate above, arising from creeping, branched sterile threads. Conidia cylindrical, nucleate and granular 15–22 x 3–4 μ., some of them uniseptate and constricted, subcatenulate in series of 2–3, the upper one sometimes bearing 2–3 conidia standing in a digitate manner on the apex. The fungus forms small cinereous white patches 2–4 mm. diam. either indefinitely limited or partly bounded by the veinlets.

Ramularia Dioscoreae.

On leaves of *Dioscorea villosa*, Racine, Wis., Aug., 1889. Dr. J. J. Davis, No. 189. Hypophyllous in small, whitish patches, thickly scattered over the entire surface of the leaf which is faintly mottled with yellow above. Fertile hyphae erect 25–35 x 4 μ. mostly toothed above. Conidia oblong-cylindrical, obtuse, 1–septate, 15–25 x 3½–4½ μ. The hairs of the leaf are surrounded by the fungus which gives them a whitish incrusted appearance. This is very different from *Cercospora Dioscoreae* E. & M.

Ramularia lethalis.

On leaves of *Acer rubrum*, London, Canada, June, 1890. J. Dearness, 1730. Spots irregular, subconfluent, 3–6 mm. across, black-brown, extending over and killing the leaves. Hyphae hypophyllous, slender, 12–15 x 2 μ. Conidia elliptical to oblong, 5–12 x 2½–3½ μ., the longer ones 1–septate, the shorter ones continuous.

Peronospora Impatientis.

On leaves of *Impatiens fulva*, Wilmington, Del., Apr., 1889. A. Commons, 1373. Forming small, loose tufts becoming more or less confluent, at length in an almost continuous thin white coat on the lower surface of the leaves. Conidial hyphae bare for 200–300 μ. below and 8–10 μ. thick and continuous, above this sending out about 3 alternate branches nearly at a right angle, each of these branches generally trifidly divided, each division bearing at its extremity about 3 straight spreading spicules bearing the globose 12–14 μ. or elliptical 15–17 x 12–14 μ. conidia. Oospores not seen.

Titæa Clarkei.

Parasitic on *Dichaena strumosa*, on *Quercus ilicifolia*, Vineland, N. J., Apr., 1888. Miss C. H. Clarke. Forming punctiform or elongated (½–1 mm.), white appressed tufts of closely aggregated, hyaline, quadrilocular conidia which are made up of two vertical cells the upper one of which is globose or slightly elliptical, 7–9 μ. diam. and the lower one subovate and smaller but bearing on each of the two opposite sides a slightly curved or nearly straight spreading arm 40–45 μ. long with two constrictions near the base where it is about 4 μ. thick, and gradually attenuated above to a slender bristle-like tip. Occasionally there are three of these arms. The conidia are borne on pedicels 15–25 x 3 μ. 4–5 times constricted and arising from a cellular stratum. This appears referable to Saccardo's genus *Titæa*, from the single described species of which it differs in the constricted arms and pedicel which give it a very ornate appearance. The species is dedicated to its discoverer Miss C. H. Clarke whose name is already familiar to the students of mycology.

Rhinotrichum muricatum.

On decaying bark, Adirondack Mts., 1887. Dr. Geo. A. Rex. Appears like a thin clay-colored or grayish tomentose coating on the matrix, effused and continuous for several cm. Prostrate hyphae brown, sparingly septate, branched, sending up an abundance of erect straight roughened branches 100–125 μ. long and 10–12 μ. thick, and mostly attenuated gradually above, bearing on all sides the subelliptical, ferruginous-brown conidia which are often a little bulging on one side and are about 7 x 3 μ. The erect fertile branches appear as if coated with coarse sand.

Zygodesmus tuberculosus.

On decaying roots in swampy woods, Newfield, N. J., Oct., 1889. Hyphae, hyaline, about 10 μ. diam. repeatedly branched above, septate, branches erect, terminal divisions obtuse, 10–12 μ. diam. with 2–4 sporophores 12–16 x 3 μ., bearing the oblong hyaline 15–20 x 5–6 μ. conidia. The hyphae are collected in small (½–1 mm.) tubercular tufts closely crowded or subconfluent forming a dull white nearly continuous stratum resembling a tubercular *Corticium*.

Zygodesmus limoniisporus.

On rotten maple, London, Canada, Oct., 1889. Dearness, 957. Forms a thin drab-yellow stratum on the wood. Hyphae coarse (6–8 μ. diam.) subhyaline septate, the extremities much branched and assurgent, forming the thick (20–25 x 10 μ.) basidia which are somewhat swollen and obtuse above with 4 stout spicules bearing the lemon-shaped, yellowish-hyaline briefly pedicellate conidia, 7–9 x 5 μ.

Coniosporium subgranulosum.

On decorticated poplar, Sand Coulee, Cascade Co., Montana., Oct., 1889. F. W. Anderson, 646. Forming small black, gregarious, pulvinate sori composed of slightly adherent subglobose, granular-roughened, brown conidia 4–5 μ. diam. Occasionally two conidia are connate so as to appear 1–septate. Approaches *Torula*.

Fusicladium Angelicæ.

On living leaves of *Angelica atropurpurea*, Racine, Wis., Sept., 1890. Davis, 9035. Hyphae hypophyllous, continous, brown, subundulate, 40–50 x 5–6 μ., toothed above, seated on a sphaeriaeform, sclerotoid base, finally deciduous leaving the black sclerotoid base exposed and resembling the perithecia of a *Sphaerella*. Conidia terminal, clavate 1–septate, hyaline, 30–40 x 8–10 μ.

Clasterisporium dothideoides.

On dead twigs and stems of *Shepherdia argentea* and *Artemisia cana*. Valley of the Teton in Northern Montana, July, 1889. F.

W. Anderson 540 and 554. Bursting through cracks in the bark in small (½ mm.) compact, black tufts which bear some resemblance to an erumpent *Dothidea.* Conidia ovate-oblong or oblong-cylindrical 3-septate, yellow-brown, mostly a little curved, 25–40 x 12–15 μ., rounded at the ends and borne on hyaline, simple or imperfectly branched basidia (fertile hyphæ) 20–30 x 5–7 μ.

Cercospora Kalmiæ.

On living leaves of *Kalmia latifolia*, Newfield, N. J., Jan. 1, 1890. Spots amphigenous orbicular, dark brown, about ½ cm. diam. or by confluence much larger, with a narrow yellowish (not raised) border, concentrically wrinkled. Tufts of hyphae epiphyllous sphaeriaeform, scattered, black, consisting of a tubercular base about 100 μ. diam. from which arise in a dense, spreading fascicle the smoky hyaline, closely undulate, continuous or faintly septate, 70–80 x 3½–4 μ. hyphae, slightly toothed above and bearing the obclavate, hyaline, faintly 3–5–septate, slightly curved conidia. This is quite different from *C. sparsa* Cke. which is hypophyllous and not on any definite spots.

Cercospora pachyspora.

On leaves of *Alisma Plantago* and *Peltandra Virginica*, Wilmington, Del., Oct., 1889. A. Commons, 1013, 1014. Spots amphigenous, large (1–2 cm.), cinereous, often elongated or marginal, limited by a narrow purplish border. Hyphae in dense tufts, nearly hyaline, continuous, undulate, entire or sparingly toothed above, 60–75 x 4–5 μ., lead colored. Conidia oblong, 3-septate, 35–50 x 8–10 μ., or elongated, obclavate, 5–7 μ., septate, 60–80 x 8–10 μ. This is very distinct from *C. Alismatis* Ell. & Holw. or *C. Callae* or *C. Nymphaeacea* C. & E., though all these have the lead colored hyphae.

Cercospora caespitosa.

On living leaves of *Eustachys petraea* and *Chloris Swartziana*, Ocean Springs, Miss., Sept., 1889. Prof. S. M. Tracy, No. 1215. Mostly hypophyllous, forming scattered, brownish-black tufts ¼–⅓ mm. diam. and much resembling the minute sori of some *Puccinia.* Hyphae densely tufted, deep brown, 3–5-septate, closely undulate and geniculate above, 70–100 x 4 μ. Conidia cylindrical-fusoid, slightly curved, hyaline 20–35 x 3–3½ μ. *C. striaeformis* Winter, to which this must be closely allied, grows in elongated tufts and has the conidia more slender.

Cercospora Davisii.

On leaves of *Melilotus alba*, Racine, Wis., July, 1889. Dr. J. J. Davis, 1089. Spots amphigenous, dark brown, suborbicular, $\frac{1}{4}$–$\frac{1}{2}$ cm. diam., margin subindefinite. Hyphae amphigenous, cespitose, pale brown, geniculate or shouldered and crooked, more or less septate, 40–50 x 5 μ. Conidia very variable, oblong-cylindrical to obclavate, 20–80 x 4–5 μ. multinucleate, becoming 5–6–or more septate, hyaline. Different from *C. Meliloti* Ouds. as decided by Oudemans himself to whom we have sent specimens.

Cercospora Houstoniæ.

On the lower leaves of *Houstonia cærulea*, Wilmington, Del., April, 1890. Commons, 1371. Hyphae 20–30 x 3–4 μ., continuous, brownish, scarcely toothed, subundulate, rising from a minute tubercular base and forming minute, scattered tufts on the upper surface of the leaves. Conidia subhyaline, lanceolate, 30–40 x 3 μ. granular and nucleolate, becoming 1–3–septate.

Cercospora Osmorrhizæ.

On *Osmorrhiza longistylis*, Newark, Del., May, 1890. Commons, 1416. Racine, Wis. Davis 9031. Spots amphigenous, grayish-black, 2–3 mm. diam. situated on dead areas of the leaf, indefinitely limited. Hyphae loosely fasciculate, 60–70 x 3 μ. sparingly septate, subolivaceous, shouldered and toothed above, few in a fascicle. Conidia slender multiseptate, hyaline, 80–120 x 3–4 μ.

Cercospora Acnidæ.

On *Acnida cannabina*, Wilmington, Del., Sept., 1889. A. Commons, 1011. Spots amphigenous, suborbicular, 1–3 mm. diam. dirty white, margin dark. Hyphae amphigenous, brownish, continuous, geniculate and more or less toothed above, 35–50 x $3\frac{1}{2}$–$4\frac{1}{2}$ μ. Conidia obclavate, hyaline, 3–5–septate, 60–75 x 3–$3\frac{1}{2}$ μ.

Cercospora Negundinis.

On leaves of *Negundo aceroides*, Lincoln, Nebraska, Aug., 1889. Roscoe Pound, No. 37. Spots amphigenous $\frac{1}{4}$–$\frac{1}{2}$ cm. diam., rusty brown, lighter in the center, subindefinite, mottled with small white spots or specks. Hyphae epiphyllous, tufted on a tubercular base, straight, continuous, nearly hyaline, obtuse and slightly toothed above, 25–30 x 5–7 μ. Conidia obclavate 2–4–septate, hyaline, 90–110 x 5–6 μ. Quite different (according to spec. from de Thumen) from *C. acerina* Hartig.

Cercospora Senecionis.

On leaves of *Senecio aureus*, Wilmington, Del., Aug., 1889. A Commons, No. 978. Spots amphigenous, suborbicular, 1–3 mm. diam. subconfluent, rusty brown at first and surrounded by a dark purplish discoloration, then grayish-white. Hyphae fasciculate, scattered, erect, brown, 3–4–septate, subgeniculate above, 100–150 x 4–5 μ. Conidia subcylindrical, multiseptate, hyaline, not constricted, 90–120 x 5–6 μ. This is different from *C. Jacquiniana* Thum. of which we have specimens from Dr. Winter.

Cercospora infuscans.

On fading leaves of *Rhus venenata*, Wilmington, Del., Oct., 1890. Commons, 1621. Spots at first brownish and limited by the veinlets of the leaf, becoming confluent and black, occupying and killing the affected part which becomes dead and brittle. Hyphæ hypophyllous, fasciculate, erect, slightly bulbous at base and somewhat toothed above, septate, dark, 70–85 x 4 μ. Conidia clavate or oblong-clavate, tinged with olive or sooty-black but transparent, 30–60 x 4–5 μ., 3–6–septate and often constricted at the septa. Accompanied by numerous small, sterile perithecia, apparently some young *Sphaerella*.

Cercospora Comandrae Ell. & Dearness.

On leaves of *Comandra umbellata*, London, Canada, Aug., 1890. Dearness, 294. Spots small (1–2 mm.), round, reddish-brown, definite. Hyphae short, 12–20 x 3–3½ μ., simple, entire, straight, obtuse, tufted on a small tubercular base. Conidia slender, obclavate, 70–80 x 3–3½ μ., nucleate (and faintly septate)? nearly straight.

Cercospora Mikaniae.

On leaves of *Mikania scandens*, Mississippi. Tracy, 1567. Hypophyllous. Hyphae 100–120 x 4 μ., septate, brown, subequal, fasciculate, more or less bent, sparingly toothed above, tufts effused forming indefinite olive-brown patches and more or less confluent over the entire lower surface of the leaf, but not on any definite spots. Conidia oblong-clavate, 3–6–septate, olivaceous, 40–85 x 5–6 μ.

Cercospora Halstedii.

On living leaves of *Carya tomentosa*, Cold Spring, N. Y., July, 1890. Dr. B. D. Halsted. Hypophyllous. Effused, forming indeterminate, olive-black patches 2–4 mm. diam. but without any definite spots. Hyphae erect, brown, sparingly septate, 100–150 x 5–7 μ., closely undulate or crisped and torulose above. Conidia obclavate, brown, 65–80 x 5–7 μ., about 3–septate and sometimes constricted at the septa, the broad triseptate part occupying about one-half the length.

Cercospora Medicaginis.

On *Medicago denticulata*, College Station, Texas, May, 1890. H. S. Jennings, 146. Spots rusty-brown becoming dirty-brown, suborbicular and subindefinite, 3–5 mm. diam. Hyphae amphigenous but more abundant above, nearly hyaline at first, then yellow-brown, continuous geniculate above, 35–45 x 4–5 μ. Conidia fusoid-cylindrical, hyaline, 3–6-septate, 40–60 x 3 μ. The tufts of hyphae are effused, forming a short rusty-brown coating on the spots.

Cercospora lathyrina.

On living leaves of *Lathyrus latifolius* (cult.), Newfield, N. J., Aug. 1890. Spots rusty-brown, becoming paler in the center, subepiphyllous, rather indefinitely limited, 2–5 mm. diam. Hyphae epiphyllous, cespitose, brownish, crisped or narrowly undulate above, sparingly septate, 75–100 x 4 μ. Conidia slender, hyaline, very faintly 1–3-septate, 80–110 x 3 μ.

The leaves are irregularly blotched with dirty flesh-color below. Allied to *C. canescens* E. & M., but more slender throughout.

Cercosporella pyrina.

On leaves of *Pyrus coronaria* Racine, Wis., Aug., 1890. Davis, 9033. Hypophyllous, effused, without any definite spots, at first in small, irregularly shaped patches, finally spreading more or less continuously over the entire lower surface of the leaf which then becomes more or less discolored, reddish-brown especially above. Fertile hyphae effused, short, 12–25 x 5 μ., hyaline. Conidia oblong, fusoid-oblong or vermiform, hyaline, 3–6–septate, ends obtuse.

Fusicladium effusum Winter var. **Carpineum** E. & E.

On living leaves of *Carpinus Americana*, London, Canada, Oct., 1889. Dearness, 812. Differs from the typical form in its mostly epiphyllous growth, darker color and rather smaller, paler conidia.

Clasterisporium cornigerum.

On bark of dead *Carpinus*, London, Canada, May, 1890. Dearness, 1692. Sterile hyphae creeping, septate, sending up multiseptate fertile branches 70–100 x 8–10 μ., enlarged above into the oblong-clavate, 5–7–septate, brown conidia 70–100 x 12–15 μ. at first, rounded above, then truncate, the terminal cell germinating laterally. *C. herculeum* Ell. in N. A. F. 542, has the spores only 3–4–septate. The Canada species forms flattened tufts 1–2 mm. diam., around which the fungus is more or less extensively effused.

Dendryphium muricatum.

On decaying wood of *Prunus Virginiana*, Sand Coulee, Montana, May, 1889. F. W. Anderson, No. 492. Effused, black. Hyphae erect, with short, alternate or subopposite branches bearing the 30–40 x 6–7 μ., 3–5–septate muriculate-roughened conidia in series of 4–8.

Dendryphium pachysporum.

Parasitic on some light colored *Peniophora* on rotten wood, St. Martinsville, La., July, 1889. Langlois, 1810. Hyphae subfasciculate, septate below, moniliform-jointed above, with one or two short, jointed branches, both the branches and the main hyphae bearing at their extremities one large (25–40 x 15–20 μ.) subopaque 2–3–septate conidium, the septa being darker than the body of the conidia. The lower, septate base of the hyphae about 100 x 6 μ., the upper moniliform part also of about the same length, the joints being 10–15 x 6–7 μ. olivaceous (lighter than the conidia), continuous or uniseptate.

Septonema griseo-fulvum.

On dead decorticated twigs of *Populus tremuloides*, Sand Coulee, Cascade Co., Montana, Oct., 1889. F. W. Anderson, 630. Forms a yellowish-drab-colored stratum, tolerably compact, extending for two or more cm. and more or less completely enveloping the limb. Hyphae interwoven, branched, hyaline at first, septate, finally separating at the alternate septa into yellowish-brown, 1–septate conidia 6–9 x 2½–3 μ. mostly constricted at the septum.

Sporidesmium tabacinum.

On decaying wood of *Populus tremuloides*, Sand Coulee, Montana, May, 1889. Anderson, 503. Effused, forming a pulverulent tobacco-brown stratum on the surface of the wood. Conidia globose or oblong, 25–35 μ. diam. or 25–45 x 20–30 μ. made up of globose cells about 6–7 μ. diam. Sterile hyphae inconspicuous. Conidia mostly with a short pedicel.

Macrosporium Podophylli.

On old *Aecidium Podophylli* Schw., Starkville, Miss., Apr., 1889. Prof. S. M. Tracy, 1202. Mostly hypophyllous, effused, thin, the sterile, creeping, pale brownish or subhyaline hyphae sending up short (30–40 x 4–5 μ.), continuous or faintly septate, erect subhyaline, obtuse branches with clavate, yellow-brown, 4–5-septate, muriform, 30–50 x 10–12 μ., conidia prolonged below into a distinct pedicel.

Helicosporium diplosporum.

On dead stems of *Smilax*, St. Martinsville, La., Jan., 1889. Langlois, No. 1700 (p. p.). Black, effused, velutinous, thin, composed of septate branching brown sterile hyphae from which arise the erect closely septate, subcylindrical, nearly opaque, 35–40 x 5–6 μ., fertile hyphae bearing at their tips the solitary brown conidia composed of two series of parallel connate cells curved so as to form a circular disk 20–22 μ. diam., with a notch below, the apex of the double chain of cells not quite touching its base. *Helicoma velutinum* Ell. in Torr. Bull. has the hyphae about the same, but the conidia are smaller and composed of a single series of brown cells.

Fusarium volutella.

On dead twigs of *Vitis bipinnata*, St. Martinsville, La., Oct., 1888. Langlois, No. 1505. Hyphae hyaline, simple or sparingly branched, continuous or sparingly septate, 100 μ. long or over and 4–5 μ. thick, erect, forming brush-like tufts, rising through cracks in the bark from some buried *Cytispora?* The hyphae are tuberculose-spiculose above, bearing attached to these tooth-like projections, the falcate, hyaline, 50–70 x 4–5 μ., 1-septate conidia. The habit and general appearance is that of *Volutella*.

Epidochium olivaceum.

On dead limbs of *Fraxinus*, London, Canada, June, 1890. Dearness, 1290. Sporodochia solitary or cespitose, tuberculiform, subhemispherical ½–¾ mm. diam., dark olive, carnose, erumpent finally discoid or subcollapsed. Basidia simple, stout, 20–30 x 3–4 μ., continuous, greenish-granular, becoming hyaline, subequal. Conidia subfalcate, obtuse, greenish-hyaline, granular, continuous, 25–35 x 5–7 μ.

Exosporium sociatum.

Associated with *Rhytisma acerinum* on leaves of *Acer rubrum*. Bayou Chene, La., Oct., 1888. Langlois, 1537. Sporodochia amphigenous surrounding the stroma of the *Rhytisma* and on the side of the leaf opposite to it, erumpent, minute, finally subpulverulent from the abundant conidia which are dark-brown, oblong, 3-septate, straight or slightly curved, ends mostly subacute, 12–15 x 4–5 μ., on sporophores of about the same length as the conidia.

ON THE GENUS PSILORHINUS Ruppell.

BY WITMER STONE.

While engaged in cataloguing the Corvidae in the collection of the Academy of Natural Sciences of Philadelphia, I found several interesting specimens of *Psilorhinus*, some of which did not seem to agree exactly with any of the described species, while others seemed to cast doubt upon the validity of *P. cyanogenys* of Sharpe. This led to a more minute study of the genus which was made possible by the kindness of Mr. Robert Ridgway, curator of birds in the U. S. National Museum, who has loaned me the entire series of *Psilorhinus* contained in that institution.

There have been four species of *Psilorhinus* described by authors:

P. morio (Wagl.). (*Pica morio* Wagl. Isis 1829, p. 751).

P. Mexicanus Rüpp. Mus. Senckenb. 1837, p. 189. The type of the genus.

P. cyanogenys Sharpe. Cat. Birds in Brit. Mus. iii, p. 140, 1877.

P. vociferus (Cabot). (*Corvus vociferus* Cabot. Bost. Jour. Nat. Hist. IV, p. 464, 1844).

This last was referred as a synonym of *Corvus corax* by G. R. Gray in his Hand List and this error has been followed by many other authors. How the mistake originated it is hard to see, as the description is perfectly clear. The discovery of Cabot's type in the Academy's collection led me to the correct identification of the species and I afterwards noticed that Mr. Ridgway had also discovered the true character of "*Corvus vociferus*" (Manual of N. A. Birds, p. 361, foot note).

These four species fall naturally into two groups, *P. morio* having the tail entirely brown while the others have all the feathers but the central pair broadly tipped with white.

After a careful study of the series of *P. Mexicanus* and *cyanogenys* now before me, I have come to the conclusion that the two are not specifically distinct.

The character upon which Sharpe based his *P. cyanogenys* consisted in the presence of a bluish-gray patch on the side of the head. The great variation both in the extent and intensity of this patch in the specimens in the Academy's collection led me to doubt its value as a specific character especially as I found the same gray patch conspicuously present in some specimens of *P. morio*, while in others there was more or less tendency to a lighter coloration on the malar region; in fact, in nearly all the specimens of this genus that I have seen the feathers of the malar region have a different luster from those of the side of the head; so that this character is, to say the least, very variable. From the material at hand it is impossible to make the presence of the strongly marked malar patch correspond with any geographical range or with any variation in age or plumage, and it must, therefore, be considered merely as an individual variation.

As regards *P. vociferus*, although the presence of the gray malar patch will not serve to keep it separate any more than in the case of *P. cyanogenys*, nevertheless it possesses other characters which may prove of specific or subspecific value, by which it may be distinguished from all the specimens of *P. Mexicanus* seen by me.

I refer to the size and shape of the bill and the coloration of the tail. In all the Central American specimens the bill is nearly uniform in shape though varying somewhat in absolute dimensions, while in the type of *P. vociferus* (from Yucatan) it is shorter, and deeper in proportion to its length. A specimen of "*P. cyanogenys*," however, from Mirador, has a bill of nearly the same shape though much larger.

In regard to the tail, the white tips in *P. vociferus* are much broader than in *P. Mexicanus*, measuring on the outer feathers fully two inches while in only one other specimen do they reach as much as an inch and a half and average only an inch and a quarter. Moreover, in *P. vociferus* there is a subterminal white band on the central tail feathers which are uniform brown, in all the other specimens this band is somewhat obscured in the middle of the feathers though the quill is distinctly white where it crosses.

In consideration of these differences and the lack of other specimens from Yucatan, I think we are hardly justified in uniting *P. vociferus* with *P. Mexicanus*. A more complete series of specimens may show these characters to be merely individual, as in the case of the gray malar patch, and then we can unite all birds with white tips to the rectrices under *P. Mexicanus*.

There is still another point in connection with the birds of this group, namely the coloration of the under surface. One of the Costa Rica specimens shows a sharp line of division between the brown of the neck and breast and the white of the under parts, while in other specimens the colors shade gradually into one another.

This same difference occurs in specimens of *P. morio*. The extent of the dark color also varies considerably in different specimens, two birds from Nicaragua being much darker below than any others in the series.

As regards *P. morio* the series of eleven specimens show considerable individual variation of nearly the same character as occurs in *P. Mexicanus* but nothing, I think, which can be considered of specific value.

As mentioned above one specimen (No. 3093, Phila. Acad. Coll.) shows a distinct blue-gray malar patch and spot above and behind the eye. Some have the black throat and breast separated from the lighter under surface by a sharp line while in others the colors are blended, and the throat is sometimes but little darker than the rest of the under surface.

The color of the under surface also shows great variation. It is generally light grayish-brown but in one specimen (Nat. Mus. Col. No. 4115) from San Diego, Mexico, it is nearly white and in another (Nat. Mus. Coll. No. 42139) from Orizaba, suffused with rufous especially on the under tail coverts. The wings in this specimen are also reddish-brown.

To sum up my observations on the genus, it must, I think, be considered as a group in which great individual variation occurs, variation which may eventually produce several well marked forms. At present, however, I think we can recognize but two species *P. morio* (Wagl.) extending from Tehuantepec north to the Rio Grande valley and *P. Mexicanus* Rüpp. from southern Mexico to Costa Rica with the possibility of another distinct species or race in the peninsula of Yucatan. The gray malar patch must be regarded as a variable character occurring in individuals of each species.

Below I give the measurements (in inches) of some of the specimens especially referred to above:

	Depth of bill through nostril.	Length of culmen.	Wing.
Type of *P. vociferus*, Yucatan, No. 3096, Acad. Coll.	·56	1·33	7·35
" *P. cyanogenys*," Mirador, Mex. No. 23917, Nat. Mus. Coll.	·68	1·59	8·37
P. Mexicanus, No. 3094, Acad. Coll.	·62	1·61	8·12
P. morio with gray cheek, No. 3093, Acad. Coll.	·62	1·54	8·25
P. morio, Orizaba, Mex., No. 42139, Nat. Mus. Coll.	·64	1·00	7·75

DESCRIPTION OF NEW SPECIES OF ANCTUS AND OLIVA.

BY JOHN FORD.

Anctus Pilsbryi Ford. Fig. 1.

Shell rimately umbilicated, the axis imperforate; ovate-conical, spire acute, apex black; whorls 7, slightly convex, the last somewhat contracted near the base. Aperture extremely narrow, oblong; lip flatly reflected, the central half of its length provided with a flange extending towards the inner or columellar lip, from which proceeds a corresponding convexity, thus giving to the aperture a form much like the traditional key-hole. Color grayish-white, painted longitudinally with brownish and black lines.

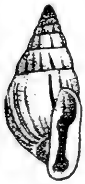

Fig. 1.

Length of shell 23, diameter 9½ mill. Width between flanges 1, width of flange on outer lip 2 mill. Color of lip white; aperture slightly shaded within. Habitat, Brazil.

Anctus angiostoma Wagner (*capueira* Spix), Fig. 2, and *A. Pilsbryi* are the only living species of the genus known, and both are in color pattern and general form very much alike. In the former species, however, the apex is not black and shining as in the latter nor are the apertures at all alike save in general outline.

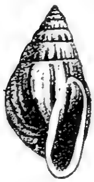

Fig. 2.

Indeed, that of *A. Pilsbryi* is absolutely distinct from any other known to the writer. This alone would justify its specific separation.

The figures were drawn from photographs of the shells and may therefore be accepted as correct.

The species has been named in honor of my friend Mr. Henry A. Pilsbry, Conservator of the Conchological department of the Academy and present Editor of the "Manual of Conchology."

Oliva cryptospira Ford. Figs. 3, 4.

Shell cylindrical, slightly enlarged near either end, producing an obese appearance. Salmon-colored, with a few dashes of white accompanied by faint zigzag brownish lines showing through the enamel, the latter being somewhat thickened and more orange in color on the basal fasciole. Spire short, *with sutures entirely concealed by a heavy callus*. Edge of lip and interior of aperture white. Length of type specimen 2¼ inches. Greatest diameter 1 inch. Habitat, Moluccas.

This shell is probably well known to veteran collectors, since it has been posing for many years as a veritable *O. irisans* Lamarck, from which species, however, it is in fact distinct.

No figure was given with Lamarck's description of *O. irisans*, but a figure probably intended for the same shell appears in Reeve's "Conchologia Iconica," Vol. 6, Pl. 6, fig. 8a, where it is classed with typical *O. irisans* Lam. That this figure does not agree with Lamarck's description in any essential feature is quite apparent.

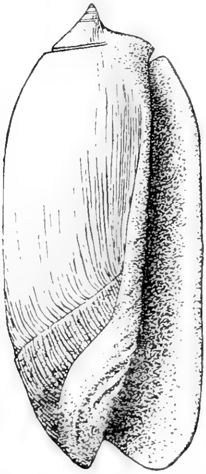
Fig. 3.

It seems, however, to have been accepted by my late friend, Mr. Tryon, as a representative *O. irisans*, since it was copied for the "Manual" without remark; although several specimens exhibiting characters similar to those shown in the figure—but which belong to *O. cryptospira* only—were at the time in the Academy's collection. Whether these specimens were accidentally overlooked, or the distinctions noted deemed too trifling for special designation, is a question that cannot now be answered.

Judging from Mr. Tryon's well-known habits of study and carefulness, it is but fair to presume that the shells were not seen by him. In consequence of this uncertainty, the responsibility of correcting the error (if error it be), is accepted rather reluctantly although in the firm belief that the change will benefit the student, as well as, in some slight degree, the cause of Science, also.

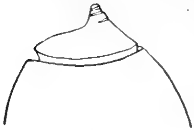
Fig. 4.

BASANITE FROM CRAWFORD COUNTY, INDIANA.

BY E. GOLDSMITH.

During a recent visit to the Wyandotte Cave, southern Indiana, I observed in one of the larger chambers, two sharply defined horizontal black veins in one of the vertical walls of light colored carboniferous limestone. The lower vein measured about one and a quarter inch in thickness, and, about fourteen inches above it, was the second vein of three inches in thickness. From a distance, by the dim light of a stearine candle, the veins appeared like coal; the touch, however, revealed a hard rock of a silicious nature, which the guide said was called chert.

Examination revealed an amorphous, very fine-grained rock having a smooth conchoidal fracture; the irregular edges are sharp and hard, so much so that they scratch glass, its hardness being equal to quartz; its luster is subresinous on a fresh fracture, becoming dull on exposure; the color is smoky-gray in mass, less so when thinning down; it is opaque except on thin edges where it is subtranslucent; it furnishes no streak; the rock is not splintery; it gives sparks with a steel. If heated suddenly it will decrepitate; a gentle heat, gradually increased, causes the smoky hue to disappear, the specimen becoming grayish-white. It is known that such rocks contain carbon, and the one under consideration contains also some water as was seen when it is heated in a tube closed at the end.

Analysis, gave the following result:

Silica	93·66 per cent.
Iron and alumina	3·10 per cent.
Water	1·34 per cent.
Carbon	0·28 per cent.

Fluorine and sodium not determined; Chlorine hardly a trace. Sp. gr.=2·605. From its general character I believe this so called Chert to be the touchstone of the assayers, otherwise called Lydian stone or Basanite.[1]

A thin section appears when magnified with a low power as regular successive layers, or striae, differing, however, from those of crystals. These striae indicate the probable existence of great pressure, since it seems to have once been colloidal silica. The distances between

[1] Dana, Descriptive Mineralogy, p. 195.

these layers are approximately 0·023 millimeter. The layers when magnified 220 times present a series of irregular waves in which the ridges seem to be indicated by granules of oxide of iron and particles of amorphous carbon. Intermingled are found inclusions of isometric

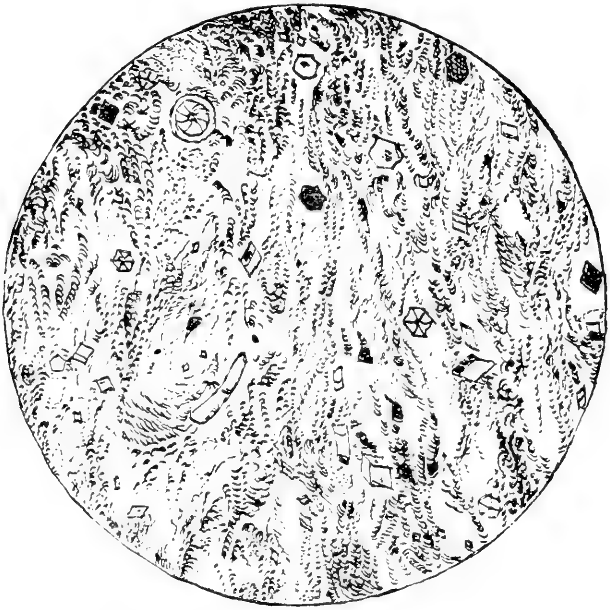

Fig. 1.

forms: cubes, dodecahedrons and also indications of a few octahedrons, some perfectly black but the greater number transparent and colorless. The opaque black microlites seem to be magnetite and the transparent ones probably carbon. Some of these latter contain specks of amorphous carbon as inclusions. The section in balsam gave at some points a strong reflection by surface illumination. The forms, however, were not well defined. Another section was etched with HF. The etching showed under the lens some cubical crystals with sharp edges and solid angles and a large number of hollows, quadrangular and hexangular in shape, from which the microlites had probably been removed by the washing, sufficient indications being left for the recognition of those interesting small bodies. The thin section from which Fig. 1 was drawn was subjected to a gradually increasing heat on a small platinum dish over the Bunsen burner until the object was red-hot. The residue was subjected to this heat for three hours when the blow-pipe flame was directed upon it to bring the heat to greater intensity. The result was that the section became nearly white. It was then reimbedded in balsam to determine the change which had taken place.

Viewed under ordinary light with a microscope, nearly all the transparent crystals had disappeared, that is to say, the forms were black, and with the proper management of the light it became evident that hollow spaces now occurred where formerly transparent crystals existed. The matrices were lined more or less with a very fine black powder which was, to all appearances, charcoal. This darkening was invariably produced wherever the microlites had but one facet before the heating. Where the silica surrounded the crystal it appeared as if the heat and air had no access and, in consequence, they were not affected, though such cases were but few in number. Some of the hollow spaces were seen by oblique light to be lined with red oxide of iron. These were the locations of the oxidized magnetite where the red powder was left intact. The hollow angular spaces may also be recognized by allowing the light to pass through the polarizer without the analyzer. Under this treatment, especially when the spaces stand squarely to the section, the burnt-out angular matrices are well defined.

The character of these microlites was determined by the application of intense heat. A silicate would not be affected in like manner. It may not be amiss to note the fact that larger carbon crystals have been observed which hold inclusions of amorphous carbon similar to those noticed in the section of basanite referred to.

Some spherical white masses formed by the heating of the section were probably due to a volatile matter which is known to form part of the composition of basanite; they resemble those frequently observed on heating minerals containing fluorine.

The acid affects the material of the plate etched with hydrofluoric acid very irregularly, and, since the rock seems to be a mixture of chalcedony and amorphous silica, a peculiar reaction occurs with polarized-light. While the chalcedony indicated phenomena of interference, the amorphous silica permitted the polarized light to pass. This is especially the case when Klein's quartz plate is interposed. The amorphous silica then appears green, when the Nicols are crossed, and the chalcedony orange-colored. On turning the analyzer 90° the colors are reversed. The hydrofluoric acid seems to affect the amorphous silica more than the chalcedony, as the latter projected irregularly over the etched surface. These projecting particles when properly manipulated reflect the light in a singular way. The reflection of the ray is such as to form a tail from the shining surface of the particles, comet-like, the end of the tail having sometimes a whirling motion with colored fringes. Occasionally, when a group of those particles is under focus, Fig. 2, the motions proceed in different directions producing a peculiarly lively effect. On the introduction of a Bertrand lens, a rosette, Fig. 3, was produced widely differing from the comet-like reflection. This rosette represents a circular form having a cone whose base has about the diameter of half the whole figure and its height slightly greater. From the foot of the cone issue delicate filamentous rays of great regularity and so brilliant that it is difficult to represent it in black and white.


Fig. 2.

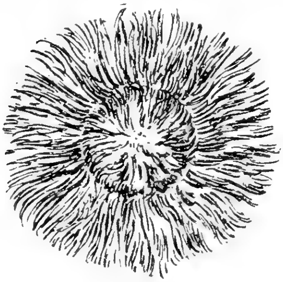
Fig. 3.


Fig. 4.

When the comet-like tail is not observed, a hollow cone is seen under the Bertrand lens, having but few rays on its base. Both phenomena are new to me in connection with micro-mineralogy. In optics the caustic plane has precisely such an appearance and in its revolution gives, necessarily, a hollow cone. From this we may infer that the comet-like tails described above are probably continuous in their whirling motion, even when they are not in a correct position to allow this to be seen under the microscope.


Fig. 5.

It may be assumed that the black hexagonal plates which remain dark between the crossed Nicols may be truly hexagonal crystals, and the darkness is due to the position of the axis; but, since they are not affected by the convergent polarized rays, the form cannot belong to that system. Neither do any of the transparent crystals respond to a like treatment. Several dozen illustrations of both phenomena were examined with the same result. That the dark forms are magnetite is rendered highly probable by the production of iron oxide by heating. On the other hand, the small transparent microlites may not be carbon, because on attempting to isolate them by hydrofluoric acid the resulting forms obtained were not distinct enough to be recognized as such, as one should expect, being granules instead of well defined crystals. On heating to redness they burned away leaving but a trace of what seems to be silica. The isolation of the supposed crystals of carbon would be proof of their identity ; the result, however, being unsatisfactory, the subject is an open question for further inquiry. Had the isolated portion been amorphous carbon, dark-colored fragments would have been seen, but such was not the case, on the contrary the rounded and elongated forms seem to refract light strongly. It may be that the exceedingly small crystals could not stand the treatment without losing their sharp edges and solid angles, thus becoming unrecognizable. The fact that the burnt-out matrices were lined with amorphous carbon after burning, points in that direction, since it is well known that the diamond when strongly heated in a vessel will lose its transparency and will either take the form of graphite or charcoal. It may be assumed that the transparent crystals are a salt with an organic acid, thus explaining the amorphous carbon after the incineration. In this case, however, the material with which the assumed organic acid was combined would remain in the matrices besides the amorphous carbon, but nothing was seen except the black powder. Furthermore, hydrofluoric acid would affect such a salt with comparative ease and leave no carbon in the residue as stated above.

I call the crystallized part of the basanite, chalcedony and not quartz because of certain indications of its fibrous structure in the circular form, showing a dark brush-like cross between the crossed Nicols, which meet in the center. If the section is rotated the cross does not change its position; but, if the analyzer is turned to 45° the brushes move about 22½° and appear of an indigo-blue color. If the Nicols are parallel, the brushes follow but 45° in each quadrant and appear blue; turning the analyzer 45° more the brushes move along to about 67½° and assume the indigo-blue tint again; finally, when the moving of the analyzer is completed in the second quadrant, the dark, brush-like cross reappears. When, therefore, the analyzer had been revolved 180°, the brush-like cross followed only 90°. As stated above the dark cross met in the center; but, on turning the analyzer when the brushes became colored, a circular space was produced in the center having a yellow color which did not change to any other.

Since no circular rings occurred and the central part of the concentric and fibrous structure of this part of the plate did not change in color when rotated, it is evident that this variety of quartz, called chalcedony, behaves in a widely different manner from quartz proper. I have not found this peculiar optical behavior described and think it to be of sufficient interest to put on record.

Explanation of the Figures.

Figure 1 represents a thin section of Basanite magnified 220 times showing the transparent crystals of carbon and the dark opaque magnetite.

Figure 2 shows a group of strongly reflecting points as seen by surface illumination.

Figure 3 the rosette produced therefrom by introducing the Betrand lens.

Figure 4 a contour of figure 3 cut vertically.

Figure 5 indicates the cone produced from reflecting points having no comet-like tails.

DESCRIPTION OF A SPECIMEN OF CHIROLOPHIS POLYACTOCEPHALUS FROM VANCOUVER ISLAND.

BY ASHDOWN H. GREEN.

A specimen of this rare blenny, *Chirolophis polyactocephalus*, taken at Alert Bay on the North East Coast of Vancouver Island in November, 1890. I give herewith a detailed description:

Body elongate, compressed. Eyes approximate; no lateral line. Scales deeply imbedded, appearing like pits, 186 in length, 54 from back to belly. Branchial rays 5. Gill membrane continuous, free from isthmus. Skin on top of head and neck loose; numerous dermal flaps and cirri. Large superciliary cirrus with three main branches. Numerous mucous pores on snout. Mouth and lips fleshy; a single row of delicately fine comb-like teeth on upper and lower jaw, closely set. Two patches of fine teeth on upper part of gullet. No teeth on vomer or palatines.

Dorsal LXIII, fleshy, the sharp points of spines projecting slightly beyond the membranes. The 8 anterior spines stronger and more blunt than the remainder, covered with loose skin, and having numerous dermal flaps, some extending beyond the spines. Dorsal not connected with the caudal.

Anal rays 46, soft and fleshy, the rays folding over one another, free for about half their length. The first ray shorter than the others, the last connected. Anal not connected with caudal fin. *Ventral* rays 3, jugular, fleshy, no spine. *Pectoral* rays 14, broad, rays broadly branched, fleshy towards base. *Caudal* rays 14, rounded, rays fleshy and broadly branched.

Coloration: two conspicuous black wavy lines behind opercle, and in front of pectorals. Numerous light colored blotches, on body, dorsal and anal, round or oval, about the size of peas or small beans. Said to be highly colored, scarlet spots, purple body, resembling *Hexagrammus superciliosus* when fresh. The specimen is now in the Provincial Museum, Victoria, British Columbia.

This fish has not previously been taken south of Alaska. A good figure has been given by Dr. T. H. Bean in Nelson's "Report on Natural History Collections in Alaska," plate XV, but no description, except the fragmentary account of a Kamtschatkan specimen given by Pallas, has ever been published.

PALAEOSYOPS AND ALLIED GENERA.

BY CHARLES EARLE.

The present preliminary notice is the result of an investigation of the *Palaeosyops* material contained in the Princeton collection. This material was collected by the various Princeton exploring parties, and is from the middle Eocene; partly from the Bridger, and partly from the Washakie division of this epoch.

The genus *Palaeosyops* was established by Leidy.[1] Since then Marsh, Cope, Scott and Osborn have made contributions to the same and allied genera. They have all felt the want of abundant material in their descriptions, and in most cases the original types described by them have never been compared, and thus one finds the confusion in the nomenclature a great obstacle. Another difficulty has been, to co-ordinate various portions of skulls and scattered teeth with each other and with the limb-bones. I have been greatly assisted by a part of an individual of *Palaeosyops paludosus* in the Princeton Collection, associated with a portion of the skull, and the bones of a posterior limb, nearly complete. During the course of this investigation I have been enabled to study the original types in the National Museum, in the Academy of Natural Sciences of Philadelphia, and in the Yale College Museum.[2] I am also indebted to Prof. Cope for allowing me to examine his collection; so that I am now in a position to bring together the work of the several authors, and to give, as well as the present known material will allow, a preliminary descriptive analysis of the forms above referred to.

NOMENCLATURE. Cope, in his Tertiary Vertebrata, has shown the relation of the nomenclature of *Palaeosyops* and *Limnohyus* proposed by Marsh and Leidy, and there is no question as to Leidy's priority. Leidy described the genus *Palaeosyops* three months before Marsh published his preliminary notice, in which he describes his *Palaeosyops laticeps*. Cope did not attempt to determine the original types of Leidy from which the genus and species, *Palaeosyops paludosus*, was first indicated. After studying Leidy's original specimens, now in the

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[1] Proc. Acad. Nat. Sci. Phil. 1870, p. 113.

[2] I wish to express my thanks to Prof. G. Brown Goode, Prof. Angelo Heilprin, and Prof. O. C. Marsh for these privileges.

National Museum, which he described,[1] and which later he figured.[2] I am convinced that they belong to the large species of *Palaeosyops*, namely that which Leidy subsequently named *P. major*. Second: that the smaller forms later referred by Leidy to *P. paludosus* were quite distinct from his types of this species. Therefore, as the original specimens were called *P. paludosus* and as they were identical with a form which he later called *P. major*, the latter name is a synonym and must drop out. As Leidy's name *P. major*, was very convenient in designating the relative size of the two species, we propose to call the smaller form *Palaeosyops minor*=the *P. paludosus*, according to the later use of Leidy, and others.

I may also add that Cope's *P. laevidens* is a different form from this smaller species of Leidy, so that Cope's specific name cannot be used.

Cope[3] accepts Marsh's statement that the original specimens figured by Leidy belong to *Limnohyus;* this is, I think, an error as the teeth are much larger, and correspond in every respect with Leidy's *P. major*. Marsh's statement that the teeth of his *P. laticeps* have the same general structure as Leidy's smaller species—namely his *P. paludosus*, is also incorrect. I have examined both types, and I shall show later that the two forms are quite distinct—one approaching the *Telmatotherium* form of molar, the other type being more like the typical molar found in *P. paludosus*. Marsh's type of his genus *Telmatotherium*[4] agrees in all particulars with the type of Scott and Osborn's *Leurocephalus*,[5] so that the latter genus must become a synonym of *Telmatotherium*. Scott and Osborn's species *T. (L.) cultridens*, I retain as a good species, and it has very interesting characters which place it rather lower in the scale than the *T. validus* of Marsh. The skull figured by Scott and Osborn in their report for 1877 as *P. paludosus*, should be referred to Marsh's genus *Limnohyops*. Its general form is very different from *Palaeosyops*, as will be shown later. After carefully considering the matter of uniting the various genera into one, I am of the opinion that

[1] Op. cit., p. 113.

[2] U. S. Geol. Survey of the Ter., Vol. I, 1873, Plate V, fig. 5, and pl. XXIII, figs. 3–6.

[3] Tertiary Vertebrata, p. 698.

[4] Am. Jour. Science and Arts, vol. IV, pub. July 22nd, 1872.

[5] E. M. Museum Bulletin. No. 1, Report Princeton Scientific Expedition Sept. 7th, 1878.

Telmatotherium may be retained, and that *Limnohyus*, or as it is now called, *Limnohyops*, should not have a generic value equal to that of *Telmatotherium*.

The type specimen of the genus *Limnohyops* is very closely related to that of *Palaeosyops* in the teeth structure, and we have good reasons for supposing that the presence of the hypocone on the last superior molar is a transition character, which is not available for generic definition. The presence of a rudimentary hypocone on the last superior molar of *Palaeosyops paludosus* is not an uncommon occurrence. The premaxillary regions of *Limnohyops* and *Palaeosyops* are identical although the skull contours are very different. The generic reference of Leidy's smaller species of *Palaeosyops*, our *P. minor*, is uncertain, very little being known of the skull or of the limb bones. The characters of the molars (see his figs., Pl. IV, figs. 3–6) are closely similar to those of *Telmatotherium*, they have the square form observed in that genus.

We may now give a brief diagnosis of the more important characters of the different genera and species, and also add an analytical table for comparison:—

I. Last superior molar with only one internal cone.

A. External lobes of superior premolars separated PALAEOSYOPS.

a. size, large.

Inferior molars stout and broad, post. tubercle a cone *P. paludosus.*

Inferior molars high and long, post. tubercle a cone *P. vallidens.*

b. size, medium.

Superior premolar II with one external lobe *P. laevidens.*

Superior premolar II with two external lobes *P. minor.*

c. size, small.

Superior premolar IV with a protoconule *P. borealis.*

B. External lobes of superior premolars straight. TELMATOTHERIUM.

a. sup. premolar II with rudimentary internal lobe *T. cultridens.*

b. sup. premolar II with internal lobe *T. validus.*

II. Last superior molar with two internal cones LIMNOHYOPS.

a. size, large.

Hypocone of last upper molar one half size of protocone *L. laticeps.*

b. size, small.

Hypocone of last upper molar about equal to protocone *L. fontinalis.*

Incertae sedis.

Symphysis of lower jaw extremely long and narrow *P. hyognathus.*

Distal extremity of nasals expanded *P. megarhinus.*

PALAEOSYOPS Leidy (=*Limnohyus* Marsh).

P. paludosus Leidy, type species—type specimen in National Museum. (Synonyms *P. major* Leidy).

1. *P. minor*, Earle, sp. nov.

Type specimen=specimen referred to *P. paludosus* by Leidy in Museum of Academy of Natural Sciences of Philadelphia.

2. *P. laticeps*, Marsh.

Type, skull, etc., in Yale College Museum.

The following diagnosis may define *Palaeosyops:*

Last superior molar usually with one internal cone.

Intermediate tubercles well developed.

Crowns of molars not prominent.

External cusps of superior premolars separated.

Second superior premolar with a well defined internal lobe.

The form of the superior molar in this genus is very characteristic, and differs quite radically from that of *Telmatotherium.* The transverse diameter of the tooth is greater than the antero-posterior. The external V's are round and shallow. The anterior buttress is widely prolonged. The median buttress is not constricted off; there is generally no external cingulum. The crowns of the teeth are low, and the intermediate conules are strongly developed. Marsh has

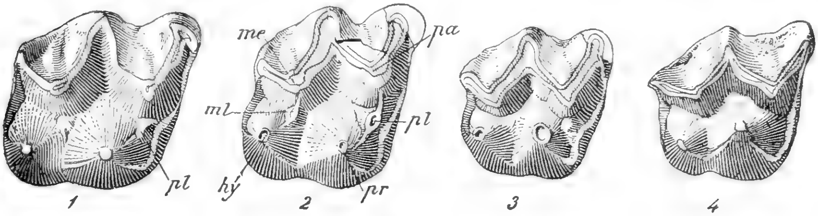

Fig. 1.

Second superior molar of

1. *Palaeosyops paludosus* Leidy. 2. *Limnohyops laticeps* Marsh. 3. *Palaeosyops minor* Sp. nov. and 4. *Telmatotherium cultridens* S. & O. ⅔ natural size. pa.=paracone, me.=metacone, pr.=protocone, hy.=hypocone, pl.=protoconule, ml.=metaconule.

pointed out the difference between the premaxillary regions of *Palaeosyops* and *Telmatotherium*. In the former genus the premaxillaries are short and depressed, their symphysis is very short and round, their anterior aspect is convex. The zygomatic arch in *Palaeosyops* is strong and decurved, and the form of the head is more like that of the Tapir than in the other genera.

1. **Palaeosyops paludosus** (Leidy.)

Syn. (*P. major* Leidy) (*Limnohyus robustus* Marsh.)

Protoconules of superior true molars large, and always present, external cingulum absent.

Transverse diameter of first superior molar greater than that of last premolar, posterior tubercle of last inferior molar cone-like, and median in posterior.

This is the largest species of the genus. It was, as we have seen, first described as *P. paludosus*, and later, from more abundant material, was designated as *P. major*.

The teeth of *P. paludosus* are very large, being wide and rather short, the external V's are characteristic of the species, being shallow, with very prominent anterior buttresses on the true molars, their median buttress is not constricted off, but is rounded and open internally. The intermediate conules of *P. paludosus* are very strongly developed, the external lobes of the superior molars are entirely without a cingulum, their anterior cingula are present, and the internal cingula incomplete. The last three premolars have well developed internal cones, with generally incomplete internal cingula, the external lobes of the last premolar are equal, and the premolars are not provided with the prominent cingula seen in *Telmatotherium*. The inferior molars are short and broad, with low crowns. The last inferior molar is a very characteristic tooth in the species: it is very short and heavy, its posterior tubercle is much smaller than the anterior portions of the tooth, is placed median in relation to the external lobes, and is not provided with the strong lateral crests and median valley seen in *Telmatotherium*. The skull in *P. paludosus* is broad and massive, its posterior portion is quite like that of the Tapir, the frontal region being higher than the occipital, but differing very much from that of the Tapir in the nasals, which were short and broad, and reached so far forward as to overhang the premaxillary symphysis. From the structure of the facial region, I conclude that this species was provided, if at all, with a very rudimentary proboscis. The malar insertion is gradual and not abrupt as seen in other species of the family. The auditory processes were distinct, the post glenoid being long and rather stout; the internal glenoid process is wanting in this species, and the paroccipitals were provided with a terminal styloid process.

The symphysis of the lower jaw is rather short, the posterior third of the lower border of jaw strongly inflected, with the angle of the same turned outwards.

2. Palaeosyops laevidens Cope.[1] (not *P. paludosus* Leidy.)

Second superior premolar with only one external lobe, external lobes of true molars without cingula. Crowns of molars low.

This species was described by Prof. Cope from the characters of the second premolar as above defined. Prof. Cope himself was not certain that his species was distinct from Leidy's form, but I have examined both of the types and find them quite different. Cope's *P. laevidens* has the molar form of a typical *Palaeosyops*, and not the square shaped tooth of *Telmatotherium*, which the smaller species of Leidy so closely resembles.

3. Palaeosyops borealis Cope.[2]

Molars of a square form with traces of transverse ridges, intermediate conules small, last superior premolar with well marked protoconule, size very small.

This, I believe, is the only species of *Palaeosyops* from the Wind River Eocene, it is very much smaller than the other forms, being perhaps about one-half the size of *P. paludosus*.

4. Palaeosyops vallidens Cope.[3]

Molars long and narrow with high crowns, posterior tubercle of last molar a cone, inferior border lower jaw straight and not inflected.

The lower jaw figured by Cope[4] will form the type of this species. Prof. Cope also figured a series of upper molars under the name of this species. He speaks of this series and the lower jaw not being

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[1] Annual report U. S. Geol. Survey Terr. 1872 (1873) p. 591.

[2] American Naturalist, 1880, p. 746.

[3] Palaeontological Bulletin No. 7, p. 1, Aug. 22nd, 1872.

[4] Tertiary Vertebrata, Pl. 52, fig. 3.

found together, and concludes that they probably belong to different species. I agree with him in this view, and consider that the superior molars should be referred to Marsh's form of *Telmatotherium validus*, as they have all the general characters of that species, and differ from *T. cultridens* in having a well defined internal lobe to the second superior premolar.

The last molar in the jaw above referred to is interesting, as it shows in some respects transition characters between *Palaeosyops* and *Telmatotherium*.

5. Palaeosyops minor, sp. nov.

Second superior premolar with two external lobes, external lobes of last superior premolar equal. Intermediate conules of true molars reduced, a strong external cingulum present.

P. minor embraces specimens which Leidy erroneously described as *P. paludosus*, figs. 3–6, Plate IV of Leidy's report for 1873. The material relating to this species is very scarce, being mostly represented by scattered teeth, and one complete series of upper molars in the Academy of Natural Sciences of Philadelphia. There is also in the collection, a lower jaw with teeth nearly complete, which Leidy referred to this species. Leidy figures a series of upper molars with a portion of the facial region attached. This specimen I have not been able to see. I believe it is in a private collection. The following molar characters will be seen to be closely similar to those in *Telmatotherium*.

The molars in *P. minor* have their axes about equal, thus producing a square tooth as is found in *Telmatotherium*. The external V's are broad and angular, their median buttresses are deeply constricted off, the anterior buttress being not widely prolonged as in the largest form. The teeth have rather high crowns and the external face is provided with a well marked cingulum. The intermediate conules in this species are not strongly marked. The transverse diameter of the last premolar is about equal to that of the first true molar; all the premolars have incomplete internal cingula, the internal lobes of the premolars are more pointed than in *P. paludosus*, and are apt to be concave toward the external side.

I have examined two series of upper molars of this species[1] and in both cases the second superior premolar was provided with two well

[1] Leidy figures (op. cit. pl. IV, figs. 3–4) a series of superior molars of this species, in which the second premolar has only one external lobe?

defined external lobes, so that Cope's *P. laevidens* does not come within the definition of this species; then again the form of the molars, the presence of strong cingula, etc., differ very much from those in Cope's species. I am able to add nothing to the skull characters, as the material that I have examined contained no skulls

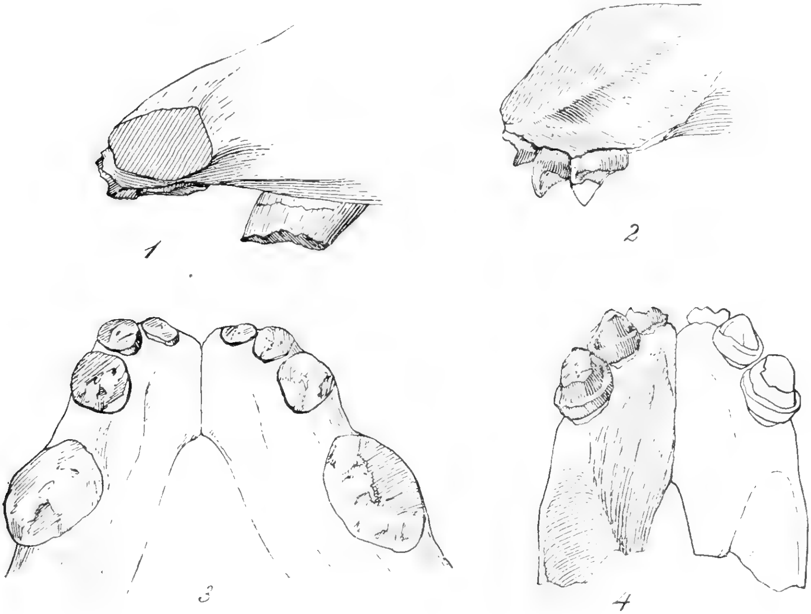

Fig 2.
Internal and ventral view of the premaxillary region 1 and 3, *Palaeosyops paludosus* Leidy. 2 and 4, *Telmatotherium cultridens* S. & O.

referable to this species, and, in fact, I may add here that this is not the common species of *Palaeosyops*, the species *P. paludosus*, above described, being the most common form.

LIMNOHYOPS Marsh

(embraces *Palaeosyops* as employed by Marsh, *Limnohyus* as employed by Leidy and others).

Molars with low crowns, rounded external lobes, well developed intermediate tubercles, well marked, transverse crests may be present on superior molars, the last upper molar with two internal cones.

1. Limnohyops laticeps Marsh.

(Syn. *Palaeosyops laticeps* Marsh, and *Limnohyus laticeps* Leidy).

Protocone of last superior molar twice the height of hypocone. Paracone of last superior premolar much larger than metacone.

This species has been placed under several genera, Marsh having overlooked Leidy's earlier description. It has now been placed in the genus *Limnohyops*.[1] The teeth characters of *Limnohyops* are very different from those of Leidy's smaller species of *Palaeosyops*. I differ from Prof. Marsh in supposing that Leidy's original type belonged to *Limnohyus*. I have shown above the true position of the original specimens.

We are fortunate in having in the Princeton collection a skull of this genus, with the occipital region complete. There are also a few teeth in the collection, which I refer to this genus. The dentition of this species is closely allied to *P. paludosus*. The teeth have low crowns without external cingula, the external V's are shallow, and round, and have the general characters of the above species, the intermediate conules in the species are well developed. One character found in this species quite different from that in *P. paludosus* is that well defined transverse ridges are developed, connecting the internal cones with the external lobes of the molars. These ridges are small, but plainly to be seen. The hypocone of the last upper molar is much smaller than the protocone. The presence of the hypocone on the last molar (as already spoken of) I consider as transitional, arising from a condition found in *P. paludosus*, where this cone is often rudimentary. The transverse diameters of premolar 4 and molar 1 are nearly equal, differing in this respect from those in *P. paludosus*. The skull contour of *L. laticeps* is very different from that of *P. paludosus*. The occipital region is higher than the frontal, resembling in this respect the *Rhinoceros*. The sagittal and lambdoidal crests are extremely heavy, and widely overhang the supra-occipital region. The nasals are more slender and longer than in *P. paludosus*. The premaxillaries resemble those found in *P. paludosus*, being short and depressed with a very short symphysis. The malar insertion is abrupt with the middle portion of the arch rounded, the infra-orbital foramen is exposed. The zygomatic arch is wide spreading and heavy. The post glenoid process is rather long and curved forward. An internal glenoid process is present in

[1] Am. Journ. Science, June, 1890, page 525.

this species. The post-tympanic process is broad and separated from the glenoid. The occipital region is low, broad and deeply concave superiorly. The carpus in *L. laticeps* is very characteristic, being much lighter than *P. paludosus*, with the facets and axis of the same arranged differently. *L. laticeps* was probably about the same height as *P. paludosus*, but was a more agile and slender form.

2. Limnohyops fontinalis Cope.[1]

Internal cones of last superior molar nearly equal. First upper molar much smaller than second, size small.

This is a strongly marked species, being about one-half the size of *L. laticeps*. The form of the skull in *L. fontinalis* closely resembles that in *L. laticeps*, although more depressed than in that species. The malar insertion is similar to the above form with an exposed infra-orbital foramen. We consider Cope's *L. diaconus* not a good species.

TELMATOTHERIUM Marsh.

(Syn. *Leurocephalus* S. & O.)

Incisors with strong basal ridges. Canines compressed with sharp cutting ridges. Molars resembling *Palaeosyops*, but with higher and more pointed crowns, the intermediate tubercles may be nearly wanting in this genus, external lobes of premolars nearly straight with no median buttresses. Hypocone of last superior molar very much reduced.

The two species of this genus, namely *T. validus* and *T. cultridens*, have their molar characters nearly identical, the specific differences being in their intermediate tubercles and in the form of the second superior premolar. Cope's species *P. vallidens* (at least the upper molars which he referred to that species) should be placed under *T. validus* Marsh.

The teeth in the genus *Telmatotherium* are easily distinguished from those of *Palaeosyops*, they have a square form, with high crowns and prominent cusps, the external V's are broad and angular, the anterior buttress is not prolonged, and the median one is large and widely constricted off, the external face of the teeth are provided with a prominent cingulum, outer face of premolars straight,

[1] Palaeontological Bulletin No. 11, p. 1, Jan. 31st, 1873.

and the second superior premolar may have a rudimentary or well defined internal cone. The premaxillaries are high and compressed, with an elongated median suture. They are very different from those of *Palaeosyops*, in which their form is short and depressed. The zygomatic arch in *Telmatotherium* is straighter and lighter than in *Palaeosyops*.

The following characters may define the two species of this genus:

1. Telmatotherium validus Marsh.

Second superior premolar with a well developed internal lobe, last upper molar without rudimentary hypocone.

The intermediate tubercles in this species are more developed than in *T. cultridens*, the first molar has a protoconule, the second has this tubercle also present, the third molar with both intermediate tubercles. The last two upper premolars have their internal cingula incomplete.

2. Telmatotherium cultridens S. & O. (*Leurocephalus cultridens* S. & O.).

Second superior premolar with rudimentary internal lobe, last superior molar with a rudimentary hypocone.

The intermediate tubercles in this species are very much reduced, the protoconules of the first upper molar only being present. The internal basal cingulum of the last two upper premolars is complete.

The two species above defined may be merely well marked varieties, but the material relating to them is not abundant, and we may leave them for the present as above given.

I shall leave for my final paper the treatment of the relationship between the genera and species in this family, and I will merely add that it includes two well marked forms of teeth: namely that of *Palaeosyops*, with low crowns and large intermediate tubercles, and that of *Telmatotherium* with very high crowns and reduced tubercles. It is the latter form of molar which I believe has led up directly to *Diplacodon* and not *Palaeosyops*, as generally stated, the latter genus having been the ancestor of *Telmatotherium*.

Incertae sedis.

Palaeosyops hyognathus S. & O. [1]

Types.—Lower jaw No. 10,273 in Princeton Museum.

Symphysis extremely long and shallow, canines

[1] The Mammalia of the Uinta Formation, Trans. Am. Phil. Soc. N. S. Vol. 16, Aug. 1889, p. 513.

small and semiprocumbent. A long diastema anterior and posterior to premolar 1.

Palaeosyops megarhinus Earle. [1]

Type.—Skull No. 10,008 in Princeton Museum.

No diastema in superior dental series, canines very small and wide spreading, superior true molars without external cingulum, distal extremity of nasal expanded.

[1] American Naturalist, Jan., 1891, p. 45.

FEBRUARY 3.

Dr. GEORGE H. HORN in the chair.

Forty-eight persons present.

Papers under the following titles were presented for publication :—

"On the External Characters of a Fœtal Reindeer and other notes." By R. W. Shufeldt.

"Crustacea from the northern coast of Yucatan, the harbor of Vera Cruz, the west coast of Florida and the Bermuda Islands." By J. E. Ives.

FEBRUARY 10.

Dr. GEORGE H. HORN in the chair.

Twenty-seven persons present.

A paper entitled, "On some recent Japanese Brachiopoda with description of a species believed to be new," by W. H. Dall and H. A. Pilsbry, was presented for publication.

Effect of environment in the modification of the bill and tail of birds.—DR. SPENCER TROTTER exhibited specimens of several of the common Finches of eastern North America, belonging to the genus *Ammodramus*. He stated that this genus, as now recognized by American Ornithologists, includes three types of birds formerly considered as representing distinct genera :—*Ammodramus, Passerculus* and *Coturniculus*. These birds undoubtedly belong to one genus and show very clearly the effect produced by environment in modifying the bill and tail and producing subgenera of birds originally coming from one stock. The species of the *Passerculus* and *Coturniculus* groups are inhabitants of the uplands and subsist mainly upon seeds which they pick up from the ground. All these birds have the short thick bill which characterizes so many of the Finch tribe. The true *Ammodrami*, however, as exemplified by the Sharp-tailed and Seaside Finches inhabit the salt marshes of the coast and subsist on the small crustacea and worms. In obtaining these animals they are compelled to probe in the soft mud in which they live and this necessity, acting through numerous generations, has produced the longer and more slender bill which characterizes these birds. The habit of clinging to the long slender reeds of the marshes and the effort to retain their perch when the reeds are swayed about by the wind has tended to produce stronger and larger feet in the true *Ammodrami* and to develope stiff pointed tail feathers in contrast to the soft rounded tail feathers of the Savannah Sparrow and other nearly related upland Finches.

The speaker also stated that in the Bobolink, another inhabitant of reedy marshes, and in the Woodpeckers and Creepers which cling to the perpendicular trunks of trees, this modification of the tail was very clearly shown. In the case of the Nuthatch, however, which has similar habits to the Woodpecker and Creeper, the tail feathers remain soft and rounded. Mr. Witmer Stone had called the speaker's attention to this fact and had further suggested that the failure to develop stiff-pointed tail feathers in the case of the Nuthatch was probably due to the bird's habit of traveling down the tree trunks instead of up, with the head directed towards the ground. Being thus unable to utilize the tail as a means of support, there has been no opportunity for environment to act in modifying its structure.

The Sandstones of Chester Valley, Pennsylvania.—The following communication was read from Mr. Theo. D. Rand:—

I desire to announce to the Academy the finding of a rock with all the characteristics of Potsdam sandstone, on the south side of the limestone of the Chester Valley. The existence of a sandstone, supposed to be the Potsdam, on the south as well as on the north side of the valley was noted by Prof. Rogers, but no full description of it was given and his observations have been doubted. The Second Geological Survey failed to find it, indeed laid stress on its absence. The sandstone south of King of Prussia was described by the late Prof. Lewis and myself, but nothing was observed to determine its age.

The construction by the Pennsylvania Railroad of a branch from near Downingtown to Trenton has afforded a better opportunity of examining the rocks of this region than any heretofore had.

This branch, known as the Trenton Cutoff Railroad, leaves the main line at Glen Loch 25·3 miles northwest of Philadelphia and goes in a nearly straight line, varying little from N. 70° E. At Glen Loch it is in the hydromica, thence passes into limestone (No 2), with usually much soil overlying; the dip being steep to southeast.

Nearly north of Paoli Station the railroad curves slightly toward the south, crosses the road running north from Paoli Station, and then enters a considerable cut. This cut is in a very sandy slate, or slaty sandstone, and in this is one stratum which has the rhomboidal jointings, the micaceous partings and the minute tourmalines, so characteristic of the Potsdam in this part of Pennsylvania.

The road running north from Paoli Station through hydromica schist, crosses, near the north foot of the South Valley Hill, a prominent outcrop of the hydromica schist, here almost roofing slate, dipping 90° to 70°, S. 35° E.; about an eighth of a mile north of this, traces of the sandstone may be seen where the road bed has been lowered to permit the branch railroad to pass over it. The cut mentioned is about an eighth of a mile east of this. The sandstone dips about S. 10° E., 30°.

Study of this region forced me to believe in the correctness of Mr. Hall's conclusion that the hydromica of the South Valley Hill overlies the limestone, and further, that the sandstone and limestone of Cream Valley are the Potsdam and limestone of the Chester Valley rising on the southeasterly leg of the synclinal which includes the hydromica. But if this sandstone north of Paoli is Potsdam, occurring as it does between the limestone and the hydromica, this theory is untenable and the theory of Prof. Rogers and of Dr. Frazer that the hydromica is older than the Potsdam must be correct. It is my wish to study this further but I desire to record the observation at once while the exposure is favorable for study, that others may have the opportunity to examine it.

February 17.

The President, Dr. Leidy, in the chair.

A paper entitled, "Notes on some little-known American fossil Tortoises," by Dr. G. Baur, was presented for publication.

On the Age of the Peace Creek Beds, Florida.—The following communication from Mr. Wm. H. Dall was read by the President:—

"I am just back from Florida and have been exploring Peace Creek where the fossil bones are found and have determined the stratigraphical relation of the beds they come out of. I thought you would like to know about it. They are under Marine Pliocene beds corresponding to part of the Caloosahatchie beds and overlie or are mixed with older Pliocene phosphatized rock which has many of the Caloosahatchie shells in it but which on the whole seems rather older. The bones then,—that is those from Peace Creek, which are all derived from one original stratum not over two feet thick,—are older Pliocene beyond any question. I found actually in the bed mastodon, manatee, horse, glyptodon and big turtle with others I did not recognize. I did not try to collect much, as my visit was hurried. I saw also beautiful Pliocene rock from Wakulla Co., with bones actually in it, as well as finely preserved casts of Pliocene shells. I think the big *Elephas columbi* is older than the forms above mentioned, at all events sections of its tusks are found right on top of the Miocene near Bartow and their state of fossilization is much more complete than in the case of the bones from the clay or Peace Creek beds."

On a probable new species of Bipalium.—Dr. Benjamin Sharp called attention to a large land Planarian, which had been given to him by Dr. Emily Hunt, who had obtained it from a green-house at Lansdowne, Pa.

The land Planarians, according to most authorities, are carnivorous and nocturnal. The reproduction of Planarians by division or fission had been known since the publication of Dalyell's valuable researches in 1814,[1] but as far as the speaker was informed, it had never been observed in land Planarians. In the specimen in his possession, a portion of the posterior end of the animal became detached at two different times. These pieces are still living and active, one being ten days and the other two weeks old.

The mouth in the land Planarians, as is the case with most of the forms, is situated near the middle of the body and opening on its under surface. One species of *Bipalium*, named by Schmarda[2] *Sphirocephalus dendrophilus*, presents a remarkable form of nerve system widely differing in complexity and arrangement from that of any other known Planarian. In the expanded or lobed anterior portion of the body (the so-called head) is situated a nerve ring closely resembling the œsophageal ring of the higher worms, and from this pass posteriorly two nerve-trunks joined by commissures or ganglia (?), strongly suggesting the segmented arrangement of the nerve system of the Annelids.

This form of nerve system suggests two very interesting questions: Are the land Planarians *progressing* toward a segmented type, or are they *degenerations* from such a type? The fact that the complete œsophageal ring does not surround the œsophagus and that the mouth is situated some distance posterior to it, would lead to the supposition that the present mouth is not the primitive one and that the œsophageal ring indicates where that primitive mouth once existed. The speaker was inclined to believe that this form of nerve system indicated rather a degeneration from a higher type than an evolution toward a more complex one.

He inclined to believe that the specimen under consideration represents a new species of the genus *Bipalium*. When in the extended condition it measured nine and a half inches; before the loss of its posterior end it was probably ten or eleven inches in length. In breadth, in its extended condition, it measured one-seventh of an inch; in thickness about one-tenth of an inch. The expanded head was roughly semicircular, measuring one-fourth of an inch across and one-fifth of an inch in length, i. e. from what might be called the neck to the anterior margin. As far as discoverable by means of a hand-lens no eye-spots or ocelli could be detected, but these may exist and if so, will be revealed by sections when examined under a higher power.

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[1] J. G. Dalyell. Observations on some interesting Phenomena in Animal Physiology, exhibited by several species of Planariae. Edinburgh, 1814.

[2] L. K. Schmarda. Neue wirbellose Thiere, beobachtet und gesammelt auf einer Reise um die Erde. Band I. Neue Turbellarien, Rotorien und Anneliden. Erste Haelfte. Leipzig, 1861. Pages 36 and 37, Plate VIII, fig. 83.

The tail is rounded and not pointed, as in most of the species of this genus; the body in the extended condition, does not taper but holds the same breadth and thickness from the neck to the end of the tail. The ground color of the animal is grayish-yellow, which is traversed by five longitudinal black bands, the central one being the broadest and those at each side of this quite faint. The external bands are marginal from the neck some distance backward, whence they run inside the margin to the tail where they join. The two pairs of lateral bands coalesce at the region of the neck and none of the bands are extended into the expanded head which differs from the rest of the animal in being of a grayish color.

Stimpson's[1] species, *B. virgatum* from Loo Choo, seems to be most nearly related to this supposed new species. The colors, however, differ, the median band passes into the head and the margins of the head and neck are thickly set with ocelli. This species is small, measuring only two inches in length.

The name Bipalium manubriatum was proposed for the new species of which an anatomical description and figures will probably be published at a later date.

Note on the Boring Sponge of the Oyster.—Prof. Leidy remarked that in a recent letter received from Mr. H. J. Carter, of England, the able authority on the Porifera, he had directed his attention to a catalogue of sponges collected by Mr. Willcox on the coast of Florida published in our Proceedings, 1884, p. 202, in which he indicates the usual massive, solid form of *Raphyrus Griffithsii*, Bk., as the boring sponge of the oyster *Cliona celata*, and further points out a branched tubular variety, the same as that described later by Prof. Leidy as *Cliona phalica*, under the name of "*ramotubulata.*"

In a recent "Report on the Porifera," by R. Hanitsch, of Liverpool, received from the author, he agrees with the speaker and Mr. Carter, that the boring sponge of the oyster, both of our shores and those of Europe, and the massive forms, represented by the *Raphyrus Griffithsii* of Bowerbank, all belong to the one species, the *Cliona celata* of Grant.

February 24.

Dr. Daniel G. Brinton in the chair.

Twenty-five persons present.

A paper entitled, "Echinoderms and Arthropods from Japan," by J. E. Ives, was presented for publication.

[1] W. Stimpson. Prodromus descriptionis animalium evertebratorum quae in Expeditione ad Oceanum Pacificum Septentrionalem a Republica Federate missa, Johanne Rodgers duce, observavit et descripsit W. Stimpson. Proc. Acad. Nat. Sci. Philadelphia, 1857, p. 30.

The death of William Massey, a member, February 16th, was announced.

The following were elected members:—Wm. S. Stewart M. D., Henry T. Coates, Richard D. Barclay, Wm. C. Carrick and Samuel N. Rhoads.

The following were ordered to be printed:—

A REVIEW OF THE CRETACEOUS MAMMALIA.[1]

BY HENRY FAIRFIELD OSBORN.

In July, 1889, I received a copy of the "Discovery of the Cretaceous Mammalia"[2] by Professor O. C. Marsh, and shortly afterwards wrote to the author calling attention to all the points in which it appeared to me he was mistaken and suggested that he should revise the paper himself.

This was a year and a half ago. In the meantime the paper has been widely distributed and its facts have been accepted without question by many who have no special knowledge of the Mesozoic mammals and with considerable hesitation and criticism by those who have. I refer especially to the notices by Lydekker,[3] Lemoine,[4] Cope[5] and Dames.[6] It seems, therefore, that it is now best to carefully review, in a manner which cannot be misunderstood either by the author or by others, what appears to me to be one of the most remarkable contributions to palæontology ever published. Criticism can, of course, be based only upon the published diagnoses, descriptions and figures in comparison with our present general knowledge of these early mammals. Other evidence is promised by the author and I venture to predict that it will confirm the greater part of the conclusions reached in this review.

First as to extent and general character: the conspectus of the author impresses us that this fauna is not only highly varied but contains forms which are mostly new to science. Four orders are believed to be represented, the Allotheria, Pantotheria, Marsupialia and Insectivora. The author finds six families among the Allotheria alone, four of which are new; five new families in all. Sixteen new genera and twenty-seven new species are described. All of the types are isolated teeth, excepting those of *Camptomus*. With the exception of *Halodon*, *Cimolomys* and *Dipriodon*, only one tooth of

[1] Presented to the Society of Morphologists, Boston, Dec. 30th, 1890; to the Academy of Natural Sciences of Philadelphia, Tuesday, Jan. 20th, 1891.

[2] "The Discovery of the Cretaceous Mammalia." O. C. Marsh, American Journal of Science, Parts I. and II., July and August, 1889.

[3] Manual of Palæontology, Vol. II, p. 1268.

[4] Academy of Sciences, Paris, March 3d, 1890.

[5] American Naturalist, June, 1889, p. 490.

[6] Neues Jahrb. f. Geol. Min. u. Pal. 1890, p. 141–3.

each species is described, *i. e.* from different parts of the jaws, and we are given to understand that the associated teeth, found with each, will be described in the Memoir now in preparation by the writer under the auspices of the United States Geological Survey.

Before this varied faunal table is generally adopted into palæontological literature, let us examine the author's types and diagnoses, keeping in mind the present state of knowledge. Previous literature has apparently not been consulted by the author except in the matter of nomenclature. The result is that some well-known principles which govern the extremely complex and confusing dentition of the Multituberculates are left out of consideration entirely, as well as some of the main characters of the dentition of the Mesozoic mammals in general, and some characters which enable us to distinguish between the teeth of mammals and those of reptiles and fishes. As regards the Multituberculates (Allotheria), it is now well known that their teeth show the following characters:

1. The rows of tubercles in the true molars of one jaw fit into the longitudinal grooves of the molars of the other jaw. 2. In some families there are three rows of tubercles and two grooves in the upper molars and two rows with one groove in the lower molars (Plagiaulacidae); in other families there are conversely two rows above and three below. 3. In every known species, the last molar is invariably simpler than the penultimate molar both as to length of crown and number of tubercles. 4. That the premolars are of two types: *a.* trenchant, *b.* tubercular. When tubercular they can be distinguished from the molars by the absence of grooves, or closure of the grooves by tubercles. 5. The primary function of the incisors is to pierce the food, the secondary function is to facilitate the backward motion of the jaws as in the rodents.

As regards the ordinal terms, Allotheria and Pantotheria, they have not as yet been defined[1] or adopted. The former is equivalent to Multituberculata which has been defined and is now in general use.[2]

A. Multituberculate Forms, (Allotheria.)

1. *Cimolomys gracilis*, (Pl. II, figs. 1–4), described as an upper molar; first referred to *Tritylodontidae* (Owen), subsequently to new

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[1] See Osborn, "Mesozoic Mammalia," p. 257.

[2] See the works of Lydekker, Lemoine, Döderlein, Trouessart, Schlosser, Osborn and others.

family *Cimolomidae.*—Comparing this type with the upper molar of *Neoplagiaulax,*[1] Lemoine, we find it is a first upper molar of one of the *Plagiaulacidae,* Gill.

2. *Cimolomys bellus,* (no figure), the type is referred to a distinct species of *Cimolomys.*—The description and measurements indicate that it is a second upper molar of *C. gracilis.*

3. *Cimolomys digona,* (Pl. VII, figs. 1–4), the type is described as an upper molar of a third species of this genus, referred to the *Cimolomidae.*—It is an upper molar of one of the *Plagiaulacidae.*

A premolar, (Pl. VII, figs. 13–16), is rightly described as an upper premolar and correctly associated with this genus, (compare fig. 19, Lemoine[2]).

4. *Cimolodon nitidus,* (Pl. II, figs. 5–8). The type is described as an upper molar representing a new genus and family, the *Cimolodontidae.*—Comparing it with the lower molars of *Ptilodus,*[3] Cope, it is evident that the type is a first lower molar of one of the *Plagiaulacidae.*

5. *Nanomys minutus,* (Pl. II, figs. 9–12), the type is described as a last upper molar of the left side and referred to the *Cimolodontidae.*—A comparison with *Ptilodus* shows that it is a last lower molar of the right side, belonging to one of the *Plagiaulacidae.*[4]

6. *Halodon sculptus,* (Pl. III, figs. 11–13). The type is a fourth lower premolar rightly referred to one of the *Plagiaulacidae.*

A superior incisor, (Pl. III, figs. 1–3) is referred to this species. —It apparently belongs to a much larger form.

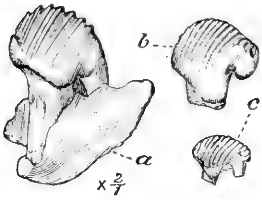

Fig. 1.
Halodon. Fourth inferior premolars of *a, H. sculptus; b, H. serratus; c, H. formosus.* After Marsh. All type specimens.

7. *Halodon serratus,* (Pl. III, figs. 14–17). The type is a fourth lower premolar, a smaller species rightly referred to one of the *Plagiaulacidae.*

A superior incisor, (Pl. III, figs. 14–17) is referred to this species.—It apparently belongs to a larger form.

It is a well known fact that the upper molars of the *Plagiaulacidae* have three

[1] "Étude sur le Neoplagiaulax de la Faune Éocène inférieure etc." Bull. d. l. Soc. Géol. de France, Feb. 12, 1883, p. 259. Pl. VI, fig. 17.

[2] Op. cit., Pl. VI, fig. 19e.

[3] This type (*C. nitidus*) has four internal and seven external tubercles; while *Ptilodus troversartianus* has four internal and six external tubercles.

[4] "The Tertiary Marsupialia," Cope, Am. Nat., July, 1884, p. 694.

rows of tubercles while the lower molars have but two, and that the cusps of the lower rows fit into the valleys of the upper teeth. This is beautifully demonstrated in the author's own figures as here reproduced and rearranged in figure 2;—*a* is the type of *Cimolomys gracilis*, which fits upon *c*, the type of *Cimolodon nitidus*; while *b*, the type of *Nanomys minutus* would probably be found to coincide similarly with the type of *Cimolomys bellus*, unfortunately not figured by the author. This gives us the characters of the molars of what was possibly a new genus (*Cimolomys*) of the *Plagiaulacidae*, intermediate between *Plagiaulax* with three well developed premolars, and *Ptilodus* with one large and one extremely small premolar. This genus cannot at present be defined, because so far as we can compare the molars and premolars, they closely resemble in size and development the corresponding teeth of *Ptilodus*. The premolars of this genus are, of course, found in the species of *Halodon*. The premolar referred to *H. serratus* agrees best in size with the molars of *C. gracilis*.

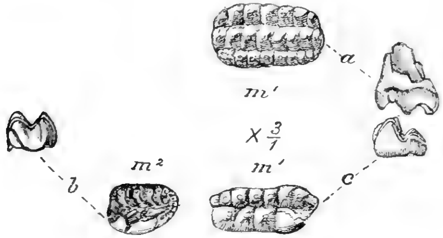

Fig. 2. *Upper and lower Molars of Cimolomys.* (Cimolomidae), *a*, *Cimolomys gracilis.* (Cimolodontidae), *b*, *Cimolodon nitidus* *c*, *Nanomys minutus.* After Marsh. All type specimens.

The accompanying restoration of the upper and lower jaws of *Cimolomys gracilis* shows the various relationships of this animal as given in the above diagnoses by the author:

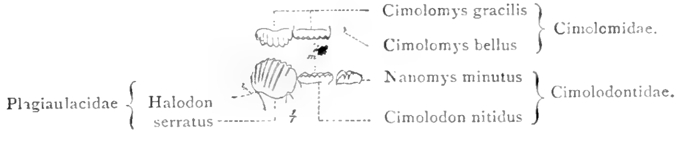

Fig. 3.
Upper and lower molars and premolars of ? *Cimolomys*, in position.

These relationships will probably be increased, rather than diminished by future discoveries.[1] As it is, an upper and lower jaw referred to three families, five genera and five species is without precedent.

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[1] See *Allacodon lentus* which belongs either to this genus or to *Meniscoëssus.*

8. *Dipriodon robustus*, (Pl. II, figs. 13–15). The type is probably correctly described as a last upper molar of the left side; it is referred to a new family the *Dipriodontidae.*

9. *Dipriodon lunatus*, (Pl. II, figs. 16–18). The type is rightly described as a first or second upper molar.—Keeping in mind the larger size and greater complexity of the more anterior molars, there is no ground for referring it to a new species.

10. *Tripriodon coelatus*, (Pl. II, figs. 19–21). The type is described as a first upper molar and is referred to a new family the *Tripriodontidae*—It resembles in the arrangement of its denticles the lower molars of *Stereognathus*, and, as shown below, is a last lower molar belonging to the genus *Meniscoëssus*, Cope.

11. *Selenacodon fragilis*, (Pl. II, figs. 22–24). The type is described as an upper molar distinguished by crescentoid tubercles from the foregoing.—It is an anterior lower molar belonging to the genus *Meniscoëssus*, Cope.

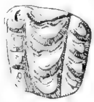

Fig. 3*a*. *Meniscoëssus conquistus*, Cope. Type. An inferior molar x 2.

12. *Selenacodon brevis*, (Pl. VII, figs. 9–12). The type is described as an upper tooth apparently from the left side.—As the accompanying figures show, it agrees in every detail, except the degree of wear, with the type of *Meniscoëssus conquistus*, Cope; it is a lower molar, probably the last.

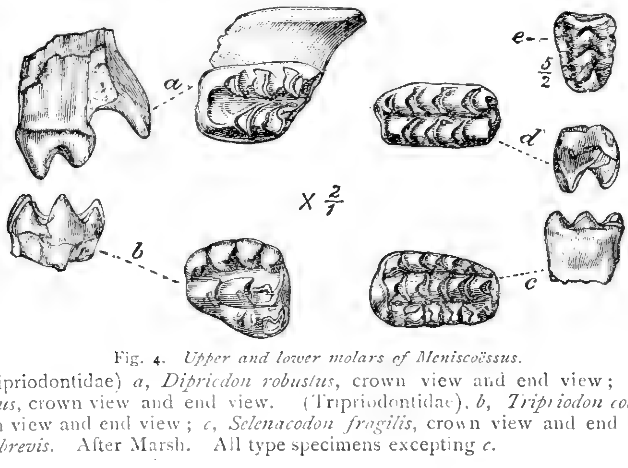

Fig. 4. *Upper and lower molars of Meniscoëssus.*

(Dipriodontidae) *a*, *Dipriodon robustus*, crown view and end view; *d*, *D. lunatus*, crown view and end view. (Tripriodontidae). *b*, *Tripriodon coelatus*, crown view and end view; *c*, *Selenacodon fragilis*, crown view and end view; *e*, *S. brevis*. After Marsh. All type specimens excepting *c*.

The lower incisor (Pl. VIII, figs. 1–3) is probably correctly referred.

13. *Tripriodon caperatus* (Pl. III, figs. 18–20). The type is correctly described as a lower incisor. No ground is assigned for referring it to a new species. Similar incisors of smaller size (Pl. III, figs. 21–22 ; Pl. VIII, figs. 1–3) are referred respectively to *Tripriodon coelatus* and *Selenacodon brevis*.

This collection of molars demonstrates that *Meniscoëssus*, like *Stereognathus*, belongs to a family in which the tubercles are crescentoid and arranged in two rows in the upper molars and three rows in the lower molars. This is admirably shown in the author's own figures as rearranged in figure 4. *a*, The type of *Dipriodon robustus* is seen to fit upon *b*, the type of *Tripriodon coelatus*. *d*, and *c*, belong to older individuals but the worn cusps and valleys coincide; they are respectively the author's types of *Dipriodon lunatus*, and a molar referred to *Selenacodon fragilis* as it agrees exactly with the type except in point of wear.

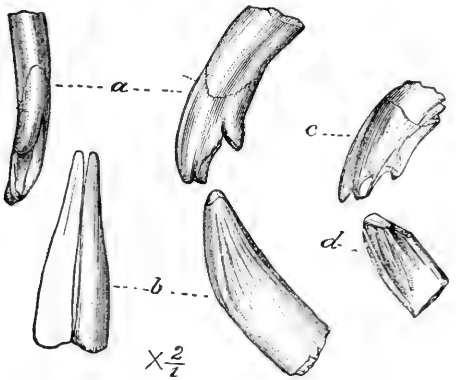

Fig. 5.
a, "Upper incisor of *Halodon sculptus*;" *b*, "Lower incisor of *Tripriodon caperatus*," type; *c*, "Upper incisor of *Halodon serratus*;" *d*, "Lower incisor of *Selenacodon brevis*." After Marsh.

The lower incisor, type of *Tripriodon caperatus*, corresponds in size with these molars, the two smaller incisors, referred to *T. coelatus* and *Selenacodon brevis*, have the same shape and grooved sides. (1) When these incisors are placed side by side as in figure 5 with the upper incisors referred by the author to *Halodon sculptus* and *Halodon serratus* we observe that the longitudinal and transverse diameters of the crowns and fangs coincide exactly in measurement, rendering it highly probable that they belong to the same species. (2) The question is, do these teeth belong to *Halodon* or *Meniscoëssus?* We observe that the lower incisor associated with

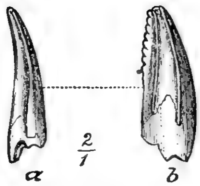

Fig. 5a.
Tooth determined as an 'upper incisor' of *Dipriodon robustus.*

Halodon formosus (Pl. VIII, figs. 32–35), has the enamel confined to a band as in *Ptilodus* and *Neoplagiaulax.* It is smooth. It is, therefore, probable that all these striated, completely enamelled incisors belong to *Meniscoëssus.* (3) When moreover it is seen that these incisors are far too large to be associated with the premolars of *H. sculptus* and *H. serratus,* we have further grounds for associating them with *Meniscoëssus* with which they agree in size. The tooth assigned by the author as the upper incisor of *Dipriodon robustus* apparently belongs to a reptile. It is unlike any incisor hitherto found with the Multituberculata.

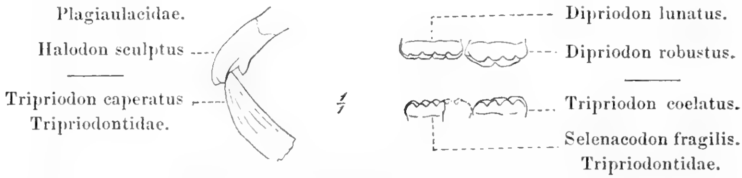

Fig. 6. Upper and lower molars of *Meniscoëssus* in position. (Association of incisors with molars conjectural.)

The accompanying restoration is based upon the foregoing considerations and shows that according to the author the relationships of *Meniscoëssus* are as varied as those of its contemporary, *Cimolomys,* including three families, four genera and seven species.

14. *Allacodon lentus* and *A. pumilus* (Pl. VIII, figs. 22–26–31). The types are described as upper molars of a genus related to *Allodon* and *Bolodon* and referred to the *Allodontidae.*—It is a universal characteristic of the molars of the Multituberculata that, as the grooves are adapted to fore and aft wear, the tubercles are arranged on the sides; in the type of *Allacodon* a tubercle stops the valley; these types are unadapted to fore and aft wear, they are, therefore, probably premolars and belong either with *Meniscoëssus* or *Cimolomys,* or possibly with some other genus, the molars of which are not represented in this collection. Upper premolars of this type are seen in *Chirox,* Cope; *Bolodon,* Owen; and *Ctenacodon,* Marsh.

15. *Oracodon anceps*, (Pl. VIII, figs. 13–16). This type is rightly described as a premolar, but no grounds are given for considering that it belongs to a distinct genus and species.

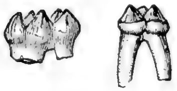

Fig. 7.
Allacodon lentus.
After Marsh. Types.

16. *Camptomus amplus*, (Pl. V, figs. 1–2). The type is a scapula with which are associated other bones, calcaneum, astragalus, interclavicle. No grounds are assigned for separating these remains from genera founded upon the teeth.—The astragalus bears the same proportion to the molar-teeth of *Meniscoëssus* that we observe in *Polymastodon*; it is also apparently perforated. The affinities of these forms to the Monotremata have been observed by Cope; the coraco-scapular facet, therefore, strengthens the supposition that some of these bones at least, belong to *Meniscoëssus*. In any case they cannot be considered as good types.

This completes the Multituberculate forms.

B. Trituberculate Forms.

17. *Dryolestes tenax*, (no figure). The type is a lower jaw with a mylohyoid groove, in which the number and character of the teeth "cannot be determined." The author's reference is provisional.

18. *Didelphops* (*Didelphodon*) *vorax*, (Pl. IV, figs. 1–3). The type is an upper molar, distinguished from *Didelphys* by intermediate tubercles.—This character does not separate it from the large number of trituberculates with similar molars; the genus is, therefore, undefined at present. The other species *D. ferox* and *D. comptus* are also undefinable.

19. *Pediomys elegans*, (Pl. IV, figs. 23–25). The type is an upper molar.—It is not distinguished generically from *Didelphodon*.

20. *Cimolestes curtus* and *incisus*, (Pl. IV, figs. 8–18). The types are lower molars.—Like *Didelphodon*, these forms cannot be defined, they are tuberculo-sectorial.

It is evident that we have here remains of two distinct and probably new genera which may be accepted without definition.

C. Incertae sedis.

21. *Stagodon nitor*, (Pl. VII, figs. 22–25). The types are a few teeth with single fangs, referred to a new family the *Stagodontidae*.—They do not resemble the teeth of any known mammal although described as having two fangs, which are, however, not shown in the figures. The premolar associated is distinctly mammalian.

22. *Platacodon nanus*, (Pl. VIII, figs. 4–12). The types are compared to the molars of *Chrysochloris*.—They do not bear the most remote resemblance to the molars of *Chrysochloris* or any other known mammal. Prof. Dames considers that they belong to the Cyprinoid fishes.[1]

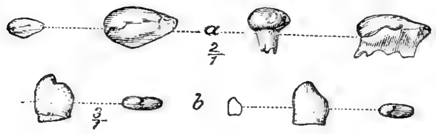

Fig. 8.
(Stagodontidae), *a*, *Stagodon nitor*. After Marsh. Types.
b, *Platacodon nanus*. After Marsh. Types.

The above types do not resemble in the most remote degree the molars in either the multituberculate or trituberculate series—the only two mammalian series hitherto represented in all the discoveries of Mesozoic or Eocene times. Nor have they, as figured, any of the characteristics which we expect to find in mammalian teeth.[2] They should, therefore, be considered either as reptilian or icthyopsidan; we cannot agree with the author that they are "evidently mammalian."

The above analysis may be summarized under the following heads, we find that the author has: 1. Separated parts which evidently belong together, *vide*, various teeth of *Cimolomys* and *Meniscoëssus;* 2. United parts which apparently or certainly do not belong together, *vide*, the large upper incisors with *Cimolomys*, the reptilian or fish molar of *Stagodon* with a mammalian premolar, the reptilian tooth as an upper incisor of *Dipriodon;* 3. Associated or identified reptilian or icthyopsidan teeth as mammalian, *vide*, *Platacodon*, *Stagodon* and incisor of *D. robustus*.

The large Cretaceous fauna described by the writer is therefore seen to be principally composed of synonyms. We must eliminate:

1. The terms preoccupied by other authors.
2. The terms founded upon different parts of the same animals and thus largely preoccupied by the author himself.
3. The terms founded upon imperfect or indefinite types.
4. The terms founded upon reptilian or icthyopsidan teeth.

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[1] This author reaches conclusions very similar to mine in regard to this paper. Neues Jahr. Min. Geol., 1890, pp. 141–143.

[2] See H. G. Seeley, "On the Nature and Limits of Reptilian Character in Mammalian Teeth." Proc. Roy. Soc., April 4, 1888, p. 129.

A. ALLOTHERIA.	=	A. MULTITUBERCULATA, Cope.
1. *Cimolomidae.* Cimolomys gracilis " bellus " digona 2. *Cimolodontidae.* Cimolodon nitidus Nanomys minutus. 3. *Plagiaulacidae.* Halodon sculptus " serratus " formosus	=	1. *Plagiaulacidae* Gill. *Cimolomys*, Marsh, two or three species.
4. *Dipriodontidae.* Dipriodon robustus " lunatus 5. *Tripriodontidae.* Tripriodon coelatus " caperatus Selenacodon fragilis " brevis	=	? 2. *Stereognathidae*, fam. nov. *Meniscoëssus*, Cope, two species.
6. *Allodontidae.* Allacodon lentus " pumilus		Probably preoccupied.
? Camptomus amplus ? Oracodon anceps		Indefinite types or preoccupied.
? B. PANTOTHERIA. ? 7. *Dryolestidae.* ? Dryolestes tenax		Indefinite type.
C. MARSUPIALIA. Didelphops vorax " ferox " comptus Cimolestes incisus " curtus D. INSECTIVORA. Pediomys elegans	 = = 	B. Order indeterminate=Creodonta, Insectivora or Marsupialia. *Didelphops*, Marsh, two species. *Cimolestes*, Marsh, ? species. Not defined.
E. INCERTAE SEDIS. 8. *Stagodontidae.* Stagodon nitor Platacodon nanus		Founded upon Reptilian or Icthyopsidan teeth.

This reduces the Cretaceous mammals described in these two papers to one well determined order or sub-order, two well determined families and four or five genera, one of which can now be well defined (*Meniscoëssus*) while the remainder are probably distinct genera which we may be able to define by the acquisition of more material (*Cimolomys, Didelphops* and *Cimolestes*). There is no question that the majority of the remaining generic names are synonyms although it is quite possible that some of the types described, such as *Oracodon* and *Pediomys* may be found to represent distinct or new genera.

It may be said that this analysis has almost entirely eliminated the work of the author. This unfortunately is what is necessary if we would render this contribution of any permanent value in palaeontology. We are then left with a series of teeth which represent rare skill on the part of the collector and are figured with remarkable accuracy by the draughtsman. A few points of interest upon the collection as a whole may be mentioned.

The *Multituberculata*. The preponderance of teeth belonging to members of this order would appear to indicate that it flourished during this period. *Cimolomys* represents a connecting form between *Plagiaulax*, upper Jurassic, with three premolars and *Ptilodus* of the lowest Eocene with two. The smallest species, *C. formosus*, apparently has as many grooves upon the fourth premolar as we observe in *Ptilodus*, and the first lower molar has even more tubercles than we find in the corresponding tooth of the lower Eocene genus. These grooves and tubercles mark the stages of development, and it would appear that *Cimolomys* is not far removed from *Ptilodus*; this relation can only be determined by the discovery of additional teeth, we may find that *Cimolomys* has a large third premolar.

Another interesting fact is that *Meniscoëssus* does not belong with the *Plagiaulacidae*, as has been generally supposed hitherto,[1] but should apparently be placed with *Stereognathus* (with which its resemblance in molar structure has always been recognized) in a distinct family, the *Stereognathidae*, distinguished by the presence of two rows of tubercles in the upper molars and three in the lower, of crescentoid pattern. The more numerous tubercles in *Meniscoëssus* would accord well with its more recent character.

[1] Cope, Osborn, Lydekker.

There are thus apparently only two families of the multituberculates represented here unless as the author has suggested, *Allacodon* belongs to the *Bolodontidae*. We have yet to find the successors of the *Tritylodontidae* and predecessors of *Polymastodon* and *Chirox* of the lower Eocene.[1]

As for the trituberculate forms there are evidently two distinct genera which probably belong to different families. The types of *Didelphops* and *Cimolestes* closely resemble molars found respectively among the Mesodonta, the Creodonta, Insectivora and Marsupialia. Their systematic position is, therefore, very uncertain from this evidence. They mark, however, a very great advance upon the Jurassic forms in tooth evolution. We find in *Didelphops*, the earliest low-crowned tritubercular molar which has been obtained, with one or two intermediate tubercles, while the lower molar is the earliest quinquetubercular tooth known. The *Cimolestes* molar is tuberculo-sectorial and presents a less marked advance upon jurassic tooth types, but has nevertheless a broad talon, with both the entoconid and hypoconid developed, whereas all jurassic forms present the hypoconid only.

The bones of the appendicular skeleton present a number of very interesting points, some of which the author mentions; these are, the coracoid facet upon the scapula; the interclavicular. We note also the flat astragalus, without a neck, apparently perforated by an astragalar foramen,[2] and with a broad cuboidal facet as well as the navicular facet. The calcaneum has a narrow sustentaculum.

We look forward with great interest to Part III of this series of papers, as the collection is a most valuable and interesting one, and the above review is not intended in any way to depreciate the importance of an increased knowledge of the Cretaceous mammals.

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[1] The nearest resemblance to *Polymastodon* is that observed in the striated lower incisors here copied in figure 5. This genus will undoubtedly be found represented in these beds.

[2] The observation rests solely upon the figure. All astragali of the lower Eocene display this foramen.

GEOLOGICAL RESEARCHES IN YUCATAN.

BY PROF. ANGELO HEILPRIN.

The observations recorded in the following pages were made in the early spring of 1890 in the course of the explorations by the Expedition organized under the auspices of the Academy of Natural Sciences. The points of investigation are included between Progreso on the northern coast, the cave-region of Calcehtok (in the first range of hills) on the southwest, Labna on the south, Tunkas (on the Valladolid road) on the east, and the Port of Ɔilam (Silam). So far as I know, no critical examination of the geological features of any portion of this region, or indeed, of any part of Yucatan, had been made prior to our visit. Unfortunately, want of time did not permit us to penetrate beyond the range of mountains (Sierra de Yucatan) above referred to, but from information received from various sources and from the general lay of the land, I am led to believe that much or most of the region beyond possesses the same general geognostic features as those which characterize the country traversed by us.

Of the few travelers who have succeeded in penetrating into the deep interior of Yucatan, there is scarcely one who has given even as much as a hint of the geology of the country; but more surprising yet, even the geography of the region is unknown. The traveler has but to consult the latest maps of the peninsula, official and unofficial, to see how varied a course might be picked out between almost any two points that are somewhat removed from one another. A direct course of 40–50 miles may differ, according to the maps used, by fully 10 or 20 degrees of the compass; mountain chains may have to be crossed or not, just as it suits the convenience of the traveler in his choice. Lakes appear in one chart, and they are replaced by water-courses in another; or both are entirely wanting in a third. Towns and roads appear where, in reality, there is but a wilderness, with possibly a traversing mule or deer path. Even the principal range of hills, that which runs in a N. W.—S. E. line from beyond Ticul in the direction of Peto, and culminates in an elevation of approximately 900 feet,[1] is wholly

[1] Determined barometrically by Mr. Edward H. Thompson, U. S. Consul at Merida; the position of this most elevated point is not far from Xul, a few leagues southeast of Labna.

omitted from some maps, while it is deflected at a right angle on other maps; again, the chain frequently appears supplemented or replaced by a S. W.—N. E. chain terminating at, or passing, Valladolid. It is difficult to account for these geographical aberrations. The map accompanying Stephens' work (1843) is in a general way accurate—much more so than most recent maps—and the position of the principal mountain mass is given in its nearly true points. That remarkably accurate observer also omits the non-existent rivers and lakes, making exception, however, in favor of the actually existing lake (southeast of Peto) of Chichenkanab.

Our scanty knowledge of the interior of Yucatan is doubtless due in principal part to the difficulty (or assumed difficulty) of penetrating into the region of the revolted Mayas. It is currently believed that no white man, except at extreme risk to his life, can penetrate into the interior either from the west or from the north; but the experience of Consul Thompson, as proved by his travels, shows that good judgment and a knowledge of the Maya language may effectually protect a non-Mexican from the dangers of assault which are certainly intended to be directed solely against the Mexicans and their supporters—in other words, against those to whom the revolted Indians decline to recognize allegiance. The so-called "wild" Indians of the interior are, in fact, identical with the Mayas of the north, and in their behavior to strangers, except to Mexicans, they are as peacefully inclined as are their (supposed) more highly civilized brethren of the north. Hence, it is not difficult to enter their country from the side of the British possessions, *i. e.*, from Balize. It is from that side that Dr. Gaumer, the well-known collector of birds (now a resident of Izamal), and his wife penetrated.

First after Stephens to make an extended tour through Yucatan was Captain Lindesay Brine, R. N., who, in the early part of 1870 (January 30th to April 8th) traversed the region from Guatemala to Sisal. A brief account of this journey, entitled "On the Ruined Cities of Central America," is published in the Journal of the Royal Geographical Society for 1872 (vol. XLII). No geological facts are given in this paper, but there is a suggestive reference to the conservative or preservative character of the climate, which may have some bearing upon the determination of age of the prehistoric ruins. It has been urged, and seemingly with much force, by those who uphold the comparatively recent construction of these buildings, that the sharp arêtes or cornices which still ornament the exterior walls cannot be of great antiquity, since continued exposure to atmospheric influences would in a comparatively brief period turn rounded edges and corners. In examining the walls of Uxmal I was especially struck with the knife-edges which mark long courses of marble, as straight and clean as though they had been laid in our own generation. I was immediately impressed with this circumstance as strong evidence tending against great antiquity. But in the light of what Captain Brine says, I am not sure that this evidence of itself carries much weight. Thus, it is asserted by this traveler, that he "found the names of Stephens, and Catherwood, and Pawling, which were written apparently with a bit of charred wood on the inner surface of the entrance archway [at Palenque], as fresh as when first done in 1840"—*i. e.*, thirty years previous. This is certainly a most extraordinary instance of resistance to atmospheric influences.

Of the very few references touching the physiography of Yucatan, the most important are contained in a paper by Dr. Arthur Schott on the coast formation of the north, published in Petermann's Mittheilungen for 1866.[1] In this paper the author discusses the nature of the long sea-dam (sand and shell dune) which skirts the coast for a length of some 170 miles, and of the brackish water-strip or lagoon which it encloses. The double formation is attributed to the antagonistic effects of the sea and of the subterranean (or submarine) outflows (of fresh water) from the land; the sea-dam is normally broken at but two or three points throughout its course, the breaks occurring in positions—as opposite the estuary of the so-called Rio Lagartos—where the terrestrial waters emerge with sufficient force, or have accumulated in sufficient volume, to overcome the oceanic pressure from the outside. Dr. Schott incidentally refers to the condition of the interior "cenotes" or sinks, whose universality throughout the region is recognized, and remarks that inasmuch as the level of the water in these is approximately that of the sea (varying two or three inches toward the close of the rainy season), the depth of the cenotes must in itself be an index of the elevation of the land surrounding them (the elevation increasing as we recede from the sea). Thus, it is held that in, and immediately about, the capital city, Merida, the cenotes have a depth of from 26–28 feet; at some little distance south of the city, 30 feet; half

[1] Die Küstenbildung des nördlichen Yukatan.

way between Merida and the north coast, 12–15 feet, and at Progreso, on the coast, 0.

I determined the depth of the cenotes about Merida and found it to be approximately as stated by Schott. But it is beyond question that the water-level in the cenotes generally, except possibly in the case of a few that are not very distantly removed from the sea, has no connection with the level of the sea. This is shown by the condition of the aguadas, or larger basins, where the level of the water is far from constant, and varies within very broad limits. The same condition is illustrated by some of the deeper caves, such as Bolonchen, for example, in which frequently no water of accumulation is met with until a level seemingly considerably below that of the sea is reached.[1]

In any consideration of the geognostic features of Yucatan, three distinct regions of the country must be recognized: the lowland plains, the mountains (perhaps more properly designated hills), and the submerged plateau which gradually shelves into the Gulf and is known as the Yucatan Bank. The last, in whatever way it be considered, is, it appears to me, geologically a part of the continental area.

The lowland plains, lying north of the Sierra de Yucatan, rise gradually as we proceed inland from the coast-border at the rate, perhaps, of a foot or a foot and a half per mile, which is, of course, considerably less than the pitch of the sea-floor immediately north or west of the peninsula. But in this feeble rise of the land we have no positive indication that it is the normal of elevation, as denudation has doubtless done something to level the country since its emergence from the sea. But from such stratigraphical correlation as we found possible to make, it would seem that the leveling has been insignificant, and perhaps not sufficient to materially alter an

[1] Stephens gives the depth to which he descended in the cave of Bolonchen as approximately 450 feet ("Incidents of Travel in Yucatan," II, p. 152, 1843). Unfortunately, there are no data at hand for determining the elevation of Bolonchen itself, but inasmuch as the town lies considerably to the south of the Sierra, on the north-and-south line of Ticul, and as the absolute elevation of the Sierra itself is here only about 450 feet, as we determined by means of a very sensitive aneroid barometer, the position cannot be more than 100–200 feet above the sea, if it is that much. The elevation of Ticul, which lies at the north foot of the Sierra, is, as I am informed by Señor Antonio Fejardo (a long-time resident of the town), approximately 90 feet. Probably the elevation of Bolonchen does not differ greatly from that of this town. It would thus seem that there has been here considerable subsidence since the formation of the cave.

original relief. At the present time the absence of running streams would naturally largely check surface degradation, but, on the other hand, an equivalent in part would be obtained from the sinking of the floor over the numerous limestone caverns with which the country abounds. At Merida, some 23 miles from the north coast, the general elevation is about 28–30 feet above the sea, at Ticul about 80–90 feet, and at a point on the Merida-Sotuta railroad, one-half mile east of Tekanto, 42 feet.[1] A line drawn from Progreso to the crest of the hills immediately south of Ticul would give a gradient approximately equal to that of a line of similar length projected northward from Progreso over the submerged plateau.

The rock formation over the greater part of the plains is that of a gray or white shell limestone, highly indurated or sub-crystalline in local areas, but rarely to the extent of obliterating its fossiliferous character. Secondary depositions of calcite, in the form of veins, crystals and nodular masses, are abundant. Where less compact the rock may be said to be a mass of loosely-united shells, a condition that is best shown in the superficial layers. Good sections of the rock are seen only in the walls of the aguadas and cenotes and in a number of railway cuts which traverse it both in a N.—S. and E.—W. line; the rock surface is, however, visible over a very large part of its extent, being but scantly covered with soil and supporting only an indifferent vegetation. Its decomposition has liberated large quantities of red earth, similar to that which is found in our own northern region (*terra rossa*) and on coral islands (*e. g.*, the Bermudas, Bahamas), and which is seemingly a residual product representing impurities of one form or another which were introduced into the limestone at the time of its formation. The great quantity of this impurity, which constitutes much or most of the soil of the country, taken in conjunction with the circumstance that the limestone is of shallow-water formation, suggests the notion that this iron-impurity is a product of the volcanic discharges which for a long period of time visited the region, and must have contributed a vast amount of oxydizable material to that which was slowly accumulating through the agency of organic forces in the Gulf basin. The surface of the limestone is eaten out into irregular knolls and hollows, which become more pronounced as we move inland from the northern coast.

[1] As determined by railroad levelings conducted by Colonel John W. Glenn.

The paleontological evidence of the fossils contained in the limestone is to the effect that the latter belongs to two periods of geological time, the Pliocene and the Post-Pliocene, but stratigraphically it is not easy to draw a line of demarkation between the two formations. It, indeed, appears as though the Post-Pliocene, except in the coastal area, were present only in patches, having been removed through atmospheric decay and denudation. It is in most places easily distinguished by the large numbers of *Venus cancellata* which fill the rock, making a true *Venus cancellata* bed, such as I observed capping the Pliocene beds on the Caloosahatchie, Florida, just below Fort Thompson. The beds occupy similar positions and hold equivalent relations to the construction of the land, and may, therefore, be considered as counterparts of an identical formation. At Fort Thompson the *Venus* bed is found at an elevation of some 24 feet above the sea, a few feet less, perhaps, than the level which the same bed holds in the exposed walls of the cenotes at Merida. At the railroad station of San Ignacio, about half way between Merida and Progreso, the same bed has fallen to a level of about 14 feet; it is there crowded with the shells of its distinctive fossil, one of the most abundant of the Gulf Mollusca. We found the same fossil equally abundant on the roadway between Kansakhab and Dilam, at points 12–15 miles or less from the coast, and not unlikely this whole northern slope between the coast and some fifteen miles inland is a Post-Pliocene surface. The low exposures, however, do not make this absolutely clear, nor do they permit us to say just how much further the same deposits extend. Post-Pliocene cappings continue at least as far as Merida, and not improbably outcrops will be found much further in the interior. But as has before been remarked, the close connection existing between the Post-Pliocene and Pliocene deposits does not permit a sharp differentiation of the two series. At first glance, indeed, I assumed that the whole northern plain was a recent formation, but a closer examination of the fossil remains leaves no doubt that the major formation is the Pliocene, which is here and there covered or obscured by more recent deposits.

My examination of the Pliocene area was made at several points in and about Merida, in numerous cuttings along the line of the Merida-Kalkini Railroad, on the line of the railroad connecting the capital city with Ticul, all along the traverse between Merida and Tunkas—some twenty miles E. S. E. of Izamal—and at various points between Tekanto and Ɔilam. The rock-formation over all this area is largely uniform, and shows frequent recurrence of the same fossils; there is no question, therefore, of its identity throughout. I enjoyed special advantages for studying fresh material in the cutting which was being made at the time of our visit eastward of Tekanto, in the railroad section connecting this town with Izamal.[1]

The following is a list of the fossils that I have thus far been able to identify from the rocks of this formation; the species preceded by an asterisk are non-living or Pliocene forms, the remainder live in the adjacent seas.

From the R. R. cutting (Camp Glenn) one and a half miles east of Tekanto:

Pecten nucleus.
Pecten n. sp.
Anomia simplex? (**A. Ruffini?*)
Plicatula filamentosa.
Lucina reticulata.
Arca Adamsi.
Venus mercenaria.
Venus cancellata.
Marginella apicina?
**Turritella perattenuata.*
**Turritella apicalis.*
Bulla striata.

From a rock outcrop west of Izamal:

**Amussium Mortoni.*

From the cenotes near Merida:

**Pecten* n. sp.
Pecten nucleus (*dislocatus*).
Cardium isocardia.
Venus Listeri.
Venus cancellata.

From a railroad cutting about half-way between Merida and Ticul:

Pecten nucleus.
Pecten sp. indet.
Pinna sp. indet.
Lucina Jamaicensis.
Lucina edentula.
Cardium magnum?
Cardium muricatum?
Venus mercenaria.
Murex Salleanus?

From a digging in the city of Merida:

**Ostrea meridionalis.*
Anomia simplex.
Pecten nucleus.
**Amussium Mortoni.*
Plicatula filamentosa.
Arca Deshayesii.

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[1] The writer is under great obligation to Colonel John W. Glenn, Engineer of this section of the Merida-Sotuta Railway, and to Mrs. Glenn for many facilities afforded the exploring party toward the prosecution of their work, and for the comforts of a railroad "camp" during a period of nearly two weeks.

**Arca* sp. indet.—Very close to *A. incongrua* and *A. scalarina* (from the Pliocene of Florida), but differing in the greater width of the ribs and in the absence of the intercostal line. The specimens are in the form of impressions and do not permit of characterization.

Arca rhombea.

**Pectunculus* sp. indet.—Seemingly different from any of the living species.

Lucina tigrina.
**Lucina disciformis.*
Lucina Pennsylvanica.
Cardium serratum.
Cardium muricatum.
Cardium isocardia?
Chama arcinella.
Venus mercenaria.
Venus Mortoni.
Artemis discus.
Macoma contracta.
Tellina sp.?
**Fulgur rapum.*
Dolium perdix.
Oliva literata.
Cypræa sp. indet.
Pyrula reticularis.
Siliquaria sp. indet.

Fulgur rapum, Turritella perattenuata, T. apicalis, Ostrea meridionalis and *Lucina disciformis* are forms which I have previously described from the Pliocene deposits (the "Floridian") of the Caloosahatchie.[1] *Amussium Mortoni*, also found in the Caloosahatchie deposits, is a well-known fossil of the Carolinian Miocene, and represents the recent *A.* (*Pleuronectes*) *Japonica* (from which it differs mainly in the disposition of the interior ribs). Besides the species above enumerated, the rocks in nearly all cases—at least, when they are largely fossiliferous—contain almost numberless impressions of a *Venus*, so far as I know, not now living, whose nearest analogue appears to be *Venus cribraria* of Conrad, a Miocene species of the Atlantic border of the United States.

The exact position in the Pliocene series which these Yucatan rocks hold cannot, perhaps, be stated, but they with little doubt, correspond at least in part with the series occurring in Florida which I have designated the "Floridian." It is true that the number of extinct species of the mollusks is seemingly less in the Yucatan rock than in that of Florida, but it should be said that in addition to the forms above enumerated, there are a considerable number, occurring mainly in the condition of unrecognizable casts, which may largely represent extinct species. The number of corals

1 "Explorations on the West Coast of Florida and in the Okeechobee Wilderness."—Trans. Wagner Free Institute of Science, vol. 1, Phila., 1887.

found associated with the molluscan remains was exceedingly limited; indeed, it was only after long search that I detected their existence at all. I picked out a good-sized clump of *Porites* from a cutting on the Merida–Ticul railroad, and found a few simple corals elsewhere. They represent only a sporadic growth, and I could nowhere determine any evidences of reef-structure.

The Mountain Region.

The rock-formation of the Sierra de Yucatan differs in many particulars from that of the basal plain. The surface rock, forming the crest and the slopes on either side—presumably an anticlinal structure—is a fairly compact red or reddish limestone, which seems to rest at nearly all places, as we had occasion to observe in the caves of Calcehtok and Loltun, on a semi-crystalline white or gray marble or on an exceedingly fine grained cream limestone, somewhat resembling in texture true lithographic stone. A brecciated limestone, containing fragments of the last mentioned rock, occurs at intervals along the base of the hills, and we also found it among the rocks used in the construction of the buildings (now ruins) of Labna. I am not absolutely certain as to the age or even as to the general nature of the red-rock. The brecciated masses are almost undoubtedly of marine origin, and they give evidence of the encroaches of the sea after the underlying rock had not only been formed but been converted into its present semi-crystalline condition. In other words, the present range of hills probably by that time already existed. It is, however, less clear that the red or reddish rock which extends away from the base of the hills, but forms their slopes, is of marine origin. Its universality would seem to indicate that it was of this nature, but at many places where I examined it, on and off the crests of the hills, it bore suspicious marks of being a disintegration product, which had subsequently undergone cementation. The only fossil that I found in it, on any surface exposure, was a *Helix* (probably identical with a species now living in the same region), which was obtained from near the summit of the pass between Ticul and Santa Elena, at an absolute elevation of perhaps 300 feet. It occurred in a thoroughly hard rock, but this circumstance is in itself no proof of actual antiquity, since in a purely calcareous region such as this one, rock cementation is a rapid process, as we had occasion to observe in the terrestrial (fossiliferous) limestone now forming near a quarry about two miles south of Ticul. In the red rock which in the cave of Calcehtok overlies the gray limestone I found the impression of a single gasteropod, which I should unhesitatingly refer to a terrestrial form, and to a genus of *Pupidae* close to *Macroceramus*, if indeed, it is not *Macroceramus* itself.[1] I could find no vestiges of marine mollusks, but yet they may well occur in other parts of the rock, and it would, perhaps, not be safe to conclude that the entire red-rock is of terrestrial origin, or that it represents a single type of formation.

No doubt attaches to the heavily-bedded gray and white limestones and marbles which are so well exhibited in some of the deeper caves, such as that of Calcehtok, for example. The mouth of this cave, according to a rough approximation, is some 200 feet above the sea.[2] At a depth of some 50 feet the red limestone appears in a solid mass, and beneath it we reach the crystalline limestones, which are disposed in layers of 10–15 feet thickness. Fossils are not abundant in this rock, and Col. Glenn, who had explored this cave on a previous occasion, was of the opinion that no fossils were to be found in it. After considerable search, however, we discovered a few in an indifferent state of preservation, and still later some whose characters were sufficiently defined to permit us to determine their relationship. Among these are a *Pecten*, with little doubt *Pecten nucleus*, the cast of a large *Marginella*, apparently the living *Marginella labiata*, a *Potamides* or *Cerithidea*, the impression of the apex of a large Oliva (of the type of *Oliva literata*), and a single impression of *Venus cancellata*. While the above forms are barely sufficient to determine the exact age of the formation in which they occur, whether Pliocene or Miocene, I am inclined to believe that it is rather the former, the mountain-rock—semi-crystalline or highly compact, and but scantily fossiliferous—being a compressional alteration of the much less compact and highly fossiliferous rock of the basal plains. But whether Pliocene or Miocene, I think it can be all but positively assumed that it is not older than Miocene, although it has been asserted that it represented the Oligocene or Vicksburgian period.[3]

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[1] Mr. H. A. Pilsbry, Conservator of the Conchological Section of the Academy of Natural Sciences, has kindly directed my attention to this relationship.

[2] The height of the pass leading to the cave we determined barometrically to be about 250 feet above the hacienda of Señor Escalante (situated at the north foot of the mountains), which is itself elevated some 60 feet. The total height of the pass is thus somewhat above 300 feet.

[3] Alexander Agassiz—"Three Cruises of the Blake," 1, p. 69.

The cave itself is a magnificent specimen of subterranean architecture and in several of its features far surpasses the Luray Caverns. The broad entering arch, a feature which we found repeated in the scarcely less imposing cave of Loltun, in the mountains southeast of Ticul (or the hacienda of Tabi), is in striking contrast to the contracted passage which leads into the famous cavern of Virginia. Huge stalactites hang from heights of 50–70 feet or more, or unite with stalagmites to form continuous columns of giant proportions. Many of these measure as much as six or eight feet in diameter, and some of them considerably more. In the cave of Loltun we measured one which was thirty-six feet in circumference about five feet above its base, and I am certain that there are others that are still larger, both here and in the cave of Calcehtok. The chambers, especially in the last named, are imposing in their dimensions, and communicate with one another by the usual clefts and narrows. There is little moisture in either of the caves; most of the chambers are thoroughly dry, and they have accumulated extensive deposits of disintegrated rock material. In the short time at our command we could not explore the caves to their furthest limits, but we saw enough to convince us that their extent was quite considerable. We descended in the cave of Calcehtok to a depth of approximately 170 feet, or to within about 30 feet of the level of the sea; unfortunately a shortage of illuminating material, and the disinclination of the Mayas to proceed further, prevented us from prosecuting our search to the end that we should have desired. The red rock which we found superimposed upon the gray limestones in the cave of Calcehtok reappears in the cave of Loltun, where, however, we failed to find the underlying older stratum. This was probably due in part to the stalagmitic crust with which much of the surface was covered, and to the circumstance that this cave is much less deep—at least in the part traversed by us—than the cave of Calcehtok.

We found among the ruins of Labna that much of the stone that was used by the ancient Mayas in the construction of their habitations was the semi-crystalline limestone, and not the surface rock that is found in the region. The builders had manifestly brought their rock from some distance, but from what special locality I could not determine. This preference for a particular building stone is also seen in a number of small ruins traversed by the railroad about two miles north of Ticul. The material there used is also a very compact gray limestone, but it differs from the limestone of the cave in being highly fossiliferous, and in lacking the subcrystalline structure of the latter. The fossils are unfortunately in too imperfect a condition to be satisfactorily determined, but they are in part crowded with an orbicular Foraminifer, or rather, its impressions, which measure about a third of an inch in diameter. From the form of the impressions, I should say that the Foraminifer is a *Patellina* (*Cyclolina*). Whence this rock was obtained I know not, but it certainly differs from the field rock which appears a short distance from the ruins.

The heights determined by us on the Sierra are the following: the summit of the pass leading over from the hacienda of Señor Escalante (near Calcehtok) 250 feet, or 310 feet, approximately, above the level of the sea; the summit of the pass leading over from Ticul to Tabi, 300 feet above Ticul, or 390 feet approximate absolute elevation; summit of the pass leading over from the hacienda of San Juan to Uxmal, 160 feet above the plain. At all of these points the hills rise fully 50 to 75 feet, or more, above the highest point reached by us; accordingly, the hills immediately south of Ticul cannot be much less than 500 feet in elevation. But as has already been said, the range further to the southeast attains 900 feet. The range itself is composite in structure, having two or three parallel lines of elevation which include longitudinal valleys.

The Yucatan Bank.

Little positive can at the present time be said regarding the structure of the Yucatan Bank. It is well known that Alexander Agassiz, who is almost the only authority that has critically touched the history of the Gulf basin, considers it, in common with the similar formation lying to the west of the peninsula of Florida, to have been formed through a process of slow organic accretion—the accumulation, through an undefined period of time, of animal debris upon an early fold (or bank) of the earth's crust—in which the force of elevation has practically played no part.[1] I have in another place discussed the probability of this view, and have stated that I could find no satisfactory evidence in support of it—on the contrary, almost the only positive data that we possess in the premises argues

[1] Three Cruises of the Blake, chapter III, Vol. 1, on "The Florida Reefs;" "Coral Reefs of the Hawaiian Islands," Bull. Mus. Comp. Zoology, XVII, April, 1889; and elsewhere.

directly against it.[1] Apart from the non-evidence we have in the matter of giant limestone banks being built up from deep water in a comparatively brief period of geological time, the position of the Pliocene and Post-Pliocene deposits in both Florida and Yucatan shows that there has been a comparatively recent uplift, and for anything that I know to the contrary, this uplift may have been quite modern, and might, indeed, be progressing to-day. But again, the evidence is all but conclusive that there has been recent subsidence;[2] and, indeed, so far as I can see, it is impossible to say whether the last movement was one of elevation or of subsidence.[3] The difficulties attending the solution of this question will be appreciated by all geologists.

The complexities that are involved in the problem of the construction of the Gulf basin are also a part of the history of the adjoining basin of the Caribbean Sea. In their united physiognomy the most distinctive feature is constituted by the deep channels of water which delimit the banks that have been briefly referred to and which are known to geographers as the Straits of Florida and Bemini and the Yucatan Passage. The depth of water in the former, whose width is some 50 miles, is between 2200 and 3000 feet; in the latter, with a width of 80–90 miles, it reaches 1000 fathoms. If we assume the greatest depth of the Yucatan Passage to be at about its middle, and that there is more or less of a regular slope of the bottom leading from either side to this point, the average gradient of the bed would be approximately 1 in 35, or about 150 feet to the mile. Much the same profile would be presented, under a like assumption, by the Straits of Florida. This slope, while it is steep, is not yet so steep that it can in any way be designated precipitous. In fact, an equal deviation from the horizontal in the ceiling of an ordinary room would scarcely offend the eye. If the Yucatan Passage were drained of its water, it would present the appearance of a

[1] The Bermuda Islands: "A Contribution to the Physical History and Zoology of the Somers Archipelago," 1889, pp. 59–61, 73.

[2] As I have stated in my Report on Florida explorations ("Explorations on the West Coast of Florida and in the Okeechobee Wilderness," Trans. Wagner Free Institute of Science, p. 15, Phila., 1887), and as Shaler has also found in the course of his own investigations (Bull. Mus. Comp. Zoology, XVI, p. 148, 1890.)

[3] Only relative movement is here implied; the interesting problem of oceanic transgression and retrocession, which has been so forcibly argued by Suess and others, is not considered in this place.

vast flat in which the eye would barely be able to detect a hollow.[1] Allowing that the deeper water is met with long in advance of the center of the channel, or for a slope of double intensity, the cut would be only in the form of a gently undulating valley, with nothing in it to remind one of a ravine or gorge. I make this comparison because I believe it will serve to a proper understanding of the conditions under which these special physiographic features may have been brought into existence.

The gradual slope—for such it can really be called—of the channel seems to dispose of the *necessity* of invoking (although by no means disproving the condition) the assistance (in the construction of the channel) of either faulting or fracture. At the same time I believe it equally disposes of the notion that the channel has been primarily formed through the scour of the Gulf Stream, as has been maintained by Alexander Agassiz; at least I see no grounds for believing that it has been so formed, and the fact that the pitch of the floor-bed is much less than it is (between the 500 and the 1000 fathom contours) along much of the adjacent continental borders where no currental scour of any magnitude is known argues against the supposition. The undulation that is present, and concavities of which form the two channels under consideration, is no greater than that which ordinarily exists over any broad plain or mesa surface of the continental areas.

That the Gulf Stream may now be to a certain extent deepening these channels is possible, but this is hardly likely to be the case. Even if it be held, as the observations of the "Blake" seem to make clear, that "the bottom of the Gulf Stream along the Blake Plateau is swept clean of slime and ooze, and is nearly barren of animal life,"[2] this fact does not necessarily argue in favor of scour, since just in the path of the most rapid current of this stream, in the Straits of Florida, where the flow is from four to five miles an hour, the researches of Pourtalès, A. Agassiz and Murray have revealed the presence of vasts deposits of ooze. It is further a suspicious circumstance, seeing that we have no evidence of the much greater antiquity of one channel over the other, that the Yucatan Passage, in which the flow is barely more than a fourth of a mile per

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[1] The actual slope of the channel's bed is not as regular as has been assumed in the above proposition, but for all practical purposes, I believe, the comparison will hold.

[2] "Three Cruises of the Blake," I, p. 259.

hour, should have a depth double that of the Florida Straits, in which the rate of flow, as has already been seen, is four miles an hour, and more. The stream with a relative velocity of 16 has excavated a channel with but half the depth of that excavated by a stream whose velocity is only 1. Of course, modifying circumstances may to a considerable extent lessen the disproportion of action, but not sufficiently to lend any probability to the theory of Gulf scour.

It is now, I believe, a widely recognized fact that the peninsula of Florida has in quite recent geological times, even so late as the newer Tertiary or Post-Pliocene, been united with the greater Antilles (or at least with Cuba) and the Bahamas into one more or less continuous land-area; the evidence, at any rate, for this supposition is of such a nature that it cannot readily be explained away.[1] And I believe it scarcely less probable that this connection was continued quite to the peninsula of Yucatan, although the separation there may have begun at a slightly earlier period. But it will be asked, if the separating channels have not been formed either through dislocation (fracture) or the wear of the Gulf Stream, in what manner has the existing disruption been brought about? I think that the theory of subsidence offers the easiest and the most plausible solution to the problem. But the theory, to be worthy of confidence, must have some facts to support it, and it behooves us to inquire if any such exist. As to a limited subsidence within a very recent geological period (Post-Pliocene)—sufficient, probably, to account (if this were necessary) for the positions of the several atoll-like reefs which have been cited by the opponents of the Darwinian theory of reef-structures in evidence against subsidence[2]—there is ample testimony. With regard to the region of the Floridian peninsula, I have stated some of the facts in the Report before referred to, and Prof. Shaler has since the time of my explorations obtained new data supporting the conclusion I had arrived at.[3] On the Yu-

[1] DeCastro, Bolet. Com. Geol. Esp. VIII, pp. 357–72, 1881; Dana, "Origin of Coral Reefs and Islands," Am. Journ. Science, 3rd Ser., vol. XXX, 1885; Suess, Antlitz der Erde; Heilprin, "The Bermuda Islands," pp. 227–28.

[2] I fail to see in what way the Alacran Reef, on the Yucatan Bank, is a true atoll.

[3] The Topography of Florida—Bull. Mus. Comp. Zoology, vol. XVI, 1890. Heilprin "The Corals and Coral Reefs of the Western Waters of the Gulf of Mexico," Proc. Acad. Nat. Sci. Phila., 1890, p. 314.

catan side the evidence is, I believe, equally conclusive. The deep hole of Bolonchen, to which reference has already been made, can reasonably be explained, if the measurements of Stephens are at all to be relied upon, only on the assumption of subsidence. The condition of some of the other caves seems also to argue in the same direction. On the north shore the solid limestone at many places abuts directly against the Gulf waters, or is even carried into them, as I had occasion to observe near the Port of Dilam, in scattered ledges and boulders. I was also informed that in the course of construction of the long pier at Progreso, masses of rock, similar to that which is found inland, were met with at various points off from the coast. Of course, the same conditions might be presented by a rising surface the moment we admit that a consolidated limestone—except such as coral and oyster reefs, etc., which are colonial accumulations or out-growths—may be formed *in extenso* beneath the water of the sea. I am not aware that a structure of this kind has as yet been definitely proved to exist. It is true that A. Agassiz asserts that he not infrequently obtained, by means of the trawl or dredge, "large fragments of the modern limestone now in process of formation,"[1] but I do not precisely see how this limestone, "consisting of the dead carcasses" of species now living in the Gulf, would be differentiated from a limestone which had been placed in the same position through subsidence.

But granting the full value of the evidence favoring subsidence, the amount of subsidence itself is not sufficient to account for the existence of the deep water between Florida and Cuba, and still less for that between Cuba and Yucatan. Prof. J. W. Spencer, in a recent and very suggestive paper on "High Continental Elevation preceding the Pleistocene Period,"[2] has brought together a number of facts, drawn largely from the condition of the (supposed) ancient estuaries of several of the American rivers, which, in the opinion of the author, go far toward indicating a very considerable subsidence along the American coast, and it is well to inquire into the relation which this (assumed) subsidence may hold to the problem under consideration. The deep submarine channels (or what are taken for them) of the Mississippi, Delaware, Hudson and St. Lawrence Rivers, which cut into the 90–500 fathom curves, are taken in part as evidence of this submergence; on the Pacific side we

[1] "Three Cruises of the Blake," 1, p. 62.

[2] Bulletin Geol. Soc. America, 1, p. 65, *et seq.*

have the testimony of the deep submarine valleys which Prof. Davidson has described from the coast of California,[1] and the fjords and friths of Washington and British Columbia.[2] While it may not be admitted that all of the above deep cuts are really old channels, geologists are more generally agreed that the one which has been so minutely traced by Lindenkohl south of Long Island is the true channel of the Hudson River,[3] which terminates at about one hundred miles southeast of the present coast line, at a depth of 2800 feet beneath the level of the sea (or 2200 feet beneath the surface of the plain or plateau into which the trough is cut). It is wholly improbable that this channel could have been formed in the manner in which some geologists have attempted to explain the so-called cañon which continues westward the course of the Congo,[4] or that it is to-day being cut in the way that Hörnlimann found the rivers Rhine and Rhone cutting into the sublacustrine deposits of lakes Constance and Geneva respectively.[5] But if not thus formed, I do not see that we are necessarily driven to consider subsidence as the only possible explanation of the occurrence; indeed, there are certain difficulties in the way of the emergence-subsidence theory, especially those relating to time, which to me seem almost insurmountable. Prof. Dana suggests as the most likely time for the emergence of the land, which permitted of the cutting of the deep sea-ward channel, the close of the Jura-Trias period (followed by the subsidence which allowed ingress of the Cretaceous waters); Upham, on the other hand, would prefer some portion of the late Tertiary or Post-Pliocene.[6]

[1] Bull. Calif. Acad. Sciences, II, pp. 265–68; see also paper by Prof. LeConte "The Flora of the Coast Islands of California in Relation to Recent Changes of Physical Geography"—Bull. Calif. Acad. Sciences, II, pp. 515–20.

[2] G. M. Dawson: "Note on some of the more Recent Changes in Level of of the Coast of British Columbia and Adjacent Regions"—Canadian Naturalist, new ser., VIII, pp. 241–250.

[3] Dana, Am. Journ. Science, Dec., 1890.

[4] Buchanan, Scottish Geographical Magazine, III, p. 222, 1887.

[5] F. A. Forel. Comptes Rendus, CI, pp. 725–28, 1885. Forel assumes that the deep cutting in the case of the European rivers just mentioned is largely (or almost wholly) due to the fact that the waters of the rivers are considerably heavier than those of the lakes, and thus sink to the bottom, scouring there the surface; but this condition does not hold with the streams discharging into the sea, except in so far as the added weight of sediment will conduce toward sinkage.

[6] American Geologist, September, 1890.

It appears to me improbable that a channel dating back to the Lower Cretaceous period could have remained open to the present time; that a million, or possibly millions of years, should not have effaced the contours of a river cut in a region of heavy oceanic sedimentation is to me incredible. And the more improbable is the condition made, when we see how smoothly the subcontinental plateau has been worn or filled in on either side of the assumed channel. Perhaps less objection can be urged against the view of recent emergence (and subsequent subsidence) which is held by Mr. Upham; the nature of the proposition is, in itself, such that it cannot readily be met by the facts of geology. Mr. Upham bases his proposition upon the concurrent testimony of facts presented by the eastern, southern, western and northern waters,[1] and from these he argues that there has been a simultaneous elevation of the entire continent, and not merely one confined to a section of the northern regions. During this period of high elevation, which is made incident to the formation of the ice of the Great Ice Age, the cutting of the deep river-channels was effected. But it is almost inconceivable that such a general continental uplift could have taken place without materially disturbing the courses of the principal rivers; the barest tilting of the land would almost certainly have changed the course of such a low-plain river as the Mississippi, but the river discharges to-day almost in a line with the excavation which is supposed to represent its former mouth in the Gulf. The same holds true with the Hudson and the Lindenkohl channel. But again, the same difficulty, only intensified, confronts us if we assume localized or regional uplift; and, further, in the event of such uplift, we should look to a much greater deformation of the coast-line than now actually shows itself. Prof. Dana has called attention to one very serious objection to the theory of recent erosion in the form (in depth) of the Lindenkohl channel; the uneroded or even surface of the plateau into which this channel is sunk seems to be to one equally grave.

It must be admitted that many of the difficulties in the case disappear if, instead of an actual rise or emergence of the land, we assume an equivalent recession of the oceanic waters; indeed, the stability of river-courses appears to me a strong argument against the see-saw movements of which continental masses are supposed to partake, and one decidedly in favor of the view of oceanic transgres-

[1] Those principally which have been recited by Prof. Spencer.

sions and recessions which has been so ably formulated by Prof. Suess and the new school of German geologists. But the removal of a difficulty is not a proof of a proposition; and I do not know that there are any facts to indicate that there has been a comparatively recent recession of the oceanic waters, beyond the continental boundaries, to an extent of 3000 feet (vertical). On the contrary, the regular succession of the Tertiary deposits along the eastern and southern borders of the United States, completing the series near the extremity of the Floridian peninsula, and the regular gradation of the animal forms which are contained in this series, seem to me to point to an opposite conclusion.

But even if we admit all that the advocates of river-erosion claim for these submarine channels, I think it still remains an open question if all the phenomena are referable to a single cause. Similarity of physiographic feature is no necessary indication of equivalency in the time of formation or equivalency in method. The deep cut of the ancient Mississippi (or what is referred to as such by Spencer and Upham) occurs at about the 500 fathom curve, whereas that of the so-called Hudson River Channel marks the 80–100 fathom line. On the theory of river-erosion the formation of the Mississippi cut, if we once admit subsidence, need not have necessitated an elevation of the land of more than 1200 hundred feet—perhaps not that much—as against the 2200 required by the Hudson Channel. That the Mississippi cut was not formed at or about the close of the Jurassic period is practically proven by the coincident position of the present mouth of the river; it is all but inconceivable that a stream should find its way to an ancient mouth after 600 miles of its lower course (as is shown in the Cretaceous Mississippi embayment) had been obliterated by the encroaches of the sea. The objections to its having been formed at a recent period of great elevation have already been stated; the remarkable evenness of the Florida Plateau argues strongly against any recent upheaval of some 3–4000 feet.

I believe that the occurrences presented near the mouth of the Mississippi have little or nothing in common with those of the Hudson; they constitute a part of the physics of the Gulf of Mexico as distinguished from those of the North Atlantic. Suess[1] and Seebach[2] have forcibly sketched the relations of the West Indian Is-

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[1] Antlitz der Erde, I, p. 698, *et seq.*

[2] Central Amerika und der interoceanische Canal, 1873.

lands and of the mountain chain or chains which traverse the larger Antilles; the parallel drawn by the former between the Carribbean Basin and that of the Western Mediterranean,[1] apart from other evidence, leaves little doubt in my mind that it partakes largely of the structure of the latter—*i. e.*, it is a sunken area of the earth's crust, which has carried with it fragments of a once continuous or nearly continuous system of mountain elevations. Parts of this mountain system can still be seen in the chain of heights (reaching an elevation of 9,000 feet, or more,) which traverses Porto Rico, the islands of Hayti, Jamaica and southeastern Cuba, pointing to continuations in Honduras and Guatemala. The similarity of the rock-formations in these different islands (with those of St. Bartholomew, Antigua, etc.) points to a community of origin, if not necessarily to continuity, but we have, it appears to me, abundant evidence of continuity—extending as far as Florida on one side and to Central America and South America on the other—in the relationship of the existing molluscan fauna of these islands, as has been shown by Bland,[2] and in that of the extinct mammalian faunas, for the elaboration of which we are indebted to the labors of DeCastro, Cope, Pomel and Leidy.[3] The conformation of the sea-bottom, as the soundings of the " Blake" have made known to us, also indicates this connection. It is probable that the disruption or subsidence, or series of subsidences, which resulted in the existing condition of region did not set in until the close of the Miocene or beginning of the Pliocene period—perhaps not until still later—as the distribution of the extinct mammalian fauna shows. What the area of this subsidence may have been it is not easy to determine, but it with little doubt included the whole of the region of the Bahamas, and probably much more to the north. From considerations other than those that have been stated, Alexander Agassiz has arrived at the conclusion of a vast change of level in the subcontinental plateau lying east of the southeastern coast-line of the United States, for he inclines to the belief that this coast-line, opposite to what is known as the Blake Plateau, at one time extended seaward approximately to what is now the position of the 500-fathom line.

[1] *Op. cit.*, I, p. 708.

[2] Annals Lyceum Nat. Hist. New York, VII, pp. 335–61; X, pp. 311–24.

[3] DeCastro, *loc. cit.*; Cope, Proc. Acad. Nat. Sci. Phila., 1868, p. 313; Smithsonian Contributions, 1883 (1878); Leidy, "Mammalian Fauna of Dakota and Nebraska," 1869.

To quote the language of this distinguished investigator: "In other words, the old continental line extended at least two hundred and fifty to three hundred miles farther to the eastward, forming a huge plateau, the hundred-fathom line of which was found where the six-hundred-fathom line now runs, and stretched as far south as to include the Bahamas and Cuba in this great submarine plateau."[1] It is true that Agassiz recognizes in the lowering of the Blake Plateau—which he considers to be a special formation organically built up from the deep, and added to "the outer edge of the former continental plateau"[2]—no evidence of subsidence, but merely the wearing action or scour of the Gulf Stream, whose operations began at about the close of the Cretaceous period. But I can see no facts which support this double conclusion; on the contrary there are many—some of which have already been stated, and others which can be drawn from the physiography of the region lying to the south and southeast—which distinctly oppose it.[3] The character of the Cretaceous deposits pretty clearly indicates that at the time of their formation they were bounded by a deep sea, and that the Blake Plateau could not have been built up until a time much later. The fact that off the coasts of North and South Carolina "small rocky banks slightly raised above the general level of the sea-bottom" occur which seemingly represent "the continuation of the Tertiary beds found inland along the adjoining shores," and that the Gulf Stream for much of its course in this region sweeps over a bottom of "hard limestone"[4] also argues in favor of a late subsidence. Suess with more justice, it seems to me, argues that the base of

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[1] "Three Cruises of the Blake," I, p. 136.

[2] *Loc. cit.*

[3] I am not absolutely certain as regards Agassiz's explanation of Gulf Stream wear. While on pp. 137 and 138 the course of the stream is very definitely traced, from the close of the Cretaceous period, in a northeasterly direction across what is now the peninsula of Florida (or through the Straits of Florida) and the Blake Plateau, we find on page 113 that a similar stream, at about the same time (or even later?), may have swept "round the north end of the Bahamas across Florida, which did not then exist, across the Gulf of Mexico, and into the Pacific over the Isthmus of Tehuantepec."

[4] A. Agassiz. *Op. cit.* p. 277.

the Bahamas is a Miocene rock,[1] and for anything we now know to to the contrary, the reef-structures may be imposed upon a Pliocene formation.

While perhaps we have no positive knowledge in the premises, I think it more than probable, following Suess,[2] that the Gulf of Mexico represents a subsiding basin similar to the Caribbean Sea, and here again a parallel can be established with the eastern basin of the Mediterranean. The close approximation of the 500, 1000 and 1500 fathom lines off the western borders of the Florida and Yucatan plateaus seemingly points to such subsidence, and it suggests, as, indeed, Suess has already intimated, that the breakage actually took place through the Florida-Yucatan Plateau. That the Mexican waters already existed as far back as the Cretaceous period is abundantly proved by the Cretaceous deposits which extend throughout the Gulf area, but it would seem that the great depth which the basin now has was acquired at a comparatively recent geological period, much of it probably at a time when many of the larger Mammalia which now inhabit the land-surface had already been introduced, and long after the Mississippi discharged near to (or in advance[3] of) its present mouth. Perhaps the absence over the greater part of the Gulf area of the newer Tertiary deposits which occur elsewhere along the southern United States may be explained on the assumption of disappearance through subsidence; at any rate, their non-existence is a suggestive fact.

To what extent the assumed subsidence of the Gulf basin may have been connected with volcanic phenomena, or have been induced through sedimental accumulation, as Prof. Shaler suggests,[4] cannot, with our present knowledge, be determined; probably both forces have acted toward a common result.

Just as we look upon the Gulf and Caribbean basins as subsided areas, so may we regard the Yucatan and Florida Passages, and to

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[1] Antlitz der Erde, II, p. 161. On the island of Antigua the rock containing *Orbitoides* dips beneath the sea. Since the above was written, it has been shown that the Oligocene deposits (containing *Orbitoides*) of southeastern Florida extend down to a depth of at least 1200 feet; the data were obtained from a boring made at Lake Worth, east of Lake Okeechobee (Darton, in Am. Journ. Science, Feb. 1891).

[2] Antlitz der Erde, I, p. 365; II, p. 159.

[3] The position of the supposed ancient channel.

[4] The Topography of Florida, Bull. Mus. Comp. Zoology, XVI.

approximately the same period of time can we assign their formation. That actual movements have taken place in the region under consideration at a quite recent period is proved by the uplift of the Yucatan mountains,[1] which, as has already been stated, belong with little doubt to the Pliocene period.

[1] Prof. Shaler has suggested that possibly the Florida plateau has been in part squeezed up through the downfall of the Gulf basin. With a subsiding area on either side of it (repeated again in the case of the Yucatan plateau) this does not appear improbable, and perhaps the gentle axial fold of the peninsula is evidence of this compressional uplift.

MARCH 3.

Dr. GEO. H. HORN in the chair.

Twenty-two persons present.

MARCH 10.

The President, Dr. LEIDY, in the chair.

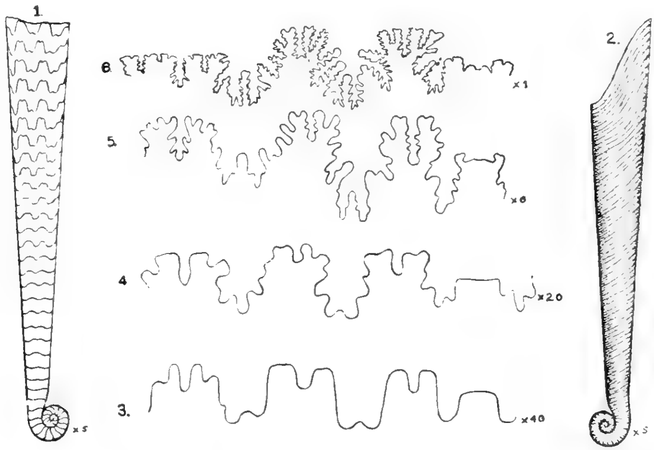
Twenty-six persons present.

Papers under the following titles were presented for publication :—

Fossil Faunas of Central Iowa. By Charles R. Keyes.

Notice of some Entozoa. By Joseph Leidy, M. D.

On the Young of Baculites compressus Say.—Mr. AMOS P. BROWN described the young of *Baculites compressus* Say, recently discovered by him in some cretaceous marl from the vicinity of Deadwood, South Dakota. Associated with them in the same material were several species of *Baculites, Scaphites* and *Inoceramus*. The young



Baculites were of the form shown in figures 1 and 2 and varied in length from 1 to 3 cm., with a diameter of 0·4 to 2 mm. Other larger fragments with the spiral end broken off were found from 1·5 to 6 cm. in diameter. An examination of the form of the septa and suture lines showed the forms to belong to the Ammonitidae, and by the examination of an extensive series it was possible to determine the genus and species.

The shell originates in a spiral of two to two and one-half turns, ranging in breadth from 0·8 to 1 mm., thence it extends in a straight line, tangent to the spiral, figure 1, or sometimes slightly reflexed, figure 2. The straight portion of the shell rapidly increases in diameter from 0·38 to 0·40 mm. at the spiral to about 1·5 to 2 mm. at 2 cm. length. Many shells were covered by the nacreous shell substance, some being preserved entire, figure 2, while in others the shell had been dissolved away leaving the suture lines exposed as in figure 1. On breaking away the pearly exterior of forms like figure 2 it was found that the last chamber occupied about one-half the length of the shell. The shell of the outer spires somewhat envelops the inner so that from the outside view the exact form of the spiral cannot be measured, it was found, however, to closely approximate the mathematical curve known as the hyperbolic spiral. That the spiral origin of this shell was not smaller than that of allied genera was demonstrated by grinding cross sections of the shell of *Scaphites Conradi* Morton; the first two turns of its spiral being 1 mm. in breadth. The siphon in *Baculites* is eccentric and was found to lie near the outer margin of the spiral, being easily seen in the fractured spirals.

The species was determined from an examination of the form of the sutures which may be traced from the simple form of that of figure 1, through forms of gradually increasing complexity shown in figures 3, 4, 5, and 6, the latter being the typical suture of the adult of *Baculites compressus* Say. In figure 5, an individual of 6 mm. diameter, the suture of the adult form is already well outlined, the specific distinction, the two deep sinuses on the right hand, being well marked.

The speaker further stated that he had been unable in the literature of the subject to find any reference to this spiral termination of *Baculites*, and believed the observation to be new. That this spiral termination has not been formerly observed was not strange in view of its small size and fragile character, it being probably broken off long before the shell had attained adult size; and it would only be preserved when as in the present instance the shells were preserved in their immature condition. This observation tends to prove that *Baculites* originated from a coiled form, and is not as supposed by some palaeontologists the original form of the *Ammonitidae*, but is rather to be looked upon as an uncoiled form developed from originally coiled parents.

MARCH 17.

MR. CHARLES MORRIS in the chair.

Twenty-six persons present.

A paper entitled "Catalogue of the Corvidae, Paradiseidae and Oriolidae in the Collection of the Academy of Natural Sciences of Philadelphia," by Witmer Stone, was presented for publication.

MARCH 24.

Dr. D. G. BRINTON in the chair.

Twenty persons present.

The death of S. S. Rathvon, a member, was announced.

The following communication was read:—

REPORT OF EXPERIMENTS NOW BEING PURSUED IN THE BACTERIOLOGICAL LABORATORY OF THE ACADEMY.

BY SAMUEL G. DIXON, M. D.

Experiments show that the twenty-fifth and the second growths of the tubercle bacillus will multiply with great rapidity when planted on a nutrient medium made up of:—

Extract of Beef	25.g
Aq: Dist:	700.cc
Dry peptone	8.g
Agar-agar	15.g
Chlor. Soda	5.g
Dist. Water (added.)	300.cc
Glycerine	100.00

The turbidity is removed by the slow mixing of the whites of two hens eggs.

If four distinct needle tracks are made with these bacilli lengthwise in a half-inch tube containing this medium, the entire surface will be covered with a thin layer of tuberculous growth within five weeks. The bacilli from the twenty-fifth culture present a variety of forms, some club-shaped, others branched, while many would appear to grow to a great length, certainly measuring in some instances three times that of the average tubercle bacillus described by the authorities on this organism.

To obtain the toxic substance of bacilli, they may be floated in a liquid medium. By this method we can filter out the toxic substance without submitting the medium to heat. With some of the toxic agents generated by aerobic micro-organisms, this method will prove of vital importance, as heat destroys many of the ptomaines.

The tuberculous poison is most readily and cheaply obtained from tuberculous lungs of cows and the viscera of other animals. Before giving a resume of the simple method of obtaining the toxic agent from the lungs, I wish to thank Dr. Francis Bridge, State Veterinary Inspector, for his kindness in furnishing the Laboratory with tuberculous material. It is owing to his courteous attention that I have never wanted for tuberculous lungs of cows since 1889. He has supplied the numerous demands at the shortest possible notice, and has insisted upon contributing his time and trouble for the benefit of science.

The tuberculous mass is first placed in a mortar and then finely chopped up with a pair of shears. Then it is thoroughly mashed with a pestle, and treated with water, or better still with water and glycerine, for twelve hours at a low temperature. It has been my habit, however, to expose it to a temperature of 40° C. for twelve hours longer; after which the substance is poured into a Chamberlain-Pasteur filtering tube, which it is permitted to slowly pass through without pressure.

Its effect on tuberculous animals would seem to be about as represented by the following reaction:—

Tuberculous Cow. Before inoculation temperature 101° F. 3 cc. of filtrate was subcutaneously injected at 10 a. m. At 5 p. m. temperature was 102°; at 10 p. m. 103°; at 12 p. m. $103\frac{4}{5}$°; at 10 a. m. $101\frac{3}{5}$°.

Guinea Pigs.[1] No. 3-A. At 11 a. m. the temperature was $101\frac{2}{5}$°; at 1 p. m. 101°; at 3 p. m. 101°. At 2.20 p. m. 1–20 cc. of tuberculous agent from lung was subcutaneously injected. At 5.45 the temperature was $101\frac{1}{5}$°; at 7 p. m. 102°; at 11 p. m. $101\frac{4}{5}$°; at 1.30 a. m. $101\frac{3}{5}$°; at 8 a. m. $101\frac{3}{5}$°; at 12.30 p. m. $100\frac{4}{5}$°; at 3 p. m. $101\frac{4}{5}$°.

No. 4-A. At 11 a. m. $101\frac{1}{5}$°; at 1 p. m. $101\frac{4}{5}$°; at 3 p. m. $101\frac{3}{5}$°: At this time 1–10 cc. toxic agent from lung of a cow subcutaneously injected.

At 5.45 p. m. temperature $102\frac{4}{5}$°; at 7 p. m. $103\frac{1}{5}$°; at 11 p. m. $102\frac{2}{5}$°; at 1.30 p. m. $101\frac{4}{5}$°; at 8 a. m. $101\frac{4}{5}$°; at 12.30 p. m. $102\frac{1}{5}$°; at 3 p. m. $101\frac{4}{5}$°.

In addition to my last report of investigations I have to refer to the treatment of tuberculosis by subcutaneous injections of dilute sulphuric acid and formic acid. Under each of these methods the animals would appear to be doing better than the check guinea pigs not so treated, yet sufficient time has not elapsed for me to make any post-mortems to determine the processes going on in the viscera. The points of inoculation, however, have healed beautifully and the animals would appear to be doing well. The experiments towards the securing of immunity are still being conducted and the

[1] Temperature in the Guinea pig is not constant; and therefore not as reliable for experimentation as either the cow or dog.

results certainly show that the animal organism can be cultivated to resist inoculations of the tubercle bacillus to a greater or less degree, as is shown by a copy of the record book in a few of the cases under treatment.

Rabbit D–100. Jan. 10th, 1891. Inoculated with a mass of twenty-fifth artificial cultivation of bovine tubercle bacillus.

Feb. 16th, 1891. Inoculated again from the same tube as in January.

Feb. 28th, 1891. Inoculated with a mass of second artificial cultivation of bovine tubercle bacilli.

At this time the animal presents a healthy appearance and the points of inoculation have healed up.

Rabbit D–101. Showed the same result as rabbit D–100

Without going into further detail, I will simply state that a number of guinea pigs have given like results; whereas the animals inoculated with a mass of the second cultivation of bovine tubercle bacilli, not having been previously inoculated with the attenuated virus, sickened with tuberculosis and in some instances died.

The last experiments confirm the fact that the tubercle bacillus does lose its virulence to a certain degree by cultivating it continuously on an artificial medium.

Dog C–1. Eight weeks old, weight 1½ lbs. Was inoculated with second artificial culture of bovine tubercle bacillus and died within ten days, of toxæmia.

Dog C–2. Same age and weight as C–1. Under the same treatment, also sickened with tuberculosis.

Dog C–3. Same age and weight as C–1. Was at the same time inoculated with twenty-fifth artificial culture of bovine tubercle bacillus. While the others sickened with tuberculosis, this one shows no outward manifestation of the malady.

In one of my recent communications, I referred to the fact that I had been injecting predigested fat plus antiseptics into the intestinal tract of animals suffering from tuberculosis with some success and also that I was subcutaneously introducing some of the bile salts. The results from the bile salts have not been at all constant; while the subcutaneous injection of glycerine into the tuberculous animals, which I recently referred to in a Medical Journal of this city, has apparently given a result which will stimulate work in this direction.

Two dogs eight weeks old had respectively a mass of the second cultivation of bovine tubercle bacilli subcutaneously introduced.

In seven days one was dead apparently from the toxic effect of the product of the bacilli.

The day that this dog died, the other presented a line of symptoms indicating toxæmia to a very marked degree. The animal was hardly able to stand and I had every reason to believe it was fast losing its vitality.

One-half cc. of pure glycerine, well diluted, was subcutaneously introduced. In a short time the animal showed physical improvement and in twelve hours it was restored to apparently a good condition. It would seem that the glycerine enabled the viscera to get rid of the toxic agent that otherwise would have passed into the general circulation.

March 31.

Mr. Charles Morris in the chair.

A paper entitled "On Paramelaconite and the associated Minerals," by Geo. A. Koenig was presented for publication.

The deaths of Wistar Morris, a member, and P. W. Sheafer, a correspondent, were announced.

George S. Morris, Lieut. R. E. Peary, U. S. N., William D. Robinson, M. D. and Edgar Strayer, M. D. were elected members.

The following were ordered to be printed:—

ON SOME RECENT JAPANESE BRACHIOPODA, WITH A DESCRIPTION OF A SPECIES BELIEVED TO BE NEW.

BY W. H. DALL AND H. A. PILSBRY.

The collection of Brachiopoda described in the following pages was made by Mr. Frederick Stearns of Detroit, Michigan, when travelling in Japan during the years 1889–90. The specimens were dredged in depths not exceeding thirty fathoms, at localities along the eastern coast southward from Tokyo to Kii Channel and in the Inland Sea as far south as Jojo-sima.

The specimens are in the collections of the Academy of Natural Sciences of Philadelphia and of Mr. Stearns.

Genus **TEREBRATULA** Auct.

Terebratula (**Davidsoni** var ?) **Stearnsii**, Dall and Pilsbry, Plate IV, figs. 1–3.

Shell large, waxen white or yellowish, smooth except for lines of growth, somewhat wedge-shaped, laterally compressed behind, wider in front, valves moderately inflated, larger or neural valve subtriangular in outline, deep, the sides flattened, straight, diverging, the front margin evenly rounded; viewed laterally the profile of the line (the hæmal valve being downward) between the two valves rises slightly to a weak flexure in front of the hinge plate and then descends forming a long curve, rising to a more marked flexure almost an angle, where the sides meet the front margin; between the two anterior angles the anterior margin of the neural valve is moderately convex downward while the hæmal valve, subangulate at the corners, is correspondingly excavated between them; the middle portion of the neural valve is slightly flattened as in *Eudesia Raphaelis*, the beak is prominent, high and inflated, the foramen large, circular and (in the specimen) much worn, the lower part projects curving downward to a point, but does not touch the hæmal valve when the shell is closed; deltidial area narrow, with no mesial groove, bordered by a sharp angle and concavely excavated. The hæmal or smaller valve is less flattened and shallower than the other. the apex is entirely concealed under the curved beak of the opposite valve; internally the cardinal process is rounded, the hinge short and rather weak, unsupported by any buttresses; there is no mesial septum in either valve; the partial sinuses are barely distinguishable, there seems to have been five in the neural and four in hæmal valve, narrow, slender, extending straight forward and beginning to dichotomize only near the front margin. The loop resembles somewhat that of *T. depressa* Lam , and is especially notable for the breadth of the lamina and the keeled mesial ridge of the anterior transverse portion ; this part is usually more rounded-over in *Terebratula.*

Long. of neural valve 48·5 ; max. lat. of the same 33·0 ; max. diameter of shell 28·0 mm.

Habitat, eastern coast of Japan, Province of Kii.

This shell recalls some varieties of *T. depressa* Lamarck from the Greensand of Britain. As the specimen is unique, it was not thought best to separate the valves to study the loop but sufficient could be seen from the natural opening to determine that the species belongs rather to the *T. vitrea* type than to that of *T. sphenoidea.* From both and from any other species known, it differs in the prominence and narrowness of the mesial bend or fold in the transverse anterior part of the loop.

There is no species known from Japan or the Pacific which could be identified with this one unless it be the *Terebratula Davidsoni* A. Adams, which is treated by Dr. Davidson in his last publication (Trans. Linn. Soc., Zoology, 2nd Ser. part 1, p. 9, Pl. 1, figs. 14–16, 1886) under the head of *Liothyris vitrea* var? *Davidsoni* but which can hardly be regarded as varietally connected with *T. vitrea.*

T. Davidsoni is only known from two small specimens dredged in 55 fathoms at Satanomosaki, Japan, by A. Adams. Dr. Davidson says "I am not certain that this small species is really a variety of *T. vitrea,* * * * they much resemble the typical var. *minor.* One of the specimens bore some resemblance to young examples of *Liothyris uva* from the Gulf of Tehuantepec ; but differs from it, according to A. Adams, in its more solid structure and globose form and in the foramen being smaller and entire" (op. cit. p. 10). From the figures and observations which have been published, it would seem highly probable that *T. Davidsoni* is an adult shell measuring about 18·0 mm. in length while the young of *T. Stearnsii,* as indicated by the lines of growth, is a more circular shell in outline and less evenly globose. The specimen figured shows no indication of compression or distortion and the wedge-like outline of the adult seems normal. If this conclusion is correct and this peculiarity be constant, the species will be well characterized by it. We are of the opinion that the species is distinct from *T. Davidsoni,* but leave the question open until more material shall be available. We have dedicated the new species to Mr. Stearns from whom it was received. With regard to its relations to *T. uva*, it may be observed that specimens of *T. uva* in the National Museum from Guayaquil, have an entire foramen, as figured by Dr. Davidson, as does the original type specimen, so that the implication of A. Adams is not sustained by the facts. But *T. uva* is readily distinguished from any other species by the fact that it is finely obsoletely radiated all over, with rather sparse radii, situated much as in *T. subquadrata* Jeffreys, but less sharp and wider. To a casual inspection the shell appears smooth, but a careful examination reveals the sculpture. *T. Stearnsii* is destitute of such radii. The relative size of the foramen in *Terebratula*, of course, is a character of no importance. Its margins are always eroded and its size depends entirely on the amount of friction to which it has been subjected during life. Specimens of *L. vitrea* from still, deep water, which were attached only to very small branches of decorticated Gorgonians, have an extremely minute foramen; while specimens from more agitated waters, attached to rock or coral surfaces, have quite a large pedicle and foramen.

Genus **TEREBRATULINA** Orbigny.

Terebratulina Crossei Davidson.

Terebratulina Crossei Davidson, Journ. de Conchyl. XXX, p. 106, pl. VII, fig. 1, 1882; Trans. Linn. Soc. 2, Zool. IV, p. 33, pl. III, figs. 4–6, 1886.

Two specimens of this fine species were included in the series sent by Mr. Stearns. They were attached to a large fragment of a silicious sponge. Habitat, "Inland sea," south of Province Kii.

Genus **TEREBRATELLA** Orbigny.

Owing to the peculiar development through which the loop passes before reaching the adult condition it is quite certain that *Eudesia* (or *Waldheimia* of most authors) belongs in the subfamily containing *Terebratella* and *Megerlia* rather than that to which *Terebratula* proper and *Terebratulina*, may be referred.

Terebratella Gouldii Dall. Plate IV, figs. 4–5.

Magasella Gouldii Dall, P. Z. S. 1871, p. 307, pl. XXXI, fig. 11a–c. Davidson, op. cit., p. 96, pl. XVII, figs. 20–22, 1887. (*Magasella Stage.*)

Shell waxen white, more or less stained with extraneous dark brown or black matter, large, thin; evenly radiately sculptured with uniform equal delicate costæ separated by very distinct but not very deep interspaces of about equal width; the costæ begin to dichotomize about the middle of the shell and maintain a remarkably uniform size over the whole surface but do not crenulate the adult margin; there are about 13 costæ to a centimeter of width; valves wider behind the middle, hæmal valve with a very faint concave medial flexure or concavity (possibly due to an injury in youth) marked on the anterior margin by an obscure wave at each side and, on the neural or larger valve, by an analogous eminence or reverse flexure; the anterior margin otherwise is rather evenly rounded; hæmal valve flattish, in the type specimen with some indentations near the beak which show that its growth was cramped when young by projections of the stone to which it was attached or some other agency; beak of the hæmal valve not prominent; cardinal process obscure, concave medially; cardinal margin extensive nearly straight; neural valve more convex, beak not very prominent, con-considerably eroded; lateral areas flattened, foramen incomplete, the grooves marking off the pseudo-deltidia on each side very oblique obscure and close to the edge of the hiatus; interior with the pallial sinuses large, one on each side and arborescent but obscure on account of the condition of the specimen; neural valve with a short obscure thickened septal line mesially; hæmal valve with a well-elevated, subtriangular, rather short septum to which the lower portion of the loop is attached on each side by a slender process; loop very slender throughout, the transverse processes situated very near the crura which are rather strong; the anterior part of the loop reaching within a centimeter of the anterior margin before recurving, the recurved portion very narrow and delicate; the hinge is laterally well extended but feeble. Max. lat. 42·0; long. of neural valve 37·0; diameter of shell 20·0 mm.

Habitat, eastern coast of Japan, between Yeddo and Oshima.

It is now well understood, through the researches of Mr. Herman Friele and subsequently of Dr. Davidson and others, that the stages of development having their permanent representatives in the genera *Magasella*, *Terebratella* and *Waldheimia* are successively exhibited in the development of the last mentioned, while *Terebratella* stops short with the second stage. Consequently, when a small species of *Magasella* is discovered, it may be taken for granted that a large species of one of the three above mentioned genera exists in the vicinity, and it is impossible to say which, unless the series is traced. Usually the large adult form has been found first, and, when two names have been applied to the stages, that of the *Magasella*, or smallest stage, is generally the one which falls into synonymy. Many of the latter were named and properly discriminated before the connection between them was understood, though the remarkable parallel between them was pointed out in detail in these Proceedings in 1873. One such case was that of two *Magasellæ* described by Mr. Dall and the late Dr. Davidson, respectively, in the paper on Japanese brachiopods published by the latter in 1871. Mr. Dall has since been able, by the examination of a graded series, to trace the adult of *Magasella Adamsi* Davidson to *Eudesia Grayi* Davidson. The *M. Adamsi* differed from the *M. Gouldii* Dall in its coarser radii, in having its mesial flexure in the opposite direction and by its less transverse form. The long sought for adult of *M. Adamsi* is at last supplied by the present species, which in spite of the difference in size, differs from the adult *Eudesia Grayi* in much the same way. The character of the sculpture and the direction of the flexure being quite the same, as well as the transverse form, there can be no reasonable doubt that the two are thus genetically connected. The direction of the flexure, which at best is very feeble in the normal adult *E. Grayi*, may change in growth or become asymmetrical, so that the slight concavity is in the smaller valve, but this is not the case in the *Magasella* stage, and in fact is only evident in the variety *transversa* Davidson.

The transverse processes of the present specimen are represented only by small remnants attached to the loop near the crura and to the short septum. Still the size of the specimen is so large that this deficiency is probably to be attributed to accident or injury, rather than an indication that *T. Gouldii* progresses to the *Eudesia* stage and is, in its final adult form, a *Eudesia*.

The transverse form of the shell favors the opinion that it does not develop beyond the *Terebratella* stage, the dimensions of the specimen also point toward its being adult, since no instance is known of a subordinate stage of any brachiopod reaching more than one quarter this size before the transformation of the loop becomes complete.

This fine and remarkable species is distinctively characterized by its fine and uniform sculpture. It most resembles *T. cruenta*, of New Zealand, which is bright red, a much coarser and heavier shell, with a complete foramen and much more prominent beak. They cannot be confounded by any one who carefully inspects them. The nearest Japanese resemblance is offered by *Eudesia Grayi* which is even coarser than *T. cruenta* so that there seems no reason, even in the absence of the loop, why they should not readily be distinguished.

The following stages are now known in Pacific brachiopods, an asterisk indicating the adult stage :—

MAGASELLA.		TEREBRATELLA.		EUDESIA.
M. Aleutica Dall,	=	*T. frontalis* Midd.*		
M. Adamsi Dav.,	=	*T.*	=	*E. Grayi* Dav.*
M. lævis Dall,	=	*T. pulvinata* Gld.,	=	*E. venosa* Sol.*
M. Gouldii Dall,	=	*T. Gouldii* Dall.*		
M.	=	*T. Coreanica* Reeve,*		
M. radiata Dall,	=	? *T. transversa* Sby.*		
M. Patagonica Gld.	=	*T. dorsata* Gmel.*		
M.	=	(*Megerlia*) *Jeffreysi Dall*	=	(*Laqueus*) *Californicus** Koch.

Subgenus **LAQUEUS** Dall.

Terebratella (Laqueus) Blanfordi Dunker.

Terebratula Blanfordi Dkr., Ind. Moll. Mar. Jap., p. 251, pl. XIV, figs. 4–6, 1882.
Terebratella Blanfordi Davidson, op. cit., p. 83, pl. XV, figs. 9–12, 1887.

Two specimens of this fine species are included in the lot sent. They show that this species instead of being a typical *Terebratella* is a *Laqueus* and the one of all the species of this North Pacific group which shows the peculiarly complicated loop in its finest development and strength. These also show that, in life, the pallial sinuses are red in color, broad and branched, somewhat as in *Eudesia venosa*, a fact which has not hitherto been noticed. The specimens are from the eastern coast.

Laqueus rubellus G. B. Sowerby.

Terebratula rubella Sowb., Proc. Zool. Soc. Lond. 1846, p. 94.
Laqueus rubellus Davidson, op. cit., p. 113, pl. XIX, figs. 1–5.

Numerous specimens of this beautiful species were collected along the coast at and near Joja Shima. Some of them are quite as brilliantly striped as the figures in Sowerby's Thesaurus, which Davidson seems to think exaggerated.

Genus **EUDESIA** King.

Waldheimia King, Perm. Foss., p. 81, 1850; not of Brullé, Hist. Nat. Ins. Hymenopt. IV, p. 665, Nov., 1846; (Hymenoptera.)
Eudesia King, Perm. Foss., p. 144, 1850; Dall, Index Names of Brach. Bull. U. S. Nat. Mus. VIII, p. 28, 1877.

Eudesia Raphaelis Dall.

Waldheimia Raphaelis Dall. Am. Journ. Conch. VI, p. 3, pl, VII, figs. a–d, 1870. Davidson, op. cit., p. 58, pl. XI, figs. 11–13, 1887.

Japanese coast near Yeddo, Pumpelly. Sagami Bay, 100–200 fathoms, Döderlein.

A single specimen somewhat smaller and more wedge-shaped than the original type, and with stronger folds, was included in the lot sent.

This shows the deep brown color to be a constant character and confirms the opinion of the writers and the late Dr. Davidson as to the validity of this species, which had been referred to *E. septigera* by Dr. Jeffreys.

NOTES ON SOME RECENT BRACHIOPODS.

BY WM. H. DALL.

Terebratella transversa Sowerby. Plate IV, figs. 8, 9.

T. transversa Sowerby, P. Z. S. 1846, p. 94. Dall, Proc. Acad. Nat. Sci. Phila., 1873, p. 185. Davidson, Linn. Soc. Trans. iv, p. 78, 1887 (partly).
T. caurina Gould, Proc. Bost. Soc. Nat. Hist. III, p. 347, 1850.

Habitat, the Oregonian province, including the southern part of Alaska and thence southward to San Pedro, California, low water to 100 fathoms.

I include this species because it is to some extent mixed up with the history of *Eudesia Grayi* and the present seems a good time to clear up the confusion.

Eudesia (or *Waldheimia*) *Grayi* is a well characterized Japanese species somewhat resembling the rounder sculptured forms of *T. transversa* but with a different loop and hardly any mesial flexure. It had been erroneously reported from Catalina Island, California and an examination of the specimens so named showed that they belong to the genus *Terebratella* and I named them accordingly *Terebratella occidentalis.* The Californian shell is quite rare and, fifteen years afterwards, having found that *T. transversa* is occasionally marked with crimson, I began to suspect that my *occidentalis* was merely a brighter colored, more sharply sculptured southern race of *transversa.* The types of *occidentalis* being inaccessible, I had no means of deciding in regard to this suspicion which was communicated to the late Dr. Thos. Davidson with the result that certain varieties of *transversa* were (as it now appears wrongly) identified and figured as my *occidentalis.* In the last publication of Dr. Davidson (Trans. Linn. Soc. 2, Zool. IV, pl. 16) figs. 14 and 14a represent a variety of *T. transversa* but not *T. occidentalis* as there supposed. Figure 13 is a reproduction of my original, rather obscure figure of *occidentalis.* The reception of a fine specimen of *occidentalis* collected by the U. S. Fish Com. Str. Albatross and an opportunity of inspecting my original types now in the museum of the State University at Berkeley, California, has shown that the two forms are perfectly distinct and *T. occidentalis* is therefore to be reinstated in its independence.

T. transversa has two principal varieties, a nearly smooth and somewhat rounded form, which might retain in a varietal sense the original name, since it has been so applied by Davidson (op. cit. pl. 16); while the other is still more transverse, strongly sculptured, and for which Davidson has retained Gould's name of *caurina*. The latter form is more commonly found near shore and even just below low water of extreme spring tides. In deep, quieter water it grows to a much larger size and is smoother; in one collected by Prof. O. B. Johnson of Seattle, State of Washington, in the deep water off Port Orchard, Puget Sound, the neural valve measures 50 mm. high and 58 mm. wide, while the two closed valves have a diameter of 31·0 mm. This places the species among the largest living brachiopods and certainly the largest living *Terebratella* as far as known. In specimens from south of San Francisco the livid pink of the northern form is frequently replaced by a vivid crimson.

Terebratella occidentalis Dall. Plate IV, figs. 6, 7.

Terebratella occidentalis Dall, Proc. Cal. Acad. Sci., IV, p. 182, pl. 1, fig. 7, 1871. Proc. Acad. Nat. Sci. Phil., 1873, p. 184.

Terebratella transversa Davidson, in part, not of Sowerby.

Monterey and Santa Barbara Islands, California, Dall, Cooper, etc.

A fine specimen dredged off San Clemente Island, California, by the U. S. Fish Commission Steamer Albatross, shows that this species is distinguished from *T. transversa* Sowerby and all others by the fact that its strong mesial fold is convex in the smaller or hæmal valve instead of concave; in the smaller number and more angular character of its radiating ribs; and from northern *T. transversa* in being pure white, painted with crimson, instead of gray or orange ferruginous; though in the matter of color the southern specimens of *transversa* are like *occidentalis*.

Eudesia (venosa Sol. var. ?) **lenticularis** Deshayes.

Waldheimia lenticularis (Desh., 1839), Davidson, op. cit. p. 52, pl. IX, figs. 2–13, 1886.

Terebratula pulvinata Gould, Proc. Bost. Soc. Nat. Hist., III, p. 347, 1850.

Terebratella pulvinata Carpenter, Dall, *et. al.*, Davidson, op. cit. p. 90, pl. XVI, fig. 15, 1887.

Habitat, New Zealand, Hutton, Dr. Kershner, U. S. N.; Patagonia, U. S. Expedition under Wilkes, also U. S. Fish Commission Steamer Albatross, at Stations 2778 and 2779 in Magellan Strait at a depth of 60–80 fathoms. Not "Puget Sound" as originally stated by Gould, from erroneous labels of the Wilkes Expedition.

Æ. lenticularis is not well distinguished from varieties of *E. venosa* and is, probably, in its typical form a local race, representing for New Zealand the Patagonian *venosa*. Strictly intermediate specimens are in the U. S. National Museum from the Straits of Magellan. I showed a good many years ago that the Puget Sound locality was an error and that Gould's specimen almost certainly came from Orange Harbor, Patagonia. The figures given by Davidson from New Zealand specimens of the stages through which *Eudesia lenticularis* passes, before assuming its normal adult loop, show conclusively that Gould's *Terebratula pulvinata* is the *Terebratella* stage of the adolescent *Eudesia lenticularis* or the *E. venosa* from which the former is doubtfully distinct.

Dr. Davidson has suggested that it might be a smooth *Terebratella dorsata* (op. cit. p. 91) but his first supposition that it was an immature *Eudesia venosa* was much nearer the mark. It has nothing of the aspect or texture of *T. dorsata*, and, had the specimens actually been examined by him, I think he would never have entertained that idea. A second specimen agreeing with Gould's type was found attached to an *E. venosa* collected at Orange Harbor.

Genus **MEGERLIA** King.

Megerlia monstruosa Scacchi.

Terebratula monstruosa Scacchi, Osserv. Zool. 2, p. 8, 1833.
Morrisia gigantea Deshayes, Moll. Isle Bourbon, p. 37, pl. 32, figs. 9–10, 1863.
Megerlia truncata Linné, var. *monstruosa* Davidson, op. cit. p. 108, pl. XIX, figs. 21–22a, 1887.
Megerlia disparilis Dall (name only) U. S. Nat. Mus. Bull. No. 37, p. 28, No. 8, 1889.

Habitat, Mediterranean, 15–229 fms. also the Atlantic in deep water; Isle of Bourbon, near Mauritius, Maillard; Barbados, on dead coral from 100 fathoms, U. S. Fish Commission.

The young shell referred to, which was obtained at Barbados some years ago, presents some characters which greater age would have obscured; the foramen, as in *Platidia*, occupies normally part of both valves, and its margins, slightly prolonged do not show any evidence of distortion, erosion or disease. The larger or neural valve is covered with spongy tubercles arranged approximately on the incremental lines but more or less irregular. The smaller or neural valve is much smoother, and at this age marked only with incremental lines. Neither valve shows any radiating ribs such as are so strongly marked on the beaks of the average *M. truncata*. It is well known to dredgers how abundant *M. truncata* is where it occurs living at all. A moderately large cobble, overgrown with coral or corallines will sometimes afford forty or fifty specimens. Now there seems no reason to doubt the assigned habitat of Maillard's specimen, and that from Barbados is beyond dispute. Consequently we have (if we persist in regarding *M. monstruosa* as a monstrous form of *M. truncata*) the anomaly of a monstrous variety of a brachiopod being found in widely separated parts of the world unaccompanied by the normal form.

This I do not believe. For some time I have regarded the *M. monstruosa* as probably a distinct species. Dr. Davidson also had strong suspicions of its distinctness; refused to consider it as a mere monstrosity, but, with characteristic caution, placed it in his last work as a "variety" of *M. truncata.* I regard the discovery of this *Megerlia* in the West Indies as conclusive evidence of its specific independence of *M. truncata* beside being an interesting addition to the fauna of the Americas.

Explanation of Plate IV.

1. *Terebratula Stearnsii* Dall and Pilsbry; 48·5.
2. *Terebratula Stearnsii*, front view; 33·0.
3. *Terebratula Stearnsii*, side view; 48·5.
4. *Terebratella Gouldii* Dall; 42·0.
5. *Terebratella Gouldii*, side view; 37·0.
6. *Terebratella occidentalis* Dall, view of rather aged specimen; 31·0.
7. *Terebratella occidentalis*, same specimen from in front; 31·0.
8. *Terebratella transversa* Sowerby, young specimen of same size as the preceding for comparison of sculpture and flexure; 36·5.
9. The same, front view; 36·5.

The numerals indicate the actual length in millimeters of the longest diameter of the figure referred to, measured on the specimen figured when placed in the position represented.

CRUSTACEA FROM THE NORTHERN COAST OF YUCATAN, THE HARBOR OF VERA CRUZ, THE WEST COAST OF FLORIDA AND THE BERMUDA ISLANDS.

BY J. E. IVES.

The Crustacea treated of in this paper were collected for the greater part on the northern coast of Yucatan and in the harbor of Vera Cruz, during the early months of 1890 by the Expedition in charge of Professor Angelo Heilprin, sent by the Academy of Natural Sciences of Philadelphia to investigate the Natural History of Yucatan and Mexico. The writer, who was a member of the Expedition, is indebted to Professor Heilprin for the opportunity of working up this portion of the collection.

The paper also includes a list of the Crustacea collected upon the west coast of Florida in the spring of 1886 by Professor Heilprin and Mr. Joseph Willcox under the auspices of the Wagner Free Institute of Science of Philadelphia,[1] and the description of a new Isopod, collected by the Academy's Expedition to the Bermuda Islands in 1888.

It is remarkable that the shores of Yucatan and Mexico, portions of the American Continent among the first to be discovered by Europeans, should be among the last to have their zoology investigated. Nothing whatever, with one or two isolated exceptions, has been known hitherto of the fauna of the shores of Yucatan, and very little of that of the eastern coast of Mexico.

The material collected by the Expedition has added considerably to the knowledge of this region. The carcinological results may be briefly summarized as follows.

Five new species and one new variety are described and figured: a species described by Say from the coast of New Jersey and two described by Dana from Rio Janeiro, and not referred to since their original description, have been redescribed and one of them figured: other little known and unfigured species have been figured; and some interesting conclusions have been arrived at in regard to the synonymy of some of the species, and the geographical distribution of the crustacea of the Caribbean region.

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[1] See Professor Heilprin's Report "Explorations on the west coast of Florida and in the Okeechobee Wilderness," Trans. Wagner Free Institute of Science, vol. 1, 1887.

In reference to the character of the coasts upon which the specimens were collected in Yucatan and Mexico, the following paragraphs are quoted from the author's report upon the Echinoderms collected by the Expedition.[1]

"The northern coast of Yucatan possesses a sandy beach largely made up of shell fragments. The water, off the coast, is very shallow, the 10 fathom line being 20 miles from the shore, and the 100 fathom line about 150 miles. Three miles off the shore, in the neighborhood of Progreso, the bottom is of a sandy character, although a few small corals were brought up in the dredge. Along the shore to the westward of Progreso is a small Serpuloid reef. Large quantities of sea-weed and sponges are thrown upon the beach and lie decomposing in the sun. These and numerous water-worn specimens of *Orbicella annularis* and a large Escharine species of Bryozoan, with some specimens of *Xiphogorgia anceps*, indicate the existence of a region rich in animal and vegetable life not very far from the shore."

The harbor of Vera Cruz is an area of luxuriant coral growth, madrepores and brain corals being especially abundant.

The specimens from the west coast of Florida were collected in the shallow waters of that region from Cedar Keys to the Caloosahatchie River. The shore line consists of sandy or shelly beaches and mud flats. The 10 and 100 fathom lines are about the same distance from the coast as in the case of northern Yucatan.

While engaged in working upon the Brachyura discussed in the following pages, the author came to the conclusion that it would be advantageous to carcinologists to have a special term for the four posterior pairs of appendages of crabs, now known as the "ambulatory legs." The term *cruriped*,[2] a word of similar construction to *cheliped*, has therefore been introduced. It was found that confusion often arose in the use of the term legs, it being used indiscriminately either for the four posterior pairs of appendages alone, or for all five pairs. The term "ambulatory leg" used by Mr. Miers and others is cumbersome, and may be well replaced by *cruriped*. In the following pages, therefore, the term *chelipeds* is used for the anterior pair of appendages of Brachyura, *cruripeds* for the four posterior pairs of appendages and *legs* when speaking of all five pairs.

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[1] Proc. Acad. Nat. Sci. Phila., 1890, pp. 317, 318.

[2] *Crur* leg, *ped* foot.

The species enumerated and described below are arranged under the localities in which they were collected. The systematic portion of the paper is followed by some considerations in regard to their geographical distribution and a chronological list of the general literature of the higher crustacea of the West Indian region which it is believed will be of use to future students of these shores.

YUCATAN.

DECAPODA.

Pericera trispinosa.

Pisa trispinosa, Latreille, Encyclopédie t. x, p. 142.
Pericera trispinosa, A. Milne-Edwards, Crust. Mis. Sci. Mex. p. 52, pl. 15, fig. 2.

A single specimen, dredged in shallow water off Progreso. The postero-lateral spines are much broader than in Guerin's[1] figure of this species. The specimen closely resembles the figure given by A. Milne-Edwards. Specimens in the collection of this Academy from Cuba and the Tortugas closely resemble the specimen collected. The living crab was of a bright scarlet color.

Microphrys bicornutus.

Pisa bicornutus, Latreille, Encyclopédie. t. x, p. 141.
Microphys bicornutus, A. Milne-Edwards, Crust. Miss. Sci. Mex. p. 61, pl. xiv, figs. 2–4.

A young individual, dredged in 20 ft. of water off Progreso.

Libinia dubia.

Milne-Edwards, Hist. nat. Crust. Vol. I, p. 300, pl. xiv *bis.*, fig. 2.

A dead specimen collected upon the beach at the Port of Silam.

Panopeus Herbstii.

Milne-Edwards, Hist nat. Crust. t. I, p. 403.
A. Milne-Edwards, Crust. Miss. Sci. Mex. p. 308, pl. LVII, fig, 2.

Two young males from the Port of Silam.

Pilumnus aculeatus.

Say, Jour. Acad. Nat. Sci. Phila (1) Vol. I, p. 449.
A. Milne-Edwards, Crust. Miss. Sci. Mex. p. 282, pl. L, fig. 1.

Three specimens dredged in 20 feet of water off Progreso.

Menippe mercenaria.

Say, Jour. Acad. Nat. Sci. Phila. (1) Vol. I, p. 448.

A young specimen from the Port of Silam.

[1] Iconographie du Règne animal de G. Cuvier, Crust. pl. 8, fig. 3.

Eucratopsis crassimanus.

Dana, U. S. Explor. Exped. Vol. XIII, Crust. p. 311, pl. 19, fig. 2a-d.
S. I. Smith Trans. Conn. Acad. Vol. II, p. 35.

A female of this interesting species was obtained at the Port of Silam. Professor Dana described the species from a specimen obtained by the Wilkes Exploring Expedition, probably at Rio Janeiro. It has not since been recorded from any locality and its rediscovery upon the coast of Yucatan is of much interest. A broad distribution is thus indicated.

Ocypoda arenaria.

Ocypode arenarius Say, Journ. Acad. Nat. Sci. Phila. (1), Vol. I, p. 69.
Ocypoda rhombea Dana, U. S. Explor. Exped. Crust. p. 322, pl. XIX, fig. 8.

A dried specimen collected upon the beach at Progreso.

Gelasimus speciosus, n. sp. Pl. V, figs. 6 and 7.

Four fiddler-crabs were collected at the Port of Silam which apparently represent an undescribed species.

They consist of three males and one female, and agree well in their character.

The species may be described as follows.

Rostrum broad between the orbits. Male abdomen seven-jointed. Carapace smooth, moderately elevated; posterior edge, between the posterior pair of cruripeds, three-fifths of the length of the anterior edge; antero-posterior diameter about two-thirds of the length of the anterior edge. Margin of the meros of the larger cheliped minutely denticulate, inner flat surface smooth, outer convex surface with scattered transverse rows of minute tubercles. Carpus, inner surface smooth, outer surface minutely tubercled. Manus long and slender. In a specimen fifteen mm. wide between the antero-lateral angels of the carapace, the manus is thirty-one mm. long to the tip of the dactylus, and nine mm. wide across the broadest portion of the palm. The length of the palm is rather less than two-fifths, and its breadth rather less than three-tenths, of the entire length of the hand. The fingers are long and slender, the pollex is perfectly straight, and the dactylus is narrow at its base between the superior and prehensile borders, rather longer than the pollex, little arcuate and gently curved toward the tip. Palm minutely granulated on the outer surface, on the inner surface with a row of tubercles running upwards and backwards from the lower margin to the carpal groove, and continued upwards and forwards from the carpal groove towards the upper margin. Proximal portion of the palm behind this groove minutely granulated, distal portion smooth. Pollex and dactylus smooth, with three rows of minute tubercles upon their prehensile margins, tubercles of the outer and inner rows very minute and closely approximated, those of the middle row slightly larger, of irregular size and not closely approximated, the five at the base of the dactylus being most prominent and increasing in size from the base outwards; one or more tubercles nearly as prominent as these latter, in each of the fingers near their middle. The inner row of the tubercles upon the pollex continued upwards and slightly backwards upon the palm nearly to its upper margin. A slight ridge of tubercles in front of it at the base of the dactylus. The ridge forming the upper border of the carpal groove minutely denticulated and its anterior end not continued downwards and forwards upon the palm.

This form is closely allied to *Gelasimus vocator* as characterized by Professor Kingsley.[1] It differs from it principally in the length and shape of the larger cheliped. In *Gelasimus speciosus*, the larger cheliped is about twice the length of that of *Gelasimus vocator*. The fingers are longer and more slender, the dactylus is less arcuate, the granulation upon the outer surface of the palm is finer and the ridge forming the upper border of the carpal groove is not continued forwards and downwards upon the palm but is terminated by a slight groove separating it from the upward and forward extension of the tubercular ridge of the lower portion of the inner surface of the palm. The sides of the carapace are also rounded and less angular than in *Gelasimus vocator*. In the long and slender character of the fingers it approximates *Gelasimus stenodactylus*, but is distinguished from this species by the fact that the fourth, fifth and sixth segments are distinct from each other and not anchylosed into one piece.

The following species have been described since the monograph of the genus by Professor Kingsley.[2]

G. Thomsoni, Kirk. Trans. New Zealand Inst. vol. XIII, p. 236, 1880, Wellington. New Zealand.

G. Huttoni, Filhol, Mission de l'IleCampbell, Rec. Vénus, III, pt. 2, (Crustacea).

G. Cimatodus, Rochebrune, Bull. Soc. Philomat., Paris; (7) t. VII, p. 171, 1882-1883, Senegambia.

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[1] Proc. Acad. Nat. Sci., Phila., 1880, p. 147, pl. X, fig. 20.

[2] Loc ut. pp. 135-155.

Pachygrapsus gracilis.

De Saussure, Mem. Soc. Hist. Nat. Genève, t. XIV, p. 443, pl. II, figs. 15 and 15a, c.

A male collected at the Port of Silam.

Sesarma cinerea.

Grapsus cinereus, Bosc. Hist. Nat. Crust. vol. I, p. 258, pl. V, fig. 1; Say, Jour. Acad. Nat. Sci., Phila., (1) vol. I, p. 442; (non *Grapsus cinereus*, op. cit. p. 99.)

Two males and two females, collected at the Port of Silam.

Hippa emerita.

Cancer emeritus, L., Syst. Nat., ed. 12, p. 1055, (pars).
Hippa emerita, Miers, Jour. Linn Soc., vol. XIV, p. 323, pl. V, fig. 9.
Hippa analoga, Stimpson, Jour. Bost. Soc. Nat. Hist., vol. VI, p. 485; Miers, op. cit., p 324, pl. 5, fig. 10.
Hippa talpoidea, Verrill, Report of U. S. Commissioner of Fish and Fisheries, 1871 and 1872, p. 548, pl. II, fig. 5.

Numerous specimens of this widely distributed species were obtained at Progreso and the Port of Silam. It is used by the fishermen as bait, and large numbers are dug from the sand.

Specimens of *Hippa* are in the collection of the Academy from the eastern and western coasts of the Americas; from California, Guatemala, Panama, and Chili, and from Massachusetts, New Jersey, Florida, Brazil and La Plata. A careful examination of the abundant material leads me to the conclusion that the forms on the Pacific and Atlantic sides of the continent represent but a single species. The supposed distinctive characters enumerated by Stimpson and Miers, such as the shape, width and rugosity of the carapace, the shape of the frontal lobes, of the antennal spines, of the lobe of the third joint of the outer maxillipeds, and of the last abdominal segment, do not appear to be constant. Variation in these characters exists in forms from both the Pacific and Atlantic waters, and I have not found it possible to fix upon any character by which to distinguish the forms from the two areas. All the characters mentioned above are more or less variable, in the specimens from either side. The carapace may be broader or narrower, more or less rugose, the shape of the frontal lobes, and of the lobe of the third joint of the outer maxillipeds, varies, and the antennal spines vary in their length and may be directed slightly inwards or outwards. The specimens from any one locality, however resemble each other, and the tendency towards variation expresses itself in local varieties. The specimens from the west coast appear to be usually more rugose than those from the east coast, but it is by no means a constant character.

No good typical figure of this species exists. That given by Professor Verrill is the best, but the carapace is usually narrower at its anterior extremity than is shown in his figure. The figure given by H. Milne-Edwards in the "Règne Animal"[1] under the name of *Hippa emerita*, Fabr., is much narrower than any specimen of this species which I have seen, and its general aspect excites a suspicion that it represents a specimen of *Hippa asiatica*,[2] and not of *Hippa emerita*.

Clibanarius formosus, n. sp. Plate V, figs. 1 and 2.

Three hermit crabs were collected upon the beach at the Port of Silam which apparently belong to an undescribed species of the prolific genus Clibanarius. For them I propose the foregoing name. The species may be characterized as follows:—

Carapace with the anterior margin angular; possessing a small acute median tooth; about four-fifths as broad as long. Eye peduncles slender, about as long as the anterior margin of the carapace, their basal scales small with three or four teeth on the anterior margin. External antennæ with the last joint of the peduncle nearly three times as long as the penultimate and with the basal scale of moderate size; its acute extremity reaching the distal edge of the penultimate joint. Chelipeds small, of equal size; manus oblong-oval, covered with numerous tubercles from which arise tufts of short hairs; meros joint with a small black-tipped spine at its antero-dorsal extremity. Cruripeds somewhat compressed; tarsus of the first and second pairs slightly longer than the penultimate joint; with several longitudinal series of small pits into which are inserted tufts of short hairs. Color in alcohol a dull orange, the cruripeds with four broad longitudinal stripes of reddish-brown upon the tarsal and penultimate joints; the stripes situated upon the dorsal lateral and ventral surfaces respectively. The preceding or fourth joint with two broad stripes upon its outer surface, and one upon its dorsal surface.

Length of the carapace, 25 mm.

In general characters this species resembles very closely the common form of the southern coast of the Eastern United States,

[1] Crustacés, pl. 42, fig. 2.
[2] H. Milne-Edwards, Hist. Nat. Crust. ii, page 209.

Clibanarius vittatus Bosc,[1] but differs from it in its smaller chelipeds, and in its color pattern. The external antennæ are also apparently about one-fifth shorter than in *C. vittatus.*

The following species of *Clibanarius* may be added to those enumerated by Stimpson in his Prodromus.[2] The greater number have been described since the publication of his list. They are arranged in chronological order and without regard to the question of synonymy.

C. tubularis L., Syst, Nat., Ed. 12, 1767, p. 1050; Risso, Crust. de Nice, p. 56, 1816. Mediterranean.

C. misanthrops Risso, Hist. nat de l'Eur. mér., t. V, p. 40, 1826; Roux, Crust. de la Medit. pl. 14, fig. 1. Mediterranean

C. ornatus Roux, Crust. de la Medit., 1830, pl. 43. Marseilles.

C. strigimanus White, Proc Zool. Soc. 1847, p. 122. Van Dieman's Land.

C. Cubensis de Saussure, Mem. Soc. Hist. Nat. Genève, Vol. XIV, p. 455, 1857. Cuba.

C. turgidus Stimpson, Bost. Jour. Nat. Hist. 1857, p. 484, pl. XXI, fig. 1. Puget Sound.

C. carnifex Heller, Sitzungsb. Akad. Wissensch. Wien Vol. XLIV, pt. I, p. 259, 1861. Red Sea.

C. signatus Heller, id, p. 252. Red Sea.

C. Rouxi Heller, Crust. südl. Europa, Wien, 1863, p. 279. Gibralter.

C. barbatus Heller, Reise der Oesterreichischen Fregatte Novara, Crust. p. 90, Taf VII, fig. 5, 1868. Auckland.

C. infraspinatus Hilgendorf. Crustaceen von Ost Afrika, 1869, p. 97.

C. cayennensis Miers. Proc. Zool. Soc. 1877, p. 657. Cayenne.

C. carnescens Miers, id, p. 658. Cayenne.

C. speciosus Miers, loc. cit. Brazil.

C. Lordi Miers, loc. cit. Vancouver Island, B. C.

C. Mediterraneus Kossmann, Archiv. für Naturg., vol. XLIV, p. 257, 1878. Mediterranean.

C. eurysternus Hilgendorf, M. B. Akad. Wissensch. Berlin, 1878, p. 822, pl. III, figs. 9 and 10. Mozambique.

C. Padarensis De Man, Journ. Linn. Soc. Vol. XXII, p. 242, Pl. XVI, fig. 1. King Island, Mergui Archipelago.

C. arethusa De Man, id. p. 252, King Island, Mergui Archipelago.

Alpheus heterochelis.

Alpheus heterochelis, Say, Journ. Acad. Nat. Sci. Phila., (1) Vol. I, p. 243,

Alpheus lutarius, de Saussure, Mem. Soc. Hist. Nat. Genève, t. XIV, p. 461, Pl. III, fig. 24.

A male and female, obtained at the Port of Silam.

Palæmonella Yucatanica, n. sp. Pl. V, fig. 8.

A small female prawn with eggs attached was dredged in twenty feet of water off Progreso. It is allied to *Palæmonella tenuipes* of Dana (1852, p. 582, pl. 38, fig. 3) and appears to be an undescribed species. I have named it *Palæmonella Yucatanica.* It may be characterized as follows.

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[1] Histoire Naturelle des Crustacés, Vol. I, p. 327, Vol. II, pl. XII.

[2] Proc. Acad. Nat. Sci. Phila. 1858, p. 225.

Rostrum straight, from its origin to its apex about as long as the carapace, projects beyond the anterior edge of the carapace about as far as two-thirds of the length of the basal scale of the outer antennæ, arises about midway between the anterior and posterior edges of the dorsal surface of the carapace, its origin marked by a tooth, between this and the apical tooth of the rostrum there are six other teeth equally spaced, the posterior one being directly above the base of the outer antenna, two teeth on the under surface near the apex. Peduncle of inner antennæ as long as the basal scale of the outer antennæ. Antennal tooth directly above the base of the outer antenna; hepatic tooth in a line drawn midway between the first and second teeth of the rostrum, counting from its base, and a little below the antennal tooth. Second pair of pereiopods with meros about as long as from the posterior edge of the dorsal surface of the carapace to the basal tooth of the rostrum; its distal end not spined, carpus about as long as the meros, its distal end with a very minute spine, manus about as long as from the second tooth of the rostrum to its apex; fingers about half the length of the hand.

It may be distinguished from *Palæmonella tenuipes* by the shorter hand of the second pair of pereiopods, not longer than from the first tooth of the rostrum to its apex; by the lack of spines upon the distal end of the meros and the presence of only a rudimentary spine upon the distal end of the carpus; also by the position of the first tooth of the rostrum, midway between the anterior and posterior edges of the dorsal surface of the carapace, the greater length of the peduncle of the inner antennæ and the basal scale of the first antennæ, which are as long as the manus, and the less anterior position of the hapatic tooth which is one-quarter to one-third of the length of the carapace removed from the anterior edge.

STOMATOPODA.

Squilla prasinolineata.

Squilla prasinolineata Dana, Crust. U. S. Explor. Exped. p. 630, Pl. XLI, fig. 3.

Squilla Dufresnii (Leach) Miers, Ann. Mag. Nat. Hist. (5), Vol. V, p. 18, Pl. II, figs. 8 and 9.

A small female squilla, about 2½ inches in length, was collected at the Port of Silam. It agrees well with Dana's description of *Squilla prasinolineata.* It also resembles the figure of *Squilla Dufresnii,* given by Mr. Miers in his Monograph of the Squillidæ, and I am therefore led to regard this latter species as a synonym of

Squilla prasinolineata. The squilla in the collection of the British Museum, described and figured by Mr. Miers under the name of *Squilla Dufresnii,* had had the name attached to it in manuscript by Leach but had never been previously described. White in his "List of the specimens of Crustacea in the collection of the British Museum," 1847, p. 83, recorded Leach's manuscript name but gave no description. Dana published his description of *S. prasinolineata* in 1852, and if as I have assumed, these two species are synonymous, then Dana's name must be used, as no description was attached to the publication of Leach's name in 1847. The specimen in the collection of the British Museum which Mr. Miers doubtfully refers to *Squilla prasinolineata,* appears to me in all probability not to belong to it. He says that the median carinules of the exposed thoracic and first to sixth post-abdominal segments are obsolete, whereas Dana says only "in part obsolete." Dana says that the lateral margins of the three exposed segments of the thorax are entire, whereas the figure given by Mr. Miers shows that the two posterior segments have a small anterior lobe. Mr. Miers also says that the median longitudinal carina of the carapace is indistinctly furcate only in its anterior portion, whereas Dana states that it is not distinctly furcate near the front, but towards the posterior margin opens for a short distance. Mr. Miers also states that in his specimen the terminal post-abdominal segment is proportionally narrower and more elongated than in *Squilla Dufresnii,* but I fail to see any difference in this respect between Mr. Miers' figure of this latter species and Dana's figure of *Squilla prasinolineata.*

Mr. Miers' figure shows that the specimen he is describing has a well developed lateral process to the first exposed thoracic segment, whereas the specimen collected in Yucatan only has a small insignificant lateral process such as is shown in his figure of the thoracic segments of *Squilla Dufresnii.* Dana's species was described from Rio Janeiro. *Squilla Dufresnii* of Miers has no locality. The species has not since been recorded from any new locality and the finding of it on the coast of Yucatan is therefore very interesting.

ISOPODA.

Ligia Baudiana. Pl. VI, fig. 2.
Milne-Edwards, Hist. nat. crust., t. III, p. 155.

Three small specimens of this species were collected at the Port of Silam. It was originally described by Milne-Edwards from San Juan d'Ulloa, the fortress of the harbor of Vera Cruz. Mr. E. J.

Miers (1877) has described specimens from Cayenne, and also states that there are specimens of it in the British Museum from Rio Janeiro. De Saussure has also recorded it from Cuba. The small slender appendage of the inner ramus of the uropoda that Mr. Miers speaks of I did not find in the Yucatan specimens, but as he suggests they may have been lost. The specimen figured has been enlarged two diameters.

Cirolana mayana, n. sp. Pl. VI, figs. 3–10.

Three small specimens of a *Cirolana* were obtained at the Port of Silam which do not correspond to any described species. They are distinguished from all other species by the form of the antennæ, and represent a new species which may be characterized as follows.

Body narrow, about three and one-third times as long as broad, with the sides nearly straight and parallel, smooth and polished with few punctations.

Head sub-hexagonal, about one and three quarter times as broad as long, antennulæ rather longer than the breadth of the head, antennæ as long as from the interior margin of the head to the posterior margin of the third thoracic segment; sigmoid in shape, at its origin bending backwards, then bending forwards and then backwards; segments of the flagellum forming the anterior concavity armed anteriorly each with two bundles of numerous bristles one on the upper and other on the lower edge, thus forming a brush shaped structure.

First thoracic segment nearly twice as long on the median line as the second; second, third and fourth segments equal; fifth and sixth segments rather longer and seventh segment half the length of the sixth. The epimera of the fourth, fifth, sixth and seventh segments are produced posteriorly into an angle, and those of the second and third segments are subquadrate, all have an impressed line running antero-inferiorly.

Spines and bristles upon the legs are not numerous. A small portion of the first abdominal segment exposed. The lateral angles of the abdominal segments acute not rounded. The telson about two-thirds as long as broad, minutely crenulate on its posterior border, with very short spines inserted in the notches.

The largest of the three specimens from which this description has been drawn is about 9 mm. in length. In the smaller specimens the series of bristles upon the antennæ are not so well developed.

The most characteristic features of this species are the brush-like arrangement of bristles upon the antennæ and the crenulate posterior border of the telson.

As no list of the species of this genus has been published since the "Histoire Naturelle des Crustacés" I append the following list of species described to the present day:—

C. (*Eurydice*) *pulchra* Leach, Trans. Linn. Soc., vol. XI, p. 370, 1815; Milne-Edwards, Hist. Nat. Crust., t. III, p. 238. England.

C. cranchis Leach, Dict. Sci. Nat. t. XII, p. 347; Bate and Westwood, Brit. Sess. Crust., p. 296, with figure. England.

C. (*Nelocira*) *Swainsonii* Leach, loc. cit.; Milne-Edwards, Régne Animal, pl. 67, fig. 4. Sicily.

C. hirtipes Milne-Edwards, Hist. Nat. Crust. t. III, p. 236, pl. 31, fig. 25, 1840; Régne Animal, pl. 67, fig. 6. Cape of Good Hope.

C. elongata Milne-Edwards, loc. cit. Mouth of Ganges.

C. sculpta Milne-Edwards, op. cit. p. 237. Malabar.

C. Rossii White, List of the Specimens of Crustacea in the Collection of the British Museum, 1847, p. 106. No description given. He refers to the Zoology of the Erebus and Terror, t. 5, fig. 9, but I have been unable to find this figure among the monographs of this expedition. Auckland Islands.

C. borealis Lilljeborg, Ofversight, Kongl. Vetensk. Akad. Förhandl, arg. 8, 1851, No. 1, p. 23. Norway.

C. armata Dana, U. S. Explor. Exped. vol. XIII, pl. II, Crust., p. 771, pl. 51, fig. 5, 1852. Rio Janeiro.

C. latistylis Dana, op. cit., p. 772, pl. 51, fig. 6. Borneo.

C. (*Eurydice*) *orientalis* Dana, op. cit., p. 773, Pl. 51, fig. 7. Sooloo Sea.

C. multidigitata. *Aega multidigitata* Dana, op. cit., p. 768, Pl. 51, fig. 3. Borneo.

C. polita Stimpson, Marine Invert. Grand Menan. Smithsn. Contrib., vol. VI, p. 41, 1853. Grand Menan.

C. concharum Stimpson, loc. cit. Charleston, S. C.

C. Solæ Hesse, Ann. Sci. Nat. (5) t. V, p. 259, 1866. Brittany.

C. Raiæ Hesse, op. cit. p. 260. Brittany.

C. molvæ Hesse, op. cit. p. 261. Brittany.

C. elongata Hesse, op. cit. p. 262. Brittany.

C. merlangi Hesse, op. cit. p. 264. Brittany.

C. spinipes Bate and Westwood, Brit. Sess. Crust. p. 299 with figure, 1867; Harger, Bull. Mus. Comp. Zool. vol. XI, p. 91, pl. I, fig. 2, pl. II, fig. 1. England and North America.

C. rugicauda Heller, Reise der Fregatte Novara, vol. II, pt. 3, p. 142, t. XII, fig. 13, 1868. St. Paul.

C. truncata Norman, Ann. Mag. Nat. Hist. (4), vol. II, p. 421, pl. 23, figs. 12, 13, 1868. Shetland Isles.

C. Rossi Miers, Ann. Mag. Nat. Hist. (4) vol. XVII, p. 218, 1876; Cat. Crust. New Zealand, p. 109, pl. III, fig. 3. New Zealand and Auckland Islands.

C. Arabica Kossmann, Reise in die Küstengebiete des Rothen Meeres, p. 114, t. VIII, figs. 7–12, t. IX, figs. 1–4. Red Sea.

C. microphthalma Hoek. Niederländ. Arch. Zool., suppl. I, Lief. 3, taf. II, figs. 13–17, 1882. Arctic Sea.

C. lata Haswell, Proc. Linn. Soc. New South Wales, vol. VI, p. 192, pl. IV, fig. 1, 1882. Port Stephens, N. S. W.

C. lata var. *integra* Miers, Zool. Coll. H. M. S. 'Alert,' p. 304, 1884. Albany Island.

C. longicornis Studer, Abh. Akad. Berlin, 1882, II, p. 28, pl. II, fig. 15. Table Bay; South Africa.

C. lævis Studer, Abh. Akad. Berlin, 1883, p. 21. pl. II, fig. 8. Queensland.

C. impressa Harger, Bull. Mus. Comp. Zool. vol. XI, p. 93, pl. I, fig. 3, pl. II, fig. 3, 1883–1885. North Atlantic.

C. Schiödtei Miers, Zool. Coll. H. M. S. 'Alert,' p. 302, pl. XXXIII, fig. A, 1884. Arafura Sea, Torres Straits.

C. tenuistylis Miers, op. cit. p. 303, pl. XXXIII, fig. B. Prince of Wales Channel.

C. Cookii Filhol, Mission de l'Ile Campbell, Recueil de Mémoires relatifs à l'observation de Passage de Vénus sur le Soleil. Paris, p. 455. Campbell Island.

Cymodocea caudata.

Næsa caudata Say, Jour. Acad. Nat. Sci. Phila. (1), vol. I, p. 482.

A single specimen of this interesting species was collected in twenty feet of water, off Progreso. The species does not appear to have been recorded from any locality since its original description by Say, from Egg Harbor, New Jersey. On plate III (figs. 11–14), will be found dorsal and lateral views, a view of the fourth leg on the right side, and of the male sexual organs. The species has been well described by Say. The male genital organs upon the middle of the ventral surface of the seventh thoracic segment consist of two spine-like appendages, with a broad groove upon the posterior surface.

This form does not come properly within the genus Næsa, either as defined by Leach,[1] Milne-Edwards,[2] or Gerstæcker.[3] I have placed it provisionally under *Cymodocea*, believing with Mr. Beddard (1886, p. 145) that the genera *Dynamene*, *Næsa* and *Cilicæa* probably represent variations of form of this type, sexual or otherwise, of no primary importance.

M. Hesse[4] has worked out the sexual dimorphism of several related species inhabiting the coasts of France. The figure given on pl. VI, (figs. 11–14) was drawn from a male specimen from the Bermuda Islands collected by the Academy's Expedition to that locality in 1888 under the charge of Professor Angelo Heilprin. Six specimens all males were collected. There appears to be a tendency in the four spines within the sinus of the posterior abdominal segment to become double. The three tubercles upon the first exposed abdominal segment may also be double. The largest specimen from Bermuda is 10 mm. in length.

Associated with these were six specimens of a related form, in which the exterior uropoda are short and lamellate. I supposed at

[1] Dictionnaire des Sciences Naturelles, t. XII, p. 341.
[2] Histoire Naturelle des Crustacés, t. III, p. 216.
[3] Bronn's Thier-Reichs, Bd. V, p. 223.
[4] Ann. Sci. Nat. (5), t. XVII, p. 1–35, Pls. 1–3.

first that these were the females of *Cymodocea caudata*, but further examination showed the presence of well developed male appendages in one of the specimens, and I am therefore compelled to regard them as a distinct species, which I have described as *Cymodocea Bermudensis* (see p. 194).

CIRRIPEDIA.

Chelonobia testudinaria.

Lepas testudinaria Linn. Syst. Nat. Ed. X., p. 668.

Chelonobia testudinaria Darwin, Monograph of the Cirripedia, p. 392, pl. 14, figs. 1a–1d, fig. 5; pl. 15, fig. 1.

A single specimen was collected at Progreso. Large numbers of the Green turtle (*Chelonia mydas*) are taken at this locality, and this species of barnacle is probably found upon them.

XIPHOSURA.

Limulus polyphemus.

Monoculus polyphemus Linn. Syst. Nat. Ed. X, p. 634.

Polyphemus occidentalis DeKay, Natural History of New York, Crust., p. 55, pl. XI, figs. 50, 51.

The King Crab is very abundant upon the beach at the Port of Silam. It has already been recorded from Laguna de Terminos, at the southern extremity of the Gulf of Mexico, by Professor H. Milne-Edwards (1880 (1), foot note, p. 4). Professor Benjamin Sharp informs me that it breeds in the harbor of Nantucket, and to Professor Kingsley I am indebted for the information that it breeds in great abundance at Cape Ann, Massachusetts. The species is thus seen to have a very extensive north and south range.

VERA CRUZ.

DECAPODA.

Mithraculus sculptus.

Maia sculpta Lamarck, Hist. Nat. Anim. sans Vert., t. V, p. 242.

Mithraculus sculptus A. Milne-Edwards, Crust. Miss. Sci. Mex., p. 105, pl. XX, fig. 2.

Four specimens of this species were collected at Vera Cruz. Three of them in which the carapace is less than 10 mm. broad, have no teeth either upon the pollex or dactylus. The fourth specimen, in which the carapace is about 20 mm. broad, has teeth of the ordinary type upon both fingers.

Liomera longimana.

A. Milne-Edwards, Nouv. Arch. Mus. (1) t. I, p. 221, pl. XII, figs. 7, 7a, 7b.

A young specimen apparently of this species was found in a cavity of a coral, *Madrepora palmata*, collected at Vera Cruz.

Neptunus Sayi.

Lupa Sayi Gibbes, Proc. Amer. Assoc. 1850, p. 178.
Neptunus Sayi A. Milne-Edwards, Arch. Mus. (1) t. X, p. 317.

There are three young specimens of this species in the collection of the Academy labelled Vera Cruz. One of them was donated by Dr. T. B. Wilson. The other two do not bear the name of the donor.

Neptunus cribrarius.

Portunus cribrarius Lamarck, Hist. Anim. sans, Vert. t. V, p. 259.
Lupa cribraria Milne-Edwards, Hist. Nat. Crust. t. I, p. 452, pl. XVII, fig. 1.

A female was obtained at Vera Cruz.

Ocypoda arenaria.

Loc. cit.

Several specimens were collected at Vera Cruz.

Grapsus grapsus.

Cancer grapsus L., Syst. Nat., ed. X, pl. 30.
Grapsus pictus A. Milne-Edwards, Crust. Règne Animal, Cuvier, pl. 22.

A male was obtained at Vera Cruz.

I have used the specific name given to this species by Linnæus, in 1758, and not the designation of *maculatus* applied to it by Catesby[1] in 1743. Most authors have used Catesby's name, but as this antedates the tenth edition of the Systema Naturæ, it should be abandoned in favor of Linnæus' name. Lamarck[2] in 1801 erected a new genus for the reception of this species with an allied form, and gave to the new genus, the name of the Linnean species. This he renamed *Grapsus pictus.* I am of opinion, however, that Linnæus' specific name should not be abandoned, on account of its use generically, and I therefore retain it.[3]

Penæus Brasiliensis, var. *Aztecus*, n. var.

A number of shrimps were obtained at Vera Cruz, which belong to this species, but differ from the typical form in the very long flagellum of the outer antennæ. The flagellum is from seven to ten

[1] Nat. Hist. of the Carolinas, vol. II, p. 36, pl. XXXVI, fig. 1.
[2] Système des Animaux sans Vertèbres, p. 150.
[3] Report of Committee on Zoological Nomenclature, Proc. Amer. Assoc. Adv. Sci. 1877, pp. 50, 51, LXVIII.

times the length of the carapace, from its anterior to its posterior edge, not including the rostrum. On account of the remarkable length of the flagella they appear to me to constitute a new variety which I have named *Aztecus*.

The species itself closely resembles *Penæus canaliculatus* of Oliver (see Spence Bate, 1888, p. 243, pl. XXXII) which inhabits the Indo-Pacific region. It may be distinguished from it by the presence of a spine upon the second and third joints of the first pairs of pereiopods instead of one upon the second joint only, and by the presence of two teeth instead of one upon the ventral surface of the rostrum.

I have examined Latreille's original description,[1] but have identified the specimens collected by means of Milne-Edwards' characterization of the species in the Histoire Naturelle des Crustacés, t. II, p. 414. Mr. Spence Bate[2] has also discussed this species.

WEST COAST OF FLORIDA.

DECAPODA.

Libinia dubia.

Loc. cit.

Five specimens collected in Anclote Bay. Two of these are young individuals, in which the median row of spines of the carapace and the rostral spines are relatively much more developed than in the adult.

Panopeus Texanus.

Panopeus Texanus Stimpson, Ann Lyc. Nat. Hist., New York; vol. VII, p. 55. A. Milne-Edwards, Crust. Miss. Sci. Mex., p. 312, pl. LVIII, fig. 4.

Numerous specimens collected at Point Pinellas, Tampa Bay, and in Anclote Bay.

They differ slightly from the figure given by M. Milne-Edwards. The postero-lateral border of the carapace is rather shorter, and the antero-lateral spines are less closely approximated.

Panopeus Herbstii.

Loc. cit.

A single specimen, dredged in 9–12 feet of water, off Manatee River, Tampa Bay, probably belongs to this species. It differs, however, from the typical form in the broad leaf-shaped character of the antero-lateral teeth of the carapace. (See Pl. V, fig. 7.)

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[1] Nouv. Dict. Hist. Nat. t. XXV, p. 175.

[2] Ann. Mag. Nat. Hist. (5) vol. VIII, p. 175.

Menippe mercenaria.

Loc. cit.

Specimens were obtained at Anclote Bay, Sarasota Bay and in 9–12 feet of water off the Manatee River, Tampa Bay.

Achelous spinimanus.

Portunus spinimanus Latreille, Encycl. Mèth., t. X, p. 188,

Achelous spinimanus A. Milne-Edwards, Arch. Mus., t. X, p. 341, pl. XXXII.

Specimens were obtained off the Manatee River, Tampa Bay, at Sarasota Bay and at Boca Noga, Little Gasparilla Inlet.

They exhibit a considerable amount of variation, specimens agreeing in all other characters, differ in the shape of the abdominal segments, the number of spines upon the anterior border of the arm or the size of the posterior antero-lateral spine.

Gelasimus pugilator.

Ocypoda pugilator Bosc, Hist. Nat. Crust., t. I, p. 250.

Gelasimus pugilator H. Milne-Edwards, Ann. Sci. Nat. (3), t. XVIII, p. 149, pl. IV, fig. 14.

Gelasimus vocans Dekay, Nat. Hist. of New York, Crust., p. 14, pl. VI, fig. 9.

Numerous specimens obtained at Perico Island, Sarasota Bay.

Calappa flammea.

Cancer flammea Herbst, Krabben und Krebse, vol. II, p. 161, pl. XI., fig. 2.

Calappa flammea Miers, "Challenger" Brachyura,, p. 284, pl. XXIII, fig. 1.

A male was collected in Little Gasparilla Inlet.

The specimen resembles Herbst's figure, but lacks the clearly marked reticulations of the dorsal surface of the carapace, which is very faintly mottled with reddish brown.

Persephona punctata.

Cancer punctatus L., Syst. Nat. ed. XII, p. 1045.

Persephona punctata Miers, "Challenger" Brachyura, p. 312, pl. XXV, fig. 5.

Two males were obtained, one from 9–12 feet of water off Manatee River, and the other in Sarasota Bay.

Polyonyx macrocheles.

Porcellana macrocheles Gibbes, Proc. Am. Assoc., vol. III, p. 191; Proc. Elliott Soc. Charleston, S. C., vol. I, p. 6, pl. I, fig. 5.

Polyonyx macrocheles Faxon, Bull. Mus. Comp. Zool., vol. V, p. 256, pl. III, fig. 11.

A male and female were obtained in 9–12 ft. of water off Manatee River.

As Professor Kingsley (1879, p. 408) has already pointed out, the carapace is much broader in the female than in the male.

Clibenarius vittatus.

Pagurus vittatus Bosc, Hist. Nat. Crust. t, I, p. 327; t. II, pl. 12, fig. 1.

A number of specimens obtained at Little Gasparilla Inlet.

This species has only been figured by Bosc, and as his representation of it is very unsatisfactory, I have refigured it. (Pl. V, figs. 3 and 4). The outline drawing represents one of the medium-sized specimens collected at Little Gasparilla Inlet. The right anterior cruriped has been given in detail to show the color markings and the tufts of hair. In alcohol, the carapace is yellowish with a reddish tinge; the dorsal surface of the chelipeds reddish-brown mottled with yellow, ventral surface yellowish; the tarsal and penultimate joints of the cruripeds reddish-brown with eight narrow longitudinal yellow bands. Two of these bands are upon the dorsal surface, two upon the ventral and two upon each of the lateral surfaces. The two dorsal bands are closer together than the others. The ventral surface of the cruripeds is much lighter than the dorsal and lateral surfaces.

Eupagurus pollicaris.

Pagurus pollicaris Say, Jour. Acad. Nat. Sci. Phila. (i), vol. I, p 162.
De Kay, Natural History of New York, Crust., p. 19, pl. VIII, fig. 21.

Three specimens, one male and two females, collected in 9–12 feet of water, off Manatee River, in Tampa Bay.

Eupagurus annulipes.

Stimpson, Ann. Lyc. Nat. Hist. New York, vol. VII, p. 243.

A single specimen of this small species collected at Anclote Bay.

The species so far as I am aware has not been recorded since it was first described by Dr. Stimpson, from Beaufort Harbor, N. C.

Hippolyte Wurdemanni.

Gibbes, Proc. Amer. Assoc., vol. 3, 1850, p. 197.

Three specimens obtained at Point Pinellas, Tampa Bay.

This species has not been recorded since it was originally described by Professor Gibbes from Key West and Charleston Harbor. Professor Gibbes' description is very good. The carpus of the second pereiopod is multiarticulate; synaphipods and psalistomata are absent; the flagellum of external antenna is about four times as long as the carapace, measuring from the tip of the rostrum to its posterior edge; the longer flagellum of the internal antenna is about three and a half times as long as the carapace, and the shorter flagellum is about three times as long.

As the species has not yet been figured, I have figured one of the specimens collected. (Pl. VI, fig. 1). It is enlarged two diameters.

Palæmontes exilipes.

Stimpson, Ann. Lyc. Nat. Hist. New York, vol. X, p. 130.
S. I. Smith, U. S. Comm. Fish and Fisheries, Rept. of Commissioner for 1872 and 1873, p. 640, pl. I, fig. 1.

Specimens of this fresh water species were collected in the Caloosahatchie River, in the canal connecting Lake Hikpochee and Lake Okeechobee, and in Lake Okeechobee.

Penæus Brasiliensis.

Latreille, Nouv. Dict. Hist. Nat., t. XXV, p. 256.
Spence Bate, Ann. Mag. Nat. Hist. (5) vol. VIII, p. 175.

Specimens collected at Anclote Bay; Sand Key, Clearwater Bay and at Boca Noga, Little Gasparilla Inlet.

BERMUDA.

Cymodocea Bermudensis, n. sp. Pl. VI, figs. 15, 16.

Six small specimens were found associated with specimens of *Cymodocea caudata*, from the Bermuda Islands, which appears to be a new species.

This species may be characterized as follows. Head short, about twice as broad as long. First segment of the thorax longer than any of the following, about as long as the head, three times as broad as long; the remaining thoracic segments about equal in length, half as long as the first thoracic segment.

Two abdominal segments exposed to view; first segment about twice as long as the preceding thoracic segment, its posterior border nearly straight; terminal segment large, about one third of the length of the whole body; subtriangular in shape; posterior angle truncated; elevated in the center and descending steeply to its lateral and posterior margins; three tubercles arranged transversely upon its elevated portion.

Uropoda, short, lamellate, inner and posterior borders straight, outer border slightly convex.

Anterior and posterior antennæ of about equal length. Peduncles of anterior antennæ three-jointed, with first joint stout compressed, second very short compressed, the third long and slender; flagellum multiarticulate. Peduncle of second antennæ, four-jointed, first joint slender, very short, second joint longer, third and fourth joints longer, of about equal length, slender, flagellum multiarticulate. Legs terminating in a well-developed claw with a smaller claw at its base, similar to that of *Cymodocea caudata*. (See Pl. VI, figs. 15, 16.)

The longest specimen 6 mm. in length.

Geographical Distribution.

In the chronological list at the end of this paper will be found the titles of all important monographs dealing with the higher crustacean fauna of the West Indian region. As this list represents a summary of our knowledge of the region, I will merely mention here briefly the most important contributions to the subject.

In 1817, Thomas Say, who might aptly be termed the Father of American Invertebrate Zoology, published in the first volume of the Journal of this Academy a series of papers entitled, "An Account of the Crustacea of the United States." These papers contain descriptions of a number of new species principally from the Southern coasts of the Eastern United States. The species are nearly all characteristic forms of Florida or the West Indies, and his papers may therefore be regarded as the first contribution to our knowledge of this fauna. In 1850, Gibbes, in a paper on the carcinological collections of the United States, described a number of new forms, the greater part of them being from the same region as those described by Mr. Say. In 1852, Dana published his historical monograph on the Crustacea collected by the United States Exploring Expedition, in which the species collected at Rio Janeiro are enumerated, and many new ones from that locality described. In 1858, H. de Saussure described a number of new species from the coast of Mexico and the West Indies, and in the following year Dr. Stimpson published the first of three papers, continued in the years 1860 and 1871, in the Annals of the Lyceum of Natural History, of New York, in which he described many new species from the region opened up by Say and Gibbes. M. A. Schram, in 1876, published a manuscript by Dr. Isis Desbonne, enumerating the Crustacea of Guadeloupe, and describing some new species. In the following year Heller, in his report upon the Crustacea, collected by the Novara Expedition, gave a list of species obtained at Rio Janeiro, with descriptions of some new species. In 1869, Professor S. I. Smith published a notice of the Crustacea collected by Professor C. F. Hartt, on the Coast of Brazil, 1867, which contains a list of species collected and descriptions of new species, and also a list of all the species of Crustacea known upon that coast at that date. In the same year Dr. Ed. V. Martens published a description of some fresh and brackish water Crustacea from Southern Brazil, collected by Dr. Reintz-Hensel. In 1870, Dr. Stimpson published his preliminary report upon the Crustacea, dredged in the Straits of Florida by L. F. de Pourtalés, of the United States Coast Survey. In 1872 appeared a paper by Dr. Ed. V. Martens on the Crustacea of Cuba. Five years later, Mr. E. J. Miers described several new species from Cayenne, and in 1879, Professor Kingsley published his list of Decapod Crustacea, found at Fort Macon, N. C. In the same year he also published a paper upon a collection of Crustacea from Virginia, North Carolina and Florida.

During the years 1873–1880 appeared the report of Prof. A Milne-Edwards upon the Crustacea collected by the Mission Scientifique au Mexique. Professor Milne-Edwards originally intended to make his report a complete monograph of the Carcinological fauna of both sides of Central America, but owing to the destruction of nearly the entire collection of the Commission during the bombardent of Paris, he was unable to do this. The report although imperfect as a complete monograph is an excellent work. The greater part of the Brachyurous Crustacea of these waters are described, and illustrated by very fine figures.

In 1881, Prof. Milne-Edwards published his Preliminary report upon the decapod Crustacea dredged in the Gulf of Mexico and the Caribbean Sea by the United States coast survey steamer "Blake" during the years 1877, 1878 and 1879. In this report many interesting deep sea types are described.

In 1887, Prof. C. L. Herrick published an extensive paper entitled "Contributions to the Fauna of the Gulf of Mexico and the South." The subject of the paper is a collection of Crustacea made in Mobile Bay. A number of new and little known species are described and figured. The paper on account of its comprehensiveness and numerous illustrations, should be a very valuable addition to the literature of the subject. I am sorry to state, however, that although I have had occasion to make very little use of it, my slight acquaintance with it, has not left a very favorable impression upon my mind. In the figure of *Palæmonetes vulgaris,* Pl. V, fig. 7, there has been drawn one thoracic leg too many, six legs instead of five, and in the figure of *Penæus setiferus* on the same plate, fig. 6, there are three instead of two teeth upon the frontal and hepatic regions. In the latter case the third tooth that has been drawn does not exist in any member of the genus. As the species figured is a common one, there can be no doubt that the figure is intended to represent this species, but if it were correct, the existence of a third spine would probably be sufficient to make a new genus of it.

In addition to the papers that have been enumerated, should be mentioned the several monographs on the different groups of Crustacea collected by the Challenger Expedition, including species from the Bermudas, St. Thomas, and Bahia.

It will be apparent from the preceding resumé of the literature of the Crustacea of the West Indian region that although much is known of the subject, our knowledge is as yet by no means complete Much remains to be learned of the Crustacean fauna of the Eastern coast of South America. Several collections of Crustacea have been made at Rio Janeiro, but we do not know with certainty how far south of this point the Caribbean Crustacea extend.

North of Rio Janeiro Professor Hartt collected at the Abrolhos Reefs, and at a few points on the East coast of Brazil. Of the fauna of the Northeastern coast of Brazil, and of the Northern coast of South America and the Eastern coast of Central America we have only very scattered knowledge. Even of the Gulf of Mexico itself our information is very limited. Northward from Florida to Cape Hatteras the coast is much better known. From Cape Hatteras to New Jersey is still nearly a terra incognita. The only contribution to our knowledge of this latter portion of the coast is a scanty list of Crustacea collected by Mr. P. R. Uhler in Chesapeake Bay.

Of the Crustacea of the West Indian Islands much remains to be known. We have a fair knowledge of the fauna of Cuba and Guadeloupe, and a very limited knowledge of that of Hayti, St. Thomas and St. Martin. The Crustacea of the Bermuda Islands are known from the Academy's Expedition to these Islands in 1888. Dr. Isis Desbonne has described many species peculiar to Guadeloupe and we may reasonably look for species peculiar to some of the other unstudied West Indian Islands.

The lists of Crustacea collected in various regions are usually of much less value than they might be, from the fact that they do not give any particulars in regard to the specimens collected. It should always be stated in such lists whether the specimens occur in abundance or are rare. In some cases also, young specimens are found during the summer which have developed from larvæ brought to these shores by warm currents, and which perish during the winter. Such species certainly cannot be regarded as normally inhabiting these shores. This occurs on the coasts of Southern New Jersey, where during the summer numerous specimens of *Ocypoda arenaria* both in the Megalops stage and in the very young adult stage can be collected on the beach. No large adult specimens are found. *Neptunus cribrarius* is also occasionally obtained on the coast, but this species on account of the rarity of its occurrence, can only be regarded as an occasional visitor and not as an inhabitant. It is probably brought north by the warm currents from the south. Mr. S. I. Smith has treated of this subject, and records the occurrence of young specimens of five southern species of Decapods upon the shores of Long Island and of Vineyard Sound. Besides these he records two southern species brought in on whalers, and three pelagic species characteristic of the Gulf stream, which have been stranded upon the Northern coasts. These facts should therefore be carefully considered and when an area of distribution is defined for a given species it should only include those localities in which the species is constantly found in greater or less abundance. Mr. S. I. Smith, in the Crustacea of the Atlantic Coast of North America north of Cape Cod, has exemplified this method and his paper is consequently of great value. Besides entering carefully into the range of the species, he has also given the depth of water which they inhabit.

The following list represents the species collected by the Academy's Expedition to Mexico, together with their general distribution :—

YUCATAN.

Pericera bispinosa. West Indies, Yucatan, Bahia.
Microphrys bicornutus. Florida to Desterro, West Indies.
Libinia dubia. Cape Cod to Yucatan, West Indies, West Coast of Africa.
Panopeus Herbstii. Carolina, Florida, Yucatan, Aspinwall, Bahamas.
Pilumnus aculeatus. Fort Macon to Yucatan, Guadeloupe.
Menippe mercenaria. Beaufort, N. C., to Florida, Yucatan, Bahamas.
Eucratopsis crassimanus. Rio Janeiro, Yucatan.
Ocypoda arenaria. Fort Macon to Rio Janeiro, West Indies.
Gelasimus speciosus. Yucatan.
Pachygrapsus gracilis. Florida, Yucatan, West Indies.
Sesarma cinerea. Virginia to Florida, Yucatan, West Indies.
Hippa emerita. Massachusetts to LaPlata, West Indies, California to Chili.
Clibanarius formosus. Yucatan.

Alpheus heterochelis. Fort Macon to Abrolhos Reefs (Brazil), West Indies, Panama and Nicaragua.

Palæmonella Yucatanica. Yucatan.

Squilla prasinolineata. Yucatan, Rio Janeiro.

Ligia Baudiniana. Yucatan, Vera Cruz, Cuba, Cayenne, Rio Janeiro.

Cirolana Mayana. Yucatan.

Cymodocea caudata. Egg Harbor, New Jersey (visitor ?), Bermuda, Yucatan.

Chelonobia testudinaria. Circumtropical.

Limulus polyphemus. Massachusetts to Gulf of Mexico.

VERA CRUZ.

Mithraculus sculptus. West Indies, Vera Cruz, Fernando Noronha.

Neptunus Sayi. Gulf Stream.

Neptunus cribrarius. Ft. Macon to Vera Cruz, Guadeloupe, Rio Janeiro.

Liomera longimana. West Indies, Vera Cruz.

Ocypoda arenaria. Fort Macon to Rio Janeiro, West Indies.

Grapsus grapsus, Circumtropical. West Indies to Pernambuco.

Penæus Brasiliensis, var. *Aztecus.* Vera Cruz.

Penæus Brasiliensis. New Jersey to Bahia, West Indies, Nicaragua, Whydah (W. Africa).

FLORIDA.

Libinia dubia. Cape Cod to Yucatan, West Indies, West Coast of Africa.

Panopeus Texanus. Cape Cod to Florida and Texas.

Panopeus Herbstii. Carolina, Florida, Aspinwall, Bahamas.

Menippe mercenaria. Beaufort, North Carolina to Florida, Yucatan, Cuba, Bahamas.

Achelous spinimanus. South Carolina, Florida, Brazil, Martinique, Chili.

Gelasimus pugilator. Cape Cod to Florida.

Calappa flammea. North Carolina to Florida, West Indies.

Persephona punctata. Beaufort, North Carolina, Florida, Guadeloupe, Cuba.

Polyonyx macrocheles. Beaufort, North Carolina to Florida.

Clibanarius vittatus. Florida, West Indies, Brazil.

Eupagurus pollicaris. Massachusetts to Florida.

Eupagurus annulipes. Beaufort, N. C., Florida.

Hippolyte Wurdemanni. Charleston Harbor, Key West, Fla.

Palæmonetes exilipes. (Fresh Water.) Florida, South Carolina, Lake Erie, Lake Michigan.

Penæus Brasiliensis. New Jersey to Bahia, West Indies, Nicaragua, Whydah (W. Africa).

The comparative ranges of these species may be graphically illustrated by the following table. The horizontal line opposite the name of a species represents its longitudinal distribution along the Eastern coast of the American continent. Where species have been recorded as occurring at distant points, such as Yucatan and Rio Janeiro, these localities have been connected by a line passing through the intervening regions, although the species may not as yet have been recorded from these regions, as it is probable in all the cases in which this has been done that the species occur there.

Cape Cod. Cape Hatteras. Florida. West Indies. Yucatan. Aspinwall. Bahia. Rio Janeiro. Desterro.

YUCATAN.

Pericera trispinosa
Microphrys bicornutus
Libinia dubia
Panopeus Herbstii
Pilumnus aculeatus
Menippe mercenaria
Euciatopsis crassimanus
Ocypoda arenaria
Gelasimus speciosus
Pachygrapsus gracilis
Sesarma cinerea
Hippa emerita
Clibanarius formosus
Alpheus heterochelis
Palæmonella Yucatanica
Squilla prasinolineata
Ligia Baudiniana
Cirolana Mayana
Cymodocea caudata
Chelonobia testudinaria — Circumtropical.
Limulus polyphemus

VERA CRUZ.

Mithraculus sculptus
Neptunus Sayi — Gulf Stream.
Neptunus cribrarius
Lionèra longimana
Ocypoda arenaria
Grapsus grapsus — Circumtropical.
Penæus Brasiliensis

FLORIDA.

Libinia dubia
Panopeus Texanus
Panopeus Herbstii
Menippe mercenaria
Achelous spinimanus
Gelasimus pugilator
Calappa flammea
Persephone punctata
Polyonyx macrocheles
Clibanarius vittatus
Eupagurus pollicaris
Eupagurus annulipes
Hippolyte Wurdemanni
Palæmonetes exilipes — Fresh Water.
Penæus Brasiliensis

The preceding table suggests the division of the Caribbean province into two sub-provinces, which may be termed respectively the Carribbean and the Brazilian. The Caribbean, extending southwards from Cape Hatteras to Central America, including the West Indian Islands, and the Brazilian extending from Central America to Rio Janeiro. A consideration of what is known of the distribution of the Crustacea of the entire Caribbean province has also led me to adopt this view. By far the greater number of the species enumerated by Rathbun from Brazil are peculiar to that coast and the same can be said of the species enumerated by Kingsley from the Carolinian and Floridian shores. The fauna of the latter region is undoubtedly very closely related to the West Indian proper, of which indeed it may be regarded as a part.

Professor Dana, as early as the year 1852, in his monograph of the Crustacea collected by the United States Exploring Expedition, discussed the question of the geographical distribution of the Crustacea in a way that has laid all future marine zoologists under a debt of gratitude to him. He showed very clearly the important part that the temperature of the water plays in the distribution of marine littoral species. The chart of the world prepared by him, showing the isocrymes or lines of greatest cold, affords the key to many a perplexing problem. He divides the region which I have termed the Caribbean into four Provinces, the Caribbean, including the West Indian Islands, the Eastern coast of Central America and the Northern and Northeastern coast of South America, from the region of the Mississippi River to beyond Bahia; the Floridian Province, including Key West and the Southern extremity of Florida, together with the Bermudas; the Brazilian Province, including Rio Janeiro, and extending north nearly to Bahia; and the Carolinian Province, including Northern Florida, Georgia and the Carolinas as far north as Cape Hatteras. It appears to me, however, that these four provinces should be merged into a single province, the Caribbean, which may be subdivided into two sub-provinces, the Caribbean and Brazilian, as outlined above. It is, I think, impossible to separate the Carolinian, Floridian and Caribbean provinces of Dana. Our knowledge of the species inhabiting these regions has increased greatly since the publication of his work, and the range of the species is known to be greater than he supposed. The extension of the Floridian fauna northwards to Cape Hatteras is probably owing to the fact that the shores of Florida, Georgia and the Carolinas, as far north as Cape Hatteras are bathed by an overflow of the warm waters of the Gulf Stream. The Arctic Labrador current coming from the North, along the Eastern coast of the United States, according to Commander Bartlett[1] does not extend south of Cape Hatteras, but at that point goes under the Gulf Stream eastwards. North of Cape Hatteras the Gulf Stream is deflected northeastwards, and is more or less separated from the coast by the cold Labrador current.

On the Northern coast of Yucatan, as evidenced by the collection of the Mexican Expedition, the Brazilian and Caribbean subprovinces to a certain extent overlap.

There appears therefore to be two centres of distribution in the Caribbean region, a Floridian and a Brazilian, giving rise to the two provinces which overlap in Central America.

Professor Dana in his classical work enumerates eight species common to the warm waters of both sides of the American Continent, and Professor Kingsley in his paper upon the genus *Alpheus*, mentions 15 additional species. Professor Dana also pointed out the fact that the genera of the east and west coasts are largely characteristic of the region embraced by these two coasts, and that a large proportion are common to both shores. He distinguished the region represented by these coasts as the Occidental Kingdom. He was unable, however, to account for this relationship of the eastern and western coasts, as at that time there did not appear to be any evidence of the recent submersion of any part of Central America. It is now well known, however, that during the Tertiary period a connection must have existed between the waters of the Atlantic and the Pacific. This connection will explain the existence of species common to both shores. The Cretaceous rocks of Mexico, and the Tertiary deposits of Yucatan discovered by the Academy's Mexican Expedition[2] together with the recognized Cretaceous and Tertiary deposits of northern South America,[3] further point to a time when there was a free intermingling of the waters of the Atlantic and of the Pacific. The close relationship of the two faunas, as evidenced by the large proportion of genera common to the eastern and

[1] Report of the U. S. Coast and Geodetic Survey, 1882, p. 37.

[2] See Professor Heilprin's report in the Proceedings of the Academy for 1890, pp. 445–469.

[3] See Dr. Hermann Karsten "Géologie de l'ancienne Colombie, Bolivarienne, Vénézuela, Nouvelle-Grenade at Ecuador" Berlin, 1886.

western shores of the continent, and their general similarity, is thus explained. The separation of North and South America also probably explains the well marked division of the continental portion of the West Indian region into a Brazilian and Caribbean sub-province.

The peculiar distribution of *Limulus polyphemus* is worthy of note. It breeds north of Cape Cod and extends at least as far south as Yucatan. It apparently does not extend as far south as Bahia, but it may be found to occur on the South American coast between that point and Yucatan. So far as is yet known it is characteristic of the Eastern coast of North America. The presence of closely related species in the Moluccas and on the coast of Japan, suggests, as pointed out by Prof. H. Milne-Edwards,[1] a former connection of the Atlantic and Pacific Oceans. This may have been that even of the Cretaceous, as the genus appears to have undergone little modification since an early geological period. The presence of members of this genus in the Triassic, Jurassic, Cretaceous and Oligocene beds of Europe and Syria, render it also possible that both the American and Asiatic species may have had as their original center of distribution the Mesozoic and Cenozoic seas of Europe, the one migrating westwards and the other eastwards, and that neither species has been derived from the other, but both from a common European ancestor.

The author having previously been engaged in working up the Echinoderms collected by the Academy's Expedition to Mexico,[2] a comparison of the distribution of the Echinoderms and Crustacea on the two sides of the continent, in the tropical and sub-tropical regions, naturally suggests itself to the mind. Among the Echinoderms no species are known, with absolute certainty, to be common to both coasts; if there are any, they are undoubtedly very few in number, while in the Crustacea, as stated above, there are supposed to be twenty-three species common to the two areas. Professor Verrill,[3] however, has pointed out that notwithstanding the absence of identical species of Echinoderms, there is a very close relation between the faunas of the two coasts. A large proportion of the genera are represented on both sides. The fauna of the Pacific coast is also very distinct from the Indo-Pacific fauna. The absence of identical species of Echinoderms upon both coasts and their presence

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1 Crust. Miss. Sci. Mex , p. 4.

2 Proc. Acad. Nat. Sci. Phila., 1890, pp. 317–340.

3 Trans. Conn. Acad. vol. I, pp. 339–351.

in the Crustacea may be explained upon the supposition that the comparatively recent connection of the oceans which allowed the passage of some of the Crustacea from one coast to the other, was not of sufficient magnitude, or did not extend through a period of time long enough to allow the less active Echinoderms to migrate, or their larvæ to be carried, from one region into the other. The general similarity, on the other hand, of the Echinoderms inhabiting both shores, points to an earlier period, as in the Crustacea, when there was uninterrupted communication between the two areas. The present distinct specific, and to a certain extent generic, character of the two faunas point to a subsequent complete separation of the two regions. This again must have been partially obliterated, allowing a slight intermingling of the active forms of the two areas.

As stated above, from the geological researches conducted by the Mexican Expedition, and other explorations in Central and South America, it is now known that Mexico and more or less of Central and northern South America were submerged during the Cretaceous period, and it is probable that there existed during this period a tropical and sub-tropical American littoral fauna, undifferentiated into Eastern and Western regions. During the succeeding Tertiary period Central America were elevated, forming a complete barrier between the two oceans, during this period the differentiation of the two faunas took place. At a still later period there was probably a partial subsidence of Central America, allowing the passage of a few forms of the one region into the other.

Literature of the stalk and sessile-eyed Crustacea of the West Indian region.

1817 Thomas Say. An account of the Crustacea of the United States. Jour. Acad. Nat. Sci. Phila. (1) vol. I.

1836 Thomas Bell. Some account of the Crustacea of the coasts of South America, with descriptions of new genera and species; founded principally on the collections obtained by Mr. Cuming and Mr. Miller. Trans. Zool. Soc., vol. 2, p. 39. Includes three crabs from the coast of Brazil.

Ar. Fr. Aug. Weigmann. Beschre bung einiger neuen Crustaceen des Berliners Museums aus Mexico und Brasilien. Arch. f. Naturg., Bd. I, pp. 145–151. One species of Atya and four of Palæmon.

1850 Lewis R. Gibbes. On the Carcinological collections of the United States and an enumeration of species contained in them, with notes on the most remarkable, and descriptions of new species. Includes Decapoda and Stomatopoda.

1852 J. D. Dana. Crustacea. U. S. Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U. S. N., vol. XIII. Includes species collected at Rio Janeiro.

1857 M. F. E. Guérin-Méneville. Animaux articulés, a pied articulés in La Sagra's Histoire physique, politique et naturelle de L'Ile de Cuba. Paris. Crust., pp. XIII–LXVIII.

1858 H. de Saussure. Mémoire sur divers Crustacés nouveaux des Antilles et du Mexique. Mém. Soc. Hist. Nat. Genève, vol. XIV, p. 419.

1859 William Stimpson. Notes on North American Crustacea, No. I. Annals of the Lyceum of Natural History of New York, vol. 2, pp. 49–93, pl. 1. Brachyura and Anomura.

1860 William Stimpson. Notes on North American Crustacea, in the Museum of the Smithsonian Institution, No. II, op. cit. pp. 176–246, pls. II. and V. Brachyura and Anomura.

1867 M. A. Schramm. D'apres un manuscrit du docteur Desbonne. Crustacés de la Guadeloupe, Ire partie, Brachyures, Basse-Terre.

1868 Camil Heller. Crustaceen. Reise der Oesterreichischen Fregatte Novara, Zoologische Theil, Bd. II, abth. III, No. 1. Includes Crustacea collected at Rio Janeiro.

1869 Sidney I. Smith. Notes on new or little known species of American Cancroid Crustacea, Proc. Bost. Soc. Nat. Hist., vol. XII, pp. 274–289. Includes species of the genera Xantho and Panopeus from the Caribbean region.

Sidney I. Smith. Notice of the Crustacea collected by Prof. C. F. Hartt on the coast of Brazil in 1867. Trans. Conn. Acad., vol. II, pp. 1–41.

Ed. v. Martens. Südbrasilische Süss– und Brackwasser Crustaceen nach den Sammlungen des Dr. Reinh. Hensel. Arch. f. Naturg., Jahgr. 35, pp. 1–37, Taf. I and II. Includes species of the genera Boscia, Trichodactylus, Sylviocarcinus, Dilocarcinus, Gecarcinus, Cardisoma, Pelocarcinus, Uca, Helice, Sesarma, Gelasimus, Æglea, Astacus, Atya, Palæmon, Bithynis, Cryphiops.

M. Schramm. Catalogues des Coquilles et des Crustacés de la Guadeloupe envoyés a l'Exposition Universelle de 1867 par l'Administration de la Colonie. Collections caillet de I. Desbonne. Basse-Terre.

1870 William Stimpson. Preliminary Report upon the Crustacea dredged in the Gulf Stream in the Straits of Florida by L. F. Pourtalès, Assistant U. S. Coast Survey, part 1, Brachyura, Bull. Mus. Comp. Zool., vol. II, p. 109.

Sidney I. Smith. Notes on American Crustacea, No. 1, Ocypodoidea. Trans. Conn. Acad., vol. II, pp. 113–176.

1871 William Stimpson. Notes on the North American Crustacea in the Museum of the Smithsonian Institution, No. III, Ann. Lyc. Nat. Hist., New York, vol. x, pp. 92–136. Decapoda.

1872 Ed. v. Martens. Ueber Cubanische Crustaceen nach den Sammlungen Dr. J. Grundlach's, Arch. f. Naturg., Jahrg. 38, p. 77. Decapoda and Stomatopoda.

T. Hale Streets. Notes of some Crustacea from the Island of St. Martin, W. I. collected by Dr. Van Rygersma, Proc. Acad. Nat. Sci. Phila., pp. 131–134. Species collected: *Pericera cornuta*, *Gelasimus affinis*, *Calappa galloides*, *Dromia lator*, *Petrolisthes nodosus*, *P. jugosus and Palæmon Jamaicensis.*

1877 E. J. Miers. On a collection of Crustacea, Decapoda and Isopoda, chiefly from South America with descriptions of new genera and species, Proc. Zool. Soc., pp. 653–679.

1878 J. S. Kingsley. A synopsis of North American species of the genus Alpheus, Bulletin of the U. S. Geological and Geographical Survey of the Territories, vol. IV, pp. 189–199.

J. S. Kingsley. Notes on the North American Caridea in the Museum of the Peabody Academy of Science, at Salem, Mass., Proc, Acad. Nat. Sci. Phila., pp. 89–98.

J. S. Kingsley. List of the North American Crustacea, belonging to the suborder Caridea. Bull. Essex Inst., vol. X, pp. 53–71.

J. S. Kingsley. List of the Decapod Crustacea of the Atlantic Coast, whose range includes Fort Macon, Proc. Acad. Nat. Sci. Phila., pp. 316–330. Decapoda.

P. R. Uhler. List of animals observed at Fort Wool, Va. Chesapeake Zoological Laboratory of Johns Hopkins University, vol. 1, Crustacea, pp. 25–27.

1879 J. S. Kingsley. On a collection of Crustacea from Virginia, North Carolina and Florida, with a revision of the genera of Crangonidæ and Palæmonidæ. Proc. Acad. Nat. Sci. Phila., pp. 383–427. Decapoda.

S. I. Smith. The stalk-eyed Crustacea of the Atlantic Coast of North America, North of Cape Cod. Trans. Conn. Acad., vol. V, page 27. Includes a con-

sideration of the respective limits of the Northern and Southern littoral Crustacean fauna of the Eastern coast of North America.

1880 (1) Alphonse Milne-Edwards. Études sur les Xiphosures et les Crustacés de la règion Mexicaine. Mission Scientifique au Mexique et dans l'Amerique Centrale. Paris. Imprimerie nationale.

S. I. Smith. Occasional occurrence of tropical and sub-tropical species of Decapod Crustacea on the coast of New England. Trans. Conn. Acad., vol. IV, pp. 254.

(2) Alphonse Milne-Edwards. Reports on the results of Dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexicò and in the Caribbean Sea, 1877, '78. '79, by the U. S. Coast Survey steamer Blake, Lieut-Commander C. D. Sigsbee, U. S. N., and Commander J. R. Bartlett, U. S. N., commanding. VIII Études préliminaires sur les Crustacés. Bull. Mus. Comp. Zool. Cambridge, pp. 1–68. Decapoda.

1881 J. S. Kingsley. Notes on North American Decapoda. Proc. Bost. Soc. Nat. Hist., vol. XX, pp. 145. Includes description of Floridian decapods of the genera Mithraculus, Mithrax, Lambrus, Panopeus, Pilumnus and Pachygrapsus.

E. J. Miers. Notice of Crustacea collected by P. Geddes, Esq., at Vera Cruz. Jour. Linn. Soc., vol. XV, pp. 85–87. Species collected: *Panopeus* sp.? *Pachygrapsus socius*, *Pinnotheres Angelicus?*

Alphonse Milne-Edwards. Considerations générales sur la Faune carcinologique des grandes profondeurs du Golf de Mexique. Comptes rendus, t. 92, pp. 384–388.

1886 Emil A. Göldi. Studien ueber neue und weniger bekannte Podophthalmen Brasiliens. Beiträge zur Kentniss der Süsswasser-Genera; Trichodactylus, Dilocarcinus, Sylviocarcinus und der marinen Genera Leptopodia, Stenorhynchus.

E. J. Miers. Report on the Brachyura collected by H. M. S. Challenger, during the years 1873–1876. Includes Crustacea collected in the neighborhood of Bermuda, Fernando Noronha and Bahia.

W. K. Brooks. Report on the Stomatopoda collected by H. M. S. Challenger, during the years 1873–1876.

Frank Evers Beddard. Report on the Isopoda collected by H. M. S. Challenger, during the years 1873–1876.

The two preceding papers include species collected in the neighborhood of Sombrero, St. Thomas, Bermuda, Fernando Noronha and Bahia.

1887 C. L. Herrick. Contribution to the Fauna of the Gulf of Mexico and the South. List of the fresh-water and marine Crustacea of Alabama, with descriptions of the new species and synoptical keys for identification. Memoirs of the Denison Scientific Association, Granville, Ohio, vol. I, No. I.

1888 C. Spence Bate. Report on the Crustacea Macrura dredged by H. M. S. Challenger, during the years 1873–1876.

J. K. Henderson. Report on the Anomura collected by H. M. S. Challenger, during the years 1873–1876.

Thomas R. R. Stebbing. Report of the Amphipoda collected by H. M. S. Challenger, during the years 1873–1876.

The three preceding monographs include species collected in the neighborhood of Sombrero, St. Thomas, Bermuda, Fernando Noronha and Bahia.

Angelo Heilprin. Contributions to the Natural History of the Bermuda Islands. Proc. Acad. Nat. Sci. Phila., pp. 302–328. Includes a list of the Crustacea collected in the Bermudas.

1889 R. J. Pocock. Contributions to our knowledge of the Crustacea of Dominica. Ann. Mag. Nat. Hist. (6), vol. III, p. 6.

Explanation of Plate V.

Fig. 1. *Clibanarius formosus*, natural size.
Fig. 2. Dorsal surface of the right hand.
Fig. 3. *Clibanarius vittatus*, natural size.
Fig. 4. Dorsal surface of the right hand.
Fig. 5. *Gelasimus speciosus*, natural size.
Fig. 6. Inner surface of the hand.
Fig. 7. *Panopæus Herbstii.* Dorsal surface of the carapace, showing the leaf-like antero-lateral teeth.
Fig. 8. *Palæmonella Yucatanica*, enlarged two diameters.

Explanation of Plate VI.

Fig. 1. *Hippolyte Wurdemanni.* Enlarged two diameters.
Fig. 2. *Ligia Baudiniana.* Enlarged two diameters.
Fig. 3. *Cirolana Mayana.* Enlarged three diameters.
Fig. 4. Right side, enlarged three diameters.
Fig. 5. Dorsal view of right anterior antenna much enlarged.
Fig. 6. Anterior view of same.
Fig. 7. Last abdominal segment with appendages much enlarged.
Figs. 8, 9, 10. First, fourth and seventh legs of the right side.
Fig. 11. *Cymodocea caudata*, view of left side enlarged three diameters.
Fig. 12. Dorsal view, enlarged three diameters.
Fig. 13. Seventh thoracic segment, with the male appendages, much enlarged.
Fig. 14. Fourth leg of the right side, much enlarged.
Fig. 15. *Cymodocea Bermudensis*, enlarged three diameters.
Fig. 16. Left side, enlarged three diameters.

April 7.

Mr. Theodore D. Rand in the chair.

Fifty-three persons present.

Papers under the following titles were presented for publication :—

Mexican Grasses: An enumeration of the Grasses collected by Mr. C. G. Pringle in Mexico in 1890. By F. Lamson Scribner.

Mineral Localities of Philadelphia and Vicinity. By Theodore D. Rand, William W. Jefferis and J. T. M. Cardeza, M. D.

April 14.

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

Twenty-five persons present.

A paper entitled "Note on Mesozoic Mammalia," by O. C. Marsh, was presented for publication.

The deaths of Mr. Aubrey H. Smith, member, on the 14th and Mr. A. Sydney Biddle, member, on the 9th inst. were announced.

April 21.

Mr. Charles Morris in the chair.

Twenty-four persons present.

The death of Mr. P. W. Sheafer, a member, March 26, was announced.

Pedomorphism.—Dr. Harrison Allen spoke of the disposition occasionally exhibited in adult mammals, for the proportions of different parts of the body to remain as they were in the immature individuals. He claimed for this peculiarity that it is not due to arrest of growth but to the fact that certain parts preserve the peculiarities of the young; thus, for example, among the bats, the so-called species *V. lucifugus* exhibits a number of characteristics which are found in the immature animal and which are the same in kind as those that exist in an individual which in every other respect answers to the description of the adult. In young bats, the foot and thumb are apt to be large as compared with the same parts in the adult, at the same time that the auricle and tragus are correspondingly small and the snout high, blunt and nearly naked. The parts often so remain. Dr. Allen proposed for this peculiarity the term pedomorphism. "*V.*

lucifugus" becomes a pedomorphic variety of *V. subulatus*. It might be expected that pedomorphic varieties closely resemble each other when the same disposition is exhibited in closely allied species. It is almost impossible to distinguish the pedomorphic variety of *V. subulatus* from that of *V. nitidus;* or, to express it differently, the "*V. lucifugus*" from the range of *V. subulatus* is an almost identical form with the "*V. lucifugus*" from the range of *V. nitidus*. Some species exhibit the disposition to retain pedomorphic variation to a greater degree than others, and it is held to be probably true that the existence of this disposition to so remarkable a degree in the North American species of *Vespertilio* accounts for the great confusion which has existed in this genus.—Writers imply by their language that there is but one kind of variation, namely, the geographical. It is an advantage to recognize two kinds, namely, the pedomorphic and the geographical.

April 28.

Dr. George H. Horn in the chair.

Twenty-four persons present.

The following were elected members:

John Arschagonni, M. D., Robert P. Morton, Witmer Stone and Edwin Corlies Atkinson.

Charler Otis Whitman of Worcester, was elected a correspondent.

The following were ordered to be printed:—

ECHINODERMS AND ARTHROPODS FROM JAPAN.

BY J. E. IVES.

The marine invertebrates enumerated and described in the following pages were collected by Mr. Frederick Stearns, of Detroit, Michigan, during nearly a year's residence in Japan. He was assisted by an intelligent Japanese, who visited at intervals the entire southeastern coast from Tokyo by Sagama and Saruga, along Kii, Awa and Toza, and the north shore of the Inland Sea as far west as Bingo, in communication with the fishermen, who dredge for fish and molluscs in water sometimes as deep as thirty fathoms.

The southeastern coast of Japan is washed by the warm waters of the Kuro Schiwo, the continuation of the north equatorial current of the Pacific. The fauna of this coast is essentially Indo-Pacific, although it possesses many species both of echinoderms and crustaceans peculiar to it.[1] There does not appear to be any evidence of a recent connection of the southern portion of Japan with the mainland, and the Indo-Pacific species found there must have been carried thither by the Kuro Schiwo, probably in the larval condition. The forms that are peculiar may be regarded as Indo-Pacific types differentiated by the special character of these shores.

The knowledge of the echinoderm and crustacean faunas of these coasts has been largely derived from the collections made by Ph. Fr. von Siebold. The star-fishes collected by him were described by Müller and Troschel in the System der Asteriden, to whose descriptions additional information was furnished by Dr. Von Martens in 1865.[2] The crustacea were monographed by De Haan in the "Fauna Japonica," and this beautiful work even at this day leaves little to be desired by the systematist. To the knowledge of the latter group, additions were made by Stimpson [3] in 1857, 1858 and

[1] For a discussion of the limitations of the Japanese region see Professor Dana in his monograph of the Crustacea of the U. S. Exploring Expedition; Prof. A. Agassiz in the Revision of the Echini and Dr. Paul Fischer, in the Manuel de Conchyliogie.

[2] Arch. f. Naturg., Jahrg. 31, pp. 345–360.

[3] Prodromus descriptionis animalium invertebratorum quæ in expeditione ad oceanum Pacificum septentrionalem a Republicâ federatâ missâ Cadwaladaro Ringgold et Johanne Rodgers ducibus, observavit et descripsit. Proc. Acad. Nat. Sci. Phila., Pts. I–III, 1857; Pts. IV–VII, 1858; Pt. VIII, 1860.

1860, and by Miers[1] in 1879. Dr. Ludwig Döderlein[2] has made the most important addition to the department of Echinoids, recording in 1885 forty-seven species of sea urchins collected by himself in Japan, of which twenty were new. The most important contribution to the Pycnogonoids of Japan was made in 1890 by Dr. A. Ortman,[3] who described the specimens collected by Dr. Döderlein. Three new species, collected by Dr. Hilgendorff in Japan had already been described by R. Böhm[4] in 1879. The Challenger Expedition collected on the southeast coast of Japan. Its various monographs contain contributions to the fauna of this coast.

The entire collection made by Mr. Stearns was not forwarded to me, only duplicates being sent where more than one specimen was collected. I am, therefore, unable to give any particulars as to the abundance or scarcity of the forms obtained, except in the cases where only one specimen was found, when that fact is stated.

I wish to acknowledge my indebtedness to Mr. Stearns, for his liberality in making possible the publication of the plates accompanying this paper.

In the following pages the species of echinoderms and crustacea collected by Mr. Stearns are enumerated, a new Ophurian, a new crab, and a new and interesting Pycnogonoid are described, and several species of star-fishes hitherto unfigured, have been figured.

ASTEROIDEA.

Astropecten armatus.
Müller und Troschel, System der Asteriden, p. 71.

Astropecten Japonicus. Pl. VII, figs. 5–9.
Müller and Troschel, op. cit., p. 205.

Only a single specimen collected by Mr. Stearns.

Astropecten scoparius. Pl. VIII, figs. 1–4.
Müller and Troschel, op. cit., p. 71.

Luidia quinaria. Pl. IX, figs. 5–9.
Von Martens, Archiv f. Naturg. 1865, p. 352.
Sladen, Challenger Asteroidea, p. 253.

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[1] On a collection of Crustacea made by Capt. H. St. John, R. N. in the Corean and Japanese Seas. Pt. I, Podophthalmia, with an appendix by Capt. H. C. St. John, Proc. Zool. Soc. 1879, pp. 18–61, Pls. I–III.

[2] Seeigel von Japan und den Lius Riu Inseln, Arch. f. Naturg., Jahrg. II, pp. 73–112, and Die Japanische Seeigel. 1, Familien *Cidaridæ* und *Salenidæ*, Stuttgart, 1887.

[3] Zool. Jahrbb. Bd. 5, pp. 157–167.

[4] S. B. Gesellsch. Naturf. Freunde zu Berlin, 1879, pp. 53–60.

Asterina pectinifera. Pl. X, figs. 1–4.
Müller and Troschel, op. cit , p. 40.
Von Martens, op. cit., p. 352.

Nine specimens of this species were sent by Mr. Stearns, indicating that it is found in abundance. It agrees in general characters with *Asterina miniata*, but differs from that species in the more heap-like arrangement of the spinelets of the paxillæ, in the absence of a well marked series of paxillæ along the middle line of the dorsal surface of each arm, and in the color.

Nardoa semiregularis var. **Japonica.** Pl. VII, figs. 1–4.
Von Martens, op. cit., p. 351.

Cribrella sanguinolenta. Pl. IX, figs. 1–4.
O. F. Müller, Zool. Dan. Prodr., p. 234.
Sladen, op. cit., p. 542.

Asterias Amurensis. Pl. VIII, figs. 5–8.
Lütken, Vidensk. Meddel. Kjöbenhaven, 1871, p. 296.
Sladen, op. cit., p. 575.

This species is closely related to *Asterias versicolor* of Sladen. Future investigation may prove them to be identical.

Asterias torquata.
Sladen, op. cit., p. 570, Pl. CII, figs. 1–4.

Only a single specimen was collected by Mr. Stearns.

OPHIUROIDEA.

Pectinura Stearnsii, n. sp. Pl. XI, figs. 1–5.

Disk covered beneath the granulation with small coarse scales; granulation fine and close; radial shields large, irregularly oval, somewhat acute at both ends, nearly twice as long as broad. Mouth shields large, sub-triangular; supplementary plate semi-circular, less than one-fourth the size of the mouth shields. Side mouth shields small, smaller than the supplementary plates. Fourteen mouth papillæ to each angle; the two outer papillæ very broad, sub-quadrate, as broad as three of the others. At the apex of the mouth angle are two papillæ half as broad as the outer-most mouth papillæ, projecting into the mouth angle one on either side with their bases resting upon the side mouth shields.[1] Five rounded teeth. Length of the arms from the edge of the disk to the tip, rather more than four times the diameter of the disk. Upper arm plates entire; lower arm plates quadrate with the angles truncated with slight indentation of the aboral edge; half as broad again as long. Pores

[1] Unfortunately, through an oversight, the number and shape of the mouth papillæ. are not clearly shown in the accompanying figure of this species.

between the first and second under arm plates. Two tentacle scales, the inner one longer than the outer, with a round end, the outer broader than the inner one, shorter and truncated, overlapping the base of the lowest side arm spine; side arm plates occupying two-thirds of the height of the arm, near the base of the arm, with eleven short flattened arm spines, the lowest arm spine the longest, the rest subequal about one-half the length the side arm plate.

Dorsal surface of the disk in dried specimen dirty brown, mottled with darker and lighter brown. Radial shields chocolate brown. Dorsal surface of the arms greenish-gray irregularly banded with dark brown and spotted with lighter. Ventral surface of the disk brownish around the edges and reddish spotted with lighter towards the center. Ventral surface of the arms grayish towards the extremities and reddish spotted with lighter in the neighborhood of the disk.

In the specimen described, diameter of the disk 30 mm., length of an arm from the edge of the disk to the tip, 105 mm.

This species is allied to *Pectinura marmorata*[1] from the Philippines, but may be distinguished from it by its much smaller supplementary mouth shields, its higher side arm plates, its shorter and flatter arm spines, and its truncated, not rounded, outer tentacle scale.

A single specimen has been presented to the Academy by Mr. Stearns.

Ophioplocus imbricatus. Pl. XI, figs. 6–10.
Müller and Troschel, op. cit., p. 93.
Lyman, Proc. Bost. Soc. Nat. Hist., Vol. VIII, p. 76; Illus. Cat., p. 69, Mem. Mus. Comp. Zool., Vol. I; Challenger Ophiuroidea, p. 20, Pl. XXXVII, figs. 10–12.

Three specimens. The largest with a disk 28 mm. in diameter, one-third of the length of an arm, and the smallest with a disk 13 mm. in diameter, one-fourth of the length of an arm. Genital slits, as observed by Mr. Lyman[2] on specimens from Japan and Java in the Leyden Museum, extending to the mouth shields, thus reaching for more than half the distance from the aboral edge of the mouth shields to the edge of the disk. The specimens collected by Mr. Stearns also differ from the typical form of *Ophioplocus imbricatus* in the presence of a number of small supplementary arm plates between, or on the edges of the larger plates.

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[1] Lyman, Bull. Mus. Comp. Zool., Vol. 3, pp. 222, 223, Pl. V, figs. 1–7.

[2] Bull. Mus. Comp. Zool., Vol., VIII, p. 228.

ECHINOIDEA.

Goniocidaris biserialis.

Stephanocidaris biserialis, Döderlein, Archiv f. Naturg. Jahrg. 51, p. 80.

Goniocidaris biserialis, Döderlein, "Die Japanische Seeigel," Theil. I, pp. 10–13, Taf. V, Taf. VIII, fig. 8a-h.

A single test of this interesting species was collected by Mr. Stearns. The coronal, genital and ocular plates are moderately thick.

Diadema setosum.

Gray, 1825, Ann. Phil., p. 4 (from Rumph.).

A. Agassiz, Rev. Echin., Mem. Mus. Comp. Zool. Vol., III, p. 274, Pls. IVa, etc.

Strongylocentrotus depressus.

A. Agassiz, Proc. Acad. Nat. Sci. Phila., p. 440; Rev. Echin., Mem. Mus. Comp. Zool., Vol. III, p. 440.

A single specimen collected.

Strongylocentrotus tuberculatus.

Lamarck, Anim. sans Vert., p. 50.

A. Agassiz, Rev. Echin., p. 449, Pl. V b, figs. 4–5, Pl. XXXVI, fig. 4.

Temnopleurus Reynaudi.

Agassiz, C. R., Ann. Sci. Nat., VI, p. 360.

A. Agassiz, Rev. Echin., p. 461, Pl. VIII, figs. 22–24, Pl. VIII a, figs. 6, 7.

Temnopleurus toreumaticus.

Leske, Additamenta ad. Klein, p. 91.

A. Agassiz, Rev. Echin. pp. 463, 464, Pl. VIIIa, figs. 4–5.

Toreumatica Hardwickii, Gray, Proc. Zool. Soc. 1855, p. 39; A. Agassiz, op. cit., pp. 460, 461, Pls. VIII, VIIIa, XXV, XXXVI.

In the series of six specimens presented to the Academy by Mr. Stearns, three are forms connecting *Temnopleurus toreumatica* and *Temnopleurus Hardwickii* as defined by Professor Alexander Agassiz in the Revision of the Echini, and I am, therefore, compelled to regard the latter species as a synonym of the former. One specimen having rather deep pits, has the ocular and genital plates covered with prominent tubercles, and other specimens show the passage from the deep rectangular pits to the bevelled grooves of the ambulacral and interambulacral regions.

Toxopneustes pileolus.

Lam., Anim. sans Vert., p. 45.

Alex. Agassiz, Rev. Echin., Mem. Mus. Comp. Zool., Vol. III, p. 497, Pls. VIIIb, etc.

A single specimen obtained.

Echinanthus testudinarius.

Gray, Proc. Zool. Soc. 1851, p. 35; Cat. Echin. Brit. Mus., p. 6, Pl. 1, fig. 1.

A. Agassiz, op. cit., p. 514.

Laganum decagonalis.

Lesson, Blainville, Dict. Sci. Nat. Scut., p. 229.

A. Agassiz, op. cit., p. 520, Pls. XIIIe, XXXVII.

In the specimens presented to the Academy by Mr. Stearns the connecting walls do not ramify, and as there can be no doubt that these specimens belong to this species, the distinction between the genera *Peronella* and *Laganum*, as defined by Professor Alexander Agassiz, does not hold good.

Echinarachnius mirabilis.

Barnard, A. Agassiz, Proc. Acad. Nat. Sci. Phila. 1863, p. 359.

A. Agassiz, Rev. Echin., Mem. Mus. Comp. Zool., Vol. III, p. 526, Pls. XIII a, XXXVII.

Schizaster Japonicus.

A. Agassiz, Proc. Acad. Nat. Sci. Phila. 1879, Vol. XIV, p. 212; Challenger Echinoidea, p. 202, Pls. XXXVI, XLIII, XLV.

CRUSTACEA.

Pugettia incisa.

Pisa (*Halmius*) *incisa*, De Haan, Fauna Japonica, Crust., p. 98, Pl. XXIV, fig. 3, Pl. G.

Pugettia incisa, Miers, Challenger Brachyura, p. 40.

Chlorinoides longispinus.

Maja (*Chorinus*) *longispina*, De Haan, op. cit., p. 94, Tab. XXIII, fig. 2, *Maja* (*Chorinus*) *aculeata*.)

Chlorinoides longispinus, Miers, Challenger Brachyura, p. 53.

Schizophrys aspera.

Mithrax aspera, Milne-Edwards, Hist. Nat. Crust., Vol. I, p. 320.

Schizophrys aspera, A. Milne-Edwards, Nouv. Arch., Vol. VIII, p. 231, figs. 1–1f.

Lambrus validus.

Parthenope (*Lambrus*) *validus*, De Haan, op. cit., p. 90, Tab. XXI, fig. 1, Tab. XXII, figs. 1–3.

Atergatis floridus.

Cancer floridus, L., Syst. Nat., ed. XII, p. 1044.

Atergatis floridus, Dana, Crust. U. S. Explor. Exped., p. 159, Pl. VII, fig. 4.

A single specimen was collected.

Goniosoma Japonicum.

Goniosoma sexdentata, De Haan, op. cit., 41, Pl. XII, fig. 1.

Goniosoma Japonicum, A. Milne-Edwards, Arch. Mus., t. X, p. 372.

Goniosoma acutum, A. Milne-Edwards, Nouv. Arch., t. V, p. 150, Pl. VII, figs. 8–10.

The specimen given to the Academy by Mr. Stearns is intermediate in character between *G. Japonicum* and *G. acutum*, and I have, therefore, given the latter species as a synonym of the former. The posterior antero-lateral tooth on the right side is produced as in Milne-Edwards' figure of *G. acutum*, but on the left side it is not produced and is not longer than the preceding tooth. The carapace is rather less extended at the sides than in the figure of this species, and rather more so than in the figure of *G. Japonicum*. The antero-lateral teeth are rather less prominent than in *G. acutum* and rather more so than in *G. Japonicum.* The outline of the postero-lateral borders of the carapace is also intermediate in character. Three other specimens from Japan in the Museum of this Academy show the passage of the one form into the other.

Macrophthalmus dilatatus.
Ocypoda (Macrophthalmus) dilatata, De Haan, op. cit., p. 55, Tab. XV, fig. 3.

Brachynotus (Heterograpsus) penicillatus.
De Haan, op. cit., pp. 32, 60, Tab. XI, fig. 5.

Helice tridens.
De Haan, op. cit., p. 57, Tab. XI, fig. 2; Tab. XV, fig. 6.

Sesarma affinis.
Grapsus (Pachysoma) affinis, De Haan, op. cit., p. 66, Tab. XVIII, fig. 5.

Eriocheir Japonica.
Grapsus (Eriocheir) Japonicus, De Haan, op. cit., p. 39, Tab. XVII.

Philyra pisum.
De Haan, op. cit., p. 131, Tab. XXXIII, fig. 7.

Arcania undecimspinosa.
De Haan, op. cit., p. 135, Tab. XXXIII, fig. 8.

Leucosia unidentata.
De Haan, op. cit., p. 133, Tab. XXXIII, fig. 3.

Leucosia longifrons.
De Haan, op. cit., p. 132, Tab. XXXIII, fig. 4.

It is very probable that this and the preceding form represent merely two varieties of the same species.

Dorippe Japonica.
Von Siebold, Spicilegia, Fauna Japonica, p. 14.
De Haan, op. cit., p. 122, Pl. XXXI, fig. 1 (*Dorippe callida*).

Cryptodromia Stearnsii, n. sp. Pl. XII, figs. 1–3.

Carapace sub-pentagonal in outline, the angle of the pentagon directed forwards being occupied by the rostral teeth as broad as long; upper surface very convex, smooth, minutely punctate, with a few minute scattered tubercles, cervical groove well defined. An ill-defined groove bounded on either side by a slight elevation leads to the depression between the lateral rostral teeth. Median rostral tooth small, triangular, depressed; lateral rostral teeth well developed, rounded triangular, their inner borders depressed, supra-orbital tooth very small. The posterior border of the orbit forming a slight prominence. Three small antero-lateral teeth, the third or most posterior placed at the junction of the lateral and the antero-lateral edges of the carapace; the second placed on a level with the third, at about two-thirds of the distance from the posterior border of the orbit to the third, and the first placed rather higher upon the carapace than the other two, at about one-third of the distance from the posterior border of the orbit to the third tooth. Lateral border divided by a groove which commences at about one-third of the distance from the third antero-lateral tooth to the posterior border of the carapace. Behind the groove at its commencement is a small tooth. This groove is continued backwards and inwards across the branchial area and ends by passing forwards into the groove separating the branchial and cardiac regions. The subhepatic area is small and has four small teeth, two of them placed one behind the other beneath the eye, along the inner border of the area; a third placed behind these two; and a fourth placed half way between the last mentioned and the second antero-lateral tooth on the edge of the carapace.

Two large tubercles upon the distal edge of the outer surface of the carpus of the cheliped, a smaller one behind these two, and a still smaller one above this one. Two tubercles upon the distal end of the upper surface of the manus, the outer tubercle the larger of the two, and a minute tubercle situated at the proximal end of a row of three minute tubercles along the inner edge of the upper surface. The carpal joints of the two anterior pairs of cruripeds (ambulatory legs) end in two tubercles, the propodal joints in one. In the specimen examined only the first pair of the last two pairs of cruripeds are entire, and they possess but a single claw each.

The entire specimen under examination is covered with apparently a pilose pubescence.

The species closely resembles *Cryptodromia Japonica* but may be readily distinguished from it by the presence of three antero-lateral teeth instead of two.

The genus *Cryptodromia* was established by Stimpson in 1858,[1] and the following species, have been referred to it:—

C. nodipes, *Dromia nodipes* (Lamarck) Milne-Edwards, Hist. Nat. Crust., t. II, p. 177, 1837; Guerin, Icon., Pl. 14, fig. 1.

C fallax, *Dromia fallax* (Lamarck) Milne-Edwards, op. cit., p. 176; Mauritius.

C. lateralis, *Dromia lateralis*, Gray, Zool. Miscell., p. 40; Haswell, Cat. Austral. Crust., p 139.
Australia, New Zealand and Japan.

C. coronata, Stimps., Proc. Acad. Nat. Sci. Phila., 1858, p. 239.
Bonin Islands.

C. tuberculata, Stimps., op. cit., p. 239.
Gaspar Straits, Island of Kikaisima and Bay of Kagosima.

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[1] Proc. Acad. Nat. Sci. Phila. 1858, p. 225.

C. tumida, Stimps., op. cit., p. 240.
Bay of Fou-kow, Island of Ousima.
C. canaliculata, Stimps. loc. cit.
Gaspar Straits, Loo-choo Islands, Kikaisima Island.
C. tomentosa, *Dromia tomentosa*, Heller, S. B. Akad. Wiss. Wein, Bd. XLIV, Abth. I, p. 241, 1861.
Dromia (*Cryptodromia*) *tomentosa* Hilgendorf, M. B. Akad. Wiss. Berlin, 1878, p. 813. Taf. II, figs. 3-5.
Red Sea; Ibo Island, Mozambique.
C. pentagonalis, *Dromia* (*Cryptodromia*) *pentagonalis*, Hilgendorf, op. cit., p. 814, Taf. II, figs. 1, 2.
Ibo Island. Mozambique.
C. Japonica, Henderson, "Challenger" Anomura, p. 6, Pl. I, fig. 2.
Off Yokoska, Japan.
C. nodulifera, Henderson, op. cit., p. 8, Pl. I, fig. 3.
Off the Australian coast.
C. incisa, Henderson, op. cit., p. 10, Pl. I, fig. 4.
Off Twofold Bay, Australia.

Mr. Miers[1] records a young specimen from the Corean and Japanese Seas of doubtful species, and Dr. de Man[2] records another young specimen of doubtful species from the Mergui Archipelago.

Lyreidus tridentatus.
De Haan, op. cit., p. 140, Tab. XXXV, fig. 6.

Eupagurus constans.
Stimpson, Proc. Acad. Nat. Sci. Phila. 1858, p. 248.
Henderson, Challenger Anomura, p. 67, Pl. VI, fig. 8.

A single specimen collected.

PANTOPODA.

An interesting Pycnogonoid collected by Mr. Stearns apparently represents a new species. In describing it I have followed in a general way the nomenclature of parts adopted by Dr. Hoek in his monograph of the Pycnogonoids collected by the Challenger Expedition. I differ from him slightly, however, in terming the whole of the trunk, from its junction with the proboscis to the commencement of the abdomen, the cephalothorax, instead of confining that term to the first segment of the trunk. This appears to me to be a more correct use of the term, as when the cephalon and thorax are united, the cephalon ceases any longer to be the cephalon pure and simple, and the thorax, in the same way, any longer the thorax pure and simple. The whole then becomes the cephalothorax, and any part of it is a part of the cephalothorax.

The following is a description of the species.:—

[1] Proc. Zool. Soc. 1879, p. 44.

[2] Jour. Linn. Soc., Vol. XXII, p. 211, 1888.

Ascorhynchus Japonicus, n. sp. Pl. XII, figs. 4–10.

Body strong, slender; its surface very minutely tuberculated; tubercles themselves, when highly magnified, seem to be multi-tuberculate; proboscis one-third of the total length of the body; abdomen one-half of the length of the proboscis; three strong spines placed on the dorsal posterior margin of the first three cephalo-thoracic segments. Proboscis stout, pyriform, triangular in transverse section; sides of the proboscis not longitudinally furrowed, divided by constriction into an anterior and a posterior portion, the anterior portion nearly twice as long as the posterior portion, the whole resembling an unopened rose-bud; truncated at its extremity. Mouth large, triangular.

Length of the first cephalo-thoracic segment about two-fifths of that of the whole cephalo-thorax. Anterior portion rectangular, bearing at the angles the mandibles. No azygous knob between the mandibles. Palpi inserted at about one-quarter of the distance between its anterior and posterior extremities, a slight elevation between the palpi. Slightly narrowed immediately behind the insertion of the palpi. Large, conical, oculiferous tubercle situated between the lateral processes of the ovigerous legs at rather more than half the distance from its anterior to its posterior border, possessing four distinct eyes of moderate size; the two anterior eyes rather larger than the two posterior; pigment of a light reddish color. A rather smaller tubercle is found upon its dorsal posterior border. Lateral processes for the insertion of the ovigerous legs, short, not longer than the width of that portion of the segment directly in front of them; those for the insertion of the true legs long, three times as long as those last mentioned.

Second and third cephalothoracic segments about as long as their lateral processes which are rather longer than those of the first segment; each segment possessing a prominent tubercle upon its postero-dorsal margin. Fourth cephalo-thoracic segment of about the same length as the third.

Abdomen long and narrow, slightly swollen at the extremity.

Mandibles three jointed, chelate, claws very small, slight. First joint the longest; second joint rather more than half as long as the first joint.

Palpi incomplete in the specimen, only eight joints being present, but apparently of very nearly the same form as in *Ascorhynchus gla-*

ber Hoek.[1] First two joints extremely small; the third the longest, half as long as the proboscis; the fourth short, the fifth nearly four times as long as the fourth; the sixth short, slightly shorter than the fourth; the seventh about twice as long as the sixth; the eight slightly longer than the seventh.

The ovigerous legs have the fourth joint the longest, as long as the anterior portion of the proboscis; the fifth rather shorter; the sixth about one-half the length of the fifth; the seventh, eighth, ninth and tenth slightly decreasing in length from the sixth; the terminal claw minute; the first joint very small; the second and third about one-third of the length of the fourth. The denticulated spines placed in several rows of different sizes. The fourth, fifth and sixth joints armed with bristles most numerous at the distal extremities of the fifth and sixth joints.

The legs in the specimen collected are all imperfect but correspond in general shape to those of *A. glaber*, as shown in Dr. Hoek's figure. Of the first pair, the first, second and third joints are present; of the second, the first, second, third and fourth; of the third and fourth, the first, second, third, fourth and fifth. The joints of the first pair of legs are slightly shorter than those of the second pair, and the joints of second pair, are slightly shorter of those of the third and fourth pairs. Of the third pair, the first joint is nearly as long as the lateral process; the second nearly twice as long as the first joint, the third rather shorter than the first; the fourth joint about half as long again as the proboscis, and the fifth joint rather shorter than the fourth. The legs are hairless. The fourth and fifth joints where present are furnished with a row of minute tubercles upon the dorsal surface, such as is found in *Ascorhynchus glaber*.

The specimen collected is a male, the fourth joint of the legs being slender, the genital pores minute, and the ovigerous legs well developed. The genital pores are situated on the ventral extremity of the second joint of the two posterior pairs of legs.

Color of the dried specimen, a light yellowish brown.

Length of the proboscis,	12·5 mm.
Length of the trunk,	18·5 mm.
Length of the abdomen,	6·0 mm.
Length of the whole body,	37·0 mm.

[1] 'Challenger' Pycnogonida, pp. 53–55, Pl. VI, figs. 5–9; Pl. XV, fig. 16.

This is a very fine species, much larger than any other species of the genus yet known. The only other species which approach it in size are *Ascorhynchus glaber* and *Ascorhynchus orthorhynchus*. It is nearly half as long again as *Ascorhynchus glaber*, the larger of these two species.

It is closely allied to the latter species, but differs from it in the following well-marked characters:—

1. The proboscis is divided into two portions, is truncated and not longitudinally furrowed while in *A. glaber* it is divided into three portions, is sharply pointed and each of its three sides is longitudinally furrowed.

2. The oculiferous tubercle bears four distinct eyes, whereas in *A. glaber* it is entirely destitute of eyes.

3. The surface of the whole body is covered with a very minute granulation, whereas in *A. glaber* it is entirely smooth, with the exception of the dorsal cephalo-thoracic spines.

It will be seen from the above description that this is a species of great interest. The form to which it is closely related, *A. glaber*, was dredged in the Southern Ocean, between the Cape of Good Hope and Kerguelen Island in 1375 fathoms. The species from Japan was obtained in shallow water. The presence of eyes in *A. Japonicus* and the simple character of the proboscis, divided into two portions instead of into three, causes the question as to whether this species does not represent the ancestral type of *A. glaber*, which may have become adapted to deep water and migrated southwards.

Dr. Hoek in his monograph of the Pycnogonida collected by the Challenger Expedition, gives a list of the species then known. The following species of *Ascorhynchus* have been described since, all from Japan.:—

A. cryptopygius, Ortmann, Zool. Jahrbb. Bd. 5, p. 159, Taf. XXIV, fig. 2, 1890.
A. glabroides, Ortmann, op. cit., p. 160, Taf. XXIV, figs. 3a, 3b.
A. bicornis, Ortmann, op. cit., p. 162.

Of the nine species now known, five are peculiar to Japan.

Explanation of Plates.

Plate VII.

Fig. 1. *Nardoa semiregularis* var. *Japonica*, dorsal surface, natural size.
Fig. 2. Ventral surface, natural size.
Fig. 3. Portion of the dorsal surface of an arm, enlarged.
Fig. 4. Portion of the ventral surface enlarged.

Fig. 5. *Astropecten Japonicus*, dorsal surface, natural size.
Fig. 6. Ventral surface, natural size.
Fig. 7. Portion of the dorsal surface of an arm, enlarged.
Fig. 8. Portion of the ventral surface, enlarged.
Fig. 9. Portion of the side of an arm near its base, enlarged.

Plate VIII.

Fig. 1. *Astropecten scoparius*, dorsal surface, natural size.
Fig. 2. Ventral surface, natural size.
Fig. 3. Portion of ventral surface, of an arm, enlarged.
Fig. 4. Portion of dorsal surface enlarged.
Fig. 5. *Asterias Amurensis*, dorsal surface, natural size.
Fig. 6. Ventral surface, natural size.
Fig. 7. Portion of the dorsal surface of an arm, enlarged.
Fig. 8. Portion of ventral surface, enlarged.

Plate IX.

Fig. 1. *Cribrella sanguinolenta*, dorsal surface, natural size.
Fig. 2. Ventral surface, natural size.
Fig. 3. Portion of dorsal surface of an arm, enlarged.
Fig. 4. Portion of ventral surface, enlarged.
Fig. 5. *Luidia quinaria*, dorsal surface, natural size.
Fig. 6. Ventral surface, natural size.
Fig. 7. Portion of dorsal surface of an arm, enlarged.
Fig. 8. Portion of the side of an arm near the base, enlarged.
Fig. 9. Portion of the ventral surface of an arm, enlarged.

Plate X.

Fig. 1. *Asterina pectinifera*. Dorsal surface, natural size.
Fig. 2. Ventral surface, natural size.
Fig. 3. Portion of dorsal surface, enlarged.
Fig. 4. Portion of ventral surface, enlarged.

Plate XI.

Fig. 1. *Pectinura Stearnsii*. Dorsal surface, natural size.
Fig. 2. Ventral surface, natural size.
Fig. 3. Portion of the dorsal surface of an arm near the base, enlarged.
Fig. 4. Portion of ventral surface of an arm near the base, enlarged.

Fig. 5. Portion of the side of an arm near the base, enlarged.
Fig. 6. *Ophioplocus imbricatus.* Dorsal surface, natural size.
Fig. 7. Ventral surface, natural size.
Fig. 8. Portion of the dorsal surface of the disk and an arm, enlarged.
Fig. 9. Portion of the ventral surface of the disk and an arm, enlarged.
Fig. 10. Portion of the side of an arm near the base, enlarged.

Plate XII.

Fig. 1. *Cryptodromia Stearnsii,* dorsal surface, natural size.
Fig. 2. Ventral surface, natural size.
Fig. 3. Left side of the carapace, natural size.
Fig. 4. *Ascorhynchus Japonicus,* dorsal surface, natural size.
Fig. 5. Ventral surface, natural size.
Fig. 6. Right side of the trunk with anterior appendages, without the legs, natural size.
Fig. 7. Oculiferous tubercle, viewed from the right side, enlarged.
Fig. 8. Oculiferous tubercle, viewed from above, enlarged, *a* anterior margin, *b* posterior margin.
Fig. 9. Fifth joint of the fourth leg on the right side, enlarged.
Fig. 10. Mandibles, viewed from above, enlarged.

ON THE EXTERNAL CHARACTERS OF FŒTAL REINDEER, AND OTHER NOTES.

BY R. W. SHUFELDT, M. D.

Mr. Lucien M. Turner, on the 20th of May, 1884, collected at Fort Chimo, Ungava District, Hudson's Bay, two specimens of fœtal Reindeer, or Woodland Caribou (*Rangifer tarandus caribou*, Kerr), one being a male and the other a female. They were taken from slain does, "one from each, and within eighteen days of delivery," and at once consigned to strong alcohol, the tank containing them being sent to the Smithsonian Institution at Washington. Early in February, 1886, Professor Baird sent them to the writer, then residing at Fort Wingate, New Mexico, for anatomical description; owing to the fact, however, that my investigations upon the osteology of arctic birds then engaged every moment of my available time, they were not examined until nearly the middle of June of the same year. Although they had been in spirit two years, they were found to be in excellent condition, and I at once made the drawing of the head of the male, which illustrates the present paper. As will be seen further on, the male fawn of this pair is somewhat larger than the female, with which it differs in several minor details other than those pertaining to the organs of sex.

The male subject I found to possess a very full coat of soft fine hair which completely covered its body, extending up to the lips and snout, and well inside of the external ears. In the median line in front, from below the jaw to the root of the neck, this hair is so long as to form a conspicuous beard, becoming longer as we proceed towards the last-named locality, where it is the best developed.

About the muzzle, this hair is of a dark blackish-brown color, which shades off as we advance towards the forehead, and again becomes darker around the eye.

The ears are completely covered with a coat of soft fur of a light brownish-clay color, darkest at their bases, and shading off toward their tips. The remainder of the hair of the head is of a fawn-brown, which color extends down on the neck, but as we come on to the body this changes to a dark chocolate-brown above, and a clay-colored brown on the lower parts and abdomen.

The limbs are of about the same shade as the back, and the tail, which is well developed, is dark above and lighter beneath. No pure white occurs upon either of the specimens.

Fig. 1.

Left lateral view of the head of fœtal Reindeer (*R. tarandus caribou*). A much reduced copy made by the author from his life-size colored figure.

Unfortunately, the eyes were found to be nearly destroyed for any purpose, and it was not only impossible to tell the color of the irides, but the long keeping had rendered them useless for anatomical description.

All of the hoofs were found to be fairly well developed, except at their antero-internal tips, where the horn-substance had been of such a delicate and elementary character as to have become quite shrunken and wrinkled by the action of the alcohol.

These remarks apply equally well to the condition of the hoofs of the posterior rudimentary digits, of which, as usual, there are two at the back of each foot.

Either external nostril is an aperture of considerable size, and viewed from above it is parallel to the longitudinal axis of the body, while seen upon lateral aspect it is oblique with its posterior commissure the higher.

Eyelashes are well pronounced on the eyelids, especially on the superior ones, being best developed on the middle of the lid, and becoming shorter as we proceed in the direction of either canthus.

A portion of the umbilical cord remains attached to either one of the specimens, but the placentæ were not sent with them.

The theca of the penis is attached to the abdomen to within 4·4 centimetres of the umbilical cord, beyond which it is pendant, and in this young specimen was found to completely ensheathe the organ which it contains. This theca is very well covered with rather long hair of a bright clay color.

At this age the testicles have not as yet descended and in the subject now under consideration, the scrotal sack is small and shrunken. All of the hoofs are of a clear horn color.

Caton found the "tarsal gland large" in the adult of this species, and says of it, that "on the Woodland Caribou, the tuft of hairs over the tarsal gland also has its characteristics, which enable one who has studied it to readily recognize it, though it is more variable in size and shape than on the moose."

"The hairs composing the tuft occupy a descending position. From the upper end the tuft commences tó rise up gradually, and so continues to the lower end, where the elevation is greatest. The length of this tuft is two inches, while the breadth is one inch and three lines. The middle of this tuft is a yellowish-white, for a horizontal extent of two inches, and a vertical extent of one inch and three lines. The greatest diameter of the white portion is near the lower border of the tuft. Below the white portion the tuft shades down to the olive-brown of the rest of the leg. It occupies the internal cavity of the hook posterior to the central part. It is not quite so large in proportion to the size of the animal as on most of the other species, neither is it much below them in relative size. It is not so exactly alike on each individual of this species as it is on the smaller species."[1]

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[1] CATON, JOHN DEAN: The Antelope and Deer of America, New York, 1877, pp. 253–54. Mr. Caton in comparing the above condition of these glands with the European Reindeer found that they correspond in all essential particulars. In this connection I would like to say that at the time my dissections were made upon these fawns, my library and my facilities for consulting books were limited. Mivart's "Cat;" the works of Owen, Flower, Oldfield Thomas, Chauveau, Huxley, and a number of others were, however, in my field library. Doctor John Dean Caton was at that time in Monterey, California, and I wrote him for a copy of his excellent volume upon "The Antelope and Deer of America," just cited; and it is my desire to express to him here my grateful thanks for his having telegraphed to his son at his home in Chicago, with the effect of placing a gift of the volume very promptly in my hands for use.

This description answers very well indeed, for both the position and appearance of this tarsal gland and its tuft in the fœtus. Here, however, the gland is quite rudimentary and the tuft is proportionately smaller. The color of the hair seems to agree with Mr. Caton's description, also,—but so diminutive are these glands in this young subject, that little can be learned about them from the exterior, and a study of their internal structure falls within the domain of the histologist rather than that of the anatomist. I have failed to discover any metatarsal glands or inter-digital ones in this subject. The authority just quoted found them in the hind feet only, and if they are present in the fœtus in my hands, they are exceedingly rudimentary.

Mr. Caton calls attention, too, in the adult, to a white band surrounding the top of each hoof;—this is likewise absent in my specimens. The adults of this Caribou make considerable use of their accessory hoofs, and these are "subject to muscular control;" such a condition seems to be foreshadowed in the fœtus, especially in the feet of the anterior limbs, where the accessory hoofs are large and situated low down.

Previous to cutting down upon this specimen, (b) I made careful drawings of the tarsus and foot of the anterior and posterior limbs, together with the form of the tail; and these are here reproduced as drawings illustrating this paper. Passing next to the consideration of the female specimen we find that beyond the sexual differences as pertaining to the organs of reproduction, and being rather smaller in size, it presents us with no special departures in its general appearance, either as regards color or form, from the male just described. Perhaps the coat of the female may be a shade lighter, and the hair down the median line of the throat beneath is not quite so conspicuously long. The vulva and external genitals have advanced to a point of development that we might expect in a ruminant of this tender age, and offers nothing for special remark. It is fairly well covered by the tail.

Most fœtal mammals at this age show a pre-natal emaciation, which, in these specimens, has been enhanced by the action of the alcohol upon their delicate tissues and muscles.

I did not think it necessary at the time to weigh either of these specimens, for the reason, that they were saturated by the alcohol, and that other changes must have taken place in them, which would render such data of but little or no use.

Such strictures, however, do not apply to careful measurements of external parts. Of these I have quite fully availed myself, and they are presented in the subjoined table.

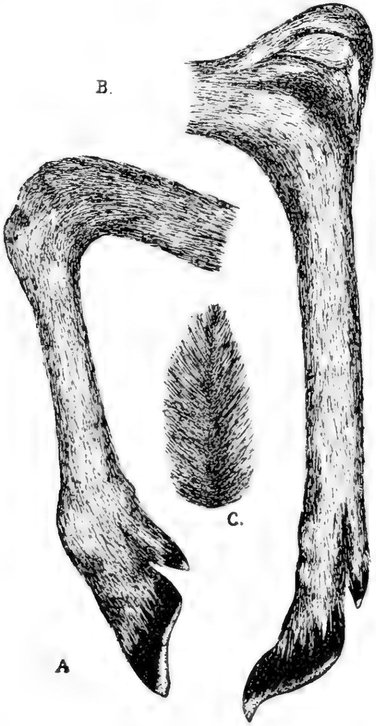

Fig 2-A. Inner aspect of the right tarsus, metatarsus and foot of the anterior limb of a fœtal Reindeer (*R. tarandus caribou*).

B. Corresponding aspect and parts of the hinder limb; same specimen. The tarsal gland is here seen covered by its lighter colored tuft of hair.

C. Superior aspect of the tail of the same specimen. The under side of the tail in this fœtus is of a light brownish fawn color, while above, it is rather of a chestnut shade. It is white on the lower side in the adult. Figures all drawn by the author from the subjects, and much reduced.

Measurements of fœtal specimens of R. tarandus caribou (Alcoholics, eighteen days prior to birth):—

	MALE.	FEMALE.
	CMS.	CMS.
Total length including tail,	71.00	70.00
Girth immediately behind the arms,	35.00	32.00
Length of head,	17.00	16.8

Length of nostril,	2.00	2.00
Between the eyes,	9.5	9.2
Height of ear,	8.00	7.8
From anterior canthus of eye to tip of nose,	8.5	8.3
Between the ears,	5.00	5.00
Girth of middle of neck,	16.00	15.3
Length of tail,	8.2	7.2

All the measurements were taken previous to making any of the dissections. Other things being proportionately equal it will be observed that "girth of neck" and "length of tail" constitute the greatest differences.

Myological Notes.

A complete dissection of the muscular system of these fawns was not made by me for the reason, or rather reasons, that my labors at the time were cut short by the operation of certain laws or customs to which I was subservient, and over which I had no personal control, and, which, at the same time, were hostile to the prosecution of researches in anatomy. In the meantime, and at a later period, this material passed out of my hands, as more general work engaged me, and I returned it to the Museum. The description of such muscles as I was enabled to work out, however, is fully worthy of record as so many facts for the guidance of laborers in the same fields in the future. Moreover, reindeer are being rapidly exterminated, and any notes upon their morphology are sure to be of value in time to come.

Dermal System of Muscles.—In this fœtal specimen the group of cutaneous muscles, whose function it is to act upon and agitate the skin covering certain areas of the body, are as yet but feebly developed.

We can make out, however, without difficulty the following:—

The *platysma myoides* is quite conspicuously developed, being carried on the skin over the sides of the face as far forwards as the nasal region where, no doubt, it assists in the twitching movements of the skin about the nose.

In the mid-anterior region of the neck it becomes quite thick, especially in the line of integument which supports upon its outer aspect the elongated hair there found in this animal.

Its fibres become very pale as they spread out over the dorsal aspect of the neck, and the entire muscle is lost and fades away as we pass to the region of the shoulders and upper thoracic area.

The *panniculus carnosus,* or that great muscular envelope the function of which is to act upon the integuments of the entire trunk, is here but moderately displayed. I dare say, though, that in the adult reindeer this interesting muscle will be found fully as well developed as it has been described by several anatomists of the horse, and by others in the *Felidæ.*

In this fœtus it is best marked where it is intimately attached to the lateral integuments of the thorax and abdomen, and over the abdomen itself.

In the median line from a short distance in front of the umbilicus to a point well upon the sternum, it arises from a thin fascia more or less intimately connected with the skin by its outer surface, and to the external oblique by its inner. Posterior to this, the fibres are in the skin, and radiate from the periphery of a circle surrounding, but lying without, the umbilicus. The posterior border of the muscle is thick and extends toward the thigh, while for the rest, the fibres spread out, closely connected with the skin, over the sides of the lower thoracic region and the abdomen, and the lateral aspects of the thigh. It does not seem to meet, in this young subject, the fellow of the opposite side along the dorsum. But from its rounded carneous margin, the fibres appear to merge into a delicate fascia, which extends over this region and down the sides of the thigh. In the integuments overlying the sacral area, however, the carneous fibres appear again, and can be faintly traced as far as the root of the tail.

Chauveau in describing the *panniculus carnosus* of the horse, says: "This muscle has, besides, a very remarkable insertion into the humerus, which was noticed by G. Cuvier in his 'Lecons d'Anatomie comparée,' and which appears to have been omitted, at least so far as Solipeds are concerned, in every treatise on veterinary anatomy. The following is what we have often observed in this respect: On reaching the posterior border of the ulnar mass of muscles, the panniculus divides into two superposed layers; one, superficial, is carried to the muscles of the anterior member; the other, deep, soon terminates by an aponeurosis which is united to the great pectoral muscle, and is bordered at its upper margin by a nacreous aponeurotic band, which penetrates between the thorax and the muscles of the arm to be fixed to the small trochanter."[1]

[1] CHAUVEAU, A. The Comparative Anat. of the Domesticated Animals, 2nd Ed. 1884, N. Y.; trans. and ed. by G. Fleming, p. 187.

A very similar arrangement I find to exist in this fœtal reindeer, but its seems to me that the dermal system can only claim that layer which is here confined to the skin, and which by its fascial extensions it has the power of twitching over the anterior and upper part of the chest and on the fore-limb. Intimately connected with this, and with the great pectoral over which it lies, is, to be sure, another layer that here seems to be entitled to rank with the more important muscles of the front of the chest. It arises from the fascia over the median line of the sternum, and is closely connected with the skin above, which covers it. We find its insertion, however, not upon the small trochanter, but upon the shaft of the humerus, at the interno-anterior aspect of the summit of its distal third, above the internal condyle. Before arriving at the point of insertion, the fibres of the muscle converge to form a flattened fasciculus, which passes down between the muscles of the arm. Undoubtedly by its contraction this muscle can, in connection with the true dermal layer alluded to above, and with which it is associated, act upon the skin of these parts, but I am strongly inclined to believe that it represents one of the pectoral muscles as they have been described in the cat.

Mivart in his anatomy of this animal, divides the *pectoralis* into *five* portions, and of the insertion of the second portion he says, "It is inserted into the outer side of the deltoid ridge of the humerus, and extends down (between the biceps and brachialis anticus) to the summit of the lowest third of the humerus." In this reindeer the outer margin of this muscle for its proximal two-thirds is attached to the fascia dividing the muscles at the inner side of the brachium.

It is very evident that in the adult this muscle will act powerfully both on the humerus and the anterior chest walls, while, when the animal stands at rest, the action of its more superficial fibres can be made to agitate the integuments of the parts. Be this as it may, I will not enter upon a second description of the muscle here, though I think strictly speaking it should be regarded as an auxiliary pectoral, and not as one of the dermal system proper.

Of Certain Muscles of the Head.—Considering the tender age of the subject before us, the musculature of the ear, eye, mouth, and face is very well developed.

[1] Mivart St. George, F. R. S. The Cat, New York, 1881, page 145. This work I find to be an exceedingly useful one to those engaged upon dissections of the Mammalia.

The *myrtiformis* muscle seems to be unusually large, and of an irregular quadrilateral form. It arises from the side of the nostril, and being firmly connected with the skin, its fibres descend downward and backward to be lost in the dense tissues of the upper lip.

The *orbicularis oris* is, as a sphincter of the mouth or lips, a very feebly developed muscle here, and great care is required, to trace its delicate fibres in the tissues where they lie hidden.

The *levator labii superioris alæque nasi* on the other hand is perhaps the most conspicuously developed of all the facial muscles in this young deer. It arises from the malar and superior maxillary bones, and its fibres forming a strong flat muscle, pass directly forwards, closely connected with the integument, and above the alveolar process of the upper jaw, to become blended with the fibres of the orbicularis oris in the upper lip, and are lost upon the ala of the nostril.

The *orbicularis palpebrarum* is also pronounced, but presents us with nothing peculiar, or any marked departure from that muscle as we find it among the deer generally. I have, however, failed to make out satisfactorily an *occipito-frontalis*, a *levator anguli oris*, a *pyramidalis*, and a number of other less important muscles of the face. In the adult, where through use they had become more clearly defined, no doubt a number of them could be traced, and I see that Professor Mivart has worked them out in an admirable manner in the cat, but they need not further concern us here.

The musculature of the eye and ear, is, considering the age of the specimen, very completely advanced, and I suspect strongly developed in the case of the former structure in adult life.

The *Attolentes auriculum* are a handsomely developed pair of muscles that nearly meet each other on the median line of the skull between the external ears. By their action these appendages of the organ of hearing may be powerfully drawn toward each other.

A strong *zygomato-auricularis* is also seen as we remove the integuments of the head. It arises from the zygoma, and passing backwards and upwards is inserted upon the outer aspect of the pinna.

Other representations of the group of muscles that control the varied movements of the external ear are easily traced, and in most cases well defined.

A *buccinator* can be made out as we trace its delicate fibres in the sides of the lips, and as far back as the alveolar processes of the jaws extend.

As usual in mammals, the *masseter* is divided in two layers, the fibres of the outer one passing obliquely backwards, while those of the deep portion being more or less vertical.

The muscle arises from the zygoma for its infero-anterior portion, and from the malar bone. Passing down in a way already indicated, they become inserted into the outer aspect of the ascending ramus of the lower jaw, completely filling the concavity there existing.

A *temporal muscle* is no larger, if as large, as the *masseter*. Either one fills the shallow temporal fossa at the side of the skull, and measuring the distance between their nearest points to each other, over the vault of the skull, with a flexible tape measure, I find them to be separated by an interval of seven centimetres. The tendon of a temporal is inserted as usual into the coronoid process of the mandible, entirely upon its mesial side.

The *pterygoids* are well-developed muscles, but present nothing worthy of especial note in these fœtal specimens of our reindeer.

NOTICE OF SOME ENTOZOA.

BY PROF. JOSEPH LEIDY.

Distoma crassum Busk. Cobbold: Proc. Linn. Soc., 1860, vol. V, p. 5.

Mr. Busk, an English surgeon, in 1843 announced the occurrence, in the intestine of a Lascar or Hindoo seaman who died in London, of a large species of Fluke for which he suggested the name of *Distoma crassum.* Fourteen specimens obtained ranged from 4 to 6 cm. long by 1·7 to 2 cm. broad. The same parasite has since been reported as occurring in Chinese and in Europeans living in China.[1] In our Proceedings for 1873, p. 364, I gave notice of a specimen from a Chinese boy, which I then supposed to be a larger individual than usual of the more common *D. hepaticum.*

On several occasions I have had the opportunity of examining some large Flukes from the liver of our Deer, *Cervus Virginianus,* and the Domestic Ox, which appear to be identical with the *D. crassum.* The specimens preserved in alcohol, and submitted to me, are as follow:

Six individuals, obtained from the liver of a Doe, in the Adirondack Mts. of New York, by Dr. R. A. F. Penrose. These range from 5 to 6 cm. long by 1·5 to 2·5 cm. broad, and 1·5 to 2·5 mm. thick.

Three individuals from the liver of a Calf, at Hot Springs, Ark., obtained by Dr. G. W. Lawrence. The specimens much contracted and hardened by strong alcohol, measure 3·5 cm. long by 2 to 2·4 cm. broad. An imperfect one is from 3 to 4 mm. thick at the broken border; white for half the thickness dorsally and black ventrally.

Two individuals recently received from Texas, from Dr. M. Francis, Veterinary Surgeon, who writes that the monster Flukes occur there in cattle in limited number, "in the liver-tissue and not in the bile-ducts like the *Distoma hepaticum.* The specimens measure 3·5 and 4 cm. long by 2 and 2·5 cm. broad.

The Flukes from all three hosts accord in character except size, and in many points appear closely related with the *D. hepaticum.* They are elliptical in outline and of greater proportionate breadth than in the latter. The oral pole is conical but not abruptly prolonged as in that species. The caudal pole is broadly rounded and

[1] Cobbold, Parasites, 1879, 21.

entire or medially slightly emarginate. The dorsal surface is convex, smooth and cream-colored; the ventral surface flat or slightly concave, minutely granulate or brownish margined with black, due to the vitelline organs shining through. The oral and ventral acetabula are from 4 to 5 mm. apart; the former oral about 1·5 mm. wide; the latter slightly larger. Genital aperture midway between the acetabula. Penis in some individuals exserted as a short tortuous papilla. The sides of the body, extending from near the head to the tail, occupied by intensely black dendritic vitelline organs. The body is less tenacious than in *D. hepaticum*, is soft and easily broken.

Accompanying the monster Flukes from Texas, were eighteen specimens of the ordinary Liver-Fluke, *Distoma hepaticum*, up to 3·5 cm. long by 9 mm. broad, which Dr. Francis observes are very destructive to Cattle and Sheep in some parts of Texas.

The facts related of the recent occurrence of the large Fluke in the Deer and Ox, in different portions of the United States, would impress one with the idea that the parasite is common with us, but in view of its conspicuous character and its not having been previously noticed such is probably not the case. May there be any relation between the occurrence of the parasite in this country and the influx of a Chinese population? The facts seem curiously coincidental with the first discovery of *Trichina* in man in England and its subsequent discovery in the hog in this country. The Guinea-worm is believed to have been introduced into tropical America with the Negro from Africa.

Sclerostomum armatum Rudolphi, var. **major** Diesing: Syst. Helm. II, 304.

Dr. Edward Landis recently submitted to my examination three worms found coiled in as many thick-walled cysts, in the lung of a Horse. These appear to me to be the larger variety of the *Sclerostomum armatum*, usually found occupying the intestines of the same animal. The specimens, all females, are from 25 to 30 mm. long by 1·5 mm. thick at the fore part. The body is robust, cylindrical, more tapering behind, brownish-red, annularly striate; head dome-like, defined by an annular stria; mouth large, surrounded by a prominent annular lip marked by eight radii; tail short, conical, obtuse.

Ascaris anoura Dujardin: Hist. Nat. des Helminthes, 1845, 221. Leidy: Proc. A. N. S. 1856, 51.
Ascaris attenuata Molin: Prod. faunae helminth. venetae, 1860, 282.
Ascaris rubicunda Schnyder: Monog. T. Nematodon, 1866, 42.,

From the stomach of a Python, *P. molurus*, which recently died in our Zoological Garden, Dr. John L. Hatch obtained a large mass of translucent red and green worms, which were submitted to my examination. These appear to be the *Ascaris anoura* of Dujardin, subsequently described under other names by Molin and Schnyder. The worms for the most part penetrated the recesses of three larger tumefactions of the mucous membrane of the stomach. The greater number of the worms were immature, translucent, of a blood-red color, with a darker intestine shining through, and ranging from 6 to 7 cm. long by about 0·6 mm. thick. The mature females ranged from 10 to 20 cm. long by 1·5 to 2·5 mm. thick. The males ranged from 7 to 16 cm. long by 0·875 to 2 mm. thick.

The body of the worms was most narrowed in advance, from pale red to nearly colorless in the largest and deeper to blood red in the smaller ones; with the intestine shining through of variable pea green to greenish-brown and dark brown in the latter, and with the tortuous ovaries and testes milk white. Cephalic extremity lighter colored, strongly tapering and with distinctly trilobate mouth. Tail very short, conical, the length about equal the breadth at base. The male of more slender proportions, with the caudal end incurved and the tail more pointed, with a row on each side of ten preanal papillæ, one on each side of the anus and two rows of two on each side of the tail. Spicules of the penis long, linear, curved and equal. Pharynx long, cylindrical clavate; rectum very short.

Worms closely agreeing with those of the Python I have observed from two of our common snakes, the Hog-nose Snake, *Heterodon platyrhinus*, and the other, from the accompanying description, supposed to be the Milk-snake, *Ophibolus triangulus*. A portion of the stomach of the latter, preserved with the worms, show them to have the same habits as those of the Python; partially occupying the recesses of a tumefaction of the mucous membrane.

NOTE ON MESOZOIC MAMMALIA.

BY O. C. MARSH.

I have recently received from Prof. H. F. Osborn a pamphlet entitled " A Review of the Cretaceous Mammalia," which is intended as a criticism on two of my papers, and is the latest addition to his publications on Mesozoic mammals. This review contains no new facts, and is mainly an application of the author's theories, which may in part prove to be true, but at present are without substantial basis. To attempt to refute all the assumptions he makes would involve a long discussion of known Mesozoic mammals, and take time from more important work. A brief notice of a few points, therefore, must suffice for the present.

The author of this review has never collected any Mesozoic mammals, has no specimens of the kind, and has only seen a part of those belonging to others, who have shown them to him as a matter of courtesy, in some cases even when an investigation was intended or in progress. Of more than a thousand specimens of Cretaceous mammals on which my investigations are based, he has not seen a single one, and no others are known except a few fragments. Of several hundred specimens of Jurassic mammals which I have secured in the West, he has seen perhaps one-tenth, while of other Mesozoic mammals from this country, he cannot have seen in all more than a half dozen specimens.

Prof. Osborn's qualifications for discussing Cretaceous mammals may be fairly judged from his papers on other Mesozoic mammals. One or two examples will make this evident.

He began this work, in 1886, by describing two specimens of *Dromatherium* Emmons, and making a new genus of one of them, on insufficient grounds. He criticised Emmons' work, especially one figure, but this he subsequently modified. His own figures of one of these fossils agree neither with each other nor with the specimen, as a recent comparison shows.

He next turned his attention to the Mesozoic mammals in the British Museum, beginning with *Tritylodon*, described and figured by Owen. Again Prof. Osborn did not agree with the original authority, but announced that a point of " remarkable interest" had not been appreciated by Owen, namely, a large parietal foramen, showing that "the primitive Mammalia, of this family at least, had a pineal eye of some functional size and value," which fact "adds to the rapidly accumulating evidence for the reptilian ancestry of the mammals." A reference to the specimen itself proved that there was no foundation for the announcement, and Prof. Osborn has since in part corrected it. (Science, vol. ix, pp. 92, 114 and 538, 1887.)

The results of Prof. Osborn's further study of the Mesozoic mammals in the British Museum were not considered important by some of the best authorities there, and some of his observations they disproved, in my presence, by referring to the fossils themselves. His figures of these specimens, moreover, are not accurate, and in some cases are misleading, as a single example will show. In his Mesozoic Mammalia, Plate VIII, he gives a new figure of the type of *Phascolotherium*, but a comparison with the original specimen shows that this figure is erroneous in at least four important points; namely, the first incisor; the crown of the last molar, which is wanting in the specimen; the positions of the dental foramen and of the mylohyoid groove. His method of regarding different isolated specimens as identical, and making a "composite" drawing of them as representing a single type, has led him into serious errors. This method, which belongs rather to metaphysics than to natural science, Prof. Osborn has again used in the present review, and with no better results.

This long review purports to discuss my first and second papers on Cretaceous mammals. The first thing that strikes the careful reader is the title he gives to these papers. My own title was a simple one, "Discovery of Cretaceous Mammalia," and it is only fair to expect, in an elaborate review, that the title, at least, will be correctly quoted. Instead of this, Prof. Osborn has added two other words, giving it a different meaning and quoting it as:—"The Discovery of the Cretaceous Mammalia." He read this review in no less than three different cities, and published an abstract elsewhere, yet apparently had no time to read my title of four words carefully enough to quote it correctly. A small matter, perhaps, but proof positive of careless work.

The next point to be noticed is, that my order *Allotheria* is rejected as not having been defined, and a later term, *Multituberculata*, is adopted because it has been defined. This direct statement of Prof.

Osborn is incorrect, as my order was defined when proposed in 1880 (Am. Jour. Sci., vol. xx, p. 239). The cumbersome term, *Multituberculata*, was not defined when proposed by Cope in 1884, but Prof. Osborn kindly attempted this in 1888. His definition, unfortunately, does not include some characteristic forms of the group, but takes in accurately the genus *Mastodon*, although this great Proboscidian can hardly be considered a Marsupial.

By way of instruction, Prof. Osborn indicates what he terms "the main characters of the dentition of the Mesozoic mammals in general, and some characters which enable us to distinguish between the teeth of mammals and those of reptiles and fishes." This is a most promising statement, but loses some of its force when we find that it has not saved him from precisely these mistakes, either in his previous papers or in the present review, as I show later.

He is scarcely more fortunate in his announcement of what he regards as the well-known characters of the teeth of one group, the *Allotheria*. I have probably seen all the Mesozoic mammals examined by Prof. Osborn in Europe, and likewise quite a number of others, including the type of *Stereognathus*. He is certainly wrong in several of his main conclusions, and in others there are many facts against him.

A more correct restatement of some of the characters of this group would be as follows:

(1.) No true *Plagiaulacidæ* are known with three rows of tubercles on the upper molars.

(2.) No *Allotheria* are known with certainty to have three rows of tubercles on the lower molars.

A careful study, moreover, of the known specimens of the true *Plagiaulacidæ* would have shown him the strong probability, at least, that the genus *Bolodon*, which he makes the type of a distinct family, is based on the upper jaws of *Plagiaulax;* also, the probability, as I have before suggested, that the type of *Stereognathus*, of which he makes another of his numerous families, is an upper jaw, although described as a lower one.

Bearing in mind these points, Prof. Osborn's main criticisms are seen to be without foundation, and the errors largely his own. By substituting theory for the actual study of well-preserved specimens, he has placed on record the fact that he seems unable to tell upper from lower teeth in Mesozoic mammals, or the teeth of reptiles and fishes from those of mammals.

There is now conclusive evidence that the Cretaceous molar teeth with three rows of crescents belong to the upper series, as I described them. Prof. Osborn's reference of these to the lower jaw is based merely on theory with only conjecture to support it. The same fundamental error runs through most of his review, and measures the value of his criticism.

Another unfortunate error of Prof. Osborn was mistaking the tooth of a Cretaceous reptile for a premolar of a mammal, and not only describing and figuring it as such, but making this a basis for using, even in this review, a generic name (*Meniscoëssus*) against well-known laws of nomenclature. This supposed premolar he figured and described in his Mesozoic Mammalia, p. 218, and has elsewhere strongly defended its mammalian character. There is not a particle of evidence of this, as every one familiar with similar specimens knows.

Notwithstanding this mistake, Prof. Osborn ventures to assert in this review, that a tooth which I described and figured as a molar of a mammal, *Stagodon*, has but a single fang, does "not resemble the teeth of any known mammal," and that the genus was "founded upon reptilian or ichthyopsidan teeth." I distinctly stated that this tooth has two fangs, and the bases of these were indicated in one of my figures. Moreover, several well-preserved specimens, since obtained, show two distinct roots and other features which prove these teeth mammalian beyond doubt.

In his Mesozoic Mammalia, p. 221, Prof. Osborn describes and figures as a premolar a specimen which is now almost certainly known to pertain to a fish, and not to a mammal. I have a very similar specimen from the same locality, which is pronounced the same species by those who have examined both. This I purchased many years ago of a well-known collector in Stuttgart, who called it a mammal tooth. When investigating Mesozoic mammals later, I examined this specimen with care, and found it to be made up of two portions of fish teeth (*Hybodus*) neatly cemented together, making four cones on a quadrate base, as in the fossil Prof. Obsorn described. A friend who saw my specimen has since sent me from Europe drawings of a third supposed mammal tooth from the same locality (Diegerloch), which he considers the same as mine. The drawings are characteristic, and indicate another specimen of apparently the same sort. Others are probably in existence, as the demand for Mesozoic mammals is great, and the supply has hitherto been limited.

One or two points more should be mentioned about Prof. Osborn's work on Mesozoic mammals; namely, his replacing, on insufficient grounds, scientific names, especially those of families and genera, by other names of his own; also, using the figures of other authors without the usual credit. As an example of the latter, I may cite this use of no less than five of my figures of Jurassic mammals, in his memoir on Mesozoic Mammalia.

Prof. Osborn in his review alludes to "the extremely complex and confusing dentition" of some Mesozoic mammals, and of the truth of this statement his own papers afford many illustrations besides those here mentioned. What this perplexing subject really needs, however, is more facts and less theory. Believing this, I have endeavored to secure new facts by long and laborious explorations, hoping in this way to clear up some of the confusion which so puzzles fireside naturalists. The 1,500 specimens of Mesozoic mammals I have thus secured, fragmentary though most of them are, will, I trust, prove of some service in this work, although their full investigation has been delayed by other duties.

No one who has earnest work to do can afford to spend time in the ungracious task of pointing out errors in the work of others. For this reason I have hitherto said nothing about Prof. Osborn's papers on Mesozoic mammals, intending to wait until my own memoir, for which I have collected so much material, should make it my duty to review the whole subject. The injustice of his criticism on my preliminary work while in progress made a brief reply necessary; the full discussion, I must still reserve for my memoir.

FOSSIL FAUNAS IN CENTRAL IOWA.

BY CHARLES R. KEYES.

Since the appearance of preliminary statements on the Lower Coal Measures of Central Iowa[1] some time ago, considerable additional material has been obtained, which presents some instructive considerations concerning the distribution of ancient life through that region. In the article alluded to thirty-five genera and nearly sixty species are mentioned. The present paper increases these figures to 51 and 84 respectively. There still remain many forms not yet sufficiently worked out for incorporation here. The interest, however, lies not so much in the numerical increase of the species discovered, as in the information imparted in regard to both the geologic and geographic range of the various types within, and without, the limits of the state; and in the exhibition, in many forms, of structural features which have hitherto been more or less obscure.

A recent geological reconnaissance of the locality has disclosed a large number of stations where animal life was at one time very prolific. Several new horizons have been definitely made out, on account of which the distribution in time of the various forms is capable of being traced with greater accuracy than has hitherto been possible.

In the earlier studies relating to the fauna of the Des Moines Coal Measures three striking facts were emphasized in particular. These may be summarized as follows:

(1.) In those zoological groups having an optimum habitat marine, there was not only a fewness of species but also an extreme paucity of individuals.

(2.) The Brachiopods, though well represented in both genera and species, were not as proportionately abundant as might be expected when it is remembered that this type of life had now nearly reached its greatest expansion and culmination.

(3.) The fauna was predominantly molluscan—more than three-fourths of the entire number of species being gasteropods and lamellibranchs.

The later observations fully corroborate the suggestions previously made and add further testimony as to the correctness of the conclusions already set forth.

[1] Proc. Acad. Nat. Sci., Phila., 1888, pp. 222–247.

Before passing to specific considerations, a brief sketch of the stratigraphy is perhaps necessary for a better understanding of the relations of the several faunas of the different horizons. A somewhat detailed section of the rocks as exposed at the locality in question, is represented in the subjoined scheme:

General Section of Rocks at Des Moines.

	Feet.	In.
26. Variegated clayey shales,	13	
25. Blue limestone, nodular, impure, weathering brown (F),	0	8
24. Variegated shales,	8	
23. Bituminous shales, with concretionary masses below (F),	3	
22. Coal,	2	
21. Light yellow and drab shales	7	
20. Variegated clayey shales	4	
19. Nodular limestone, earthy, passing in places into marl, highly fossiliferous (F),	0	6
18. Light colored and variegated clay-shales,	5	
17. Impure limestone, like No. 19, but not so fossiliferous (F),	0	10
16. Light colored, clayey shales,	5	
15. Soft micaceous sandstone, concretionary in places, and passing into sandy shales elsewhere,	25	
14. Light colored shales,	4	
13. Impure coal,	2	
12. Light and dark-colored clay-shales,	20	
11. Bituminous shales, highly fossiliferous (F.),	0	8
10. Coal,	2	
9. Fire clay,	1	
8. Variegated and sandy shales,	15	
7. Sandstone, massive,	6	
6. Coal,	4	
5. Fire clay,	2	
4. Variegated shales, sandy in places,	30	
3. Bituminous shales (F.),	5	
2. Coal,	5	
1. Fire clay,	1	

The beds above number 15 have been referred to the middle coal measures by St. John. They carry three thin bands of blue earthy limestone, nodular or fragmentary and weathering brown. Usually fossils are to be found in them, often quite abundantly. About a score of species have been thus far recognized from these layers. These calcareous bands are quite persistent over a wide area. The lower two are only five or six feet apart, while the third is about twenty-five feet higher. The clayey material between them appears to decrease in thickness towards the southwestward. The triple calcareous bed exposed at the water's level on the Raccoon river at Commerce, eight miles from Des Moines may possibly represent the three bands. At that place they are only a few inches apart. In the immediate vicinity of Des Moines the following species have been obtained from these layers. It is to be noted that they are all typical marine forms ; and that nearly all of them also occur in the dark shales of the lower coal measures, as has already been fully shown elsewhere, but their numbers and distribution in the lower horizons are very limited.

Rhombopora lepidodendroides Meek.
Lophophyllum prolificum McC.
Cyathophyllum torquium Owen.
Eupachycrinus cragini M. & W.
Synocladia biserialis Swallow.
Chonetes flemingi N. & P.
Chonetes mesoloba N. & P.
Rhynchonella uta Marcou.
Retzia mormoni Marcou.
Athyris argentea (Shepard.)
Productus semireticulatus Martin.
Productus muricatus N. & P.
Productus cora d'Orb.
Productus costata Sowerby.
Spirifera lineata Martin.
Spirifera camerata Martin.
Spirifera planoconvexa Shumard.
Spirifera kentuckensis Shumard.
Streptorhynchus crenistria Phillips.

The Middle Coal Measures at Des Moines cannot be well separated from the lower member, and the hitherto recognized line of demarkation is perfectly arbitrary. At best the group is of very doubtful utility. The thickness of the strata referred to the Middle Coal Measures in Iowa is in reality considerably less than was at one time supposed ; while the vertical extent of the Lower Coal Measures has been found to be very much greater than it was regarded by White and others, who placed it at about two hundred feet.

A carefully made section was recently constructed along the line of the Des Moines River from Harvey in the east-central part of Marion county to Des Moines and from the latter place to De Soto along the Raccoon river—a distance of sixty-five miles. The detail of the strata from the top of the St. Louis limestone to the base of the Upper Coal Measures have thus been rather minutely worked out across that portion of the state referred to. In addition a large number of fossils were obtained from the several horizons, so that the vertical distribution of a large number of species was accurately determined within the limits of the region passed through. That part of the section in the immediate vicinity of the capital city of Iowa received particular attention with reference to the faunal zones.

It is to be noted that in the Lower Coal Measures of the region there is a marked absence of calcareous layers and for this reason the great paucity in the remains of truly marine forms is very marked. The sandy material is also rather limited; and in it occur no organic remains except those of a few plants. Argillaceous deposits make up by far the greatest proportion of the formation. The clay-shales are ashen, drab or black in color; sometimes also red, yellow and blue. The light-colored shales are for the most part unfossiliferous, though occasionally fern impressions and casts of Lepidodendron roots are found. The dark colored bituminous varieties on the other hand are not unfrequently abundantly charged with fossils. As it has been shown elsewhere the coal of Central Iowa is deposited in numerous lenticular masses of greater or less extent. These beds may have a horizontal measurement from a few hundred yards to several miles. Usually a black shale of a few inches or a few feet in thickness immediately overlies the coal basins. It is these particular layers that are most highly fossiliferous. In many cases brilliant pyrite has replaced the hard parts of the fossils; but in others the calcareous matter has remained perfectly preserved, the pure white shells forming a striking contrast with the black matrix.

Fusulina cylindrica Fisher.

Fusulina cylindrica Fisher, 1837: Oryct. du Gouv. de Moscou, p. 126, pl. xviii, figs. 1–5.

Fusulina cylindrica Owen, 1852: Geol. Sur. Wisc., Iowa and Minn., p. 130.

Fusulina cylindrica Meek. & Hayden, 1859: Proc. Acad. Nat. Sci., Philada., p. 24.

This is the first recognition of protozoan remains in the Lower Coal Measures of Des Moines. Their occurrence thus far has been confined to a single horizon, which is just below the lower member of the so-called middle section of the Iowa Upper carboniferous. The species is very widely distributed both in time and space, in consequence of which many varietal phases would be expected. There is, therefore, apparently very good grounds, as has been suggested by White, for regarding the various forms described as *Fusulina depressa*, *F. ventricosa*, *F. robusta*, *F. gracilis*, etc., identical with Fisher's species; the slight alleged differences being due rather to local variations in environment than to specific differentiations.

Archæocidaris edgarensis Worthen & Miller.

Archæocidaris edgarensis Worthen & Miller, 1883: Geol. Sur. Illinois, vol. VII, p. 337, pl. xxx, fig. 15.

A few primary spines, which correspond in all particulars with those noted by Worthen and Miller from the Upper Coal Measures of Edgar county, Illinois, have been obtained in concretionary layers overlying a coal seam near the upper part of the Lower Coal division. The echinoid remains from the Upper Carboniferous of America are exceedingly meagre, and much additional material is needed for comparative studies. The urchins of the Lower Carboniferous are much more satisfactory, but the great richness of the crinoidal faunas, that are always associated, has usually caused them to be, for the most part, overlooked.

As might be readily inferred, the remains of echinoderms are of rare occurrence in a locality having the lithological characters such as are presented in the district under consideration. Previous to the present announcement, the only known fossils of this group were a few segments of the stem and several brachial plates of *Eupachycrinus.* The latter were highly nodose but the nodosity was not extended into such long spines as in *E. cragini* which was found in limestone bands at the base of the Middle Coal Measures of the same locality.

Chonetes lævis Keyes.

Chonetes glabra Geinitz, 1866: Carb. und Dyas in Nebraska, p. 60, t. iv, figs. 15–18. (Not Hall, 1857.)

Chonetes glabra Meek, 1872: U. S. Geol. Sur., Nebraska, p. 171, pl. iv, fig. 10; and pl. VIII, figs. 8a, 8b.

Chonetes lævis Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 229, pl. xii, figs. 3a, 3b.

Chonetes geinitzianus Miller, 1890: N. A. Geol. and Palæ. p. 339.

In the original diagnosis of *Ch. lævis* the statement was made that it was probably the same shell as was described by Geinitz as *Ch. glabra* from the Upper Coal Measures of Nebraska. At that time comparisons could not be made to establish the identity of the two forms with any degree of certainty. The evidence now at hand, leaves little room for doubt in this respect. Geinitz's name, however, had been preoccupied by Hall in 1857 for a species from the Upper Helderberg. *Chonetes lævis* being the next available term must, therefore, be adopted; though Miller has more recently proposed the name *Ch. geinitzianus* for the same shell, which title, of course, must be regarded as a synonym.

Since the discovery at Des Moines of the eight specimens used in the original description large numbers of this species have been found near the same locality, scattered through a bed of bituminous shale fifteen feet in thickness. These are associated with its near congener *Ch. mesoloba.* The difference between the two species, as pointed out in the remarks accompanying the description of *Ch. lævis,* holds good throughout the entire series collected. Inasmuch as some of the specimens often show faint, radiating striæ it has been suggested that these shells are merely water-worn individuals of other species. This, however, does not appear to be the case, since large numbers of *Ch. lævis* and *Ch. mesoloba* are found intimately associated; and in the latter the radiating striæ are very sharply defined and well preserved. Besides the conditions under which the shells existed show conclusively that all influences of wave action were absent during the burial of these organisms.

According to Meek this species has been recognized in boreal America on the shores of the Youkon river of Alaska.

Chonetes flemingi Norwood and Pratten.

Chonetes flemingi Norwood & Pratten, 1855: Jour. Acad. Nat. Sci., Phila., vol. III, p. 26, pl. ii, figs. 5a,–5e.

Chonetes verneuiliana Norwood & Pratten, 1855: Jour. Acad. Nat. Sci., Phila., vol. III, p. 26, pl. ii, figs. 6a,–e.

Chonetes verneuiliana Shumard, 1855: Geol. Sur. Missouri, p. 216.

Chonetes verneuiliana Meek, 1872: U. S. Geol. Sur. Nebraska, p. 170, pl. i, fig. 10a,–b.

There seems to be but little doubt that the two forms, considered specifically distinct, of Norwood and Pratten and by them called *Chonetes flemingi* and *Ch. verneuiliana* are identical. Careful comparisons of a large number of these forms from various localities in central Iowa show every conceivable gradation between the two so-called species. The peculiarities of *Ch. verneuiliana* as opposed to those of *Ch. flemingi* appear to be chiefly due to local differences of station. Moreover, the types of Norwood and Pratten's *Ch. verneuiliana* seem to be somewhat abnormal in their growth and therefore do not present the most characteristic features of the form.

Rhynchonella uta (Marcou).

Terebratula uta Marcou, 1858: Geol. N. A., p. 51, pl. vi, fig. 21a,–e.

Rh. (*Camarophoria*) *osagensis* Swallow, 1858: Trans. St. Louis Acad. Sci., vol. I, p. 219.

Camarophoria swalloviana Shumard, 1858: Trans. St. Louis Acad. Sci., vol. I, p. 394, pl. xi, fig. 1a, e.

Camarophoria globulina Geinitz, 1866: Carb. und Dyas in Nebraska, p. 38, t. iii, fig. 5 (not *C. globulina* Phillips, 1834).

Rhynchonella osagensis Meek, 1872: U. S. Geol. Sur. Nebraska, p. 179, pl. i, fig. 9.

Rhynchonella osagensis Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 571, pl. xxvi, fig. 22.

Rhynchonella uta White, 1875: Exp. and Sur. 100 merid., vol. IV, pt. i, p. 120, pl. viii, fig. 4.

The form under consideration is one of very wide distribution. The range of variation is quite extensive as is attested by the numerous specific terms that have been applied to it. Reference to a large series of specimens from localities widely separated geographically, appears to indicate that the synonymy of the species as already given, is probably correct, though other names may yet be included. Notwithstanding the fact that *Terebratula uta* and *Rhynchonella osagensis* were proposed the same year, Marcou's name has priority of several months as has been satisfactorily shown by White. Geinitz referred this same form to the European *Camarophoria globulina* Phillips; but at present it does not seem advisable to consider the two forms as specifically identical. It is not improbable that the shell described by Marcou is the same as certain forms, known under other names, from the Lower Carboniferous rocks.

Lima retifera Shumard.

Lima retifera Shumard, 1858: Trans. St. Louis Academy Sci., vol. I, p. 214.
Lima retifera Geinitz, 1866: Carb. und Dyas in Nebraska, p. 36, t. ii, figs. 20 and 21.
Lima retifera Meek, 1872: U. S. Geol. Sur. Nebraska, p. 188, pl. ix, fig. 5.

The specimens collected at Des Moines and referred to this species consist only of a few fragments. Finely preserved examples have, however, been found not far from the locality mentioned and hence the species may be properly included in the fauna of the district. The true generic characters of the forms have not as yet been satisfactorily made out; and it is therefore with some hesitation that they are here allowed to remain under *Lima*.

Aviculopecten whitei Meek.

Aviculopecten whitei Meek, 1872: U. S. Geol. Sur. Nebraska, p. 195, pl. iv, fig. 11, a, b, c.

In the present state of confusion concerning the specific limits of the various forms of the genus it is difficult to satisfactorily make out the synonymy of the different species. The large number of individuals already described and referred to the genus will illustrate how cogent is the necessity for a thorough revision of the group. Different species have been based upon the right and left valves of the same shell. Others have attained specific distinction merely upon trivial variations of the "ears;" for it is now well known that in the majority of the species of the group these characters differ very much in the two parts of the same shell.

While the Des Moines specimens are manifestly identical with Meek's *A. whitei* the relationships to other forms cannot at this time be taken into consideration.

Avicula longa (Geinitz).

Gervillia longa Geinitz, 1866: Carbon. und Dyas in Nebraska, p. 32, t. ii, fig. 15.
Avicula longa Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 578, pl. xxvi, fig. 1.

This species occurs very abundantly at Des Moines in the lower portion of the so-called Middle Coal Measures. It has not as yet been recognized below this horizon, at least in Iowa. Westward the same form is found in the uppermost portion of the Upper Coal Measures and also in the Permian strata of early authors. It probably has a very much wider geographical range over the Mississippi basin than has hitherto been suspected.

Geinitz has intimated that Swallow's *Bakevellia pulchra* may be very closely related; but as the description of the latter is so unsatisfactory and is unaccompanied by figures it is not possible now to make out the exact relationships of the two forms.

Macrodon obsoletus Meek.

Macrodon obsoletus Meek, 1871: Rep. Reg. Univ., W. Va.

Macrodon obsoletus Meek, 1875. Geol. Sur. Ohio, Pal. vol. II, p. 334, pl. xix, fig. 9.

The bivalve under consideration was originally described from the Apalachian region, where it appears to be rather widely distributed through Pennsylvania, West Virginia and Ohio. But it has not before been recognized west of the Mississippi river. The Iowa shells are somewhat larger than those from the more eastern localities but do not differ essentially from the typical forms of the species. Meek's type specimen is a good cast showing the characters perfectly. The shell is radiately striated.

Nucula beyrichi Schauroth.

Nucula beyrichi Schauroth, 1854: Zeit. der Deut. Geol. Gesel., vol. VI, p. 551, t. xxi, fig. 4.

Nucula beyrichi Geinitz, 1866: Carb. und Dyas in Nebraska, p. 21, t. i, figs. 36, 37.

Nucula beyrichi Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 589.

As remarked by Meek, there is some doubt as to the correct reference of the American forms of the group to the European species of Von Schauroth. Comparisons of the Iowa specimens of this species and *N. parva* of McChesney give no indication of the identity of the two shells as has been suggested at various times. One of the most striking differences between the two forms is the forward position of the beaks in the one and the central location of the umbones in the other. None of the Des Moines shells have been examined internally to ascertain the character of the hinge teeth and muscular impressions.

Schizodus alpina (Hall).

Dolabra alpina Hall, 1858: Geol. Iowa, vol. I, p. 716, pl. xxix, fig. 2.

Schizodus alpina Meek & Hayden, 1864: Palæ. Upper Mo., p. 58.

The original locality of *Schizodus alpina* is Alpine Dam on the Des Moines river. Hall referred the form with some doubt to

Dolabra; and it was not until some years afterwards that Meek & Hayden suggested that the shell belonged probably to *Schizodus*. As the specimens occur in Iowa, the shells are usually wanting; so that only internal casts are commonly met with.

Pleurophorus permianus Swallow.

Pleurophorus permianus Swallow, 1858; Trans. St. Louis Acad. Sci., vol. I, p. 192.

Clidophorus pallasi Geinitz, 1866: Carb und Dyas in Nebraska, p. 23, t. ii, fig. 3. (Not *Mytilus pallasi* de Vern., 1845.)

Pleurophorus occidentalis ? Meek, 1872: U. S. Geol. Sur. Nebraska, p. 212, pl. x, fig. 12. (Not *P. occidentalis* Meek & Hayden, 1858.)

The Des Moines forms appear to be the same as those described by Swallow as *Pleurophorus permianus*. And although the type is a cast the prominent ribs on the posterior slope leave little doubt as to its identity. The Iowa shells are, however, well preserved, showing all the minute details of structure.

Geinitz's figure 4 on tafel ii in his "Carbonformation und Dyas in Nebraska" is manifestly the same form; and cannot be regarded as de Verneuil's *Mytilus pallasi*. Meek, however, in the U. S. Geological Survey of Nebraska refers Geinitz's shells to *P. occidentalis* of Meek & Hayden; but there now seems to be considerable doubt as to the correctness of this view. In the Catalogue of American Paleozoic Fossils Miller has assigned all of Geinitz's forms to Meek's *P. oblongus*. This reference is only partly correct, inasmuch as Geinitz's *C. pallasi* embraces two distinct forms.

Pleurophorus subcuneatus Meek and Hayden.

Pleurophorus subcuneatus Meek & Hayden, 1858: Trans. Albany Inst., vol. IV, p. 81.

Pleurophorus subcuneatus Meek & Hayden, 1864: Pal. Upper Mo., p. 66.

Pleuropherus simplus Geinitz, 1866: Carb. und Dyas in Nebraska, p. 24 (not of v. Keyserling).

There is but little doubt that the form from Des Moines is identical with that figured by Geinitz in 1866, as *Pleurophorus simplus* of Keyserling. Meek and Hayden had already described it under *P. subcuneatus*, but their figures are inaccurate and give a very erroneous conception of the real shape of the shell. This was, however, corrected by Meek in Dana's Manual of Geology.

Astartella vera Hall.

Astartella vera Hall, 1858: Geol. Iowa, I, p. 715, pl. xxix, fig. 1.

The form under consideration was originally described from Iowa but since the appearance of the first diagnosis of the species more than thirty years ago little has been known of it within the limits of the state.

Although a thorough examination of all the forms described under the genus has not been made, the differences, as compared with *Astarte,* do not appear sufficiently great to give Hall's term a separate generic rank. Further comparisons may not, however, confirm this suggestion and hence until complete evidence is at hand *Astartella* should, perhaps, be allowed to stand as a valid generic group.

Dentalium annulostriatum Meek & Worthen.

Dentalium ? annulostriatum Meek & Worthen, 1870: Proc. Acad. Nat. Sci., Phila., p. 45.

Dentalium ? annulostriatum Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 589.

Dentalium annulostriatum Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 234.

On a former occasion, the finding of six specimens of this species was recorded. Since that time a number of additional individuals have been obtained from higher horizons and associated with a similar fauna. The peculiar annular costæ which are so prominent and so characteristic of the species have given rise to the suspicion that these shells should more properly be assigned to a different genus than that to which they are now referred. However this may be, until a more critical study of the shells has been made, it is, perhaps, advisable to allow the form to remain under its original generic title. The character of the costæ are quite anomalous as compared with the surface markings of the other members of the group, while the great prominence of the annulations, as usually exhibited, is by no means as constant as might be supposed. In some individuals the rings are only faintly developed and the surface of the shells thus appears nearly smooth.

Dentalium meekianum Geinitz.

Dentalium meekianum Geinitz, 1866: Carb. und Dyas in Nebraska, p. 13, tab. i, fig. 20.

Dentalium meekianum Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 590, pl. xxix, fig. 8.

Dentalium meekianum Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 234.

All the species of *Dentalium* described from the Upper Carboniferous of North America have been recognized at Des Moines. Half a dozen other forms have been noticed in the Lower Carboniferous of the Mississippi basin, while Whitfield has called attention to a single form from the Upper Helderberg. The latter is, therefore, the earliest form of the genus, now known from the American continent.

The species here recognized represent three distinct types of the genus: the first having the surface ornamentation composed of a series of ridges transverse to the axis of the shell, thus forming annular elevations; in the second the costæ are much less prominent and are arranged obliquely or spirally; and the third has the ribs running longitudinally.

Dentalium sublæve Hall.

Dentalium obsoletum Hall, 1858: Geol. Iowa, vol. I, p. 724, pl. xxix, figs. 16, 17, 17a. (Not Schlotheim, 1832).

Dentalium sublæve Hall, 1877: Miller's Am. Palæ. Foss., p. 244.

The specimens recently obtained and referred to this species are somewhat smaller than the individuals originally figured by Hall. The longitudinal costæ are quite pronounced as might be expected in young and well-preserved shells. Inasmuch as Hall assigned no locality to the specimens described, more or less doubt must exist as to the exact identification of his species. But as the type specimens were probably among other material from Iowa, it is thought that the shells from the central part of the state represent younger individuals of the species in question. In the original description Hall gave the name *D. obsoletum* to the form under consideration, but that term had been preoccupied by Schlotheim nearly thirty years. The name was, therefore, in 1877, changed to the one it here bears.

This type of *Dentalium* has an exceedingly wide range in both time and space. Forms almost indistinguishable from the Carboniferous shells of Des Moines are found in the Eocene of the Gulf states and along the Atlantic coast.

Pleurotomaria modesta Keyes.

Pleurotomaria depressa Cox, 1857: Geol. Sur. Kentucky, vol. III, p. 569, pl. viii. figs. 10, 10a. (Not Passy, 1832)

Pleurotomaria modesta Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 238.

Pleurotomaria kentuckensis Miller, 1890: N. A. Geol. and Palæ., p. 431.

At the time of the original diagnosis of *Pleurotomaria modesta* it was not known just what relation this form bore to Cox's *P. depressa* though it was stated that the two would probably prove identical. An examination of material other than that which was used in the previous notes leaves but little doubt that the two forms are specifically the same. The name *Pleurotomaria depressa*, however, was preoccupied by Phillips in 1836 and the term was also used by de Koninck and by Passy. *Modesta* therefore becomes the specific designation of the form. Miller has lately proposed the term *P. kentuckensis* for the same shell but this name, of course can only be placed as a synonym.

In the vicinity of Des Moines this species is now known to have a considerable vertical range. It occurs near the base of the lower coal measures and extends into the middle coal horizon. Its geographic range is also quite extensive.

Pleurotomaria carbonaria Norwood & Pratten.

Pleurotomaria carbonaria Norwood & Pratten, 1855: Jour. Acad. Nat. Sci., Phila., (2), vol. III, p. 75, pl. ix, fig. 8.

Pleurotomaria carbonaria Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 239.

The original specimens of this species are from Williamson county, Illinois. A very similar form has been described from Newport, Indiana, under the name of *P. newportensis.* Apparently the only difference ascribed is that the latter has its revolving band raised instead of depressed. Further comparisons may eventually show this character is varietal rather than specific. This suggestion seems all the more plausible since many individuals which are unquestionably *P. carbonaria* have the band scarcely sunk below the surface.

Pleurotomaria sphærulata Conrad.

Pleurotomaria sphærulata Conrad, 1842: Jour. Acad. Nat. Sci., Phila., vol. VIII, p. 272, pl. xvi, fig. 12.

Pleurotomaria coronula Hall, 1852: Stansbury Exp. to Great Salt Lake, p. 413, pl. iv, fig. 4, f. 6a–d.

This form is the leading member of a widely distributed group of shells which manifestly belong to a single species but which in different parts of its range has received a variety of specific names. Notwithstanding, however, the many varietal phases exhibited there is always a peculiar constancy of characters by which the form is readily distinguished from other shells of the genus. In this country a very large number of species of *Pleurotomaria* have been described, embracing many diverse types. The same state of affairs also existed in Europe until de Koninck attempted to set aside the prevalent difficulties by breaking up the genus into several groups, which in fact are more or less easily separable even according to general shape. The original genus was thus greatly restricted and the various sections raised to an equal taxonomic rank. In its main aspects de Koninck's scheme will doubtless be found very convenient in its application to the American Pleurotomariæ. In this connection it may be further stated that the work along this line has already been partly done and the results thus far reached have been eminently satisfactory.

Pleurotomaria valvatiformis Meek & Worthen.

Pleurotomaria valvatiformis Meek & Worthen, 1866: Proc. Acad. Nat. Sci., Phila., p. 273.

Pleurotomaria valvatiformis Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 602, pl. xxix, fig. 9.

The form under consideration is the smallest of the group yet observed in the Mississippi basin. It apparently belongs to the same section as the large *P. carbonaria* already mentioned. The species seems to have a much wider geographic range than has hitherto been suspected but owing to its small size has usually escaped notice.

Murchisonia quadricarinata (Worthen).

Loxonema quadricarinatum Worthen, 1884: Bul. 2, Illinois State Mus. Nat. Hist., p. 7.

Loxonema quadricarinatum Worthen, 1890: Geol. Sur. Illinois, vol. VIII, p. 140.

So manifestly different is Worthen's species from the forms of *Loxonema* that no hesitation is experienced in removing it from the genus under which it was originally described. While there is a probability amounting almost to certainty, of this shell being a true *Murchisonia*, all doubts as to its correct reference cannot be entirely removed until the apertural parts, which are in no specimens yet discovered perfectly preserved, can be throughly examined.

Bellerophon montfortianus Norwood & Pratten.

Bellerophon montfortianus Norwood & Pratten, 1855: Jour. Acad. Nat. Sci., Phila., (2), vol. III, p. 74.

Bellerophon montfortianus Geinitz, 1866: Carb. und Dyas in Nebraska, p. 8, tab. 1, fig. 13.

Bellerophon montfortianus Meek, 1872: U. S. Geol. Sur. Nebraska, p. 225, pl. xi, fig. 15.

Bellerophon montfortianus Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 235.

Like several other members of this group *B. montfortianus* is widely distributed over the Mississippi basin; and also through the Apalachian region. Owing to the extreme delicacy of the shell it is rarely obtained in a good state of preservation. It may be characterized as follows:

Shell with inner whorls rather small; body turn greatly expanded toward the aperture; umbilicus nearly closed; aperture ample, more or less distinctly reniform; labial sinus rather narrow, deep; revolving band rather constricted, well defined, and depressed with a narrow median elevation. Outer lip extremely thin, regularly rounded on each side of the central cleft; much thickened towards the umbilicus. Inner lip well marked by a callous accumulation which is particularly prominent towards the middle. Surface ornamented by numerous fine rounded filiform ribs running longitudinally, every third or fourth one of which is much more elevated than those lying between; these are crossed transversely by minute raised striæ. With the exception of the last half of the outer whorl the shell is also marked by large transverse, more or less broken ridges on each side of the median sulcus.

This beautiful species appears to be much more abundant in Pennsylvania, West Virginia and other portions of its eastern range, than in the region west of the Mississippi river, where it seems to be largely replaced by closely allied forms.

Bellerophon urii Fleming.

Bellerophon urii Fleming, 1828: Brit. Anim., p. 338.

Bellerophon urii Norwood & Pratten, 1854: Jour. Acad. Nat. Sci., Phila., vol. III, p. 75, pl. ix, fig. 6.

Bellerophon carbonarius Cox, 1857: Geol. Sur. Kentucky, vol. III, p. 562.

Bellerophon blaneyanus McChesney, 1860: New Palæ. Foss., p. 60.

Bellerophon carbonarius Geinitz, 1866: Carb. und Dyas in Nebraska, p. 6, tab. i, fig. 8.

Bellerophon carbonarius Meek, 1872: U. S. Geol. Sur. Nebraska, p. 224, pl. iv, fig. 16; and pl. xi, 11a–c.

Bellerophon urii Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 236.

The complete synonymy of this species has been given in the publication last referred to above, and therefore does not require further mention here. As stated on a former occasion there are apparently no good reasons for regarding the form usually called *B. carbonarius* as distinct from the familiar and widely distributed European *B. urii.* The American shell was early referred to *B. urii* by Norwood and Pratten; and it was not until some years later that Cox renamed the specimen. The number of longitudinal carinæ is exceedingly variable, fifteen to thirty being the usual limits, though in very large individuals the costæ often exceed the latter figure.

The geographic distribution of this species is very wide. Aside from its common occurrence in Europe it ranges in America from the eastern slope of the Apalachians to the Rocky mountains.

Bellerophon subpapillosus seems to be merely a local unimportant variation, perhaps an abnormal development. The papillæ are often recognizable on some of the Iowa shells. Certain of the latter individuals show this peculiarity even more distinctly than the type specimen itself; and from this extreme there are all gradations to perfectly smooth surfaces.

Straparollus catilloides (Conrad).

Inachus catilloides Conrad, 1842: Jour. Acad. Nat. Sci., Phila., vol. VIII, p. 273, pl. xv, fig. 3.

Euomphalus rugosus Hall, 1858: Geol. Iowa, vol. I, p. 722, pl. xxix, fig. 14. (Not *E. regusos* Sowerby.)

Straparollus (*Euomphalus*) *subrugosus* Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 607, pl. xxix, fig. 11.

Euomphalus rugosus White, 1884: Geol. Sur. Indiana, 13th Ann. Rep., p. 161, pl. xxxii, figs. 11, 12.

Euomphalus rugosus Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 241.

There appears to be but little doubt that the form described by Conrad from the region east of Apalachians as *Inachus catilloides* and *Euomphalus rugosus* of Hall are identical. Although Conrad's original diagnosis is very brief, his figure shows clearly what shell he had under consideration. A careful comparison of a large series of Pennsylvania specimens and those from the Mississippi basin fails to bring out any difference sufficiently great to warrant a specific separation of the shells from the two localities. This form is commonly known throughout the continental interior under Hall's name. His designation, however, is preoccupied by Sowerby; and for this reason Meek & Worthen proposed *subrugosus* for the specific term. After all, it is very probable that the form in question should properly be regarded as identical with a certain European species; and further comparison may necessitate the mergence of the two species now regarded valid.

Straparollus catilloides as now understood is widely distributed geographically, being one of the most abundant and characteristic shells of the Lower Coal Measures. It occurs usually in the dark bituminous shales overlying the coal seams associated with other gasteropodous species. It often attains a very considerable size though seldom does the maximum measurement exceed twelve millimeters. At Des Moines the vertical range of this species is from the base to the top of the Lower division of the Coal Measures; it is also met with in the so-called middle section at Van Meter in Dallas county near the base of the Upper Coal Series; and very probably extends considerably higher. The form has not as yet been recognized in the Lower Carboniferous of the state, but its very different habitat may easily account for its absence.

Straparollus pernodosus Meek & Worthen.

Straparollus (*Euomphalus*) *pernodosus* Meek & Worthen, 1870: Proc. Acad. Nat. Sci., Phila., p. 45, pl. xxix, figs. 14a–c.

Straparollus (*Euomphalus*) *pernodosus* Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 604, pl. xxix, figs. 14a–c.

Euomphalus pernodosus Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 241.

The species of this group occurring in central Iowa belong properly to the section with angular whorls, to which Sowerby gave the generic term *Euomphalus*. The relations of the forms heretofore generally referred to Sowerby's section and those belonging to Montfort's genus *Straparollus* have already been pointed out at length.[1] It has thus been satisfactorily shown that the two genera are practically co-extensive and as Montfort's term has priority it must be adopted for the group of paleozoic gasteropods distinguished by having the shell rather thick, planorbiform, or depressed conical, broadly and deeply umbilicated; whorls angular or rounded, usually closely coiled, but often barely in contact; aperture sharply pentagonal or sub-circular; labium generally sharp. The surface of the volutions is for the most part smooth, or showing only numerous lines of growth; but sometimes with one or more distinct longitudinal carinæ.

In Iowa the transition forms between the two sections above alluded to are fully represented in certain species of the Kinderhook and Burlington formations. The gradations are complete from those species having elevated spires and rounded volutions—like *S. macromphalus* Winchell—to those with depressed spires and angulated whorls—as *S. roberti* (White). In the latter examples the turns are flattened above and the extremity of the spiral portion situated midway between the upper and lower planes of the volutions. The shell is thus perfectly planorbiform with one side angular and the other rounded.

Naticopsis nana (Meek & Worthen).

Platystoma nana Meek & Worthen, 1860: Proc. Acad. Nat. Sci., Phila., p. 463.

Naticopsis nana Meek & Worthen, 1866: Geol. Sur. Illinois, vol. II, p. 365, pl. xxxi, fig. 4.

This minute form was originally described under *Platystoma*; and there is yet reason for believing that it may actually belong to that group instead of *Naticopsis*, as Meek & Worthen afterwards thought. Should further study indicate that the species is actually a member of the first group its name becomes *Strophostylus nana* since it has been recently shown that *Strophostylus* must be applied to the *Platystoma* section as founded by Conrad.

Trachydomia wheeleri (Swallow).

Littorina wheeleri Swallow, 1860: Trans. St. Louis, Acad. Sci., vol. I, p. 658.

Naticopsis (*Trachydomia*) *wheeleri* Meek & Worthen, 1866: Geol. Sur. Illinois, vol. II, p. 364.

Naticopsis wheeleri Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 595, pl. xxviii, fig 3.

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[1] Proc. Acad. Nat. Sci, Phila., 1889, p. 291; also Am. Geol., vol. V. p. 193–197.

Naticopsis wheeleri White, 1884: Geol. Sur. Indiana, Ann. Rept. for 1883, pt. ii, p. 162, xxxii, figs. 13, 14.
Trachydomia nodulosa Worthen, 1884: Bul. No. 2, Illinois State Mus. Nat. Hist., p. 8
Trachydomia wheeleri Keyes, 1889: American Geologist, vol. IV, p. 195.
Trachydomia wheeleri Keyes, 1890: The Nautilus, vol. IV, p. 30.
Trachydomia nodulosa Worthen, 1890: Geol. Sur. Illinois, vol. VIII, p. 146, pl. xxiii, figs. 11, 11a.

Trachydomia was originally proposed by Meek & Worthen in 1866 as a subgenus of *Naticopsis* McCoy. It is now believed that the characters are sufficiently well marked to admit of a distinct generic separation from McCoy's genus. The chief features distinguishing the two sections as recently made out may be here briefly restated. In *Naticopsis* proper, as represented by the typical forms, and by the majority of American species referred to the genus, the shells are relatively thin; the spire very short; the outer lip extremely thin and sharp; the inner lip also thin and slightly depressed; the last volutions generally more or less distinctly flattened or concave on the upper half and marked toward the suture by numerous small, short, equidistant costæ, parallel to the lines of growth. In contradistinction, the shells of *Trachydomia* are massive with the spire larger and more elevated, the outer lip very thick, but abruptly becoming sharp; the columella very heavy, the callosity thick and greatly extended; the volutions covered with numerous equidistant nodes.

The first species of this group described from the American paleozoic rocks was called by Swallow *Littorina wheeleri*. Since the appearance of Swallow's notice, three other forms have been given specific names: *T. nodosa*, which was regarded by Meek & Worthen as the type of the genus; *T. hollidayi* Meek & Worthen, and *T. nodulosa* Worthen. Now the known shells of this type have a very wide geographical distribution, occurring at numerous places in Illinois, Iowa, Missouri, Kansas and, according to White, also in New Mexico. A careful comparison of a considerable number of shells from widely separated localities leads to the conclusion that the known forms of *Trachydomia* should all be referred to two species—*T. wheeleri*, the one earliest described, and *T. nodosa*. The various slight modifications in size, number of nodes, and amount of callous material deposited can all be explained by local differences in environment. And the complete intergradation of the several forms renders this view necessary.

The callosity of the inner lip often becomes very much thickened in some individuals, but this prominence is not conspicuous in the majority of examples. It is interesting to note in this connection that among the shells from Illinois, there are a number in which the coloration of the callous portions and of the interior surface is still visible. In some cases the color is an intense shining black; in some a purplish-black; in others a dull faded purple; and in a few the color has nearly disappeared. Aside from the apertural parts, all traces of the original coloration of the shells are lost. Under the ordinary circumstances of fossilization, the color could hardly be expected to be preserved except in rare cases; and the few recorded instances of paleozoic species retaining such characters are of peculiar interest.

Aclisina minuta (Stevens).

Aclis minuta Stevens, 1858: Am. Jour. Sci., (2), vol. xxv, p. 259.

Aclisina minuta de Koninck, 1881: Ann. de Mus. Roy. d'Hist. Nat. de la Belgique, T. VI.

Aclisina minuta Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 240.

The form under consideration was first noticed by Stevens as *Aclis minuta*. In 1881, de Koninck established the genus *Aclisina* for the *Turritilla striatula* group of shells, which also embraced *Aclis minuta* and several other American forms. In this country the shells are all quite minute and at present are unknown except in the Coal Measures. On account of this small size these gasteropods have usually escaped notice; and it is for this reason probably that they have been reported from so few localities. As has been remarked elsewhere they occur quite commonly at Des Moines in company with vast numbers of other minute mollusca.

Loxonema scitula Meek & Worthen.

Loxonema scitula Meek & Worthen, 1860: Proc. Acad. Nat. Sci., Phila., p. 464.

Loxonema rugosa Meek & Worthen, 1860: Proc. Acad. Nat. Sci., Phila., p. 465.

Loxonema scitula Meek & Worthen, 1866: Geol. Sur. Illinois vol. II, p. 377, pl. xxxi, figs. 10a–c.

Loxonema rugosa Meek & Worthen, 1866: Geol. Sur. Illinois, vol. II, p. 378, pl. xxxi, figs. 11a–c.

There have been described from the Coal Measures of the Mississippi basin several species similar to the one under consideration. At first glance the vertical costæ appear perfectly straight instead of arched as in the more typical forms of the genus. Upon a closer examination, however, the ribs are found to curve considerably. The relatively much larger size of the rounded ridges in this section of the genus as compared with the Devonian forms tends greatly to obscure the actual curvature.

The figures accompanying the reprint of the original description, in the second volume of the Illinois Geological Survey, are misleading in one particular; that is in having the costæ arranged directly above one another, on the contiguous whorls. In the same place the statement is also made that this is the case. Closer observation has clearly shown that this arrangement is more apparent than real; and that actually the ridges of the different turns are set slightly behind those of the preceding volution; so that in place of forming a perfectly straight, though interrupted ridge from the apex to the middle of the body-whorl, the long rounded elevation is somewhat spirally twisted.

The number of costæ varies with the size and maturity of the shell. Usually there are from three to four ribs less on each whorl than on the one immediately succeeding. Thus the eighth volution may have twenty-two or twenty-four rounded ridges while the fourth has only twelve or thirteen. Below the middle of the whorls the costæ rapidly diminish both in height and breadth and are continued as minute hair lines. The aperture is oval in outline, slightly flattened on the side towards the axis. The inner lip springs abruptly from the callous portion instead of gradually blending with it at a low angle, but otherwise this species possesses all the characteristics of the typical form of *Loxonema*.

At Des Moines this species has as yet been found only at a single horizon—near the top of the Lower Coal Measures.

Loxonema multicosta Meek & Worthen.

Loxonema multicosta Meek & Worthen. 1866: Geol. Sur. Illinois, vol. II, p. 378, pl. xxxi, fig. 12.

The remarks upon *L. scitula* are largely applicable to this species also. The costæ are much smaller as a rule and they average about one-third more than on corresponding whorls of the other species. The number on the last volution may thus be thirty or more. This form is associated with the last and like that species has only been found at a single horizon.

Soleniscus newberryi (Stevens).

Loxonema newberryi Stevens, 1858: Am. Jour. Sci., (2), vol. xxv, p. 259.

Macrocheilus newberryi Hall, 1858: Geol. Iowa, vol. I, p. 719, pl. xxix, fig. 1.

Soleniscus planus White, 1881: Expl. & Sur., W. 100 Merid., Supp., vol. III, p. xxix, pl. iv, fig. 4.

Macrochilina newberryi de Koninck, 1881: Ann. de Mus. Roy. d'Hist. Nat. de la Belgique, t. VI, p. 36.

Soleniscus newberryi White, 1884: Geol. Sur. Indiana., 13th Ann. Rep., pt. ii, p. 153, pl. xxxiv, figs. 7, 8.

Macrocheilus newberryi Keyes, 1888 : Proc. Acad. Nat. Sci., Phila.. p. 240.
Soleniscus newberryi, Keyes, 1889 : Proc. Acad. Nat. Sci., Phila., p. 308.
Soleniscus newberryi Keyes, 1889 : Am. Naturalist, vol. XXIII, p. 423, pl. xx, fig. 5.

Considerable confusion has long existed among the shells for which Phillips long ago proposed the name *Macrocheilus*. The difficulties encountered in arriving at a correct nominal history of the genus have been recently treated of at length. The more salient points may be briefly summarized here.

Macrocheilus was founded by Phillips[1] in 1841. Under it were arranged six species, three of which were *Buccinum breve* Sowerby, *B. imbricatum* Phillips and *B. acutum* Sowerby. Phillips, however, expressly stated that the first two of these properly belong to other groups and that the third was regarded as more typical. *B. acutum* hence becomes the type of the genus, as it was rightly considered by de Koninck and other European writers. An examination of many specimens of Sowerby's *Buccinum acutum* shows that the shell posseses a more or less thickened lip and a prominent revolving fold on the columella. The latter feature was long ago recognized by de Koninck.[2] It thus appears that Sowerby's form is in all respects a typical *Soleniscus* as defined by Meek and Worthen[3]; and that, therefore, this genus and *Macrocheilus* are identical.

But Phillips' term *Macrocheilus* was preoccupied by Hope in 1838 for a genus of insects and, therefore, becomes unavailable. Conrad, in 1842, proposed *Plectostylus* for a group of fossil gasteropods which evidently belonged to *Macrocheilus*; but this name also had been used by Beck five years before. In 1860, Meek and Worthen founded the genus *Soleniscus*, for certain paleozoic shells which now are known to be very closely related to the type of *Macrocheilus*. Inasmuch as the latter term had been previously used, Boyle, in 1879, substituted the name *Duncania*, which he afterwards changed to *Macrochilina*. From the foregoing, it is, therefore, manifest that the generic title *Soleniscus* has precedence for the *Macrocheilus*. group, as typified by *Buccinum acutum* Sowerby and *Soleniscus typicus* Meek & Worthen.

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1 Palæ. Foss. Cornwall, p. 103.

2 Desc. des Anim. Foss. de Belgique, 1844, p. 474.

3 Proc. Acad. Nat. Sci., Phila., 1860, p. 467.

Soleniscus humilis (Keyes).
Macrocheilus humilis Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 239.
Soleniscus humilis Keyes, 1889: Am. Naturalist, vol. XXIII, p. 423.
Soleniscus humilis Keyes, 1889: Proc. Acad. Nat. Sci., Phila., p. 308.
Macrochilina humilis Miller, 1890: N. A. Geol. & Palæ., p. 409.

With the exception of the finding of a few additional specimens since the first record of the form no further information has been obtained concerning this species.

Soleniscus gracilis (Cox).
Macrocheilus gracile Cox, 1857: Geol. Sur. Kentucky, vol. III, p. 570.
Macrocheilus gracile Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 239.
Soleniscus gracilis Keyes, 1889: Am. Naturalist, vol. XXIII, p. 423.
Soleniscus gracilis Keyes, 1889: Proc. Acad. Nat. Sci., Phila., p. 307.
Macrochilina gracilis Miller, 1890: N. A. Geol. & Palæ., p. 409.

Until quite recently this little shell seems to have been generally overlooked. Even when noticed it has been usually referred to *S. ventricosus* of Hall. The two forms are certainly very closely related but whether they will eventually prove identical or not cannot be decided at present. As remarked in another place, the smaller specimens are less ventricose and have the spire proportionally much higher than in older individuals, which simulate, somewhat, Hall's species above alluded to. As a matter of fact the latter form has been recognized only in a few instances; while its name has been applied to a very considerable number of shells which are manifestly quite different specifically.

Soleniscus paludinæformis (Hall).
Macrocheilus paludinæformis Hall, 1858: Geol. Iowa, vol. I, p. 719, pl. xxix fig. 10.
Soleniscus paludinæformis White, 1884: Geol. Sur. Indiana, 13th Ann. Rep., p. ii, p. 154.
Soleniscus paludinæformis Keyes, 1889: Proc. Acad. Nat. Sci., Phila., p. 308.

Perhaps the only question of synonymy in connection with this species is its possible identity with Conrad's *Plectostylus hildrethi.* The type of the latter, however, appears to be merely an internal cast which fact makes it almost impossible to determine the exact relationship of the two forms. In any case it is not probable that under these circumstances Conrad's name could in any way be made to supplant Hall's species.

Sphærodoma medialis (Meek & Worthen).
Macrocheilus mediale Meek & Worthen, 1860: Proc. Acad. Nat. Sci., Phila., p. 466.
Macrocheilus pulchellum Meek & Worthen, 1860: Proc. Acad. Nat. Sci., Phila., p. 467.
Macrocheilus intercalare Meek & Worthen, 1860: Proc. Acad. Nat. Sci., Phila., p. 467.

Macrocheilus mediale Meek & Worthen, 1866: Geol. Sur. Illinois, vol. II, p. 370, pl. xxxi, figs. 5a–b.

Macrocheilus intercalare Meek & Worthen, 1866: Geol. Sur. Illinois, vol. II, p. 371, pl. xxxii, figs. 6a–b.

Soleniscus medialis White, 1884: Geol. Sur. Indiana, 13th. Ann. Rep., p. ii, p. 156.

Sphærodoma medialis Keyes, 1889: Proc. Acad. Nat. Sci., Phila., p. 366.

Macrochilina medialis Miller, 1890: N. A. Geol. & Pal., p. 409.

The generic relations of *Sphærodoma* have already been fully discussed elsewhere. In contradistinction to the nearest allied genus, *Soleniscus*, the shells of this group have the volutions very convex, the spire greatly depressed, the body-whorl relatively much larger and the aperture correspondingly ample, while the columellar ridge is usually very obtuse or not defined. These forms are commonly found in the calcareous beds, while their fusiform relatives occur most plentifully in bituminous shales; the inference is, that the former were probably more strictly marine than the latter.

Bulimorpha minuta (Stevens).

Loxonema minuta Stevens, 1858: Am. Jour. Sci., (2), vol. XXV, p. 260.

Actæonina minuta Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 594, pl. xxxix, fig. 2.*

Actæonina minuta Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 240.

Bulimorpha minuta Keyes, 1889: Proc. Acad. Nat. Sci., Phila., p. 301.

The reasons for considering this species under *Bulimorpha* have already been fully stated. A further examination of the form appears to indicate that the inner lip actually is separated from the outer labrum by a distinct notch. Its nearest ally is, therefore, *B. canaliculata* (Hall). In regard to the generic relations, it may be said that the assemblage, of which this little shell is one of the members, embraces those American forms having the shell fusiform, with the spire elongated; the whorls more or less decidedly convex, the last rather large; the columella curved, abbreviated or truncated at the base; the inner lip often well defined anteriorly, and usually separated from the outer by a more or less well-marked notch; surface smooth. Accordingly, this group would include not only those forms originally comprehended under the genus *Bulimella* established by Hall but also certain other species. Some of the forms now recognized as belonging to the section have been assigned to Portlock's *Polyphemopsis,* but there is reason to believe that this term is not correctly applicable to any known American gasteropod. Hall's *Bulimella* is preoccupied by Pfeiffer and it is, therefore, necessary to find some other more appropriate term for the group in question. *Bulimorpha* founded by Whitfield is apparently the only available name for these shells, but whether this title can be eventually considered valid cannot now be decided.

Bulimorpha ? chrysalis (Meek & Worthen).

Polyphemopsis chrysalis Meek & Worthen, 1866: Proc. Acad. Nat. Sci., Phila., p. 267.

Polyphemopsis chrysalis Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 596, pl. xxviii, fig. 7.

Bulimorpha chrysalis Keyes, 1889: Proc. Acad. Nat. Sci., Phila., p. 300.

Inasmuch as *Polyphemopsis* is not recognized as an American genus the species under consideration can only be referred to *Bulimorpha* provisionally, until its generic position is more definitely known. The Des Moines specimens are not preserved sufficiently well to indicate the true structure of the anterior part of the shell. The species somewhat resembles *Soleniscus newberryi* (Stevens) but according to Meek & Worthen, it does not exhibit the columellar fold so characteristic of that group.

Goniatites nolenensis Cox.

Goniatites nolenensis Cox, 1857: Geol. Sur. Kentucky, vol. III, p. 574.

The single specimen from Des Moines is in an excellent state of preservation and shows the minutest details of structure. And while it does not agree exactly with Cox's diagnosis referred to above, there does not seem to be any valid reason for regarding it as anything more than merely an individual variation of *G. nolenensis*. The Des Moines specimens come from the base of the Middle Coal Measures. At the same locality, but at a horizon considerably lower, have been found abundant remains of a large Goniatite having a maximum diametric measurement of fully six inches. None of these large shells, however, have as yet been obtained sufficiently well preserved for accurate descriptive purposes.

Nearly a score of species of *Goniatites* have been recognized in the coal measure strata of the continental interior. These are widely distributed geographically from the Rockies to the Apalachians. Many of them were of large size and rivaled the Nautiloid forms which also flourished throughout the region.

Thrinacodus duplicatus ? (Newberry & Worthen).

Diplodus duplicatus Newberry & Worthen, 1866: Geol. Sur. Illinois, vol. II, p. 61, pl. iv. figs. 3, 3a.

Thrinacodus duplicatus St. John & Worthen, 1875: Geol. Sur. Illinois, vol. VI, p. 289.

The specimens under consideration were obtained at the now abandoned Giant Mine. They do not agree in all particulars with the typical forms of the species, as the denticles are somewhat large, more slender and much longer. They are associated with numerous molluscan shells.

Deltodus intermedius St. John & Worthen.

Deltodus intermedius St. John & Worthen, 1883: Geol. Sur. Illinois, vol. VII, p. 153, pl. ix, figs. 14, 15.

It is with some doubt that the species in hand is referred to this species which was described from the St. Louis limestone at Pella, Iowa. It corresponds, however, in all essential particulars.

The results thus far brought out may be summarized in the following.

Synoptical Table of Genera and Species.

Protozoa	Rhizopoda	genera	1	species	1
Cœlenterata	Anthozoa	"	2	"	2
Echinodermata	Crinoidea	"	1	"	1
	Echinoidea	"	1	"	1
Molluscoidea	Bryozoa	"	1	"	1
	Brachiopoda	"	10	"	16
Mollusca	Lamellibranchiata	"	12	"	18
	Gasteropoda	"	15	"	31
	Cephalopoda	"	3	"	7
Arthropoda	Crustacea	"	2	"	2
Vertebrata	Pisces	"	3	"	4

A comparison of the above table with a similar one given on another occasion confirms still more strongly the conclusions arrived at at that time. The present additions are nearly entirely confined to the true mollusks, the previously known numbers of genera and species from the locality being nearly doubled; while very little, or no gain is apparent in the other groups.

May 1.

Special meeting.

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

Thirty-six persons present.

The announcement was made from the Chair that the President of the Academy, Joseph Leidy, M. D., LLD. had died the 30th ultimo in the sixty-eight year of his age.

Whereupon the following minute was unanimously adopted:—

The Academy of Natural Sciences of Philadelphia desires to put on record its sense of the loss it has sustained in common with the entire scientific world in the death of its President, Dr. Joseph Leidy.

While his work in zoology and palæontology shed a luster on the Academy and extended its reputation wherever physical truth is valued throughout the earth, his official connection with the society, extending over a period of nearly half a century as Curator, Chairman of Standing Committees and more recently as President, was marked with discretion, tact and unswerving integrity, and actively promoted the welfare of every department.

His charity, rectitude and humility endeared him to his associates who loved the man while they admired the scholar.

The sorrow experienced by his fellow-members enables them to sympathize the more deeply with his wife and daughter to whom they desire to convey the assurance of profound commiseration in their irreparable bereavement.

A committee consisting of Prof. Angelo Heilprin, Daniel G. Brinton, M. D., Henry C. Chapman, M. D., John H. Redfield, and Harrison Allen, M. D., was appointed to make arrangements for a Memorial Meeting to be held the 12th inst.

It was resolved that the members of the Academy meet in the hall the 2nd inst. to participate in the funeral services at the church.

May 5.

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

Thirty-six persons present.

A paper entitled "Contributions to the Life-Histories of Plants, No. VI," by Thomas Meehan, was presented for publication.

Dr. Henry C. Chapman was invited to prepare a Biographical Notice of the late Dr. Joseph Leidy for publication in the Proceedings.

May 12.

Memorial Meeting.

Two hundred and thirty-two persons present.

Rev. H. C. McCook D.D., Vice President, called the meeting to order and then surrendered the chair to his associate Vice-President, Mr. Thomas Meehan, who, after stating the special object of the meeting to be a commemoration of the late President of the Academy, Dr. Joseph Leidy, invited Dr. W. S. W. Ruschenberger to preside. Dr. Ruschenberger having taken the chair the following papers were read in accordance with the report of the Committee appointed at the last meeting:—

Harrison Allen M. D., on Dr. Leidy's work in Vertebrate Anatomy.

Henry C. Chapman M. D., on his work in Invertebrate Anatomy.

Prof. Angelo Heilprin, on his work in Palaeontology and Geology.

Joseph Willcox, on his work in Mineralogy.

James Darrach M. D., on his work in Botany.

Edw. J. Nolan M. D., on his Personal Character and Services to the Academy.

Remarks were also made by James J. Levick M. D., Daniel G. Brinton, Rev. H. C. McCook D. D., Mr. Isaac C. Martindale and Mrs. Elizabeth L. Bladen.

It was announced that Dr. Chapman had accepted the invitation to prepare a Biographical Notice of Dr. Leidy.

May 19.

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

Forty-six persons present.

A paper entitled "On Land and Fresh-water Mollusks collected in Yucatan and Mexico," by Henry A. Pilsbry, was presented for publication.

The death of Prof. John LeConte of San Francisco, a correspondent, was announced.

Mr. Charles E. Smith was elected a member of the Council for the unexpired term of the late Mr. Aubrey H. Smith.

May 26.

Dr. J. Bernard Brinton in the chair.

Thirty-three persons present.

A paper entitled: "Echinoderms from the Bahama Islands," by J. E. Ives, was presented for publication,

It was resolved that as a mark of respect to the memory of Dr. Leidy the office of President be not filled until the next annual election.

Authority was duly granted for the formation of an Ornithological Section on second reading of an application signed by the following: Spencer Trotter M. D., Benjamin Sharp M. D., William L. Abbott M. D., Samuel N. Rhoades, Isaac C. Martindale, Edwin Sheppard, Henry A. Pilsbry, George S. Morris, Joseph Willcox, Charles E. Ridenour, Stewardson Brown and Witmer Stone.

The following were elected members:—

George M. Beringer, Joseph Crawford, Arthur Aimes Bliss M.D., and Wm. J. McGinty.

The following were ordered to be printed:—

CONTRIBUTIONS TO THE LIFE-HISTORIES OF PLANTS. NO. VI.

BY THOMAS MEEHAN.

On the causes affecting variations in Linaria vulgaris.

Few subjects more deserve the attention of thoughtful students of biology than the extent of variation aside from the conditions of environment. Instructive papers bearing on evolution are continually appearing, the full value of which is impaired by the passing suspicion that the authors have not fully perceived how great is the innate power to vary, independent of any external influences. That environment or surrounding circumstances have considerable influence on the production of new forms may surely be admitted without detriment to a profound belief that very much more is due to a tendency to change implanted in the organism, the laws governing which the keenest scrutiny has hitherto been baffled in the effort to detect. It is possibly from this confession of ignorance, that the advocates of change by environment have gained so much strength. He who has something tangible to please us, has more power than he who has to confess that he does not know. Those of us who would not have conceded as much to environment as is frequently claimed for it, can only insist that change is evidently going on in order, and evidently in accordance with a regular plan,—while if all claimed for environment were conceded to be sound, it would subject change to the mere chapter of accidents; and the harmony, and the exact dependence of one thing on another, which everywhere prevails, could scarcely exist.

It has been my fortune to have to show that in many cases where variations have been charged to crossing by foreign pollen, or by other "conditions of environment," it was extremely probable that the sole actor in the work was this unknown law of change; while I have shown in many monotypic species, or in species removed from all possibility of intercrossing with other species, that the variations are quite as wide as if there had been full opportunity for the supposed laws of environment to operate.

Here I will call attention to the interesting variations any one may find in an hour's walk among *Linaria vulgaris*, the common yellow toad-flax, in any district where the conditions are absolutely identical, and the plant tolerably abundant. Let one gather in the walk any specimen that seems to be slightly different from another, and he will be amazed on comparing the handful, to note how great the difference. The foliage does not vary much, but some of the most divergent flowers might pardonably be referred to distinct species, did not the intermediate forms show that they were all of one family. There are variations in color and in form. In color, some are pale straw, and others deep yellow, while the palate varies from deep orange to the faintest possible tinge of yellow. At times nearly all the corolla, except the palate, is white instead of the normal tint, and again are forms in which only the backs of the two upper segments are white. But the most interesting variations are in the form of the lower lip. This is trilobed. Sometimes the lateral lobes are so broad as to overlap each other, when the central lobe seems hardly noticeable. At other times, they are so widely separated that the trilobed character is noticed at a glance. In some instances the central lobe is scarcely produced, in others it is large and broad, extending to the line of the lateral lobes.

What has environment had to do with these widely variant forms? The most diverse will often be found in proximity where no one could suggest any difference whatever in the surrounding conditions. It is an introduction from Europe, and has no close allies that any one could name as likely to influence its pollination. Indeed, if these were present, they would be inoperative as the plant is here, and probably everywhere, a close breeder, as I noted years ago. The pollen sacs burst before the corolla opens, scattering the fertilizing dust over its stigma which is evidently influenced thereby before the wind or insects have had any chance to operate. The flowers can gain no advantage from any outside agency, usual with those where insects have some opportunity to bring in foreign pollen before it is too late.

Aside from all this is the fact that the plants in any one given locality, but a few years ago sprang from possibly one, or at most a few progenitors, which, introduced by accident from Europe, escaped the cultivators destructive hoe, and then spread, through its progeny.

There seems no escape from the deduction that the plant derives from some pre-natal influence power to vary greatly, without any regard to the long periods of time sometimes called for, and wholly independent of external influences.

ON THE SELF-FERTILIZING CHARACTER OF COMPOSITÆ.

Lepachys pinnata.—The proposition originally, I believe, presented by me, that all plants abundantly fertile are arranged for self-pollination, and are really self-fertilized receives its best illustration in Compositæ. It is rare that a floret capable of producing fertile akenes, proves barren. When I presented some years ago this natural order of plants as an illustration of this principle it was asserted by the late Professor Gray and others, that in many there were bi-lobed stigmas, the lobes being closed when the pistil pushed up through the pollen of the staminate column, and that the inner surface—the stigmatic surface—did not receive the flower's own pollen, but had to receive it from visiting insects, or it fell on each floret of some earlier opening flower. The very production of the ray florets, was regarded by these justly eminent men as to be compared to signal flags unfolded by the flower for the chief purpose of attracting insects. When it was shown that the flowers of composites invariably produced seeds, though fine netting excluded the insects usually supposed attractable by the "signal flags," namely thrips, found in so many flowers in abundance, were charged with the duty of cross fertilization, notwithstanding the proposition, well put by Mr. Darwin, that the fertilization of one flower by another on the same head was, practically, self-fertilization. It was left to me to show by easily tested observations on flowers having a marked contrast of color between the pollen and stigmatic surface, that the pollen tubes entered by the clefts in the closed bi-lobed stigmas, and that usually pollen grains on the closed lobes fell in on to the stigmatic surfaces when the expansion of the lobes took place.

The object of this brief chapter is to add to the list of these easily noted self-pollinating, and I may say, self-fertilizing species, *Lepachys pinnata* Gray. The long showy rays make magnificent "signal flags," but no one can see otherwise than that the large and showy orange pollen grains, get the chance to pollinate the brownish stigmas before any insect, not excepting thrips, can possibly have a chance to do the work.

Bidens frondosa.—In this plant we have an arrangement by which the visits of insects are prohibited. The retrorsely sharp barbed teeth of the akenia are longer than the florets, and insects could not rest on the heads without feet or wings getting entangled in these sharp barbs. It is assumed that the teeth have been produced in the barbed condition to provide ingeniously for the distribution of the seed. Certainly the barbed condition does materially aid in such distribution. And it might be contended that in the evolution of distributing agencies, the effort has been so vigorously successful as to interfere with the assumed effort in plants to avoid self-fertilization. But whether the arrangement is or is not, especially provided to insure self-fertilization, it is clear that this is the result. It cannot be said that *Bidens frondosa* has in any way suffered by ages of pure in-and-in breeding.

Aside from the seeming difficulties in the way of an insect's visit to the flowers through the protective presence of these barbed points, the author has for the past two years, taken frequent opportunities to note whether such visits are actually made, without seeing one instance. It is true bees and other honey-seeking and pollen-gathering insects usually continue at work on one particular species if at all abundant, neglecting for the time being, others equally deserving their attention. It does not follow that bees continually avoid a flower they may seem to be neglecting to-day. It is, however, scarcely probable that the author should not sometimes find bees visiting these flowers, if there was any disposition to do so. On this day, Oct. 4th, very few flowers are left, the floral season having nearly terminated. The occupants of my neighbor's large bee-farm are busy trying to profit by these last blooms of the season. A large tract under my observation is densely covered with *Aster puniceus* L. and *A. puniceus vimineus* Gray, the common Mexican weed *Galinsoga parviflora* Cav., *Solidago ulmifolia* Muhl., and our *Bidens*. But though in some instances, especially in the case of the *Galinsoga*, the branches of *Bidens* intertwine with the others, the bees neglect them.

We may be justified in assuming that *Bidens frondosa* L. is not only so arranged in the structure of its florets that foreign pollen cannot be effective, but that, through the structure and position of the barbed teeth of the akenia, insect visits do not occur, and are rendered impracticable.

On the Structure of the Flowers in Dipteracanthus macranthus.

Dipteracanthus macranthus (Nees), in gardens under the name of *Ruellia macrantha* (Mart.), should, as a true member of the genus, have the limb of the corolla "sub-equal." Two of the five divisions are, however, smaller than the others; and, with a little more effort, might have been bi-labiate. The fact is interesting as suggesting some other consideration.

In many bi-labiate acanths, the two smaller lobes form the upper portion of the flower; the three larger, the lower. In this species, and the species of some allied genera, the pair of smaller lobes form the lower portion of the flower. Examining the buds in an early stage, it may be noted that they are indifferently turned,—some having these smaller lobes uppermost, and some with them beneath. These buds, at first greenish, change to purplish eventually, and when they reach this stage, the tube twists in the case of those with the upturned smaller petals, while those in which they are lower from the first, do not twist. Thus in the end, by the twisting of the tube in one case, all the flowers eventually have the two smaller sections lowermost.

It may be stated as a broad proposition that it is so essential to the true character of this species that the smaller lobes should be lowermost, that when the accident of early formation turns them upside down, the flower will twist its tube to regain the position which we are compelled to regard as its natural one.

It is surely worth considering why it is so necessary that the flower should occupy a position which is exceptional among plants of the order, and to discover if possible, the mode by which the flower is brought to this exceptional position.

This very large flower affords good opportunities for studying the construction of its several parts. The slender tube is 1½ inches long, the stamens extend two inches beyond the tube, while the limb of the corolla is fully three inches. In many flowers the union of the primary parts out of which a monopetalous flower is theoretically composed is so thoroughly concealed that the superficial observer would not suspect the primary gamopetalous condition morphology teaches. Here, however, the strong veins of the primary structure remain, rendering it evident that the parts were really separate, and that the act of union was a subsequent event. We also see that though the stamens usually appear to grow out of, or to be borne by the corolla in Acanthaceous plants, in this species, though attached to the lower portion of the corolla tube, they are really a separate monadelphous set of four, become free from the tube eventually, and continuing for some distance into the limb of the flower, its monadelphous state.

We may pause here for a moment to reflect that a petal, transformed from a leaf as it is, loses its vigor in proportion to the completeness of that transformation. A true leaf will live say three or four months, but when transformed as a petal it will die in that many days. When the separate parts in the same flower undergo different degrees of transformation, the parts retaining most of the original leaf vigor will out-grow and control the least vigorous.

Returning now to *Dipteracanthus* we see that the two lower segments have lost, in a great measure, the venation characteristic of the three upper ones. The power to act as leaves would act, is more strongly retained by the three upper than the two lower. They have had no difficulty in retaining the upper position—or as we generally say, though possibly inaccurately—the most favored position towards the light. We can therefore explain that in the process of transformation from primary leaves to petals, two were arrested earlier than the others. These, continuing a little longer their growth as leaves, were able to get the *upper hand* of the others, which were transformed earlier. We may now see pretty clearly *how* the flowers of the *Dipteracanthus macranthus* are constructed on this peculiar plan—can we as readily tell *why?*

Let us examine first from the standpoint of the speculations so prevalent regarding the relations between winged creatures (insects and birds) and flowers. The flowers, like those of numerous Acanthaceous plants, secrete an almost fabulous amount of nectar as the blossoms are about to fade. The large open limb of the bright purple corolla must be very attractive to humming birds, or to those long-tongued insects capable of reaching through a tube an inch and a half in length. Unfortunately the stamens are so compactly arranged around the style, that one can scarcely conceive of any creature's tongue getting down to the sweets; and when, as in half the flowers, we find the tube twisted as a cork screw, we must see that nature has had no thought at all for arrangements to accommodate the winged visitors.

If we adopt the views I have advanced in many papers, and which I believe I may claim as essentially my own, that in any system of nature where some creatures are dependent on others, and recognition of these separate classes severally by others an essential condition of existence, variations in nature must, in a great measure, have been provided for the mere sake of recognition. In the "struggle for life" some means must exist by which to distinguish friends from foes, if for no other reason. It is not necessary, therefore, with my views of the interdependence of things, to look into every variation or peculiarity of behaviour, as related to a supposed benefit to the plant in the struggle for life. I doubt whether there is any special reason for the behaviour which results in this beautiful species, except the necessity for infinitive variation.

As I remember, other Acanths present similar conditions to that described in this species, but I have confined this chapter to it through having it now before me. It was to teach the lesson as much as to describe the interesting condition of things.

Aerial Roots in Vitis vulpina.

Some one sent to Professor Asa Gray, in 1863, some aerial roots of the Scuppernong grape, and received a reply from him that the interesting fact had not been before noted. He advised the collector to send a note of the fact to the author of this paper, which, with Dr Gray's letter, was done. The author could only say that it was a fact as new to him as to Professor Gray, though it was not unusual to see aerial roots from the main stems of the European grape when under hot-house culture.

The subject seems not to have again attracted attention. Recently a coil of these roots brought from the South and presented to the Academy by Joseph Walton, of Woodbury, New Jersey, showed that these aerial roots were not wholly annual as in the hot-house grapes referred to, but were three years old at least. They were several feet in length, and forked at the apex of each annual growth. Thus a three-year old root consisted of six branchlets from the original rootlet. This is interesting from the fact that in the more familiar cases the aerial rootlets are annual, to wit: in the Poison Vine, in *Ampelopsis*, and English Ivy. These well-known rootlets will, however, become permanent when occasionally finding rich material to penetrate. Josiah Nicholson, a correspondent of Joseph Walton, residing in the vicinity of the grape vines, states that many of these roots die annually, and he knows of none that have gone down from any distance and reached the earth as the Banyan and Mangrove do. An acquaintance of Josiah Nicholson's says that when a vine with these rootlets falls to the ground, they will enter the earth, but not by their tips, but by new rootlets from the surface of the older ones.

There will naturally be inquiry as to the function of these aerial roots. The question has never been answered by the growers of the grape under glass. The grape vine has never been found to be the better or the worse for their production. In the case of these wild vines, the rootlets not reaching the ground, are probably functionless. It is conceded that in plants, as in animals, habits once contracted become hereditary and continue long after the causes which produced them have ceased to exist. If the ancestors of the grape were geotropic, the stems, rhizome-like, creeping along the ground and rooting from the nodes, before the tendril-climbing habit was formed, we could say with some certainty that the aerial rooting habit now occasionally seen, is the remains of the early habit not yet wholly obliterated. It is indeed probable that the ancestors of the grape were rhizomatous or creeping, and that the present stem of the grape vine, now elevated by the tendril-climbing habit, in former times was supported by the earth alone.

Additional Note on the Order of Flowering in the Catkins of Willows.

At p. 267 of the Proceedings of the Academy for 1890, I noted the curious fact that in the male aments of willows the stamens develop from the center of the catkin first, and that growth follows upwards and downwards simultaneously from that point.

This season I have extended my observations to other species I had not before examined, with the same result. It is probably the rule with all willows.

I had not noticed the behaviour of the female aments till this season. It is well worth noting that this rule does not prevail in them, at least in three species, all I could examine. Here the stigmas appear mature simultaneously over the whole ament. No reason for this difference in character between the male and female aments suggests itself.

Self-Fertilizing Flowers.

A long list of flowers which cannot use their own pollen has been placed on record, as well as of plants that depend on insects or outside agencies for the use of their own pollen. There are also flowers which, capable of using their own pollen in a late stage of anthesis, are so constructed, as regards the relative maturity of stamens or pistils, that they may be fertilized by foreign pollen before being able to use their own. The records of all these make important material for philosophical strictures. The author of this paper has performed his own share in this work.

It is a continual thought with him, however, that the facts which bear on self-fertilization deserve equal prominence. It is a line in which there seems to be few workers. The following additions to others already recorded are offered, not because cases of absolute self-fertilization are unfrequent, but because a study of these particular instances developed other facts of interest in the study of plant life as well worth recording as the mere fact that they are self-fertilizers.

Symplocarpus fœtidus.—So much has been said of the relations between insects and flowers,—even a structure so peculiarly arranged as the skunk cabbage, *Symplocarpus fœtidus*, being claimed as an illustration of some close relation—that I devoted a half-day of the 22nd of February to a thorough examination of plants growing in the woods and swamps within a short distance of my residence in Germantown. I gained some facts in addition to those recorded in the chapter on this plant in my "Flowers and Ferns of the United States," vol. I, series 1., p. 57 et seq., 1878. It was there shown that the sexual character of the plant is variable, and that the hermaphrodite condition, as distinguishing the genus and its allies from their monœcious relatives, was a very slender line. A difference was noted in the relative maturity of stamens and pistils. Sometimes the stamens matured before the pistils, or, technically, the flowers would be proterandrous, at others the pistil matures days before the stamens, when the flowers are proterogenous. At that time I thought, as the result of the examination of a few flowers each season, that this difference was caused by the peculiarities of the season. The result of the examination of many flowers on the afternoon mentioned shows an almost equal number of both forms. Both thus existing at the same time and under the same conditions of temperature, the circumstances being in fact exactly the same, shows the difference to be of an innate character, and tending towards unisexuality. Indeed, so far as one may be justified by analogy in similar cases, and in the absence of an actual test by marking the plants and waiting for results, we may risk saying of the species that it is diœcious. If this be not the case, it is certainly tending towards diœcism.

In the one case the pistil pushes through the perianth, extending a full line beyond, and is capped by its beautiful head of stellate hair. No sign of the stamens is visible, though the pistil has evidently been protruded for several days, as it has lost the little globule of moisture that envelops it on its first appearance.

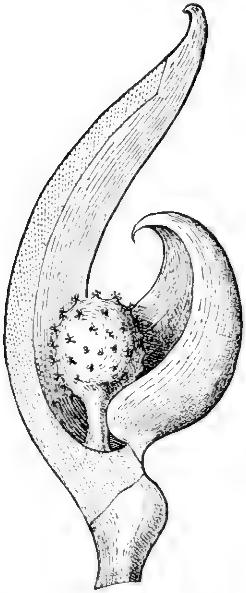
In the other case, the swelling anthers part the perianth segments, and exhibit the apex of the pistil nestling among the anthers. Finally the apex of the pistil, in company with one stamen, is protruded barely beyond where the pistil remains, but the stamen continues until the whole of the comparatively large anther extends beyond the perianth. The other three stamens follow the next day.

Certainly on one plant are flowers in which all the stamens are in advance of the pistils, and are very vigorous, while on other plants the pistil is in advance and comparatively strong, differences which in other species are associated with fertility or infertility, or, as we say, render the plants practically diœcious.

These conclusions are reached in face of the fact that they render the problem of fertilization still more difficult of solution. Although the dry pollen would indicate an anemophilous species, the manner in which the spathe is coiled around the spadix must render it next to impossible for the wind to be a material agent in carrying pollen to separate plants. As for insects, though I have seen a few flies on exceptionally warm spring days among the flowers, and other observers have noted similar insect visitors, these visits can be far from as general as we must demand before we can assign them any important part in a system of cross-fertilization. On the whole of the afternoon of Feb. 22nd, though they were the special object of the afternoon's search, the thermometer indicating 52° Fahr., no winged insect of any kind was seen. I cannot think that either insects or the wind have any material agency in fertilizing these flowers. As, however, I know that some plants in the vicinity of the examination bear an abundance of seed, the probability is that some individuals have flowers in which perfect hermaphroditism prevails, and that these are self-fertilizing.

The great variation in the color and form of the spathes and spadices of this plant has been often noticed. It is worthy of remark, however, that through all the changes, the striped and splashed character of the tints remains. The spathe may be either almost wholly yellowish-green, or purple, there will generally be striæ of one or the other color splashed over the surface.

In one case a flower was found with a double spathe, as is occasionally seen in the common garden Calla, *Richardia Africana*. The explanation given in the latter case is that the flower stem is but a consolidated mass of leaf-stalks, in which the blades of all but the white spathe have been suppressed. There is no reason, therefore



why these suppressed blades should not occasionally appear. The case of *Symplocarpus* shows the inflorescence to be also formed by the consolidation of several leaves, of which a second blade has been advanced though usually suppressed. This is the first case that I have heard of, but there is no reason why they should not be oftener found if looked for.

It may not be out of place to repeat what I have already noted in the chapter above cited that the flowers are odorless, the fœtid smell being given off only when the leaf or stem is broken. These facts were again confirmed on this occasion, showing the speculations that have been offered concerning the "carrion like odor" of the flowers as an attraction to carrion flies, to be, like many similar speculations, figments of overwrought enthusiasm.

Portulaca pilosa, L.—This is everywhere classed as an annual except by DeCandolle (Prodromus 3, p. 354) where it is classed as either annual or biennial. Among a collection of dried specimens brought by my wife from Punto Gorda, Florida, in the winter of 1887, I found a specimen with life and planted it in a flower pot, where it has continued to grow and flower annually. Now four years old, it seems likely to live for an indefinite period.

Its flowers open only, according to all authors before me, under bright sunshine, and then merely for a very brief period. De Candolle says it opens only between ten and twelve. Don, however, (Ed. of Miller, Vol. III, p. 74), notes that this is only true of days when the sun is out. Engelmann, "Plantæ Lindheimerianæ p. 155," observes that in bright sunshine it opens from 9 to 11 or 12, and at the same time notes that the neighboring *P. Gilliesii* Hook., originally from Chili, common in cultivation, opens from 8 or 9, to 2 or 3 P. M. in sunshine. My plant has never been set in bright sunshine, and thus the flowers which are produced abundantly and seed freely, have never opened.[1] They must of course, be arranged for self-pollination, or they could not seed so perfectly. Opening only in bright sunshine in their country, and no one flower opening twice, a large number of those growing in their natural places must of necessity also be close-fertilized.

The inquiry which these facts suggest is whether the chance for cross-fertilization could have been much of an object in nature in the arrangement for the opening of the flowers. It is a well known fact, that of the immense number of seeds produced by any one plant of any kind, but a very small number escape the chapter of accidents and reproduce a plant. If cross-fertilization were so desirable, it would seem that the flowers should have a better chance for effecting it than the brief period of daily opening, and limited, at this, to the few moments bright sunshine affords. As the facts stand, the greater proportion of seeds in this species are the product of close and not cross-fertilization.

To this fact we have to add that the expanding flowers do not seem to my mind to favor cross-pollination. The seed is most probably from close-fertilization in the expanded as well as in those which seed without expanding. I placed on record, Gardener's and Landsteward's Journal, 1845, that the stamens of *Portulaca grandiflora*—a mere form probably of *P. Gilliesii*—were irritable, and in 1878 (Proceedings of Ac. Nat. Sciences, 1878, p. 332) that the stamens of the common Purslane, are irritable also. Close observations have frequently been made on these flowers, because of irritability of a precisely similar character in *Opuntia* and other Cactaceæ. But in none of these observations has there been any suggestion of design or adaptation to cross-pollination by insect or other agency.

The leading object of this paper is not, however, to show the relation which the behaviour of these flowers bears to speculations on cross-fertilization, but to point out in how many particulars the character of some Portulacaceæ resembles some Cactaceæ.[2] A large number of the latter open only for a single day, and for a few hours, under sunshine, during that day. In my experience a large number

[1] Aubrey H. Smith, Proc. Acad. Nat. Sci. Phila., 1867, p. 18, notes that the flowers on the introduced plants near Philadelphia, had "fruit imperfectly developed." The undeveloped flowers probably created this impression. I have little doubt but that later the seed would have been found abundant and perfect.

[2] See also paper on this subject, Proc. Ac. Nat. Sciences, Phila., 1883, p. 84.

never expand their petals, and the sexual organs are well protected from wind and from insects, but seed just as well. The bulk of the seed certainly, if not the whole probably, are the result of close-pollination. Again we have the resemblance in the irritable stamens, in the succulence, and many other characters. It is fair to assume that both families have had a close derivation, and if we would search for the object of nature in so limiting the duration and period of opening and yet with a resulting productiveness, we should probably have to look back in the past to some necessity common to both families, and which does not exist at the present time.

Cuphea Zimpani.—Observing that with scarcely an exception the flowers of the annual species of *Cuphea* were fertile, I was led to look for the evidence of self-fertility in *C. Zimpani* in bloom in my garden, and found that it was so arranged that the reception of any pollen but its own was evidently impossible. An examination of the flower soon after the expansion of the limb would lead to the inference that it was arranged for cross-pollination. The two bearded stamens are abundantly polliniferous, while it is evident by the thick bearded mass below that the communication between stamen and pistil is completely cut off. Between the two large upper petals, however, the calyx forms a sort of sheath, down which an insect in search of honey, and not gifted with the tube-splitting habits of the humble-bee, would no doubt thrust its proboscis. It would be natural to suppose an insect thus examining a flower, would carry pollen to the next. But an examination of this sheath will show that the stigma cannot be reached in this way. That and the four other anthers remain coiled away in a nest of downy hair, which is at once the cradle and the grave of both. A more perfect adaptation for self-fertilization is seldom seen.

Daphne Cneorum.—Though I have seen this under cultivation for half a century, I have never known it to produce a seed. The flowers seem well arranged for self-pollination. The mouth of the tube is effectually closed by four anthers abundantly polliniferous, and the next day the second series of four below, also burst their sacs. The exposure of pollen is simultaneous with the expansion of the limb, and it seems next to impossible that foreign pollen should reach the stigma. The short style and stigma at the base of the tube seem perfect, but I have never been able to detect any pollen on the stigma. It is highly gelatinous and does not separate readily from the anther-cell. It looks as if it might be necessary for an insect to carry the pollen to the stigma, aiding in self-pollination as in *Yucca* and other plants. The tube is too long for the honey-bee, and the humble-bee slits the tube even before the flower opens, thus wholly avoiding contact with the stamens. It may be that in its native places self-pollination is aided by long-tongued lepidoptera, but this suggestion places the plant at a disadvantage in the "struggle for life" as it cannot travel as a self-fertilizer does.

> "He that fights, and runs away.
> May live to fight another day,"

does not apply to a plant, which cannot run.

Lopezia coronata.—That *Lopezia coronata* Andrews, a Mexican Onagraceæ common in cultivation, is a self-fertilizer, I am confident from the fact that every flower is fertile, and this is equally true of plants growing in green-houses where insects and currents of air are wholly excluded, as when growing in the open air. But I have been baffled in endeavoring to ascertain how the flowers own pollen, or the pollen of a neighboring flower, which, as is well shown by Mr. Darwin, is practically the same thing, reaches the stigma. To one who had not been assured of self-fertilization from the actual facts, the flowers would seem as perfectly arranged for cross-pollination as it is possible to be. In the early stages of the bud, before anthesis, the large single anther is introrse. It is sheathed by the blade of the petaloid stamen, and its own filament sheathes the style. At anthesis the connective twists, and the anther turns its back on the style. The anther cells burst at once, and some of the pollen undoubtedly falls on the apex of the style. The stamen soon recurves, until the face of the anther rests upon one of the sepals. At this time, however, the first day of opening, the apex can scarcely be called a stigma, for it is not till the second day that the globular, capitate, and capillate head, properly deserving of the name of stigma, is developed. Looking at the relative positions of stamen and stigma at this period, and when the latter might be regarded as in receptive condition, one might readily conclude it impossible that the flower could be individually self-pollinated. The next day the fading sepals and petals coil upwards and enfold the style and stigma. Whether the pollen which falls on the immature apex of the style at anthesis remains there till the stigma matures, or whether the pollen which has been scattered over the petals and sepals is brought up when the fading petals incurve may well be a question. Possibly, as before noted, its falls from the flower above.

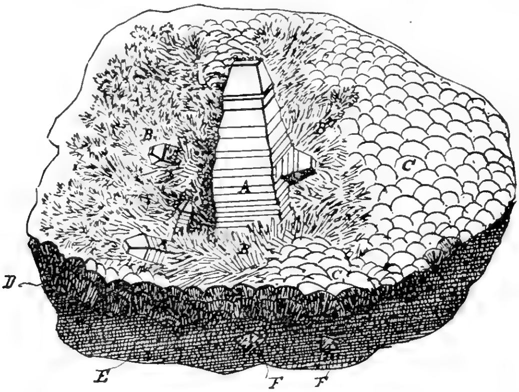
Certainly pollination is not effected by insect agency, and the chief point of this chapter is to show how error may creep in by mere speculations on the arrangement of the parts. Here is a case where one might well believe the arrangements were nicely adapted to pollination by insect agency, when in fact the plant in some way not clear, but certainly, is self-fertile.

ON PARAMELACONITE, AND THE ASSOCIATED MINERALS.

BY GEORGE A. KOENIG.

On his recent visit to the Copper Queen Mine at Bisby, Arizona, Dr. A. E. Foote obtained possession of two specimens showing crystals, which he could not associate with any known species except Anatase. The locality and association, however, speak strongly against the presence of that or any other form of the Titanium dioxide. These specimens have since passed into the collection of Mr. Clarence S. Bement who has kindly permitted me to examine and study them.

One of these specimens has been deemed of sufficient importance to be represented in the adjoining figure as a whole, to show the relation of the associated minerals. It is drawn to natural scale.



We see as the central figure a monolithic crystal (A) lying flat upon the supporting surface, but so that the pyramidal termination is entirely free and symmetrically developed. To the left there are three more pyramidal crystals of the same kind, but of smaller stature. These crystals are characterized by the most brilliant metallic adamantine luster, and purplish-black color. The crystals stand in relief against a back ground of minute acicular crystals of deep blue color (B). Upon the crystals are patches of a beautiful light greenish or silvery-white substance, which have not been individualized in the drawing, as color only could bring them out properly. The nature of both these substances will be discussed below. Under (C) are represented small, brownish-black mamillæ of limonite, shown in section at (D), exhibiting a distinct radial structure. This layer of limonite passes rapidly into a granular mixture of limonite and cuprite (E) of brownish-red color and in this we see imbedded at (F, O) crystals of native copper. Since we find both blue crystals and silvery patches on the large crystals, the genetic relation appears as follows, E, F & D, C, A, B.

The second specimen is about 3 x 4 inches in size. It looks as if it had formed at one time a part of the same large slab of which the first specimen is a fragment. Some twenty odd beautiful crystals like (A) but of smaller size, not over ½ inch in length, are either lying flat or stand erect upon the mamillary mixture of limonite and cuprite. One large blue crystal (B) and several bundles of the same are stretched across the black crystals. The latter are covered in part, mostly upon the strongly striated faces with the greenish-silvery substance mentioned above, which coating produces the impression of a patina on dark bronze.

1. *The black crystals.*—Symmetry. The habitus is strongly tetragonal. Each crystal represents uniformly a combination of (001) (111) (110). The plane (001) is very generally square, sometimes a narrow oblong. The pyramidal faces are broad and smooth at the apex, but are invariably striated parallel to the main plane of symmetry. The luster is so strong on these planes, that one easily overlooks this striation; but it shows with a small magnifying power. One or two pyramidal faces are usually broader than the others. In one of the measured crystals one face is 4 mm., two 2 mm.; one 1 mm. The horizontal edges are generally the resultants of combination of pyramid with prism. I have noticed, however, in a few crystals these edges formed by pyramidal faces alone. The habitus and color of these crystals strongly resemble that of the black or blue-black Anatase. All this might be deceptive, however. To determine the symmetry three crystals were measured, two of the larger (20 mm.) one very small one (2 mm.)

Whilst the faces are very splendent, the striation causes multiple images, sometimes of equal luminosity, and sometimes a mere shredded spectrum. Descloizeaux's artifice of covering the faces gave only a partial relief. It seems to be safest, therefore, that I record here the reflection images observed, and give my readers the opportunity, as well as the means, to decide whether my interpretation of the observed facts is, under the circumstances, the correct one.

In the following figure 2, I have reproduced the observed images obtained from the two larger crystals:

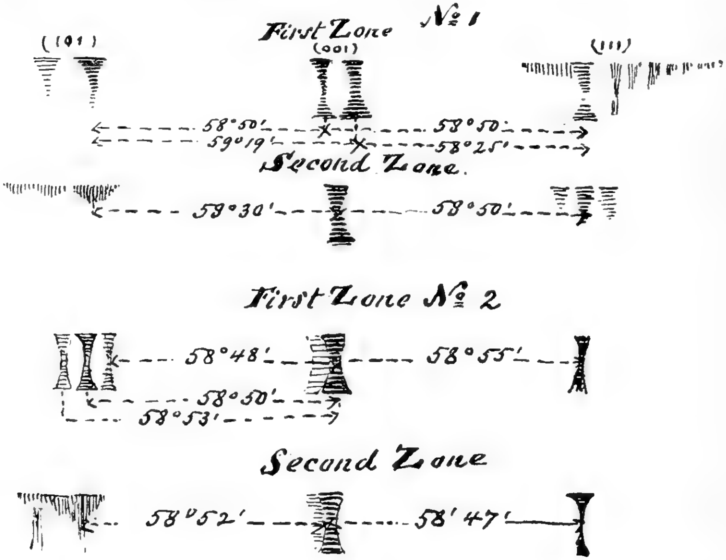


Fig. 2.

The inspection of this figure seems to allow but one interpretation, to wit that the symmetry is *tetragonal* and that the angle (001):(111) = 58° 50′. Now we have for Anatase according to V. Kockscharow (001):(101) = 60° 38′ a difference of 1° 48′.

Does this mean isomorphism of the two species? The Anatase of some localities shows only one pyramid but the cleavage is parallel to this pyramid and it is made the fundamental pyramid for this reason. I have not been able to trace any cleavage planes in the crystals under discussion. Neither basal nor pyramidal nor prismatic. This seems to oppose the notion of isomorphism. Assuming the observed pyramid as (101) then the primary pyramid follows with 66° 58′ 12″

and C = 1·6643.
against C = 1·7799 in Anatase.

I have taken, of course, V. Kockscharow's value, because I obtained from a very fine Brazilian anatase (Mr. Bement's collection) for the basal edge. 43° 20′ (Koenig.) (43° 24′ V. Kockscharow.) Groth bases his C value 1·7344 (Tabell. Uebers. 3 Aufl.) on a much larger angle.

The hardness of the mineral on the smooth basal plane was found equal to that of Apatite. The color on the faces is purplish-black, on the fracture pitch-black. The fracture is uneven, to flat conchoidal. The luster is brilliant metallic-adamantine. The substance is opaque. The streak is black. The specific gravity was found at 20° C = 5·833. The determination made with 0·8487 g. in Pyknometer. The entire crystals, weighing 1·132 g., gave on Jolly's balance two readings, of which the above is the arithmetic mean. Unless crystals, weighing at least 3 grs. be used, the values derived from Jolly's balance are not sufficiently reliable, according to my experience.

In a strong oxidizing flame, a splinter of the mineral is rounded at the edges. In reducing flame, melts easily and yields metallic copper. With the fluxes a blue glass in O fl. Dissolves in HCl with a yellow, in NHO^3 with a blue color. With $NH^4(HO)$ a very slight brown precipitate.

A preliminary analysis made with 48·2 mg. gave CuO = 46·1 Fe^2O^3 = 2·0. It is evident in this instance that the iron does not belong to the mineral, as the greater part of it was left undissolved by dilute nitric acid as a brown red, scaly powder, therefore, probably Hematite. The material used in determining the specific gravity was crushed in a steel mortar. It was then seen that the material was not homogeneous. Whilst the large bulk was black, there could be seen three red spots. They denoted the presence of cuprite, which, of course, was not strange since the mineral sits on cuprite. It was not thought advisable to remove this admixed cuprite mechanically. But if really the mineral is CuO, then the analysis must give an excess if Cu^2O be present.

0·2031 gr. gave 0·2045 Cu^2S.
0·0014 Fe^2O^3.

CuO	=	100·58
Fe^2O^3	=	0·64
		101·32

Here is then an excess of 1·32, which is Oxygen, and this corresponds to 11·8 of Cu^2O.

The substance of the crystal would thus appear to be a mixture of

$$
\begin{aligned}
CuO &= 87.66 \\
Cu^2O &= 11{\cdot}70 \\
Fe^2O^3 &= 0{\cdot}64 \\
\hline
 & 100{\cdot}00
\end{aligned}
$$

It is a matter of very common observation that large crystals enclose bodies of a different nature, sometimes even force them to participate in the mass arrangement of the predominating molecule. I can find nothing which suggests a process of alteration of either Cu^2O into CuO or the reverse. There is neither metamorphosis nor pseudomorphosis in this case. The black crystals belong substantially to what mineralogists have heretofore called Melaconite or Tenorite. The latest crystallographic work on the form of Tenorite—Melaconite is by Ernst Kalkowsky (Groth. Zeitschr., Vol. 3, p. 279). This author shows by a recalculation that the angular values obtained by Jentsch (Ann. d. Phys u. Chem., Vol. 17) on the crystallized oxyde of Copper occurring as a furnace product at Freiberg, must be considered as identical with those of Maskelyne (Report British Association, 1865) on very minute crystals from Lostwithiel. Jentsch was mistaken in assuming its orthorhombic symmetry and isomorphism with Brookite. But while Maskelyne finds the crystals from Lostwithiel as well as the thin lamellæ from Vesuvius to be *monosymmetric,* Kalkowsky comes to the conclusion, on optical ground, that they are really *asymmetric* although closely approaching the monosymmetric type. Groth (Tabell. Uebersicht, 3 Aufl.) has adopted this view, in so far as he puts an interrogation mark after the word "monosymmetric" and gives the explanation referred to, in a note. He evidently does not believe in an *isometric* form of CuO,—which Dana adopts (System of Mineral, Edition 5) on the authority of J. D. Whitney. The latter had found (Rep. L. Sup., 11·99) cubo-octahedrons of CuO and contended that they were original and not pseudomorphs on the ground that Cuprite was only observed at the same locality in unmodified octahedrons. Such an argument can hardly be sustained. For the cubo-octahedral combination is very common in Cuprite from nearly all known localities. Among some magnificent specimens recently come from the "Copper Queen Mine" I noticed cubo-octahedrons, although the majority of the specimens showed the combination (011) (001) (111)

(122). Unless some more convincing testimony be produced, we are justified in discarding the isometric symmetry as pertaining to CuO. Thus we have only the monosymmetric or possibly the asymmetric system left for the species Melaconite or Tenorite. Aside from all precedent, the tetragonal crystals are so unique in their appearance, that they should be accorded the rank of a very distinct species, and the name *Paramelaconite* is proposed for them.

Among the Melaconite in the collection of the University, there is a specimen with the locality "Arizona." It has been in the collection over twenty years, before the Copper-Queen was located, and very probably is not from Bisby. It is a middle-grain sandstone impregnated with minute black crystals. A similar specimen is in Mr. Bement's collection. I had never examined it critically before, surmising that the form would be the same as that described by Maskelyne. I find that these minute crystals, observed with a magnifying power of 250 diam., show the same habitus, combination, luster and colór as the tetragonal crystals from the Copper Queen. There are thus two localities on record for the occurrence of Paramelaconite.

2. *The blue acicular crystals. Footeite—a chloro-oxyhydrate of copper.*—The material to work on was very scant. Dr. Foote sent me broken off crystals from which I was enabled to pick out about 25 mg. of pure material, with which quantitative examinations were made. It was not deemed advisable to disfigure the beautiful specimen (fig. 1) for the sake of more material. None of the crystals weigh over 1 mg. They are either simple or twins. The simple ones represent six sided prisms with pyramidal terminations. The oblique character of the latter is usually well marked. When examined with a power of 150 diameters, it was found that the most complex combination is that represented in fig. 3.

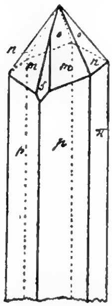


Fig. 3.

m = ${}^{1}P$
o = P^{1}
n = $\infty\ P$
d = $\infty\,\underline{\mathbf{P}}$
p = $P\,\infty$
II = $\infty\,\breve{\mathbf{P}}\,\infty$

d was observed only in two crystals; n is mostly quite small; m and o are always present. The habitus is often tabular, parallel to the plane of symmetry.

$$\Lambda\ p : p = 49° (131°)$$

$$\Lambda\ \frac{m}{m} : \frac{p}{p} = 36\tfrac{1}{2}° (143\tfrac{1}{2}°)$$

$$\Lambda\ \frac{o}{o} : \frac{p}{p} = 33° (147°)$$

These measurements are of course only approximate (being made under the microscope)—the crystal lying on face II. The plane of optical extinction encloses with edge p : p an angle of $7\frac{1}{2}°$. Positive. The system is, therefore, clearly *monosymmetric.*

The twins are either simple like the common form in Selenite, that is composition face $\infty P\infty$ rotation 180°; or two such simple twins perforate each other at right angles with the vertical axis common to both. These form then combinations like those of Harmotome. The broken off ends of such twins show the re-entering angles indicating the existence of a basal cleavage. Heated in a closed tube, a crystal turns black, without losing its shape or even its luster and yields three sublimates. The uppermost is water, the middle one is gray, the lower one green, after cooling. The colorless flame takes the characteristic blue and green colors, when a crystal is brought within its borders. On charcoal the same color phenomena, no smell of arsenic. The tests for sulphuric and phosphoric acids result *negatively.*

For the quantitative analysis only 16·5 mg. were available. This material was placed without pulverizing it, in a mixture of Ag NO^3 and dil. NHO^3 and digested at about 50°C. The crystals turned white at once and were gradually converted into veritable pseudomorphs of AgCl after the original mineral. They were then broken up, to make sure that a complete decomposition had taken places. AgCl was then filtered upon a 20 mm. filter. From the filtrate the excess of Ag was removed $BaCl^2$ added and allowed to stand over night. Then filtered. Ba removed and Cu precip. by H^2S. The precipitate was dark brown-black. No arsenic present. The filtrate boiled, made ammoniacal, filtered, and to filtrate $MgCl^2$ added. No precipitate. Absent P^2O^5. The weights obtained were:

Ag = 3·5 mg; ashes from $BaCl^2$ precip. = 0·2 mg.

CuO = 11·8 mg; ashes with C^2O^3 = 0·1 mg.

From these figures is deduced the percentage composition.

$$\left.\begin{array}{lcl} CuO & = 63{\cdot}7 = & 8{\cdot}12 \\ CuCl^2 & = 13{\cdot}5 = & 1{\cdot}00 \\ H^2O & = 22{\cdot}8 = & 12{\cdot}6 \end{array}\right\} \text{Molecules.}$$

$$\overline{100{\cdot}0}$$

Hence 8 [Cu (OH)^2] CuCl^2 + 4 H^{2}O.

Footeite has, therefore, as its nearest relative the Thallingite of Church. In the latter the ratio of Cu (HO)^2 : CuCl^2 is 4 : 1.

3. *Malachite, asbestiform.*—It would have been impossible to get enough material with which to identify the peculiar greenish silvery coating from the malaconite specimens. Fortunately there was another specimen of mixed limonite and cuprite, the entire surface of which had such a coating. Here we find it like the finest lint in the depressions of the specimens. The crystals of which this lint-like material is composed, are not fast to the surface on which they lie. With the least touch, whole flakes are detached ; but even a big flake will barely weigh one milligram. Under the microscope, the composing crystals can be seen to be needles, tabular, parallel to the clinopinacoid and showing in fact a habitus like the crystals obtained from a boiling solution of calcium sulphate. Each one individualized is light greenish in color and polarizes strongly. The silky metallic luster and white color of the flakes must be owing to interference phenomena.

Brought into a colorless flame, the flake turns shining black and fringes the seams of the flame yellowish red like calcium salts. Neither blue or green colors are visible. The mineral does not contain chlorine. No sulphur present. I managed to get 10 mg. of the clean material ; that is to say with 150 diameters I could distinguish a few brown particles of cuprite-limonite only.

This quantity gave

Ignition at beginning of cherry-red heat	3·0 mgs.
Fe^{2}O^3	0·1 mg.
CuO	6·9 mg.
	10·0

The above composition is exactly that of malachite, and all would be satisfactory if it were not for the color of the flame, for which I can find no explanation.

MEXICAN GRASSES.

BY F. LAMSON-SCRIBNER.

I. *Species Collected in* 1890, *by Mr. C. G. Pringle.*

1. (3447). **Tripsacum fasciculatum** Trin., Aschers. in Bot. Zeit. 1877, p. 525; Fourn. Mex., Pl. Enum. Gram., p. 69.

Ledges, San José Pass, fifty miles northeast of San Luis Potosi. August 15.

2. (3135). **Erianthus saccharoides** Mx., var. **Trinii** Hack. in Mart. et Eichl. Flor. Bras. II, Pars 3, p. 258.

Nodes with a ring of short appressed hairs, pruinose or shining below. Panicle about 30 cm. long, its base (in our specimen) included in the uppermost leaf-sheath, the blade of which is very narrow and about 10 cm. long. Pedicels about $\frac{2}{3}$ as long as the spikelets, thickened above, long pilose. Sessile spikelet 6 mm. long, outer glume shortly bimucronate; first glume 2-keeled, scabrous on the keels above, 4-nerved, pilose on the back; second glume scabrous on the keel near the apex and with a few long hairs on the back below, 5-nerved, ciliate on the inflexed, hyaline margins; fourth glume lanceolate, ciliate on the margins above, two-toothed; awn about 9 mm. long. Anthers 1·5–1·8 mm. long, falling from the spikelets. Styles as long as the stigmas which are exserted at maturity.

The dull white color and length of the panicle, its base enclosed in the sheath of the uppermost leaf, the hairs upon the outer glumes, the hyaline and ciliate inflexed margins of the second glume, and the ciliate margins of the fourth, all point to *Erianthus Trinii* Hack. (Monog. Androp., p. 135), but the exserted styles and length of the anthers—characters used to separate *E. Trinii* from *E. saccharoides* by Hackel—point to the last named species. These characters are doubtless variable and do not deserve to have so much value attached to them. After having made a very careful study of the material in my herbarium in connection with the descriptions given by Hackel (Monog., pp. 129, 135) of *E. saccharoides* and *E. Trinii*, I fail to find any valid character among those given to define these species, which is not broken down or lost in the descriptions given of the several varieties or subspecies enumerated. I have, therefore, preferred to regard it as only a variety. *E. saccharoides* var. *contortus* (made a subspecies by Hackel) has, I think, better or stronger claims to rank as a species than has *E. Trinii.*

Mountain sides, Tamasopo Cañon. June 24.

3. (3132). **Rottbœllia compressa,** Linn. fil. Suppl., p. 114, var. **fasciculata**: Hack. Monog. Androp., p. 286. *Hemarthria fasciculata* Kunth. Revis. Gram. I, p. 152; Fourn. Mex. Pl. Enum., Gram., p. 67; Vasey Contr. U. S. Nat. Herb. II, p. 53.

About ledges of a cascade at the head of Tamasopo Cañon in the mountains midway between San Luis Potosi and Tampico. June 24.

4. (3134). **Andropogon condensatus** Kunth. in HBK. Nov. Gen. I, p. 188, var. **paniculatus** Hack. in Mart. et Eichl. Fl. Bras., Vol. II, pars 3, p. 297: Monog. Androp., p. 388. *A. paniculatus* Kth., *A. Lhotzkyi* Steud.; Fourn., Pl. Mex. Enum., Gram., p. 61.

On exposed, cool ledges of mountain sides above Tamasopo Cañon. June 24.

5. (3446). **Andropogon macrourus** Michx., var. **corymbosus** Hack. Monog. Androp., p. 409.

Exposed slopes, Tamasopo Cañon. June 24.

6. (3128). **Hilaria cenchroides** HBK., var. **ciliatus** var. nov.

Culms slender, 35 cm. high; spikes slender, about 3 cm. long. Groups of spikelets 4–5 mm. long, pale green. Awns short, not extending beyond the lobes of the glumes, and conspicuously ciliate along their sides with short spreading or deflexed hairs. There are usually two awns between the lobes of the outer glumes of the ♀ spikelet.

Near Guadalajara. May 17.

The genus *Hilaria* may be briefly characterized as follows:—Spikelets sessile in groups of three at each joint of the zigzag continuous rachis, forming terminal spikes, the groups falling off entire. The two outer or anterior spikelets ♂ and two- to three-flowered; the posterior or inner one (next the rachis) ♀ or ☿ and one-flowered. Empty glumes much firmer in texture than the others, inequilateral, many nerved, more or less connate below, entire at apex or more often divided, usually unequally two-lobed, with one to several intermediate awns or awn-like divisions.

Hilaria cenchroides is a low, stoloniferous grass and presents considerable variation in the length and breadth of its leaves, and especially in the size of the spikelets, breadth of glumes and their divisions, length of awns, etc. In some forms the outer glumes are pale green with roseate, scarious tips, while in others these glumes are more or less thickly covered with dark purple, punctate dots.

E. Palmer's specimens (No. 197, coll. 1886) are nearly typical, very closely resembling the illustration in HBK. Nov. Gen. et Sp. I, t. 37. Pringle's specimens of 1885 (No. 493) differ but little from this. Palmer's No. 347 (1887) is less markedly stoloniferous, taller and more slender throughout with longer leaves. It is essentially the same form as that named by Dr. Vasey, *H. cenchroides* var. *Texana* (Grasses of the Southwest, Part. I, Pl. X). In the figure of this last, the outer glumes of the spikelets are represented as scabrous, as they certainly are in my specimens, although in the descriptions they are said to be "smooth."

In Pringle's No. 3128 the spikelets are decidedly shorter than in any other form I have seen, as are also the awns, and these are remarkable in that they are ciliate along their edges (see fig. 2a, Plate XIII.)

In Mexico, *H. cenchroides* is used in decoction as a popular remedy to purify the blood especially in cases of skin disease. (Bull. Torr. Bot. Club, XIV, p. 100).

7. (**3133**). **Arundinella Deppeana** Nees in Bonplandia, 1855, p. 84. Steud. Syn. Gram., p. 115; Fourn. Mex., Pl. Enum., Gram., p. 54. Same as 1552 C. Wright, Cuban collection (*A. Cubensis* Griseb. Pl. Wr., p. 533). No. 2615 Pringle, 1889, is the same.
Hemsley (Biol. Contr. Am. Bot. III, p. 252) unites *A. Auletica* Rupr. and *A. latifolia* and *A. scoparia* Fourn. with *A. Deppeana*.

First glume about as long as the third (2·2–2·5 mm.) acuminate-pointed, scabrous on the keel above, 3-nerved; third glume 3·5–3·8 mm. long, 5-nerved below, drawn out to a narrow and truncate or emarginate apex; fourth glume about 1·8 mm. long (including the obtuse and hairy callus). Awn very slender, about 9 mm. long, not flattened nor twisted below, once geniculate, bending at a point about 2 mm. above the glume (ch. ex. spec. Pringle).

About the ledges of a cascade at the head of Tamasopo Cañon in the mountains midway between San Luis Potosi and Tampico. June 24.

I refer Pringle's No. 3133 to *A. Deppeana* from the characters given by Fournier (l. c.) which it may be well to reproduce here. "Culmo gracili, 3-pedali, foliis angustis, glaucis sæpe convolutis, summo a panicula remoto, glabris cum vaginis, ligula truncata, pilosa; pedicellis nudis, paniculæ laxæ radiis patulis infra remote verticillatis, supra sparsis raris; gluma superiore caudata inferiorem superante, aristæ genu nunquam attingente, arista gracili, æqua, glumam superiorem plus quam duplam æquanti, post maturum florem refracta flexuosa."

In Plant. Cubensium, Grisebach reduces *A. Cubensis* to *A. Brasiliensis* Raddi, probably on account of the opinion expressed by Munro in regard to it. According to Trinius' figure (Icon. Gram. tab., 266) of *A. Brasiliensis*, as well as the descriptions given of this species, I must consider Pringle's plant distinct from it. *A. Brasiliensis* is a stouter grass with broader leaves, and the awns of the spikelets are much shorter, stouter, strongly flattened and twisted below the geniculation, similar to that shown in Plate XIII, figs. 9b and 9c, drawn from a spikelet of No. 1746 Pringle, 1888.

8. (**3129**). **Paspalum conjugatum** Berg., Act. Helv. VII, p. 129, Pl. 8: Trin. Icon. tab. 102; Chapm. So. Flor. Suppl., p. 666; Vasey in Bull. Torr. Bot. Club, XIII, p. 163.

By streams at Las Canoas in the valley at the head of Tamasopo Cañon. July 8.

9. (**3343**). **Paspalum gracile** Rudge?, Fourn. Mex. Pl. Enum., Gram., p. 5.

Culms erect or ascending from a geniculate or subrepent base, branched below, 20–35 cm. high. Leaves narrowly to broadly lanceolate (3–8 cm. long by 1–1·5 cm. broad) acute, cordate at base, thinly pilose on both sides and ciliate-scabrous on the margins; sheaths lax, pilose along the margins. Spikes 7–15, solitary or in pairs along the main axis, spreading 1–3 cm. long, nearly sessile, pilose in the axils; rhachis flat, 2–3 mm. broad, scabrous on the inner face and margins, back smooth. Spikelets pale greenish-white, smooth, biseriate, appressed, obtuse, 2–2·3 mm. long; pedicels about 0·5 mm. long, pilose-scabrous on the outer side.

Wet meadows about Lake Patzcuaro. November 9.

No. 240 Rusby, 1886, from Bolivia, is the same.

According to Trinius (Panic. Gen., p. 78) *Paspalum gracile* Rudge, is an exceedingly variable species, differing much in its several forms in height of culm, length and breadth of leaves, number and length of spikes, pubescence, etc. He describes the spikelets as acute while in our plant they are obtuse. In other respects the characters agree very well. Our plant should be compared with *P. pallidum* HBK., which Trinius (l. c.) regarded as only a low growing variety of *P. gracile* Rudge. No. 1696 Fendler, from Venezuela, which was distributed as *P. pallidum* HBK. is rather *P. candidum* HBK.: note the uniseriate and obtuse spikelets, characters which Kunth specially points out as distinguishing *P. candidum* from *P. pallidum*. (HBK. Nov. Gen. et. Sp. I, p. 73).

10. (**3336**). **Panicum paspaloides** Pers., Pl. I, p. 81; Fourn. Mex. Pl. Enum., Gram., p. 18; Chapm. So. Fl., Suppl., p. 666; Vasey Bull. 8 (Bot. Div. U. S. Dept. Agr.) p. 23.

Shallow water of Lake Patzcuaro, State of Michoacan. October 22.

The Indians gather this grass to feed their donkeys, oxen, etc., by pulling out of the water the thick stems which are nearly six feet long (Pringle.)

11. (3403). **Panicum divaricatum** Linn. in Elmgr. Pl. Jam. Pugil., No. 9; Fourn. Mex. Pl. Enum., Gram., p. 32; Chapm. So. Fl., p. 575; Vasey Bull. 8 (Bot. Div. U. S. Dept. Agr.) p. 39.

Very different from No. 1732, collection of 1888.

Ledges, Tamasopo Cañon. July 1.

12. (3449). **Panicum hians** Ell., var. **purpurascens** var. nov.

The three lower glumes dark purple. Branches of the panicle shorter, spikelets longer (nearly 3 mm.) and generally more crowded, and outer glumes more obtuse than in the species as found in the Southern States. Sparsely pilose near the base of the leaves, otherwise smooth throughout.

Wet hollows in prairies of Flor de Maria, State of Mexico. September 4.—*P. hians* Ell. is remarkable for the unusually large, subcoriaceous and obovate palea of the neutral floret.

13. (3452). **Panicum sulcatum** Aubl., Pl. Guian., I, p. 50; Griseb. Flor. Brit. West Ind., p. 547; Hemsl. Biol. Cent. Am., Botany, III, 496 (and p. 506 sub *Setaria*). *Setaria sulcata* Raddi var., Fourn. Mex. Pl. Enum., Gram., p. 42.

Wet shaded ledges, Tamasopo Cañon. September 30.

14. (3320). **Leersia hexandra** Sw., Prod. Fl. Ind. Occ., p. 21; Chapm. So. Fl., p. 549; Fourn. Mex. Pl. Enum., Gram., p. 2; *L. Mexicana* HBK., Nov. Gen. et. Sp., Pl. I, p. 195.

Shallow water, Lake Patzcuaro, State of Michoacan. October 25.

15. (3274). **Stipa tenuissima** Trin. (corresponds with Havard's Texan specimens so named by Dr. Vasey, Contbr. U. S. Herb. II, p. 55.)

Culms slender, simple, erect from a perennial root, 60–80 cm. high; leaves slender filiform, elongated, scabrous; ligule 2 mm. long; panicle 12–20 cm. long, slender, base enclosed in the upper leaf-sheath, branches in threes or fives, erect, 1–5 cm. long. Empty glumes with long-attenuated or subulate, hyaline and colorless tips, about 1 mm. broad at the purplish base, three-nerved, lateral nerves short; the first glume 6·5–8·5 mm. long, the second usually a little shorter; pedicels strongly scabrous. Flowering glume 2 mm. long, minutely tuberculate-roughened, crowned with a few short bristles and with a line of short appressed hairs on the back below; callus short and obtuse, pilose. Awn very slender 6–7 cm. long, minutely scabrous, strongly geniculate at about 2 mm. from the base, the long upper part flexuose. Palea rather delicate, less than one-half as long as its glume.

Carneras Pass, Coahuila, on limestone hills. September 20.

Neither Hemsley nor Fournier recognize *S. tenuissima* Trin. as Mexican. Among the species described by Fournier, *Stipa subulata* (Mex. Pl. Enum., Gram., p. 75) comes nearest to including our grass according to the characters that are given. Trinius (Act. Petrop. 1836, p. 36 and Stipac., p. 41) says of the South American plant, (the type was collected in Mendoza) "radix fibrosa, annua. Paniculæ angustissimæ teneræ, radiis subsolitariis." In our plant the root is evidently perennial and the rays of the panicle are in threes or fives; in all other respects, however, the excellent description given by Trinius for *S. tenuissima* applies most closely.

16. (3316). **Muhlenbergia Bourgæi** Fourn. Mex. Pl. Enum., Gram., p. 86. (Same as 1155 Bourgeau in herb. m.)

Annual. Culms much branched and leafy below, slender and naked above, 15–30 cm. high. Ligule acute, hyaline 3 mm. long. Leaves flat, 1–3 cm. long, 1 mm. or less broad, very finely scabrous on the margins and minutely pubescent on the upper side along the nerves. Panicle 3–5 cm. long, rather narrow, branches solitary, ascending, the lower ones 1·5–2·5 cm. long. Empty glumes unequal, the first lanceolate, acute, one-nerved, about 1·5 mm. long; the second much broader, 2 mm. long, three-nerved and acutely three-toothed at the apex. Flowering glume 3 mm. long, pilose below at the back and sides, scabrous above, awned just below the entire or bidentate apex; awn 8–12 mm. long, scabrous and strongly flexuose. Callus pilose.

Prairies of Flor de Maria. September 4.

In the closely allied *M. Clomena* Trin. (824 Pringle 1886, and 932 Parry and Palmer 1878), the culms are usually about 8–12 cm. high, the main axis of the short panicle and also its branches are strongly flexuose, at least at maturity. The second empty glume hardly 1·5 mm. long and scarcely exceeded by the flowering glume which is broader in proportion to its length and more pilose than in *M. Bourgæi*.

17. (3444). **Muhlenbergia Schaffneri** Fourn. var. **longiseta**. (*M. Schaffneri* Scribner, Bot. Gaz. IX, p. 187.)

Empty glumes scarcely one-half the length of flowering glume, awn 10–18 mm. long (2–3½ times longer than the glume). The apex of the flowering glume is often bifid, the divisions setiform; divisions 0·5–1·5 mm. long.

Foot hills of the Rio Hondo, ten miles west of the City of Mexico, growing on thin soil of ledges. August 25.

Fournier (Mex. Pl. Enum., Gram., p. 85) describing *M. Schaffneri* says, "glumis inæqualibus, inferiore profunde bidentata, brevior, superiore acuta æquante spiculam; palea inferiore integra, subulato-rostrata, seta æquante spiculam." These characters include my *M. depauperata* (Bot. Gaz. IX, 187), which, therefore, must be abandoned.

18. (3477). Muhlenbergia articulata, n. sp.

Perennial. Culms simple, erect, 60–80 cm. high, enveloped at the base, as are also the numerous innovations, by the old, persistent, and somewhat compressed leaf-sheaths which are terminated by the rigid ligules that project beyond the articulation where the fallen blades were attached. Leaves elongated, folded, terete, filiform, the upper one nearly equalling the panicle, smooth without, densely strigose-pubescent within, distinctly articulated with the sheath. Sheaths finely pubescent on the back above, at least when young, margins smooth, striate. Ligule rigid, 6–10 mm. long, entire, distinctly two-keeled, with broad, striate and decurrent margins, persistent on the old sheaths after the blades have fallen. Panicle pale-green or straw-colored, strict, elongated (30–40 cm.), rather densely flowered; branches numerous, short (2–4 cm.), erect. Spikelets lanceolate, subterete, erect on slender pilose-scabrous pedicels. Empty glumes lanceolate, acute, one-nerved, ciliate-scabrous on the nerves above, the second usually subulate-pointed and nearly as long as the floret, the first a little shorter and narrower. Flowering glume lanceolate, acute, 4–5 mm. long, three-nerved, slightly scabrous on the mid-nerve above and shortly pilose anteriorly on the distinct callus; awn strictly terminal, slender, subflexuose, 20–30 mm. long. Palea lanceolate, acute, about as long as the floral glume, two-nerved, nerves approximate, especially near the tip where they are slightly scabrous, smooth below.

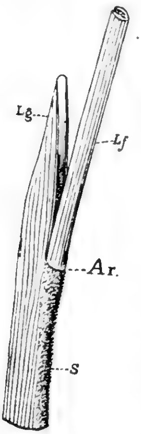


Fig. 1. *Muhlenbergia articulata*. S, Upper portion of leaf-sheath; Lg. Ligule; Lf, lower portion of the lamina; Ar, point of articulation of lamina with the sheath.

Calcareous banks, Cardenas, State of San Luis Potosi. October 7.

19. (3381). Perieilema crinitum Presl, in Rel. Hænk. I, 233, t. 37; Kunth Enum. Pl. I, p. 235: Fourn. Mex. Pl. Enum., Gram., p. 93.

Spikelets one-flowered, the ☿ surrounded at the base with numerous bristles or delicate bracts and a few ♂ spikelets. Flowering glume three-nerved, pilose at the base, long awned; nerves of the palea almost coalescing above.

A slender, branched annual 20–80 cm. high, often rooting at the lower joints; leaves long and delicate; spikelets crowded in dense clusters forming a more or less interrupted spike-like panicle, 8–20 cm. long.

Shaded ledges of a barranca, near Guadalajara, State of Jalisco. October and November.

20. (**3317**). **Sporobolus repens** Presl, Rel. Hænk. I, 241. *Vilfa repens* Trin. Agrost. I, p. 80; Fourn. Mex. Pl. Enum., Gram., 101. Same as 3285. Borgeau.

Shallow ponds (then sterile and the stems and leaves floating on the surface of the water), and in wet soil about the borders of these (then rooting and fruiting), prairies of Flor de Maria, State of Mexico. September 4.

21. (**3197**). **Sporobolus argutus** Kunth, Enum. Pl. I, p. 215: *Vilfa argutus* Nees, Agrost. Bras. 395; Trin. Agrost. I, p. 40; *Vilfa humifusa* HBK. var. B major, Fourn. Mex. Pl. Enum., Gram., p. 97. Same as 816 Pringle, 1886.

Low meadows, Valley of Mexico, Federal District. July 27.

22. (**3130.**) **Sporobolus minutiflorus** Link?; Kunth, Enum. Pl. I, p. 214. *Vilfa minutiflora* Trin. Agrost. I, p. 63; Doell Flor. Brs. fasc. LXXIX, p. 31.

Culms 20-40 cm. high, slender. Leaves flat, 3 mm. or less broad, 3–10 cm. long. Ligule very short, ciliate. Panicle exserted, pyramidal, 8–16 cm. long; branches solitary or (rarely) in pairs, the lower ones 4–6 cm. long, naked below; spikelets rather crowded above and along the secondary branches on short unequal pedicels. Spikelets 1 mm. long; second glume about 0·5 mm. long, rounded, obtuse, broader and a little longer than the first; flowering glume and palea equal, obtuse and nerveless.

Thin soil of limestone ledges, hills above Las Canoas, State of San Luis Potosi.

23. (**3335**). **Epicampes Bourgæi** Fourn.? (Mex. Pl. Enum., Gram., p. 88); *Sporobolus complanatus* Scribner, as distributed.

Perennial. Culms rather stout, simple, erect, 1·5 mm. high, compressed below, smooth, nodes pruinose. Leaves with smooth carinate sheaths longer than the internodes; ligule delicate, hyaline, 10 mm. long, acute or lacerated; lamina elongated (60 cm.) attenuate-pointed, flat, 3–6 mm. wide, scabrous on both sides and rough-serrulate along the margins. Panicle diffuse, 45 cm. long; branches irregularly scattered along the main rachis, capillary, naked below for one-half their length, the lower widely spreading, 10–15 cm. long, shorter and more erect above. Spikelets not at all compressed, 1·5–2 mm. long, one-flowered. Empty glumes ovate or oblong, obtuse, subequal, distinctly one-nerved, minutely roughened on the back, equalling or a little shorter than the floret. Flowering glume distinctly three-nerved, rather broadly obtuse, occasionally short-mucronate pointed by the extension of the mid-nerve, smooth at the base. Palea as long as its glume, two-nerved, embracing (not adherent to) the caryopsis in fruit. Stamens three. Stigmas projecting from the sides of the floret. Fruit a caryopsis, smooth, subterete, obtuse, nearly as long as the fruiting glume and loosely held in the floret by the broad margins of the palea. (Pl. XIII, figs. 4–4d).

Under cool cliffs of a barranca, near Guadalajara, State of Jalisco. November 3.

This grass differs from *Epicampes* as described by Bentham and Hooker (Gen. III, p. 1148) in its widely diffuse panicle which, with its small spikelets, resembles an *Agrostis*. The irregular (spiral ?) disposition of the branches, the firm texture of the flowering glume, large palea and terminal awn or mucro, separate it from that genus. The strictly adherent pericarp alone separates it from *Sporobolus*. From *Muhlenbergia* it is distinguished by its loosely enclosed caryopsis, this being held chiefly by the palea, to which however, it is not at all adherent. As understood by Fournier, the grass in question certainly belongs to *Epicampes*, and it is probably his *E. Bourgæi*. From his imperfect descriptions, however, one is hardly enabled to positively determine the species. Unfortunately I am not able to compare Pringle's specimens with those of Bourgeau and Liebman, referred to by Fournier as types of his *E. Bourgæi* and *E. expansa*.

24. (**3445**). **Deschampsia Pringlei**, Scribn. (in Pringle's coll., 1887, no. 1429.)

Culms slender, erect, very smooth, 60–70 cm. high. Sterile shoots (innovations) numerous, extravaginal, leaves of these rather short and narrower than those of the flowering culm. Sheaths smooth, shorter than the internodes. Ligule membranous, about 2 mm. long, obtuse, broader than the leaf-blade. Leaves flat, 5–12 cm. long, 1–3 mm. (usually about 2) wide, scabrous above and along the margins, somewhat rigid at the involute apex. Panicle 7–12 cm. long, strict, densely flowered, somewhat interrupted below; branches erect, appressed, the longer ones 2–3 cm., covering the internodes of the main rhachis. Spikelets 2-flowered with a minute prolongation of the rachilla behind the second floret, on short (usually very short) scabrous pedicels; empty glumes longer than the florets, subequal, about 5 mm. long, lanceolate, acute, one-nerved, or the second, which is a little broader than the first, indistinctly three-nerved below, scabrous along the keels to near the base, margins broadly scarious; flowering glumes oblong, rounded on the back, texture rather firm below, faintly five-nerved (nerves visible only by transmitted light) two-lobed at the apex, lobes scarious, rounded and minutely erose dentate; callus short, subacute, pilose with short stiff hairs; inter-node between the florets very short, awn from near the base of the flowering glumes, 6–7 mm. long, geniculate, twisted below; palea ⅔ as long as the glume, delicate. (Pl. XIII, figs. 1, 1a).

Damp soil of plains, La Honda, State of Zacatecas. August 19.

The type (No. 1429, 1887) was found growing in wet places, pine plains, at the base of the Sierra Madre in the State of Chihuahua. The plant from La Honda has rather narrower glumes, both empty and flowering, the latter nearly equalling the former in length, and the prolongation of the rachilla above the second floret is more conspicuous.

25. (3279). Danthonia Mexicana sp. nov.

Culms 70–90 cm. high, erect, slender, wiry. Leaves strongly involute, erect, rather rigid, pungent, scabrous without, strigose-pubescent within; ligule 2–3 mm. long, laciniate, auricled. Panicle strict, 15–20 cm. long; branches solitary or in pairs bearing 1–3 spikelets, slightly pilose in the axils. Spikelets about 15 mm. long, 3–4 flowered; empty glumes lanceolate, very acute or mucronate-pointed, 7–9 nerved, slightly unequal, the first about 12 mm. long, the second a little broader and longer, scarious-margined; flowering glumes rounded on the back, pilose with silky hairs on the lower half, bifid at the apex the divisions subulate-pointed, 9-nerved, the three middle nerves approximate and extending into the geniculate awn which is about 14 mm. long, flat and twisted below; callus subacute, densely pilose; palea narrow, about 7 mm. long, ciliate-scabrous on the nerves above. Ovary about 3 mm. long with a pubescent, cushion-like summit. (Pl. XIII, figs. 7–7*b*).

Very unlike any other North American species.

Dry limestone ledges, Carneros Pass. September 20.

26. (3465). Microchloa setacea R. Br., Prod. Flor. Nov. Hol., p. 286; Benth. Flor. Austr. VII, p. 608; HBK. Nov. Gen. et. Sp. I, p. 84, t. 22; Doell in Mart. Flor. Bras. II, 3, p. 75, t. 21; S. Wats. in Proc. Am. Acad. XVIII, p. 176.

Spikelets 2–2·5 mm. long, acute, strictly one-flowered, awnless, sessile and closely imbricate along one side of the rachis forming a slender terminal, more or less falcate spike 3–8 cm. long. Empty glumes nearly equal, persistent, one-nerved. Flowering glumes shorter, hyaline, three-nerved, and somewhat irregularly three-toothed at the broad apex, lateral nerves nearly marginal, ciliate on the back below and on the margins (with longer hairs) to the summit.

An annual with slender, densely tufted culms, 8–20 cm. high.

Sandy soil, Valley of Mexico. July 27.

27. (3451). Spartina densiflora Brongn. in Dupr. It. Bot., p. 14; E. Desv. in C. Gay Fl. Chil. VI, p. 372. (From description.)

Allied to *S. gracilis* Trin., but quite distinct.

Brackish marshes, Las Tablas. July 8.

Spartina Gouini Fourn. is apparently the same; the characters given for this species (Mex. Pl. Enum., Gram., p. 135) certainly embrace our plant.

28. (3174). Bouteloua stolonifera, *B. scorpioides* Lag.? S. Wats. in Proc. Am. XVIII, p. 176. Same as 1010 Schaffner.

Plants strongly stoloniferous. Spikes readily deciduous as a whole. Spikelets distinctly pedicellate. Callus of the ☿ floret shortly pilose, and near the middle of the pedicel of the long-awned (10–15 mm.) upper empty glumes there is a minute tuft of short hairs, glumes otherwise smooth.

Plains, State of Zacatecas, between San Luis Potosi and Aguas Calientes. August 19.

Fournier refers Lagasca's plant (*B. scorpioides* Lag.) to *Chondrosium tenue* Beauv. (*B. tenuis* S. Wats.) but it is quite impossible to identify *B. scorpioides* by the meager description—"*culmo erecto, filiformi, monostachyo; spica lineari-oblonga, spiraliter revoluta*"—given by Lagasca. So far as they go, however, these characters are rather more applicable to *B. tenuis* than to 3174 Pringle or 1010 Schaffner.

29. (3252). Leptochloa Mexicana sp. nov.

Culms simple, terete, solid, erect, 1 m. or more high from a strong creeping root-stock. Sheaths longer than the internodes. Ligule a ring of stiff hairs, 2–3 mm. long. Leaf-blade flat, 30–40 cm. long, lanceolate, 1–2 cm. broad, tapering gradually to the very acute tip, glabrous; mid-rib white and prominent below, evanescent above. Panicle pyramidal, 30–40 cm. long with a strong, sulcate-angular and smooth rachis; branches simple, rather slender, ascending, solitary or the lower subverticillate, triquetrous, scabrous on the angles, the lower 20–27 cm. long, becoming shorter above. Spikelets 10–14 mm. long, 3–4-flowered, erect and *racemose along the outer side of the branches*, remote below, approximate above; pedicels mostly shorter than the spikelets; empty glumes membranaceo-chartaceous, broadly lanceolate, acute, one-nerved, unequal, the first 4–5 the second 6–7 mm. long, scabrous on the nerve; flowering glume 3-nerved, nerves densely silky-villous for one-half or two-thirds their length from the base, mid-nerve extending into a short awn beyond the acute and *entire* apex, the nearly marginal lateral nerves evanescent above. Palea two-toothed, pilose on the nerves below, finely scabrous above. Callus densely pilose. Joints of the rachilla about 2 mm. long, pubescent above. Stamens three. Stigmas plumose, projecting from the sides of the florets. Ovary smooth.

A tall reed-like, perennial grass with solid culms which are somewhat frutescent below, broad flat leaves and ample panicle.

About dry ledges, Tamasopo Cañon. September 28.

This grass might be classed as *Diplachne* if compared with the American species referred to that genus by Bentham, rather than with the characters which he has assigned to it. In defining the genus *Diplachne* both Bentham and Hackel describe the flowering glume as one-nerved. *Molinia serotina* (*Festuca serotina* L.), referred to *Diplachne* by Bentham (Gen. Pl. III, p. 1176), has 5-nerved flowering glumes; all the American species which the same author refers to this genus have the flowering glumes distinctly three-nerved. These American species clearly possess the peculiar inflorescence which alone serves to distinguish the Chlorideæ from the Festuceæ. To me the genus *Diplachne* is not only poorly established, but really stands in the way of a simple and natural classification, and all attempts to maintain it are most likely to result in confusion. As already stated, the North American species which have recently been referred to or placed in *Diplachne* belong, by their inflorescence, to the Chlorideæ and ought to be referred to *Leptochloa*. Beauvois' genus, *Diplachne* (Agrost., p. 80, t. XVI, f. 9) was founded upon *Leptochloa fascicularis* Gray. Beauvois says nothing of the nervation of the flowering glumes; these are, however, distinctly three-nerved; nor does he mention the disposition of the spikelets, but they are manifestly arranged along one side of the branches of the simple panicle. Adding these characters to his description there is nothing left to distinguish *Diplachne* from *Rabdochloa* Beauv. (Agrost., p. 84, t. XVII, f. 3) which Bentham has very properly referred (Gen. Pl. III, p. 1173) to *Leptochloa*. *Leptochloa spicata* (*Diplachne spicata* Dœll) connects *Leptochloa* on the one side with *Microchloa*, from which it differs by its less crowded and several flowered spikelets, and on the other side with *Triodia*, from which it is separated by its one-sided inflorescence and more distinctly keeled flowering glumes; from the recognized species of *Leptochloa* it differs only in its more simple inflorescence. *Leptochloa rigida* Munro (*Diplachne rigida* Vasey) is an *Eragrostis* (*E. rigida Scribn.*)

30. (**3448**). **Leptochloa dubia** Nees, Agrost. Bras., p. 433; Chapm. So. Flor., p. 559; *Diplachne dubia* Benth. ex. S. Wats. Proc. Am. Acad. XVIII, p. 181; Vasey Grasses U. S., p. 35.

Cardenas, State of San Luis Potosi. October 7.

31. (**3267**). **Leptochloa spicata**.—*Diplachne spicata* Doell on Mart. Fl. Bras. II, 3, t. 28; Benth. Notes on Gram. Trans. Linn. Socy. XIX, p. 111; *D. Reverchoni* Vasey, Bull. Torr. Bot. Club, XIII, p. 118; *Triodia Schaffneri* S. Wats., Proc. Am. Acad. XVIII, p. 181; *Triplasis setacea* Griseb., ex Benth. l. c., et Gen. Pl. III, p. 1177.

Hills near San Luis Potosi. September 7.

32. (**3284**). **Eragrostis pectinacea** Steud., Syn. Gram., p. 272; Gray Man. Bot. 5 ed., p. 632; Fourn. Mex. Pl. Enum., Gram., p. 114.

Cardenas, State of San Luis Potosi. October 7.

33. (**3472**). **Eragrostis ciliaris** Link, Hort. Berol. I, p. 192; Chapm. Flor. So. U. S., p. 536.

Las Palmas, State of San Luis Potosi. June 5.

34. (**3334**). **Eragrostis Vahlii** Nees, Agrost. Bras., 499; Doell in Mart. Flor. Bras. II, 3, p. 154; *amœna* Presl, Rel. Hænk. I, p. 275, ex Kunth Enum. I, p. 342 (sub. Poa); *Megastachya amœna* Fourn. Mex. Pl. Enum., Gram., p. 118. *Eragrostis Pringlei* Scribn. as distributed.

Annual. Culms cæspitose, erect or ascending, 5–30 cm. high, simple or with flower-bearing branches below. Leaves flat, attenuate-acuminate, smooth on the upper surface, usually pilose; sheaths slightly compressed, striate, pilose at the throat. Panicle short (3–5 cm.) and subspicate, or elongated (10–15 cm.) with the solitary lower branches remote and more or less spreading, spikelet bearing to the base, axils pilose. Spikelets very short-pedicellate, crowded or fasciculate, erect or somewhat spreading, 5–25 mm. long, linear or linear-oblong, much compressed, many (10–50) flowered.

Empty glumes lanceolate-acuminate or acute, subequal, a little shorter than or nearly equalling the adjacent floral glumes, one-nerved, scabrous on the keel. Flowering glume 2—2·5 mm. long, ovate-lanceolate, strongly acuminate-pointed, distinctly three-nerved, scabrous on the keel above. Palea ⅓ shorter than its glume, finely ciliate along the keels. (Pl. XIII, figs. 8, 8a.)

Sandy plains, near Guadalajara, State of Jalisco. October and November.

35. (3243). Briza subaristata Lam. I, 187; Doell in Mart. Flor. Bras. II. 3, p. 134. *Chascolytrum subaristratum* Desv. in Journ. de Bot. III, p. 71; Kunth. Revis. Gram. I, p. 347, t. 87; *Briza rotundata* Steud. Gram., p. 284; S. Wats. in Proc. Am. Acad. XVIII, p. 182; Hemsl. in Biol. Cent. Amer. III, p. 579.

Perennial. Culms rather slender, 40–60 cm. high, erect or slightly geniculate at the lowermost joints. Panicle narrow, 6–10 cm. long, branches and spikelets erect. Spikelets thick, ovate or subrotund, 3–5 mm. long, 6–10 flowered. Empty glumes cymbæform, nearly equal, shorter than the first florets, scabrous above, the first three-nerved, the second seven-nerved, much broader and subcordate at base. Flowering glumes nearly as broad as long (3–3·5 mm.) deeply cordate at the base; very abruptly short-acuminate (*rostrato-apiculatæ*) the apex minutely two-toothed with a short awn or mucro between the teeth, strongly convex on the back below, this portion being coriaceous, shining and very often minutely pubescent, the broad, flat margins whitish or purplish (*B. violescens* Steud.?). Palea roundish-oblong, exactly covering the inflated portion of the flowering glume. (See Pl. XIII, figs. 10–10d.)

Calcareous bluffs, Flor de Maria and Rio Hondo. August and September.

36. (3443). Brachypodium pinnatum Beauv. var. **cæspitosus.**

Culms cæspitose, slender, somewhat geniculate and more or less branched below, 50–80 cm. high; nodes closely and downwardly pubescent; sheaths slightly scabrous, the overlapping edge conspicuously ciliate, the lower sheaths occasionally sparingly pilose; ligule 1–1·5 mm. long, fimbriate, broader than the leaf-blade; lamina flat, 2–4 mm. wide, very acute, scabrous, pilose with scattered hairs on the upper surface; raceme 6–8 cm. long, bearing 4–6 spikelets on short (2 mm.) and finely pubescent pedicels; spikelets erect or spreading, 2–2·5 cm. long, 6–9-flowered; first glume 6 mm. long, 5-nerved, the second a little broader and longer (7–7·5 mm.), 7–9-nerved, both very finely serrate on the scarious margins near the rather blunt or subacute tips; first flowering glume about 9 mm. long, 7-nerved, rounded on the back and terminating in a short (3–6 mm.) awn; palea strongly 2-nerved, 2-keeled, ciliate on the keels above. Ovary crowned with a thickened, villous appendage which extends down the sides to the base. Caryopsis broadly sulcate, adherent to the palea which it nearly equals in length, crowned with the remains of the villous appendage of the ovary. Embryo small. Lodicules conspicuous, obliquely pointed with ciliate margins. (See Plate XIII, figs. 5–5e.)

Wet meadows about Lake Patzcuaro. November 9.

This grass comes too near the European *B. pinnatum* (as represented in my herbarium) to be separated from it specifically; it is, however, rather more distinctly cæspitose in habit, and in my specimens there is no evidence of a creeping rootstalk, the presence of which is given as one of the characters of the species.

II. Species collected in 1890, *by the Expedition from the Academy of Natural Sciences of Philadelphia, under Prof. A. Heilprin.*

1. (172). **Andropogon saccharoides** Sw. Prod. Flor. Ind. Occ., p. 26; Flor. Ind. Occ. I, p. 205.

Near the City of Mexico, Mexico. April 11, 1890.

2. (67). **Ægopogon geminiflorus** HBK., Nov. Gen. et Sp. Pl. I, p. 133, t. 43; Fourn. Mex. Pl. Enum., Gram., p. 71.

Dry rocky places, Town of Orizaba, Mexico. March 28, 1890.

3. (274). **Chloris ciliata** Sw., Flor. Ind. Occ. I, p. 197; Doell in Mart. Flor. Bras. II, 3, p. 66; Kunth Enum., Pl. I, p. 263; Trin. Icon. Gram., t. 307.

Calcehtoh, Yucatan. March 11, 1890.

4. (184). **Bouteloua Americana** Scribn.
Aristida Americana Sw., Obs. 41, t., f. 2 (1791) ex Kunth.
Dinebra Americana Beauv., Agrost., p. 98, t. XVI, f. 3 (1812.)
Dinebra repens HBK.! Nov. Gen. I, 172, t. 52 (1815.)
Atheropogon repens R. & S., Syst. Veg. II, p. 416 (1817.)
Bouteloua bromoides Lag., Elench., p. 5 (1815) ex S. Wats. Proc. Am. Acad. XVIII, pp. 177 et 179.
B. litigiosa Lag. (according to specimen in my herbarium from Porto Rico, so named by Hackel.)
B. Humboldtiana Griseb. Pl. Wr., p. 132, excl. Syn.

Note. *Aristida Americana* L., cited by Kunth (Enum. Pl., p. 281) as a synonym of his *Eutriana juncifolia*, is a true Aristida which Trinius named *A. dispersa*, according to Munro in his enumeration of the grasses in the Linnæan herbarium. Dr. Watson (l. c.) united under *Bouteloua bromoides* Lag., *Heterostega juncifolia* Desv.

in Bull. Soc. Phil. Dec. (1810), and *Bouteloua Humboldtiana* Griseb. Tekanto, Yucatan, February 28, 1890.

5. (210). **Bouteloua Triæna** Scribn.
Triæna racemosa HBK., Nov. Gen. et Sp. I, p. 179, t. 61. Kunth. Enum. Pl. I, p. 284. *Atheropogon Triæna* Spreng., Syst. I, p. 293, ex Kunth; *Bouteloua Triathera* Benth. Journ. Linn. Soc. XIX, p. 104 (in part.)

Culms slender, branched at the base. Leaves flat, sparingly pilose, at least the lower ones, as are also the sheaths; ligule a ring of dense short hairs. Spikes distichously-racemose along the upper part of the culm from which they readily fall at maturity, partial rachis continued beyond the solitary spikelet into a bristle-like prolongation lying close to the lower glume which it nearly equals in length. Empty glumes narrowly oblong, one-nerved, somewhat inequilateral and slightly retuse at the blunt point, the first about 2 mm. long, the second about 3·5 mm. long. Flowering glume 3-nerved, 5–6 mm. long, slender-acuminate-pointed, scabrous on the keel above, and sometimes with a few short scattered hairs on the back (seen under the lens). Palea nearly as long as its glume, entire or bimucronate at the narrow tip. Second floret reduced to three scabrous, nearly equal awns (about 8 mm. long) supported on a smooth joint of the rachilla (stipe) which is about one-half as long as the floral glume.

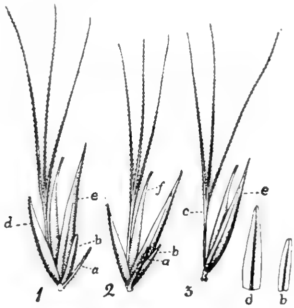


Fig. 2.
Bouteloua Triæna, 1 and 2, entire spikelets; 3, spikelet with empty glumes removed; a, continuation of the partial rachis supporting the spikelet; b, first empty glume; d, second empty glume; e, flowering glume; f, palea; c, the 3-awned rudiment. (Original).

It is doubtless the prolongation of the partial rachis which is often so closely appressed to the back of the lowest glume that Kunth mistook it for a basal awn ("glumæ 2; inferior basi aristata," Enum. Pl. I, p. 284, et HBK. Nov. Gen. et Spec. I, p. 179, t. 61, f. 1).

Our plant differs too much from the description of *Triathera Americana* Desv. (included in *Bouteloua Triathera* by Bentham) to be classed specifically with it. In that the culms are very much branched with rigid involute-sectaceous leaves; the empty glumes are ovate-lanceolate, subulate acuminate and the apex of the flowering glume is trifid with subulate divisions.

In our specimens, the culms are less branched, the spikelets nearer the main axis (more nearly sessile as understood by Kunth) than in *Triœna racemosa* as figured by Kunth, and the glumes are more unequal.

Tekanto, Yucatan. February 22, 1890.

6. (170). **Eragrostis lugens** Nees, Agrost. Bras. 505; Doell in part. Flor. Bras. II, 3, p. 140.

Near *Eragrostis capillaris* Steud. (*Poa capillaris* Linn.)

San Angelo, near the City of Mexico, Mexico. April 11, 1890.

7. (187). **Eragrostis ciliaris** Link, Hort. Berol. I, p. 192; Griseb. Flor. Brit. W. Ind., p. 532; Chapm. Flor. So. U. S., p. 563. *Poa ciliaris* Linn. in Elmg., Pl. Jam. Pug., p. 13; Sp. Pl. ed. 2, p. 102.

Tekanto, Yucatan. February 27, 1890.

8. (169). **Bromus unioloides** HBK. Nov. Gen. et Sp. I, p. 151; Doell in Mart. Flor. Bras. II, 3, p. 110.

Near the City of Mexico, Mexico. April 11, 1890.

9. (168). **Hordeum jubatum** Linn., Sp. Pl. ed. I, p. 85; A. Gray, Man. Bot. North. U. S. ed. 6, (1890) p. 672.

Near the City of Mexico, Mexico. April 11, 1890.

Explanation of Plate XIII.

Fig. 1. A spikelet of *Deschampsia Pringlei.*

Fig. 1a. The same with the empty glumes removed.

Fig. 2. A group of spikelets of *Hilaria cenchroides* var. *ciliata,* anterior view.

Fig. 2a. Posterior view of the same.

Fig. 2b. A group of spikelets of *Hilaria cenchroides* from no. 493, Pringle, 1885 coll.

Fig. 3, 3a; 3b. Spikelets of *Panicum hians* Ell., var. *purpurascens,* three views.

Fig. 3c. Palea of the neutral floret of same.

Fig. 3d. Dorsal view of the ☿ floret of same.

Fig. 4. A spikelet of *Epicampes Bourgœi* (?).

Fig. 4a. Empty glumes of the same.

Fig. 4b. A dorsal view of the flowering glume of the same.

Fig. 4c. Anterior view of floret of same, showing the palea.

Fig. 4d. Caryopsis of same.

Fig. 5. Empty glume of *Brachypodium pinnatum* var. *cœspitosum.*

Fig. 5a. Dorsal view of the flowering glume of the same.

Fig. 5b. Anterior view of floret of same showing the palea and joint of rachilla.

Fig. 5c. Ovary and lodicules of same.

Fig. 5d. Palea of same.

Fig. 5e. Caryopsis of same.
Fig. 6. Spikelet of *Leptochloa Mexicana.*
Fig. 6a. Dorsal view of the flowering glume of same.
Fig. 7. Spikelet of *Danthonia Mexicana.*
Fig. 7a. A single floret from the same showing a joint of the rachilla to the right.
Fig. 7b. Palea of the same.
Fig. 7c. Apex of the flowering glume of same with a portion of the awn.
Fig. 7d. Pistil and lodicules of same.
Fig. 8. Spikelet of *Eragrostis Vahlii.*
Fig. 8a. A portion of same showing persistent paleas.
Fig. 9. A spikelet of *Arundinella Deppeana.*
Fig. 9a. The awned floret of same.
Fig. 9b. A spikelet of *Arundinella Brasiliensis* (?) from no. 1746, Pringle, 1888.
Fig. 9. Awned floret from the same, figure to the left of 9*b*.
Fig. 10. A spikelet of *Briza subaristata.*
Fig. 10a. The empty glumes of same.
Fig. 10b. Dorsal view of the flowering glume of same.
Fig. 10c. Anterior view of the flowering glume of same with palea.
Fig. 10d. Anterior view of palea of same.

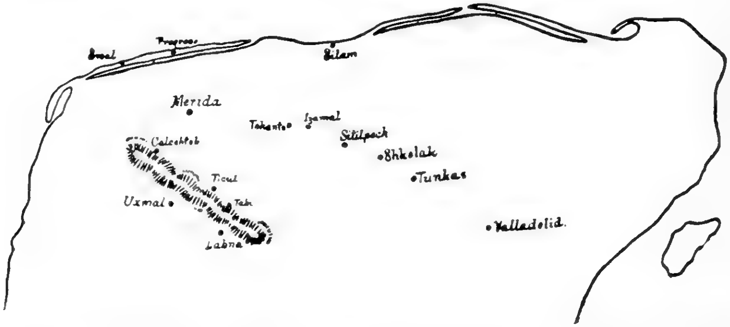
NOTE. All figures original and drawn by the author from specimens collected by Pringle.

LAND AND FRESH-WATER MOLLUSKS COLLECTED IN YUCATAN AND MEXICO.

BY HENRY A. PILSBRY.

The mollusks commented upon in the following pages, were collected by an expedition from the Academy of Natural Sciences of Philadelphia to Yucatan and Mexico during the months of February, March, April, May and June, 1890. The party consisted of Professor Angelo Heilprin (in charge), Messrs. Witmer Stone, J. E. Ives, F. C. Baker and Roberts Le Boutillier.

After touching at Havana, Cuba,[2] the party landed at Progreso, Yucatan; they penetrated southward in Yucatan as far as Tunkas and Labna.



The accompanying sketch map of northern Yucatan shows the position of the various localities at which collections were made.[3]

In Mexico proper, collections were made around Vera Cruz, at the town of Orizaba, at the city of Mexico and in its environs, at Lake Patzcuaro, situated near the western edge of the plateau, in the State of Michoacan, and at Yautepec, in the State of Morelos, lying southward from the city of Mexico, and off the Mexican plateau.

I have affixed the museum numbers of the specimens collected, after each locality.

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1 The marine shells collected on the coast of Yucatan and at Vera Cruz, have been catalogued by Mr. F. C. Baker. See Proc. Acad. Phila. 1891, pp. 45–55.

2 See appendix A.

3 See Proc. Acad. Nat. Sci. Phila. 1891, p. 136, for descriptive notes on the topography and geology of northern Yucatan.

Family TESTACELLIDÆ.

Genus GLANDINA Schum.

Glandina cylindracea Phillips.

From an examination of an authentic specimen of *G. cylindracea* I conclude that *G. carnea* Pfeiffer, is completely synonymous. The species is abundant throughout northern Yucatan.

Tekanto (61510); Tabi (61503); Ticul (61504); Tunkas (61-506); Sitilpech (61509); Izamal (61501); Labna (61507); Merida (61508); and between Sitilpech and Tunkas (61511).

Glandina spp.

A large species of this genus was collected at Vera Cruz, but the specimens (61638) are in poor condition.

Another species, also represented by bleached examples only, was found at Yautepec (61634).

Still another large species was found at Shkolak, Yucatan (61637) and at Izamal (61636), and another at Purga, Province of Vera Cruz (61635).

Glandina (Varicella) speciosa Pfr.

Orizaba (61505).

Glandina (Selasiella) perpusilla Pfr.

Hills around Orizaba (61502).

Genus STREPTOSTYLA Shuttl.

Streptostyla Edwardsiana Crosse & Fischer.

Orizaba (61513).

Streptostyla physodes Shuttl.

Orizaba (61512).

Streptostyla vexans Strebel.

Orizaba (61515).

A small, slender form, apparently belonging to this species.

Several small species have not yet been positively determined.

Subgenus ORYZOSOMA Pilsbry.

The Nautilus, iv, (ii), May, 1891.

Shell perforated; the columella thickened, simply concave, almost imperceptibly sinuous above.

Streptostyla (Oryzosoma) Tabiensis Pilsbry, n. sp. (Pl. XV, figs. 6, 7.)

Shell small, ovate-turrited, rather thin, the base deeply indented and minutely perforated. Spire conic, obtuse; whorls 6, slightly convex; apical 1½ whorls wide, forming a globose nucleus, the following ½ whorl excessively narrow. Suture simple, narrowly margined.

Aperture small, narrow above, one-half the length of the entire shell; outer lip thin, produced forward in the middle; columella thick, a little reflexed, concave on the apertural side; receding a trifle above. Surface polished, scarcely broken by slight growth-lines. Color translucent-whitish, (denuded of epidermis).

Alt. 9·8, diam. 4·8 mm. Alt. of aperture 4·8, greatest breadth of aperture 2·5 mm.

Cave in the mountains, near the hacienda of Tabi, Yucatan (61,630). Dead and denuded of epidermis.

This seems to be perfectly distinct from all described species in its funnel-shaped, perforate base, and the lack of a convex columellar fold.

Genus **PSEUDOSUBULINA** Strebel & Pfeffer.

Pseudosubulina Berendti Pfr.

Hills around Orizaba (61494).

Pseudosubulina sp.

A very minute form, probably undescribed. Orizaba (61493).

Pseudosubulina (Volutaxis) Miradorensis Strebel (?)

Orizaba (61545).

Family **LIMACIDÆ** s. lat.

Genus **ZONITES** Montf.

Zonites (Zonyalina) bilineatus Pfr.

Hills, 300–500 ft. above Orizaba (61522); a bandless form (61521) was collected at the same locality.

Zonites (Hyalinia) indentatus Say.

Yautepec (61520). This easily recognized species seems to inhabit the greater part of North America; it is the most abundant of the smaller *Zonites* in Texas.

Zonites (Hyalinia) subhyalinus Pfr.

Hills around Orizaba, about 500 ft. above the town. (61523.)

Genus **STENOPUS** Guild.

=*Stenopus*+*Guppya* Mörch+*Habroconus* C. & F.

Stenopus elegans Strebel.

Hills around Orizaba (61550); Yautepec (61549).

Family **HELICIDÆ**.

Genus **HELIX** L.

I would restrict this genus to those snails having the genital apparatus complicated by the presence of a flagellum upon the penis-sac, in the male system; and in the female system a long duct to the receptaculum seminis which frequently branches out into a long blind sac, a dart-sac or sacks, and a pair of accessory mucus or digitate glands.

In some species one or more of these organs may be undeveloped; but the majority of them are always present.

Helix aspersa Müller.

This form, introduced from Europe, is very abundant in the environs of the city of Mexico (61535), especially in the park at Chapultepec.

Helix ? (Praticola) griseola Pfr.

Vera Cruz (61534).

Genus **POLYGYRA** (Say) Pilsbry.

Equals, in part, *Anchistoma* Ads., Tryon, Fischer and others. Includes as sections, *Polygyra*, *Mesodon*, *Triodopsis*, etc.

I have adopted *Polygyra* as the name for that group of American Helices characterized by a horn-colored striate shell, with reflected white peristome, usually toothed within; ribbed jaw; genitalia simple, without dart-sac or appendages other than the essential organs, penis without flagellum, duct of the spermatheca short.

See, on this genus, Proc. Acad. Nat. Sci. Phila. 1889, p. 193.

Polygyra sp.

Yautepec (61554). Fragments only.

Genus **PATULA** Held.

This world-wide distributed genus is characterized by a discoidal or conical striated shell, usually broadly umbilicated, having a simple sharp lip, *not thickened within* or reflexed, and by the simple genitalia. Many of the species are viviparous. A host of sectional names have been proposed, mostly for groups, of but little systematic value. I regard *Acanthinula* as a section of *Patula*.

Tropical America is inhabited by a group of thin-shelled light-colored forms of *Patula* known as *Microphysa*. This name being preoccupied, we may substitute *Thysanophora* Strebel, proposed for Mexican species allied most intimately to *P. incrustata* Poey, etc.

Of this name, *Acanthinula* Strebel (not Beck) and *Ptychopatula* Pilsbry, as well as *Microphysa* Martens (preoc.) must be considered synonyms.

Microconus of Strebel is very closely allied, but it may perhaps be considered closer to the section *Discus* of *Patula*. The genus *Patula* has been much more minutely sub-divided than the existing modifications warrant.

Patula coactiliata Fér.

Tunkas (61489); Labna (61488).

Patula Hermanni Pfr.

Hills 500 ft. above Orizaba (61536).

This species has a peculiar aperture. The dentition should be examined. It may prove to belong elsewhere than in *Patula*.

Patula paleosa Strebel.

Hills 500 ft. above Orizaba (61556).

Patula granum Strebel.

A specimen apparently of this species but of a clear whitish color was collected at Progreso, Yucatan (61555).

Patula conspurcatella Morelet.

Merida (61490), Tunkas (61491) and Tekanto (61487), Yucatan; Vera Cruz, Mexico (61492).

I am unable to separate the Vera Cruz specimens from those from Yucatan.

Patula impura Pfr.

Vera Cruz (61557) Yautepec (61558) Mexico.

This differs from *P. conspurcatella* in lacking the delicate, very oblique cuticular folds usually visible on that species, if I am right in my indentification of it. I believe the *Thysanophora impura* of Strebel to=*P. conspurcatella*. These species are very closely allied to the *Patula* ("*Microphysa*") *incrustata* Poey, a species ranging along the Gulf coast from Texas to Florida, originally described from Cuba.

Patula intonsa Pilsbry, n. sp. (Pl. XV, figs. 1, 2, 3.)

Shell very small, narrowly umbilicated, thin, chestnut-brown, semi-globose. Whorls 4, well rounded, separated by very deeply impressed sutures. Apex obtuse; last whorl rounded at the periphery. Surface smooth, very lightly striatulate, having long, whitish, sparsely scattered, delicate hairs, usually rubbed off except at the sutures. Aperture slightly oblique, oval, parietal wall a little flattened. Lip sharp, acute, very slightly expanded at the columellar margin. Alt. 2, diam. 1·8 mill.

The specimens were collected at Orizaba, Mexico (61986).

The sparsely scattered, partly deciduous hairs are peculiar and characteristic.

Family PUPIDÆ.

Genus PUPA Drap.

(Section *Bifidaria* Sterki.)

Pupa contracta Say.

Typical specimens were collected at Orizaba (61433), and at Yautepec (61432).

Pupa servilis Gould.

Merida, Yucatan (61435); Yautepec, Mex. (61434).

Specimens have been examined by Dr. V. Sterki, who considers them true *servilis*. The Yautepec specimens are a trifle slenderer and paler than usual.

Genus EUCALODIUM Crosse & Fischer.

Eucalodium (Coelocentrum) filicosta Shuttlw.

Hills around Orizaba (61519).

Family BULIMULIDÆ.

Genus BULIMULUS (Leach) Auct.

Bulimulus tropicalis Morelet.

Ruins of Labna, Yucatan (61544).

Bulimulus Dysoni Pfr.

Tabi, Yucatan (61514).

Bulimulus sp.

A large number of species of this genus were collected, which the writer has not yet determined.

Family CYLINDRELLIDÆ.

Genus CYLINDRELLA Pfr.

It is evident that a number of the Cylindrellas of Central America will prove to be merely local races; the distinctions do not seem to be at all well defined.

Cylindrella speluncæ Pfr. (Pl. XV, figs. 15, 15a.)
(*C. costulata* Morel., not C. B. Ad.)

The specimens collected seem to connect this species with *C. morini* Morel. The localities are: Cave at Tabi (61517); Ticul (61987); between Sitilpech and Tunkas (61518).

C. speluncæ Pfr., var. **dubia** Pilsbry, n. var. (Pl. XV, figs. 14, 14a.)

A more slender form, always truncated and decidedly smaller, measuring alt. 10, greatest diam. 1¾ to 2 mm., having 12 or 13 whorls remaining, was collected at Labna, Yucatan. There are 17 or 18 riblets on the penultimate whorl, about the same number that the specimens of *speluncæ* before me possess.

Cylindrella Bourguignatiana Ancey. (Pl. XV, figs. 13, 13a.)
Annales de Malacologie II, p. 243, 1884–86.

This species has not heretofore been figured. The specimens before me (six in number) are part of the original lot collected by Mr. Charles Torrey Simpson on the island of Utilla, Honduras.

The species is allied to *C. speluncæ, morini* and *subtilis*, but is always truncated, having nine or ten whorls remaining; it is compact in form. There are 17 riblets on the penultimate whorl; the base is pinched into an acute carina.

Two specimens measure:—

Alt. 10½, greatest diam. 2⅓ mm., whorls 10.

Alt. 10, greatest diam. 2⅔ mm., whorls 9.

The base is not so much narrowed as it is in *C. speluncæ*, etc., and the shell is wider than *C. speluncæ* var. *dubia.*

Genus MACROCERAMUS Guilding.

Macroceramus concisus Morelet.

A very abundant species in Yucatan. Specimens were collected at Izamal (61785), Merida (61553), Tekanto (61552), Tunkas (61551), between Tunkas and Sitilpech (61786), Ticul (61575), Uxmal (61784), Santa Ana, near Calcehtok (61576).

This species seems to be slenderer than *M. Gossei*, but it is excessively variable in length. *Macroceramus Gossei* var. *arctispirus* Ancey, (Annales de Malac. II, p. 242) described from the island of Utilla, is a small form of this species, exactly corresponding with the smaller specimens which occur with typical *concisus* at Merida, Tekanto, Tunkas, and other localities.

Specimens collected by Simpson are before me, being a part of the original lot.

Macroceramus pontificus Gld.

A single immature specimen collected at Orizaba (61576) may be referred to this species, although with some doubt.

Family LIGUIDÆ.

Genus **Liguus** Montf. 1810.

(Subgenus **Orthalicus** Beck, 1837.)

This genus is in great confusion owing to the great variability of the shells and the presence of intermediate forms connecting a number of the described species.

Orthalicus princeps Brod.

Vera Cruz, (61538). Specimens a little slenderer, but which seem to be not specifically distinct were collected in Yucatan at Shkolak (61539), Ticul (61541), between Sitilpech and Tunkas (61537) and at Silam (61542).

Orthalicus Férussaci Martens.

Shkolak (61532) and Tekanto (61540), Yucatan.

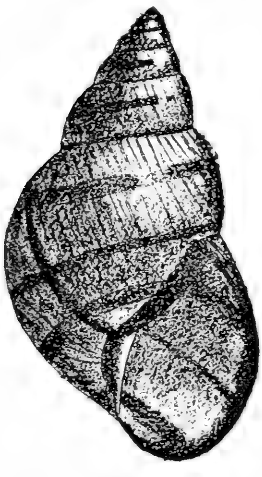
Specimens which seem to belong to this species are in the collection of the Academy from Mazatlan.

Orthalicus melanocheilus Val. (1833).

One of the most distinct species of the genus, described originally from "New Spain." The Florida specimens differ from the Mexican and Central American in a number of characters and seem to me perfectly distinct as a geographic variety.

O. melanocheilus var. **Floridensis** Pilsbry, n. var.

Shell white or slightly stained with brown, having no longitudinal zigzag flames. The body-whorl has three narrow brown bands, the upper one often broken into spots. There is a black varix on the penultimate whorl, and one or two on the body-whorl. The varices are generally *not visible within the aperture, but the three spiral bands are conspicuous there.* Lip bordered with blackish-brown; columella white-edged, but parietal callus deep-brown.



Orthalicus melanocheilus var. Floridensis.

The types of this variety are from near Cape Sable, Florida.

The synonymy of my variety includes:

Bulimus zebra W. G. Binney, Terr. Moll. U. S. Vol. IV, Pl. lxxviii, fig. 12.

O. zebra W. G. B. & T. Bld., Land and Fresh-water shells of N. A. vol. I, p. 216, figs. 370, 371.

O. undatus W. G. B., Manual of N. A. Land shells, p. 440, fig. 483.

Family **STENOGYRIDÆ** Fischer.

Genus **RUMINA** Risso, 1826.

Rumina (Subulina) trochlea Pfr.

Abundant at Izamal, Yucatan (61496). It is certainly only a variety of *S. octona*.

Rumina (Opeas) Caracasensis Rve.

Hills around Orizaba; and at Vera Cruz.

Family **SUCCINEIDÆ**.

Genus **SUCCINEA** Drap.

Succinea luteola Gould.

Progreso, Yucatan (61495).

Succinea sp.

A slender species, quite fragile and light brown in color, was collected at Santa Ana, near Calcehtok, Yucatan. (61546.)

Succinea sp.

San Juan, near Vera Cruz (61548). A single poor specimen.

Succinea campestris Say.

Specimens which I am unable to separate from this species were collected at Lake Texcoco, near the City of Mexico. (61541.)

Family **AURICULIDÆ**.

Genus **CARYCHIUM** Müll.

Carychium exiguum var. **Mexicanum** Pilsbry, n. var. (pl. XIV, figs. 7, 8, 9). The Nautilus, iv (ii), May, 1891.

Shell minute, cylindrical, tapering above to an obtuse apex; waxen whitish, somewhat translucent; whorls 4½, convex, separated by rather deep sutures. Aperture one-third the length of the shell, rather oblique; outer lip expanded, thin above, suddenly becoming very much thickened on its outer portion by a heavy deposit of callus upon its face and inner edge; columellar margin having an obtuse projection (scarcely a tooth) below, and an acute entering fold above. Surface having very delicate oblique striæ of growth.

Alt. 1·8, diam. ·8 mm.

Hills around Orizaba, at an altitude of about 500 feet above the town.

In *The Nautilus* for 1891, vol. IV, p. 109, I gave a brief notice of the forms of *Carychium* found within the United States. In my study of the Mexican specimens I was obliged to go over the whole subject anew, and to examine very extensive suites of American specimens. In the present condition of our knowledge, so far as the collections examined permit me to see, three species may be distinguished and two varieties; viz. *C. exiguum, C. exiguum* var. *Mexicanum, C. exile, C. exile* var. *Jamaicensis*, and *C. occidentalis.*

Only the collection of specimens from points geographically intermediate between the extremes of the range of this genus, and the examination of such material by a competent person, can finally decide the question of the number of naturally defined species, and which, if any of them, must be considered geographic races or subspecies.

Carychium exiguum Say. (Pl. XIV, figs. 1, 2, 3; pl. XV, fig. 16.)

Shell *cylindrical*, the last two whorls of about equal diameter. Whorls 4½. Aperture decidedly over one-third the total altitude. Outer lip sinuous, moderately thickened, very strongly arcuate at its upper outer portion.

This is the common East American form, ranging from Maine southward and westward, the limits of its range not exactly determined as yet.

Carychium exiguum var. **Mexicanum** Pilsbry (Pl. XIV, figs. 7, 8, 9.)

Shell cylindrical. Whorls 4½. Aperture equal to, or a trifle exceeding one-third the total altitude of shell. *Outer lip thickened at and below the middle by a very heavy deposit of callus upon its face.* Lower fold of the columella sub-obsolete. Surface delicately striated.

Orizaba, Mexico.

Carychium occidentalis Pilsbry. (Pl. XIV, figs. 4, 5, 6.)

Shell *distinctly conical*, tapering. Whorls 5. Aperture very oblique, larger than in *C. exiguum*, the outer lip flatly expanded, thin, *not at all thickened on its face.*

Portland, Oregon, is the only locality from which I have seen this species.

Carychium exile H. C. Lea. (Pl. XIV, figs. 10, 11, 12, 13, 14.)

Shell *elongated.* Whorls 5-5½. Aperture small, very oblique, about *one-third the length of the shell.* Outer lip more or less thickened. *Surface closely, regularly and very distinctly striated.*

Eastern Pennsylvania (H. C. Lea); Kent, Ohio (Geo. W. Dean.)

Lea found this form on the Wissahickon Creek, near Philadelphia, but I have not been able to rediscover it there.

Carychium exile var. **Jamaicensis** Pilsbry (Pl. XIV, figs. 15, 16.)

Much elongated, similar to *C. exile,* but the surface smooth, not perceptibly striated.

Jamaica (Robert Swift collection).

Genus **MELAMPUS** Montf.

Melampus coffea L.

Progreso and Silam (61470), Yucatan.

Melampus coffea var. **microspira** Pilsbry n. var.

Distinctly shouldered, spire extremely short, the earlier whorls very closely coiled, the last whorl becoming wide; color uniform pinkish-olive. Alt. 13 mm., diam 8½ mm., length of aperture 12 mm.

Progreso, Yucatan (61471).

Family **LIMNÆIDÆ**.

Genus **LIMNÆA** Lam.

Limnæa attenuata Say.

Lake Chalco, Mexico (61483).

This common form bears the same relation to our northern *L. reflexa*, that *Planorbis tenuis* bears to *Pl. trivolvis.*

Limnæa Cubensis Pfr.

Rather small specimens of this were collected in the stream at Orizaba (61482 and 61481). They vary much in the degree of exsertion of the spire.

A few notes on the synonymy of this and allied species may not be out of place here.

The *L. umbilicata* C. B. Ad. is completely synonymous with *L. Cubensis.* Havana specimens of the latter are absolutely indistinguishable from the Vermont *L. umbilicata* in our collection, received from Professor Adams himself. *L. Cubensis* (+*umbilicata*) is perfectly distinct from *L. caperata* Say, and from *L. humilis* Say, with both of which it has been confused by some authors.

The typical *Cubensis* ranges at least as far west as the Mississippi River, and eastern Texas. West and southwest of this it gives place to *L. techella* Hald., and *L. bulimoides* Lea. The last form may be considered a geographic race or subspecies of the *Cubensis. L. techella* Hald. is nearly identical with *umbilicata.*

The synonymy and range of the forms mentioned may be summarized as follows:

L. Cubensis Pfr.

Syn.: *L. umbilicata* C. B. Ad.; *L techella* Hald.

Habitat: New England to Cuba; westward to St. Louis, Missouri, southwest to Texas and Province of Vera Cruz, Mexico.

L. Cubensis var. **bulimoides** Lea.

Habitat: Western U. S., east to Dakota, Central Nebraska (at Ogallala, coll. by Simpson), and Western Texas.

The European *L. truncatula* Müll. is scarcely separable from *Cubensis* in conchological characters. I have retained the European and American forms separate because their areas of distribution are now so distinct that interbreeding can no longer occur.

The *L. humilis* Say is likely to be confused with small examples of *L. Cubensis*, but it differs in having the expansion of the columella much narrower and of a wholly different form. Say's types of *L. humilis* are before me.

Genus **ANCYLUS** Geoff.

Ancylus excentricus Morelet.

Shkolak, Yucatan (61787).

I may mention here that *Ancylus excentricus* Morelet has been collected in Comal Creek at New Braunfels, Texas, and therefore may be expected throughout Eastern Mexico. The same is true of *Planorbis cultratus* Orb., which I have also received from Southern Texas.

Genus **PLANORBIS**[1] Guettard.

Planorbis tenuis Phil.

An abundant species in the vicinity of the City of Mexico (61607; 61780; 61781; 61625).

The form called var. *Boucardi* by Crosse & Fischer intergrades perfectly with the typical *tenuis* in Lake Chalco. In Lake Patzcuaro a form was collected which is referable to *P. tenuis* v. *Boucardi*, but in which the characters of that variety are considerably exaggerated. One of these (No. 61625 of the collection) is figured

[1] *Planorbis glabratus* Say has not been found in Mexico; nor does it range in the United States, outside of the peninsula of Florida. The *P. glabratus* of authors is not the true *glabratus* of Say.

on pl. XV, fig. 4. See, in this connection, the remarks under *Physa Patzcuarensis.*

Planorbis Caribæus Orb.

Shkolak, Yucatan (61778).

The specimens correspond in every detail with Havana examples of *P. Caribæus* received from Arango.

Planorbis tumidus Pfr.

Vera Cruz (61775; 61591); Orizaba (61779).

Planorbis Maya Morelet.

Merida, Yucatan (61538; 61529). These are larger than indicated by MM. Crosse & Fischer, measuring, alt. $2\frac{3}{4}$, diam. maj. $11\frac{1}{2}$, diam. min. 9 mm.

Planorbis orbiculus Morelet (1849).

(Syn. *Pl. Haldemani* Dkr., 1850, not C. B. Ad. 1849.)

San Juan, near Vera Cruz (61593).

Planorbis Liebmanni Dkr.

Vera Cruz.

A form closely allied to the preceding, but smaller, with the last whorl wider. I regard the identification as undoubtedly correct.

This species occurs in Texas also, as far north as Austin.

Planorbis retusus Morelet?

Specimens probably referable to this species were collected at Shkolak, Yucatan (61777).

Planorbis parvus Say.

Specimens in every respect typical were collected at Yautepec, Mexico (61592).

Genus PLANORBULA Hald.

Planorbula obstructa Morelet.

Ticul, Yucatan (61589).

This species occurs abundantly in Texas as far north as Austin.

Family PHYSIDÆ Dall.

Genus PHYSA Drap.

The Mexican Physæ have been referred by MM. Crosse & Fischer to six species, as follows: *Mexicana* Phil., *Boucardi* C. & F., *Strebeli* C. & F., *Berendti* Dkr., *squalida* Morelet and *Tehuantepecensis* C. & F. Of these names, *Boucardi* is a synonym of *osculans*

(=*Mexicana, vid. infra*); *Strebeli, Berendti* and *Tehuantepecensis* are very closely allied to *squalida*, being perhaps only local forms.

A critical review of the Physæ of the United States[1] causes me to recognize in that area *eleven species* and about the same number of local forms or geographic races susceptible of diagnosis.[2]

Most Mexican specimens of *Physa* differ from those of the Eastern United States in lacking a thickening or rib within the lip-margin in the adult state. This is probably due to the far less amount of difference between the seasons, and the consequent lack of periodicity of growth in the shells. This peculiarity extends, as might be expected, to the Californian species; but in some arid localities, æstivation during the season of excessive drought produces practically the same shell-structure as that caused by the winter hybernation of our Northern Physæ.

Physa osculans Hald.

Lake Chalco, City of Mexico (61627); City of Mexico (61584 and 61586); Lake Texcoco (61585); Between San Angel and Coyoacan, south of the City of Mexico (61587); Yautepec (61788 and 61526).

An examination of Haldeman's types of *Physa osculans* (Monog. Limniades, pl. 2, figs. 11, 12), renders it certain that the *Physa Mexicana* of Philippi is synonymous. The fig. 13 of Haldeman's plate is a different species, as the author of the Monog. Limniades himself supposed. The *Physa Boucardi* of Crosse and Fischer is likewise a mere form (*not a variety*) of *osculans*, the alleged differences having no specific or varietal weight, whatever, in this genus.

Physa osculans is readily distinguishable from the eastern forms *P. hetrostropha, integra* and *gyrina*; but several described Californian Physas present no differences from the Mexican species, and must be considered synonyms.

Physa osculans var. **Patzcuarensis** Pilsbry, n. var. (Pl. XV, fig. 5.)

Shell thin, light, obconic, very broad across the upper part of the body-whorl, narrow below; spire short, small, acute, composed of four rapidly enlarging whorls, the first one black. Columella long, vertical, slightly sinuous; lip strongly arcuate above, thin; color light-brown or whitish; surface shining, wholly lacking spiral lines,

[1] See *Shells of Forest and Stream*, a handbook of Northern United States land and fresh-water shells, now in preparation.

[2] During the course of my studies of U. S. *Physa* I have examined type specimens of almost every one of the described species, nearly fifty in number.

obscurely and finely longitudinally plicated. There are no variceal thickenings, no internal lip-rib, and the surface is nowhere malleated.

Alt. 15, diam. 11; alt. of apert. 12½, greatest width 6⅓ mm.

Lake Patzcuaro, Mexico (61629). Animals of the same suite in alcohol.

This shell resembles the more extreme forms of *Physa ancillaria* Say (known as *Ph. Lordi* Bd. and *Ph. Parkeri* Cur.); and it perhaps bears the same relation to *Ph. osculans* Hald. that *Ph. ancillaria* v. *Lordi* bears toward *Ph. heterostropha.*

The relation of my new form to the boreal American types named is, however, only one of analogy; for the *Lordi* is demonstrably an extreme development of the *heterostropha* type, while my Mexican shells belong to the group of *Ph. osculans,* being in my opinion a geographic race of that species.

The cause of the dilation of the body-whorl in these shouldered Physas has not been explained. I would suggest that the form in these cases is correlated with an increase in the capacity of the air sack or lung, which occupies that part of the shell. Observation of the habits of the snail would probably reveal the reason for this additional lung capacity. It is not unlikely the result of a more continous or prolonged subaquatic residence. Precisely the same modification is found in the *Planorbis* before me from this same Mexican lake (Patzcuaro), evidently induced by the action of the same causes.

Physa squalida Morelet.

Orizaba (61530; 61583; 61598; 61581); Vera Cruz (61582).

A very abundant species at Orizaba. This is the Mexican representative of the *Physa integra* of Haldeman, a species usually confounded in the United States with *P. heterostropha* Say. I have compared the Orizaba specimens with *squalida* received from Morelet.

This species frequently exhibits variceal thickenings (indicating former peristomes), like its Northern ally *P. integra.* In this respect it differs from *Ph. osculans.*

The more lengthened forms of *Ph. squalida* resemble somewhat *Ph. pomilia* Conrad.

Genus **APLEXA** Flem.

The number of Mexican species of this genus has been about fifty per cent over-estimated by Crosse and Fischer. This opinion is founded on an examination of many specimens, and I express it with all due respect to the authors named.

They seem to have overlooked the description and figure of *Physa* (=*Aplexa*) *princeps* Phillips, described from Yucatan, in the Proceedings of the Academy of Natural Sciences of Philadelphia, III, p. 66, pl. 1, fig. 11 (May, 1846). The figure is very good.

Aplexa cisternina Morelet.

Izamal (61601), Tekanto (61599), Shkolak (61770) and Merida (61524), Yucatan.

Aplexa nitens Phil.

Vera Cruz; San Juan, near Vera Cruz (61771).

Aplexa nitens var. **spiculata** Morel.

Merida, Yucatan (61600).

Aplexa sp.

Shkolak (61772, 61773). Forms I have been unable to identify.

Family CYCLOPHORIDÆ.

Genus CYCLOTUS Guilding.

Cyclotus Dysoni Pfr.

One of the most abundant land shells of northern Yucatan. It was collected at Silam (61458; 61461), Shkolak (61459), Tekanto (61452), Labna (61435), Tunkas (61452), Ticul (61460), Sitilpech (61462), Tabi (61463), and between Sitilpech and Tunkas (61457).

The specimens from Tabi, Ticul and some other localities are prettily varied by numerous dark spiral lines and bands; these may be named form *multilineatus*. Many specimens have the costulæ of the surface simple, not all undulating, not anastomosing.

Cyclophorus (**Cyrtotoma**)—?

Two broken specimens of a species apparently new, were collected at Orizaba (61486).

Family AMPULLARIIDÆ.

Genus AMPULLARIA Lam.

Ampullaria flagellata Say.

My examination of Say's type of this species proves that *A. malleata* Jonas is a synonym. The specimen, now before me, upon which Say founded his species, is a dead shell, lacking the epidermis; it is moderately but not conspicuously malleated, and on the latter part of the body-whorl obscurely plicated in the direction of the lip-edge. It is multifasciate with brown.

The species is excessively abundant in the environs of Vera Cruz (whence Say procured it). It varies widely in respect to sculpture and color, but the numerous Vera Cruz specimens before me are rather constant in size, agreeing in the main with Say's type, which measures as follows:—

Alt. 38 mm.; diam. 35 mm.; greatest length of mouth 32 mm.; width of mouth (measured at a right angle to its length) 21½ mm. The aperture of this specimen is expanded,—a variation not uncommon in the series before me from Vera Cruz. (No's. 61447, 61446, 61448, Acad. Coll.)

The illustrations given by Crosse & Fischer on pl. 44, figs. 6, 6a, 6b, 6c, 6d and 6e, of the Expéd. Scientifique du Mex., represent the species as found around Vera Cruz, but smoother forms are also abundant, and spiral dark bands are visible on most specimens.

Ampullaria sp.

San Juan, near Vera Cruz (61450).

Ampullaria Yucatanensis Crosse & Fischer.

"Twin cenotas," Shkolak, Yucatan (61456).

Family VALVATIDÆ.

Genus VALVATA Müll.

Of this genus six species are found on the mainland of North America.

Valvata humeralis Say.

Lakes around the City of Mexico (61484). Lake Patzcuaro, West Mexico (61444).

The specimens from the last locality I at first regarded as a distinct species; but making due allowance for the modification undergone by all species of snails found in this lake, I am disposed to consider it a variety of *humeralis*. Compared with Say's type specimen of the latter, the L. Patzcuaro shells have the whorls more rapidly increasing, the last whorl being notably of greater diameter than, the corresponding volution of *humeralis;* the umbilicus is narrower, the subsutural flattening, so obvious in Say's shell, is not at all conspicuous. The obtuse basal carina is as in the type. No good figure of *humeralis* has been published, that given by Strebel having the spire too much raised; it is rather obtuse in the shells before me from the City of Mexico, as well as in Say's type; the exact locality of the latter is not given on the label, which is in the fine hand-writing of Mrs. Say, like many of Say's labelled types.

Results of great importance to biology might be derived from a study of the conditions of life in Lake Patzcuaro; the shells of various genera seem to be modified in such definite directions that the problem of the origin of certain forms would probably be presented to the observer in comparatively simple terms. It is unfortunate that although some hundreds of shells of various species were collected there by Prof. Heilprin and Mr. Baker, their limited time did not permit them to gather information on the physical characteristics of the lake.

Family **AMNICOLIDÆ** Tryon.[1]

Genus **POTAMOPYRGUS** Stimpson.

This genus of spinose rissoids is represented throughout Central America and the West Indies by numerous forms; also extending into Northern South America, and to the northward ranging as far as Comal County, Texas.

The species are excessively polymorphic, and their number can only be ascertained after a great number of specimens have been examined. As a rule, without exception, every species (or variety, whichever the forms prove to be) is dimorphic; there is a spinose, angulate form, and an acuminate, ecarinate one. Generally both are found in the same locality. This curious dimorphism has caused at least two names to be applied to every species or form. Thus, *Paludina crystallina* Pfr. is the ecarinate form of *P. coronata* Pfr.; *Hydrobia Texana* Pilsbry bears a like relation to *P. spinosa* Call & Pilsbry, etc., etc.

Potamopyrgus is a genus of great antiquity, extending at least as far back as the early eocene. It now comprises all of the fresh-water rissoids of New Zealand, a majority of those of Australia, with species in west Africa and tropical America.

As a contribution to the life-history of these interesting little snails, I may mention that the form discovered by me in Texas, *P.* (*coronatus* var?) *spinosus* C. & P., is viviparous. The young are globular, translucent, having a little over one whorl at birth.

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[1] As a sectional term under *Amnicola* I would propose the name CINCINNATIA for *A. Cincinnatiensis*, founding the distinction upon its more minute radula and the far finer denticulation of the teeth.

As to the number of naturally defined Neotropical species I am in doubt; but the examination of my material (including as many as a pint of the shells of some species) causes me to believe that there are about four or five, although this may possibly be either over or under estimated. I do not undertake here a revision of them for the reason that Crosse and Fischer have already reached the Hydrobiidæ in the progress of their magnificent work.

Ancey's *Pyrgophorus* (Bull. Soc. Mal. Fr. v, p. 188, 192, 1888) is a synonym of *Potamopyrgus*. Curiously enough, Mr. Ancey does not seem to be aware that any spinose rissoids had been described from America! He proposes the name *P. coronatus* (*de novo*, not of Pfeiffer), for the form found at Vera Cruz, which Strebel calls *P. coronatus* Pfeiffer. This form is doubtless the same as my *P. spinosus* from Texas, but it is doubtfully distinct from the species as found further South.

Potamopyrgus coronatus Pfr. Var.

Highly sculptured forms, probably referable to this species were collected at Shkolak (61595), Merida (61597) and between Sitilpech and Tunkas (61576), in Yucatan.

Potamopyrgus Bakeri Pilsbry, n. sp. (pl. XV, figs. 9, 10, 11.)
P. Bakeri Pilsbry, The Nautilus iv, May, 1891.

Shell slender, elongated, tapering, the altitude more than twice the diameter. Whorls 5½, very convex, separated by deeply impressed sutures; apex somewhat obtuse. Aperture small, ovate, its length contained more than three times in the length of the shell; peristome continuous, thin. Umbilicus a closed rimation behind the inner lip. Surface marked by delicate growth-lines, having low, inconspicuous longitudinal folds (sometimes quite regular and well marked on the upper whorls), and encircled by numerous fine, subobsolete spiral striæ. Alt. 4, diam. 1·9 mm.

Dug from the bank of a stream east of Yautepec, Mexico. (61578).

The specimens being subfossil are denuded of the epidermis and white in color. They are in sculpture not unlike some feebly sculptured forms of that truly protean species *Tryonia protea* Gld., but are readily distinguishable from that type specifically, and even, as I believe, generically; for the present species seems to me to be an aspinose form of *Potamopyrgus*, differing from all other known species and forms of that genus in its much more slender, narrow contour. I have given the name in recognition of the services of Mr. F. C. Baker, who collected the specimens.

Genus **PYRGULOPSIS** Call & Pilsbry.
Proc. Davenport Acad. Nat. Sci. vol. v, p. 9, May, 1886.

This genus was proposed for a number of small shells which agree in being ovate-conical or turreted, the whorls having a single strong carina at the periphery, which may or may not be concealed on the spire. The apex is acute. There are 4½ to 6 whorls. Aperture ovate, peristome continuous. Axis imperforate. The dentition is figured in the place cited above. The genus has nothing to do with *Pyrgula*, which belongs to a different subfamily (*Baikaliinæ*).[1] *Lyrodus* of Döring[2] may prove more nearly related.

It has been suggested to me that the finding of carinate forms of *P. Nevadensis* proves that the carinate forms are distorted by the influence of the concentrated waters of the lakes inhabited by the species; but would any malacologist seriously advocate the view that the smooth spineless forms of *Potamopyrgus* hold a like relation to the spinose, carinate types? or that the two Mississippi Valley species of *Pyrgulopsis* (found in company with perfectly normal specimens of *Amnicola, Bythinella,* etc.) owe their carinate contours to the same cause?

Besides the original illustrated monograph of this genus by Professor Call and myself in the Proceedings of the Davenport Academy of Natural Sciences for 1886,[3] there has been an "*Etude monographique du genre Pyrgulopsis*" (Bull. Soc. Mal. France, v, p. 185) written by Mr. C. F. Ancey. This paper shows in a high degree the futility of writing about things an author knows nothing about.

The species of this genus are as follows:—

P. Nevadensis Stearns.

Pyrgula Nevadensis Stearns, Proc. Acad. Nat. Sci. Phila., p. 173, figure, (1883).—Call and Beecher, Am. Nat., Sept. 1884, Vol. XVIII., pp. 851-855.—Call, Bull. U. S. Geol. Survey, No. 11, 1884.

Pyrgulopsis Nevadensis Call & Pilsbry, Proc. Dav. Acad. Nat. Sci. Vol. V, p. 10, 1886.—Ancey, Bull. Soc. Mal. Fr. 1888, p. 189.

This form has been found thus far only in northwestern Nevada, in Walker and Pyramid Lakes. Entirely smooth forms, not dis-

[1] Beecher is wholly in error in referring *Pyrgula* to the *Melaniidæ*; a family distinguished from *Amnicolidæ* and *Rissoidæ* by the most obvious external characters, such, for instance, as the genitalia.

[2] Döring, in Boletin de la Acad. Nac. de Cien. en Cordoba, vii, p. 461, 1885

[3] In this paper, *Potamopyrgus spinosus* was considered a *Pyrgulopsis*. I had at that time not yet examined its dentition. See under *Potamopyrgus*.

tinguishable from *Amnicola* have been found. The species is not closely allied to the two following, either of which it would be better to regard as the type of the genus.

P. scalariformis Wolf.

Pyrgula scalariformis Wolf, Amer. Journ. of Conch. vol. v. p. 198, pl. xvii, fig. 3, 1869.

Pyrgulopsis scalariformis Call & Pilsbry, Proc. Dav. Acad. Nat. Sci., vol. v, p. 14, 1886.—Pilsbry, Shells of Forest and Stream, pl. 14, fig. 26.—Ancey, Bull. Soc. Mal. Fr. 1888, p. 190.

For description and figures see Shells of Forest and Stream (in preparation). It has been found only at the original locality, "on the Tazewell shore of the Illinois River." No living specimens have been taken. This species it would be best to regard as the type of *Pyrgulopsis*.

P. Mississippiensis Call & Pilsbry.

Pyrgula scalariformis var. *Mississippiensis* Pilsbry, Amer. Naturalist, Jan. 1886; p. 75.

Pyrgulopsis Mississippiensis Call & Pilsbry, Proc. Dav. Acad. Nat. Sci. vol. v, p. 13, 1886.—Ancey, Bull. Soc. Mal. France, 1888, p. 191.—Pilsbry, Shells of Forest and Stream, pl. 14, figs. 23, 24, 25.

Of this species I have examined very many specimens, dredged by myself in the Mississippi River, at and just below the mouth of Rock River, Illinois. It has characters constantly separating it from the *scalariformis*. Both are figured and described in my handbook of northern U. S. mollusks, Shells of Forest and Stream.

The following species is referred provisionally to *Pyrgulopsis* on account of its similarity in contour to the shells of that genus. In possessing fine spiral lines it resembles *Potamopyrgus;* and if it is found to have the very characteristic dental characters of the last named genus, and is viviparous, it must be transferred.

Pyrgulopsis (?) Patzcuarensis Pilsbry n. sp. (Pl. XV, fig. 8).

The Nautilus, May, 1891.

Shell turrited-conic, elevated. Number of whorls unknown, the specimen being broken; the remaining 3½ whorls are strongly carinated in the middle, concave immediately above and below the keel; the last whorl is obtusely shouldered midway between keel and suture, and the median carina becomes less conspicuous. The aperture is oval, not oblique; peristome continuous, its inner margin thickened. Umbilicus reduced to a narrow fissure. Color of epidermis olive; surface marked by delicate growth lines and excessively fine close spiral striæ.

Alt. 5·2, diam. 3 mm.; Alt. of apert. 2, width 1·3 mm.

Lake Patzcuaro, Mexico (61588).

This form is so distinct that I unhesitatingly describe it, although no perfect specimens were obtained.

In general form the shell recalls the *P. Nevadensis* Stearns, described from Pyramid Lake, Nevada; but the encircling carina is less strong, the portion of the whorl above the keel is much more convex. The fine spiral sculpture of the Mexican shell also distinguishes it.

Genus **COCHLIOPA** Tryon.

Cochliopa Tryoniana Pilsbry, (pl. XV, fig. 12 .)
C. Tryoniana Pilsbry, The Nautilus iv, p. 52, September, 1890.

Figures are here given of this species, which is the second of the genus described. It is from Polvon and Rio Fula, Nicaragua. A large number of specimens are before me. They vary greatly in form and sculpture. Sometimes the body-whorl is acutely carinated, and the surface encircled with numerous acute lirulæ, but on some specimens this sculpture is almost obsolete. Old specimens become thick and solid, losing to a great extent, the spiral sculpture.

The measurements of two specimens are as follows:
Alt. 4, greater diam. 4½, lesser 4 mill.
Alt. 3⅓, greater diam. 4, lesser 3⅓ mill.

Family **CYCLOSTOMIDÆ.**

Genus **CHONDROPOMA** Pfr.

Chondropoma (Cistula) Largillierti Pfr.

An extremely abundant species in northern Yucatan. After examining several hundred specimens I find that a separation of the more coarsely ribbed forms from the finely decussated examples is not practicable, and I therefore agree with Dr. von Martens in uniting the *Cistula Grateloupi* to *C. Largillierti.* The apex is sometimes retained perfect in adult specimens of this species, several of these anomalous individuals being before me.

The exact localities are: Labna (61472), Santa Ana, near Calcehtok (61473), Silam (61416), Merida (61466), Tekanto (61468, 61467), Tunkas (61464), Uxmal (61463), between Sitilpech and Tunkas (61475), and at Tabi (61474).

The polymorphism of this species is wonderful. Adult specimens vary in length from 17½ to 9 mm. The color varies from a clear yellowish-white with numerous rows of brown spots, to dark red. The shape also is subject to great mutations.

Family HELICINIDÆ.

Genus HELICINA Lam.

Helicina arenicola Morelet.

A most abundant species in northern Yucatan. The published illustrations very inadequately represent this beautiful species, which is as variable in coloration as the *H. orbiculata* Say. Specimens were collected at Silam (61442), Ticul (61440), Labna (61438), Tabi (61437), Uxmal (61443), Tunkas (61436), Santa Ana near Calcehtok (61439), and between Sitilpech and Tunkas (61441).

Helicina lirata Pfr.

Numerous specimens taken at Labna, Yucatan (61479). Specimens were collected by Mr. C. T. Simpson at Utilla Island, off Honduras.

Helicina fragilis Morelet.

Specimens of a small, thin, greenish-horn colored turbinate species were collected at Orizaba (61478), and at Vera Cruz (61477). The columella is toothed exactly as in Strebel's figures (referred by Martens to this species), but the color is not as described by Strebel.

Helicina cinctella Shutt.

Orizaba (61480).

Helicina beatrix Angas.

This species was not collected by the Expedition. From an examination of Gabb's specimens I am led to believe that von Martens is in error in referring this species to *H. flavida* Mke. Adult specimens of *H. beatrix* measure alt. 10, diam. 9 mm., and differ as much from Guatemala specimens of *H. flavida* as most Helicinas do from one another—certainly enough for specific discrimination. The illustrious writer in the Biologia Centr. Amer. probably had not seen authentic specimens.

Sub-genus SCHAZICHEILA Shutt.

Schazicheila alata Mke.

Orizaba (61485).

Family PROSERPINIDÆ.

Genus PROSERPINA Gray.

Proserpina (Ceres) Salleana Cuming.

Both the red and the buff forms were collected at Orizaba (61455 and 61454).

APPENDIX A.

During the few hours spent in Havana the following species were collected by Mr. Baker:

Oleacina solidula Pfr. (61605).
Stenogyra octona Ch. (61573).
Patula vortex Pfr. (61604).
Polygyra paludosa Pfr.
Carocolus (**Thelidomus**) **auricoma** Fér., var. **zeta** Pfr. (61572.)
Bulimulus sp.
Limnæa Cubensis Pfr.
Vaginulus occidentalis Guild.

The specimens were marked by a longitudinal row of angular black spots on each side of the middle, on most individuals coalescent into black stripes.

Ampullaria conica Wood. (61574.)

EXPLANATION OF PLATES.

Plate XIV.

Figs. 1, 2. *Carychium exiguum* Say, typical. Drawn from specimens from Kent, Ohio, collected by Geo. W. Dean.

3. *Carychium exiguum* Say, showing umbilicus. Specimen from Vermont.

4, 5, 6. *Carycnium occidentalis* Pilsbry. Portland, Oregon.

7, 8, 9. *Carychium Mexicanum* Pilsbry. Orizaba, Mexico.

0, 11. *Carychium exile* H. C. Lea. Kent, Ohio.

12, 13, 14. *Carychium exile* Lea. Specimen with thick peristome.

15, 16. *Carychium exile* var. *Jamaicense* Pilsbry. Jamaica. (Swift Collection).

Note. The profile views are all drawn with the shell rolled to the left only enough to bring the plane of the inner and outer lips coincident with the line of vision. The figures of this plate are drawn to the same scale.

Plate XV.

Figs. 1, 2, 3. *Patula intonsa* Pilsbry. Three views of type, specimen, highly magnified.

4. *Planorbis tenuis* Phil. var. *Boucardi* C. & F. Lake Patzcuaro, W. Mexico. Natural size.

5. *Physa osculans* Hald, var. *Patzcuarensis* Pilsbry. Lake Patzcuaro. Natural size.

6, 7. *Oryzosoma Tabiensis* Pilsbry. Magnified view of the type, with profile of aperture. Hacienda of Tabi, Yucatan.

8. *Pyrgulopsis? Patzcuarensis* Pilsbry. Magnified view of the type. Lake Patzcuaro, W. Mexico.

9, 10, 11. *Potamopyrgus Bakeri* Pilsbry. Three individuals, showing variation in contour.

12. *Cochliopa Tryoniana* Pilsbry. View of a highly sculptured form, enlarged.

13, 13a. *Cylindrella Bourguignatiana* Ancey. Utilla Island, off Honduras. Specimen collected by Chas. T. Simpson.

14, 14a. *Cylindrella speluncæ* var. *dubia* Pilsbry.

15, 15a. *Cylindrella speluncæ* Pfr. Specimen from Ticul, Yucatan.

16. *Carychium exiguum* Say. Specimen broken to show the internal continuation of the columellar folds.

June 2.

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

Forty persons present.

Papers under the following titles were presented for publication:—

"A Memoir on the Genus Palæosyops Leidy, and its allies," by Charles Earle.

"New American Myxomycetes," by Geo. A. Rex, M. D.

Henry C. Chapman, M. D., was elected Curator to fill the vacancy caused by the death of Dr. Leidy.

June 9.

Mr. Chas. P. Perot in the chair.

Thirty-three persons present.

"A Memoir of Joseph Leidy, M. D., LL.D.," by Henry C. Chapman, M. D., was presented for publication.

June 16.

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

Twenty persons present.

June 23.

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

Twenty-four persons present.

A paper entitled "Description of a new species of Vampyrops," by Harrison Allen, M. D., was presented for publication.

June 30.

Dr. Geo. H. Horn in the chair.

Twenty-one persons present.

On the Wings of Bats.—Dr. Harrison Allen spoke of the manner in which the membranes of bats are sustained in the intervals between the several parts of the normal skeleton. The so called calcaneum is an accessory process to the tarsus and is designed to support the interfemoral membrane. Dr. Allen proposed to name this process the calcar. In *Vesperugo noctula* he had found a process passing down from the calcar, in the form of a delicate rod, midway between the base and the free end. An accessory cartilage at the side of the tip of the fifth metacarpal bone, was next alluded to. It is apparently intended to give additional support to the mesopatagium. It is absent in Pteropodidæ, Megadermadidæ and Phyllostomididæ. In *Nycteris* the terminal segment to the caudal series is widely expanded and serves to support the margin of the interfemoral membrane. The fact that the preserving of these various minor adaptations is not universal, suggests the conclusion that the mechanism of the flight of the bats is not the same in all the forms, and that something of the same kind of differences that are known to exist in birds, could be detected if the facilities which are available in case of the latter, existed for their investigation.

Wm. J. Serrill and B. Alexander Randall, M. D., were elected members.

August Weismann of Freiburg, i. B. and Elias Metschnikoff of Dorpat, were elected correspondents.

The following were ordered to be published:—

ECHINODERMS FROM THE BAHAMA ISLANDS.

BY J. E. IVES.

In the years 1887 and 1888, Mr. Frederick Stearns of Detroit, made a collection of Invertebrates in the Bahama Islands. He collected upon Andros and other islands near Nassau. The following list represents the Echinoderms obtained by him. It includes a description of a new species of *Amphiura*. The accompanying plate has been prepared for publication through Mr. Stearns' liberality.

ECHINOIDEA.

Cidaris tribuloides Lamarck.

Numerous specimens collected.

Echinometra subangularis Leske.

Numerous specimens found in living sponges, in three fathoms of water, on the west side of Andros Island.

Toxopneustes variegatus Lamarck.

Hipponoe esculenta Leske.

Numerous specimens collected.

Echinanthus rosaceus Linnæus.

A single specimen collected.

ASTEROIDEA.

Astropecten articulatus Say. Pl. XVI, figs. 4–8.

Asterias articulata Say, Journ. Acad. Nat. Sci. Phila. (1), vol. V, p. 141, 1825; Müller und Troschel. System der Asteriden, p. 72, 1842; Dujardin et Hupé, Suites à Buffon, Echinodermes, p. 419, 1862; Lütken, Vidensk. Meddel. pp. 127–129, 1864; Perrier, Arch. Zool. Expér. t. 5, pp. 290–291, 1878, (pars.)

A single specimen of this species was collected.

Two such eminent authorities as Dr. Lütken and Professor Alexander Agassiz[1] have differed as to the identification of Say's species. Professor Perrier in the "Revision des Stellérides," has given Professor Agassiz's *A. articulatus* as synonymous with Dr. Lütken's *A. articulatus,* but a comparison of Professor Agassiz's figures with Dr. Lütken's description, at once shows the difference between the two forms. Say's description, in my opinion, would refer more precisely to the form described by Dr. Lütken, than to that described by Professor Agassiz. Say states that the species he

[1] Mem. Mus. Comp. Zool. Vol. V, pp. 114–116, Pl. XIX.

described "is very common on the coast of East Florida and on the sea Islands of Georgia." My friend Mr. C. W. Johnson, who has collected for eight years at St. Augustine, on the east coast of Florida, informs me that the form described by Lütken is the only species of *Astropecten* which he has found in that region. There appears to me, therefore, to be very little doubt that this is the form originally described by Say.

The species figured by Professor Agassiz as *Astropecten articulatus* Say, I believe to be the *Astropecten duplicatus* of Gray.[1]

Prof. Perrier has included *A. dubius* Gray under the synonymy of *A. articulatus*, but this species is undoubtedly distinct from *A. articulatus* Say, as defined by Dr. Lütken, and is probably identical with *A. duplicatus* Gray.

Below is given a translation of Dr. Lütken's careful description of *A. articulatus*. In addition to this it may be said that in the living animal the upper side-arm-plates are orange-colored, the paxilla-area of the disk and arms purple, and the side-arm-spines purple.

"Of quite considerable size, (about 6 inches in diameter), with rather long and pointed arms. Proportion between the radii about as 1: 4. Arm angles acute. Edge-plates about 50. In the middle of the arms the paxilla-belt is still twice as wide as the edge-plates; the paxillæ, whose structure and arrangement are as usual on the disk, become larger and are composed of larger grains; in the middle of the disk they became again smaller and more delicate. The madreporic plate lies nearer to the edge-plates than to the middle of the disk. The upper edge plates are covered with grains, which become fine and bristle-like around the edges of the plates. On the outer half of the arm there may appear on each of these plates, a little low spine or protuberance. It is not unusual for it to be missing on one or another plate, or on several successive plates, but it is very unusual for it to go beyond the middle of the arm. I dare not assert positively that it can be absent entirely, as it may, perhaps, have been only lost through wear, in the examples in which I have not been able to convince myself of its existence. The

[1] See Prof. Perrier, Arch. Zool. Expér. pp. 271–272.

In my paper entitled "Echinoderms from the northern coast of Yucatan and the harbor of Vera Cruz," Proc. Acad. Nat. Sci. Phila. 1890, pp. 330–331, I identified an Astropecten, collected at Vera Cruz, as *Astropecten articulatus* Say, on account of its resemblance to Prof. Agassiz's figures. If, as assumed above, the true *A. articulatus* Say is the form described by Lütken, then the specimen collected at Vera Cruz is the *A. duplicatus* Gray.

lower edge-plates are closely covered with small spines of somewhat diverse size; the finest small bristles are situated around their edges; the largest form a transverse row along the aboral edge, and constitute a transition to the two rather short and weak, somewhat curved, horizontal edge-spines placed side by side, with which each plate is provided. The foot-papillæ usually form two rows; in the inner row are three slender spines in a group, of which the innermost is the longest and somewhat curved; in the outer row are two broad, flat, low, equally truncated, spade-formed papillæ side by side, of which the one nearest to the mouth (the adoral) in all respects stands behind the other; more rarely there are three papillæ in this row. Outside of it, there are, as a rule, in addition, 1–3 small papillæ, which in the neighborhood of the mouth become larger and more numerous, so that 7–8 can be counted in each group besides the 3 or 4 which belong to the inner row. Mouth plates covered closely by scale-like papillæ." [1]

Astropecten duplicatus Gray.

Luidia clathrata Say.

A single specimen collected.

Pentaceros reticulatus Linnæus.

A single specimen collected.

Linckia Guildingii Gray.

Echinaster spinosus Retzius.

A single specimen collected.

OPHIUROIDEA.

Ophiura cinerea Muller und Troschel.

A single specimen collected.

Ophiactis Mülleri Lutken.

Numerous specimens found in sponges on Andros Bank.

Amphiura Stearnsi n. sp. Pl. XVI, figs. 1–3.

Disk angular, outer edge of the interbrachial spaces strongly concave; covered above and below with fine scales, some larger scales are found in the brachial spaces. Radial shields of moderate length, very narrow, widely separated by the scales of the disk, parallel with each other. Mouth shields large, sub-pentagonal, one of the angles directed towards the mouth, widest at the aboral

[1] I wish to express my indebtedness to Mr. Fred. F. Myhlertz, the Danish Consul in Philadelphia, for having examined this translation for me.

edge, aboral edge convex, lateral edges slightly concave. Side-mouth-shields pyriform, the angle directed inwards and towards the mouth shield. Mouth papillæ usually ten to each angle, the second and third counting from without inwards, the largest, angular; the fourth and fifth more slender, rounded; the first or outermost small and angular.

Arms long, about ten times as long as the diameter of the disk. Upper-arm-plates sub-triangular, the apex of the triangle pointing towards the end of the arm, and much rounded off. Lower-arm-plates quadrilateral, the aboral and lateral edges slightly concave. Side-arm-plates about as high as the width of the upper-arm-plates; meeting neither above nor below. Three stout arm-spines about as long as the upper-arm-plates. One large oblong tentacle scale, about two-thirds of the length of the under-arm-plate.

General color of the dried specimen described, white; dorsal surface of the arms with a dark mottled band upon every fourth plate.

In the specimen described, diameter of the disk 5·5 mm., and length of an arm about 50 mm.

This species is characterized by the fine scaling of the disk, with the interspersed larger rounded scales; the very narrow and widely separated radial shields; the banded arms; the single large tentacle scale, and the five mouth papillæ on each side of the mouth angle. It approximates *Amphiura nereis*[1] and *Amphiura tumida*[2] but differs among other things in the single large tentacle scale and the widely separated radial shields.

A single specimen found in a living sponge on Andros Bank.

Ophiothrix Oerstedii Lutken.

Numerous specimens found in living sponges on Andros Bank.

Astrophyton costatum Lyman.

A single specimen sent to Mr. Stearns from the Bahamas.

EXPLANATION OF PLATE XVI.

Fig. 1. *Amphiura Stearnsi* n. sp. Portion of the dorsal surface of the disk and arms, much enlarged.

Fig. 2. Portion of the ventral surface of the disk and arm, much enlarged.

Fig. 3. Portion of the lateral surface of an arm near its base, much enlarged.

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[1] Lyman, Bull. Mus. Comp. Zool. Vol. X, p. 250, Pl. V, figs. 61–63.

[2] Lyman, op. cit. Vol. V, p. 225, Pl. II, figs. 28–30.

Fig. 4. *Astropecten articulatus* Say. Dorsal surface, natural size.

Fig. 5. Ventral surface, natural size.

Fig. 6. Portion of dorsal surface of an arm, at about one-third of the distance from its base, enlarged.

Fig. 7. Portion of lateral surface of an arm, near its base, enlarged.

Fig. 8. Portion of ventral surface of an arm, at about one-third of the distance from its base, enlarged.

MEMOIR

OF

JOSEPH LEIDY, M. D., LL. D.

BY

HENRY C. CHAPMAN, M. D.

"And this our life, exempt from public haunt, finds tongues in trees, books in the running brooks, sermons in stones and good in everything."

It falls to the lot of but few, living in the midst of a great community for nearly three score years and ten, to have never made an enemy during that long period, but to have gained universal affection, esteem and respect. Yet such may in truth be said of the subject of this memoir.

The ancestors of Dr. Joseph Leidy were of French-German extraction and came to this country as missionaries. Mr. Philip Leidy, his father, was born in Montgomery County, Penna., December 5, 1791, and removed, when a young man, to Philadelphia, where he engaged in the trade of a hatter. He soon retired from business in which he had been unusually successful.

He married Catherine Melick, a descendant of the well known Melick family, the founders of the celebrated "Old Farm" in New Jersey.

Joseph Leidy, the third of four children by this marriage, was born September 9th, 1823, in Philadelphia, at his father's house, No. 312 N. 3rd. St., which is still standing. When but a year and a half old, he experienced in the death of his mother a loss that would be usually and justly regarded as irreparable. His father, however, in marrying shortly afterwards, Christiana, the sister of his first wife, gave to Joseph, a step-mother it is true, but one who never knew any difference between him and her own children. He loved her as a mother, for as he said upon one occasion, "I knew no other mother; to her I owe every advancement in life."

His early education was obtained at private schools. While still a child, he showed an appreciation of natural objects, taking particular interest in minerals and plants. The boy, however, had early evinced such remarkable ability as a draughtsman that his father had taken him away from school when about sixteen years of age with the intention of educating him as an artist.

At about this period, the youth passed much of his time in a wholesale drug-store near his home. Such good use did he make of the opportunity there presented of learning the nature of drugs and the art of compounding medicines, that the proprietor recommended him as competent to take temporary charge of the retail drug-store of a customer. The success attending his conduct of the business was such as to make him consider it seriously, as a means of livelihood. The dissection of a few cats, dogs and chickens had, however, in the mean time, developed an interest in the study of anatomy and he had shown such an aptitude for dissection that Mrs. Leidy, proud of Joseph's talents and ever watchful of his interests, made up her mind that her son should become neither an artist nor an apothecary, but a physician. As Dr. Leidy said fifty years afterward in referring to the circumstances connected with his taking up the study of medicine as a profession: "My father intended I should be an artist, but my mother said that her children should learn the professions. She, being the stronger, carried the point."

In the year 1842, at the age of nineteen, Joseph Leidy began the study of medicine at the University of Pennsylvania, his preceptors being Dr. Paul B. Goddard and Dr. James McClintock. He presented to the Faculty a thesis on "The Comparative Anatomy of the Eye of Vertebrated Animals" and having complied in other respects with what was in those days deemed essential as a pre-requisite to graduation, in 1844 he received the degree of Doctor of Medicine. He at once began the practice of his profession, to which he devoted himself about two years. During that period, and even before, he had worked in the laboratory of the celebrated Dr. Robert Hare, and had assisted Dr. Goddard who was then Demonstrator of Anatomy at the University. Becoming impressed with the grave responsibilities incurred in the practice of medicine, of the demands on the time of the successful practitioner and the little leisure left to him for study, Dr. Leidy finally decided to give up the practice of medicine, with all hope of its emolument, and to devote his life entirely to study and teaching, trusting that eventually, in the attainment of a Professorship, he would obtain at least the means of livelihood.

Haud facile emergunt, quorum virtutibus obstat res angusta domi. For some time, young Dr. Leidy experienced that struggle with hardships and obstacles, incidental to the lives of so many great men, which talent, when accompanied with hard and continuous work, alone overcomes. While a student, however, Dr. Leidy, by his skill in dissecting, had impressed Professor Hornor most favorably and he was, therefore, shortly after his graduation, appointed to the position of Prosector to the chair of Anatomy.

During the summer of 1845 Dr. Leidy was elected a member of the Boston Society of Natural History, a compliment greatly appreciated, he being so young a man. A few weeks later, on the evening of July 29th., he was elected a member of the Academy of Natural Sciences of Philadelphia, with which institution his name was inseparably connected until the day of his death. Through the opportunities for advancement liberally afforded by this society, he was enabled to accomplish the scientific work of his life. Shortly after becoming a member of the Academy, he was elected Librarian, which position he held for twelve months, and so efficiently were his duties performed that on the expiration of his term of office a vote of thanks was tendered him. Vacating the office of Librarian he was elected one of the Curators. At the annual meeting in 1847, he made his first report as Chairman of the Board of Curators, a position he held continuously until the time of his death, a period of forty-four years. During his years of membership, Dr. Leidy, until almost the close of his life, attended regularly the Tuesday evening meetings of the Academy. The Proceedings and Journal giving ample evidence of the number, variety and value of his contributions to all branches of natural science during that long period.

In the year 1846, he left the University for a time, having been elected Demonstrator of Anatomy in the Franklin Medical College. After one session at that institution he returned to the University and was again associated with Dr. Hornor. At this time he also gave a private course of lectures on anatomy, which attracted considerable attention.

During the spring of 1848 Dr. Leidy accompanied Dr. Hornor to Europe, visiting England, France and Germany. On his return he began a course of lectures on histology and in the following spring lectured on physiology at the Medical Institute. Incessant application, however, threatened him with serious illness, and although ambitious and full of enthusiasm he was obliged to give up all work for some months. He was elected a member of the American Philosophical Society in 1849. The late Dr. George B. Wood having been elected to the chair of Practice of Medicine in the University, went abroad the same year for the purpose of making a collection of models, specimens, drawings, etc., with which to illustrate his lectures and invited Dr. Leidy to accompany him, knowing that he would be of great assistance in selecting the collection required. This visit, as well as the previous one abroad, was of the greatest possible advantage to Dr. Leidy, as he was not only afforded the opportunity of seeing the great museums of Europe under most pleasant auspices, but also of making the acquaintance and acquiring the friendship of such distinguished anatomists and physiologists as Owen, Majendie, Milne Edwards, Hyrtl, Johannes Müller, and many others.

On his return home, with health restored and spirits renewed, he took up again with enthusiasm his work as Prosector at the University. During this year, 1851, he was elected a member of the College of Physicians, and in 1852 he was appointed to the position of Pathologist to St. Joseph's Hospital.

The health of Professor Hornor having in the mean-time been much impaired, he was unable to continue his course of lectures during the winter of 1852. He requested the Board of Trustees to appoint Dr. Leidy his substitute. So admirable were the lectures then delivered, and so satisfied were the students with Dr. Leidy as a teacher, that upon the death of Dr. Hornor, in 1853, the substitute, though then but thirty years of age, was elected Professor of Anatomy in the University. This position he held with the most distinguished success till his death, a period of nearly forty years. His lectures were lucid, graphic and practical, and were listened to by the students, by whom he was beloved and respected, with the most profound attention. No attempt at oratory was ever made, no rhetorical flourishes were ever indulged in, the instruction being of the simplest character, but of the highest scientific excellence. Many were the anecdotes and amusing stories told of the Professor by the students, but they always redounded to his fame, and usually illustrated his wonderful knowledge of the structure of the human body. It was universally conceded that he was the highest authority on the subject of human anatomy in this country, and it may be added was equalled by few abroad, surpassed by none.

About this period the subject of paleontology attracted Dr. Leidy's especial attention, and, as we shall see when considering his scientific work in detail, much of his time was now devoted to its study.

In 1854 he became a member of the Publication Committee of the Academy, upon which he served continuously to the time of his death, being chairman of the same since 1867.

The civil war breaking out, he was appointed Surgeon to the Satterlee Military Hospital, his youngest brother, the late Dr. Philip Leidy, so beloved by his comrades, taking a most active part during four years as surgeon in the field. It was at the Satterlee Hospital that the opportunity was afforded of obtaining many of the beautiful preparations illustrative of his lectures on human anatomy and of making important post-mortem examinations, the reports of which were published in the "Medical and Surgical History of the War."

Upon the organization of the National Academy of Sciences in 1863, he was elected one of the members.

In 1864 Dr. Leidy married Anna, daughter of Mr. Robert Harden. The union was a most happy one. Not being blessed with children, they some years later adopted Alwinia, daughter of the late Professor Franks of the University of Pennsylvania. Dr. and Mrs. Leidy at once became so much attached to their little daughter, and she so devoted to her parents, that it seemed as if the love that had been so freely given to the son by his foster mother was now to be lavished by him upon his adopted daughter.

In 1871 Dr. Leidy was elected Professor of Natural History in Swarthmore College, a position for which he was eminently qualified, and which he filled to the entire satisfaction of the managers and friends of that institution. His simple, attractive way of imparting his vast knowledge of nature, fairly captivated the students and stimulated in them a love for natural science, one result of which was constant but unsuccessful attempts to find an object in nature unknown to their teacher.

In the year 1875, accompanied by his wife, he went abroad for the third time and while renewing the friendships made on previous visits, he made many new friends among the leaders of thought in London, Berlin and Paris.

On the re-organization of the Zoological Society and the establishment of the Zoological Garden in 1876, Dr. Leidy was elected one of its Directors, holding the position till his death. Though not a regular attendant at the meetings of the Board, he took an active interest in the welfare of the Society, and was ever ready to give the benefit of his advice, when asked to do so. Indeed his last official act, one week before his death, was his attendance at the meeting of the Board of Directors of the Zoological Society, May 24th, in response to a request to be present. On that occasion he spoke in reference to certain matters of importance then under consideration.

As a fitting recognition of the services rendered by Dr. Leidy to the Academy of Natural Sciences of Philadelphia, he was unanimously elected its President in 1881. This position he held at the time of his death.

The Biological Department of the University of Pennsylvania having been established in the year 1884, he was made its Director and was also elected to the position of Professor of Zoology and Comparative Anatomy. The latter appointment was a most congenial one, as it afforded him the opportunity of delivering a systematic course of lectures on those subjects to the study of which he had devoted the best years of his life. As a further proof of the respect and esteem in which he was held by his townsmen, it should be mentioned that in the following year, 1885, he was elected President of the Wagner Free Institute of Science.

In the year 1886 Harvard University honored him by conferring upon him the degree of Doctor of Learning and Laws.

Not often has a prophet been honored in his own country as was Dr. Leidy. That his services to science, however, were not over-estimated by his personal friends and admirers, is shown by the honors conferred upon him by the learned societies abroad, among which was membership in the following, not already referred to. The list is probably incomplete :—

Naturhistorischer Verein für das Grossherzogthum Hesse und Umgebung, 1848 ; American Academy of Arts and Sciences, 1849 ; Société de Biologie, Paris, 1851 ; Medical Society of Virginia, 1852 ; Linnean Society of Pennsylvania College, Gettysburg, 1853 ; Société Impériale des Naturalistes de Moscow, 1853 ; Logan Institute, Virginia, 1853 ; Zeosophical Society of the University of Pennsylvania, 1853 ; Philomathian Society of the University of Pennsylvania, 1854 ; Société des Sciences, des Arts et des Lettres du Hainault, 1854 ; Dallas Historical Society, 1855 ; Iowa Lyceum, Des Moines, 1855 ; Natural History Society of Charleston, S. C., 1855 ; Academy of Sciences, St. Louis, Mo., 1856 ; K. Leopoldinisch-Carolinische Deutsche Akademie der Naturforscher, 1857; Zoological Society of London, 1857 ; K. Baierische Akademie der Wissenschaften, 1858; Dublin University Zoological and Botanical Association, 1859; Burlington County Lyceum of History and Natural Sciences, 1859; K. Böhmische Gesellschaft der Wissenschaften, 1860; R. Accademia economico-agraria dei Georgofili di Firenze, 1861; K. K. Zoologisch-botanischer Verein, Wien, 1861; Geological Society of London, 1861; Dublin Natural History Society, 1863; Minnesota Historical Society, 1863; Entomological Society of Pennsylvania, 1864; College of Physicians and Surgeons, Reading, 1870; Anthropological Society of London, 1872; Linnean Society of London, 1872; Minnesota Academy of Natural Sciences, 1873; Société Nationale des Sciences Naturelles de Strasbourg, 1873; Sociedad Mexicana de Historia Natural, 1874; Literary and Philosophical Society of Liverpool, 1877; Historical Society of Pennsylvania, 1884; Biological Society of Washington, 1884; New York Microscopical Society, 1884; K. Danske Videnskabernes Selskab, 1886; Essex Institute, 1887; Victoria Institute, or Philosophical Society of Great Britain.

Of the many honors conferred upon Dr. Leidy by the societies of this country and abroad, none surprised him as much as the awarding to him, by the Boston Society of Natural History, of the Walker prize of $500, which on this occasion was raised to $1000 as a special recognition of his services to science. He was also the recipient of a prize from the Royal Microscopical Society in 1879, and he was awarded the Lyell medal by the Geological Society of London in 1884. The Academy of Sciences of Paris deemed him most worthy of the Cuvier medal in 1888.

Dr. Leidy went abroad in the summer of 1889 for the fourth and last time, accompanied by his wife and daughter. Unfortunately his wife's serious illness while in London, marred considerably the pleasure of the visit. Nothing could have exceeded the attention and kindness of the medical gentlemen of London whom Dr. Leidy consulted under these trying circumstances. He declared on his return that no more could have been done for his wife and himself had they been at home.

There now remains for the memorialist but little to add to what has already been said. A long, pure and useful life was drawing to its close. During the past year it had become painfully apparent to those most attached to Dr. Leidy that the end was near. Though weary in mind and sick in body, the brave old man struggled on, proudly disdaining to ask assistance in doing what he regarded as his duty. His death, which occurred April 30th, 1891, was precipitated by the severe strain experienced in the performance of his last official professional duties. No language can express the loss the members of the Academy felt that they had sustained in the death of their President. The regret was universal, sincere, heartfelt; the one wish expressed being to pay every possible respect to the memory of their distinguished associate.

In endeavoring to portray the personal character of Dr. Leidy, the disposition to indulge in unrestricted eulogy becomes almost irresistible, for the author, like his other friends, found in him no faults, or if any, only such as were peculiar to a highly sensitive, emotional and amiable nature.

That which invariably impressed all who came in personal contact with the great naturalist, was not so much his vast and extraordinary knowledge of nature, as the modest and simple way in which he described the rocks, plants and animals with which he was so familiar. His unaffected humility, simplicity and entire absence of self-assertion or conceit never failed to attract and charm those with whom he was thrown in contact. His whole nature was such as to inspire the utmost confidence, to make every one instinctively feel that he was incapable of deceit or meanness of any kind. The sterling integrity of his character was as preëminently manifested in his daily as in his professional life. So charitable and kindly was his nature that strife of any sort was most repugnant to him. Indeed so much was this the case that in some instances he submitted to what his friends regarded as injustice or imposition rather than engage in contention or discussion. Though an indefatigable worker and one of the closest of students, Dr. Leidy was far from being a recluse. On the contrary, no one more thoroughly enjoyed in a moderate way, the society of his friends or contributed more to the success of a social entertainment. As a relaxation from his work he was at one time fond of attending the theatre, and he occasionally read a novel with the same end in view, although general literature had for him but little attraction.

While the life of Dr. Leidy regarded from the ordinary standpoint was uneventful, it offers the rare instance of one steadfastly and unselfishly devoted to the study of nature; of a long and useful career unsullied by a stain and characterized as much by its sweetness, simplicity and goodness as by its great mental achievements.

Within the limits of this memoir the author can only indicate the salient features of Dr. Leidy's scientific work, the discoveries upon which were founded his great reputation at home and abroad, and upon which his future fame as America's most distinguished biologist will probably rest.

While he never regarded himself either as a mineralogist or a botanist, yet those actively engaged in the study of minerals or plants were always glad to avail themselves of his advice in the pursuit of their investigations; indeed so true was this as regards precious stones, that jewellers of long experience never questioned his estimate of the value of the gems frequently submitted by them to his inspection.

His familiarity with minerals in general was frequently shown at the weekly meetings of the Academy, when, as Curator, he called attention in an impromptu way to the additions presented during the meeting to the mineralogical cabinet. Among such verbal communications may be mentioned his remarks upon the minerals from Mount Mica, the tourmalines; specimens of corundum from North Carolina; the mineral springs of Wyoming and Utah; the eroding and polishing of quartzite and jasper by the conjoint action of wind and sand; ozocerites from the Carpathian Mountains; topaz from Brazil and Siberia; precious opal; rocks from South Mountain; the origin of citrine or yellow quartz, &c.

In this connection it may be stated that the valuable collection made by him has been purchased by the Government, and will be preserved in the National Museum at Washington. As with the minerals, he would, as occasion offered, comment informally on an interesting plant. In this manner communications were made on *Wolffia Columbiana*, the smallest and simplest of all the true flowering plants, only comparatively recently known to occur in the United States, and on *Chara* and *Vallisneria*. The hairs of the Mullein being under discussion he described the intra-cellular circulation in plants. His intimate acquaintance with botany was also shown by the constant allusions made to the various kinds of plants noticed in the different parts of the country visited by him in search of minerals or fossils. The herbarium which he presented to the Biological Department of the University contains over 1500 species of plants, collected and determined by himself.

Of the many contributions to natural history made by Dr. Leidy, his observations upon the lower forms of life deserve especial notice, on account of their originality and value, and as illustrating his remarkable ability as a microscopist and skill as an anatomist and artist. For many years on different occasions, while investigating with the microscope the minute creatures found in the streams and ponds of the neighborhood, he, like others, had incidentally noticed the presence of various forms of minute animated beings consisting simply of protoplasm and called rhizopods on account of their continually protruding and retracting their bodies in a root-like or rhizome manner. They often form shells of great beauty and variety. Becoming especially interested in these low forms of life, he determined to lay aside all other work, and to devote himself entirely to the study of these minute beings. So studiously did he adhere to this resolution, that for several years he allowed nothing to interfere with this especial study. With the object of collecting material, he visited ponds, ditches and streams in this and other States, examining also the mould on stones and between the bricks of houses, and then patiently observed with the microscope, and delineated with a master hand, the protean amœba-like changes exhibited in the life history of these wonderful beings.

The result of this incessant and arduous labor was the production of the magnificent monograph "Fresh Water Rhizopods of North America," which appeared in 1879 as one of the Reports of the United States Geological Survey of the Territories.

To those wishing to engage at some future time in similar researches it may not prove uninteresting to know that this great work was accomplished by means of a microscope that cost $50, provided with but two objectives of moderate magnifying power. In the sediment of a few drops of water squeezed from a piece of moss, thirty-eight different kinds of rhizopods, together with examples of *Micrasterias*, *Euastrum*, *Docidium*, *Closterium* and other desmids, together with several species of diatoms, were revealed by this simple apparatus.

Notwithstanding that Dr. Leidy invariably made use of very simple instruments in his microscopical investigations, he rarely made mistakes, though the first to admit such when substantiated. In this connection, it may be appropriately mentioned, that his observation made in 1861, that the Gregarina, a minute unicellular entozoon, infesting the stomach of the cock-roach and other insects, was provided with muscular fibres, was questioned by European microscopists, and indeed, was denied by the elder Van Beneden. Thirty years afterward, the observation was fully confirmed by the investigations of the younger Van Beneden, who admitted that he must agree with Dr. Leidy, even at the expense of his father's accuracy.

Among the simple forms of animal life, though more highly organized than the Rhizopods and Gregarinæ, the sponges attracted Dr. Leidy's attention. Among the more interesting forms described by him, may be mentioned *Pheronema Annae*, so-named in honor of his devoted wife. He was the first to correctly describe the position which that exquisite siliceous sponge, the *Euplectella* of the Philipines, assumes in a state of nature and the manner in which it is anchored by its strands, a reversed position having been previously assigned to it by the greatest of English anatomists. The beautiful hydroid, *Eucoryne elegans*, resembling a minute rose bush, was dredged up by Dr. Leidy, in the bay of Newport. This, together with sponges and other marine animals, supplied the material for his paper in the Journal of the Academy entitled: "Marine Invertebrate Fauna of Rhode Island and New Jersey." *Urnatella gracilis*, a peculiarly interesting fresh water polyzoon was discovered by Dr. Leidy in the Schuylkill river just below the Fairmount dam. Its body wall is so translucent as to permit movements of the alimentary canal to be seen under the microscope. The mouth of the polyp-head or bell is surrounded with a circle of ciliated tentacula. It is described and beautifully illustrated in the Journal of the Academy.

While investigations like those just referred to are of interest to the biologist, his researches in helminthology appeal also to the medical profession and the entire community on account both of their scientific and practical value. The discovery, by Leuckart, of the cause, and therefore of the mode of prevention, of trichinosis in man, was entirely due, as that eminent authority himself says, to the discovery by Dr. Leidy of *Trichina spiralis* in the pig.

As far back as 1846, one morning while at breakfast, just as he was about to partake of a piece of pork, Dr. Leidy noticed that it contained minute peculiar specks, which after submitting to microscopic investigation, he recognized as being encysted Trichinæ. The account of this observation, published in the Proceedings of the Academy, attracting the attention of Leuckart, it occurred to the distinguished German helminthologist that trichinosis in man might be due to the eating of raw pork containing trichinae. This was afterwards shown to be the case. Dr. Leidy's reputation as a helminthologist was world wide, and his numerous contributions to that subject are held in the highest esteem abroad, being continually referred to in the standard works of Diesing, Leuckart, Cobbold and others. Throughout the United States he was regarded as the highest authority on entozoa and parasites. Physicians from all parts of the country were constantly sending to him for determination, flukes, tape and thread worms, trichinae, ticks, etc., in the hope of securing suggestions from him as to the best means of preventing the recurrence of parasites in their patients.

His "Observation on the Parasites of the Termites or White Ants" published in the eighth volume of the Journal of the Academy, was directly in this line of investigation. His memoir entitled, "A Flora and Fauna within Living Animals," constituting part of the Smithsonian Contributions to Knowledge for 1853, had already established in the most striking manner, the fact that the alimentary canal of many animals such as beetles, cock-roaches and centipedes, are the natural homes of a most diversified animal and vegetable life. Indeed the mucous membrane of the intestines of certain beetles presents the appearance of a flower garden. The description of *Enterobryus* led Prof. Robin to the later discovery of the species in the *Julus terrestris* of Europe.

The work just referred to is not only a remarkable one as having revealed to the naturalist a number of new forms of animal and vegetable life living parasitically within the bodies of higher animals as their hosts, but as containing the most profound reflections, the truth of which modern research has confirmed in every particular, upon the origin and extinction of life upon the earth. In speaking of the origin of entozoa and entophyta at page 9 of the paper under consideration, the author observes: "The study of the earth's crust teaches us that very many species of plants and animals became extinct at successive periods, while other races originated to occupy their places. This probably was the result, in many cases, of a change in exterior conditions incompatible with the life of certain species and favorable to the primitive production of others. . . . . . Living beings did not exist upon earth prior to their indispensable conditions of action, but wherever these have been brought into operation concomitantly, the former originated. . . . . . Of the life, present everywhere with its indispensable conditions, and coeval in its origin with them, what was the immediate cause? It could not have existed upon earth prior to its essential conditions; and is it, therefore, the result of these? There appear to be but trifling steps from the oscillating particle of inorganic matter to a Bacterium; from this to a Vibrio, thence to a Monas, and so gradually up to the highest orders of life! The most ancient rocks containing remains of living beings, indicate the contemporaneous existence of the more complex as well as the simplest of organic forms; but, nevertheless, life may have been ushered upon earth, through oceans of the lowest types, long previously to the deposit of the oldest palaeozoic rocks as known to us!!"

Although, unfortunately for science, he rarely indulged in such speculations, it may well be asked where in the whole range of biological literature can there be found a more concise and fitting statement of what is known as the theory of Natural Selection, Survival of the Fittest or, in a word, of Darwinism, than is expressed in the above quotation. Prophetic words indeed: the "Origin of Species" appeared five years later.

As a further illustration of the wide range of his biological studies may be mentioned his knowledge of entomology. This was shown in a most happy manner some thirty years ago by his reply to the Councils of Philadelphia, in answer to their inquiries as to the best methods of protecting the shade trees of the city from the depredations of insects. Perfectly familiar with the structure, development and habits of the canker worm, the scale bug, the tufted caterpillar, the sack bearer, and the borer, the insects that are most destructive to our shade trees, he suggested various simple but effective methods by which the insects could be destroyed with least injury to the trees.

One would not suppose that the subject of "basket worms" would be suggestive of poetical ideas, yet in speaking of the development of the insects, he observes that, from the pupa case "is produced the moth, the male of which awaits the night to leave his habitation in search of a mate. The female never leaves her silken dwelling, nor does she even throw aside her pupa garment: it is her nuptial dress and her shroud."

Minute butterflies were always interesting to him, and the collection he made many years ago is still a very attractive feature in the entomological collection of the Academy.

Among his most important contributions to the anatomy of insects should be mentioned his account of the structure of the walk-ing-stick insect, *Spectrum femoratum*, communicated to the Academy in 1847, and his description of the mechanism by which the membranous wings of the locust are closed. The anatomy of the hemipter, *Belostoma*, then a rare insect, but lately quite commonly attracted by the electric light, was the subject of a communication appearing in the Journal of the Academy. The admirable figures in that paper, as well as those illustrating the internal anatomy of the neuropterous insect *Corydalus cornutus* in its three stages of existence are to this day made use of by such high authorities as Packard and others to illustrate their standard works on entomology.

One of the most important of Dr. Leidy's observations upon the structure of articulate animals was his discovery in 1848 of eyes in barnacles, *Balanus*. It is especially interesting in this connection to note the fact that Darwin remarks in his monograph on the Cirripedia, p. 48, "owing to Professor Leidy's discovery of eyes in a Balanus, I was led to look for them in the Lepadidæ."

During the same year there appeared in the American Journal of the Medical Sciences his researches upon the comparative anatomy of the liver. This communication is based upon the study of the organ in numerous invertebrate and vertebrate animals and the view is advanced that its structure is essentially the same in all orders of animals. According to our author's theory, the liver consists of more or less numerous membranous tubes or cæcalined with cells whose office it is to elaborate the bile from the blood supplying the organ. As the bile so elaborated passes from the cells into the spaces between them, and as these intercellular spaces are continuous with the interior of the inter-lobular biliary duct, they must be regarded as the beginning thereof. The intimate structure of the liver does not differ then in any way from that of any other true gland, the simplest expression of which is a basement membrane separating a blood-vessel from a secreting cell. This view of the structure of the liver was accepted by but few of the anatomists of the day. It has, however, been shown by later study that the liver begins as a diverticulum of the intestine in which the relation of the basement membrane to the blood-vessels and secreting cells is the same as that indicated by Dr. Leidy. Further modern investigation has shown that the liver contains more urea than any other gland in the body, thus confirming the opinion as to the biliary function of the tubes opening into the intestines of insects and which have been usually regarded as renal by most anatomists on account of their containing uric acid and sodium urate.

In 1844, Dr. Leidy, then twenty-one years of age, was asked by Dr. Amos Binney, of Boston, to contribute an article on the special anatomy and physiology of the terrestrial gasteropoda of the United States for the proposed general work on that subject then in preparation by the latter. Before the special anatomy was completed, the death of Dr. Binney, unfortunately, put a stop to further work in that direction. Nevertheless, the result of Dr. Leidy's investigations were later published in Binney's work on the terrestrial gasteropoda of the United States, as edited by Gould. To appreciate the importance of this admirable monograph, beautifully illustrated from drawings by the author, it must be remembered that at the time of its appearance, the only systematic work on the anatomy of the mollusca was Cuvier's classical treatise published in 1817. While it is true that there are some errors of interpretation in Dr. Leidy's paper, recognized later by the author, yet to this day it is in the hands of every specialist and is continually referred to in the standard works on the anatomy of the mollusca. In this connection it is an interesting fact that the first scientific communication of any kind, made by Dr. Leidy, at least as far as known to the writer, was a paper on the anatomy of *Littorina angulifera* submitted July 16th, 1845 to the Boston Society of Natural History and published in the Journal of that Society, no doubt on account of Dr. Binney's interest in the author.

The latter was not then a member of the Academy of Natural Sciences of Philadelphia, but being elected a few days later, July 29th, he presented, on the 14th day of the following October, his first communication, "Notes taken on a Visit to White Pond, N. J." The extinct mollusca described in the paper may still be seen in the Museum of the Academy. These specimens are interesting not only as constituting the subject of his first communication to our society, but as offering one of the few instances of descriptions of fossil invertebrata to be met with in Dr. Leidy's numerous paleontological works. It need not be added, however, that his knowledge of the extinct forms of invertebrate life was as extensive and exact as was his acquaintance with recent forms.

When he began his biological studies, the waters of every ditch, stream, and pond in the vicinity of the city, teemed with various kinds of invertebrate life, unfortunately since destroyed by sewage and coal oil. Many of these were new to science and constituted, as we have seen, the subject of most of his researches upon the anatomy of the invertebrates. The opportunities afforded at that time for investigating the anatomy of vertebrates, other than the most common forms, were very limited, depending, as the Zoological Garden had not been established, upon the chance of a travelling menagerie losing a specimen by death while exhibiting in the city.

His contributions to our knowledge of the anatomy of recent vertebrates were, therefore, few in number. Among these may be mentioned his communication in the Proceedings of the Academy, illustrated with figures, on certain peculiar bodies resembling the Pacinian corpuscles of man, found along the course of the intercostal nerves in the boa constrictor. The anatomy of the abdominal viscera of the three-toed sloth, the subject of another communication to the Academy, is interesting as containing a description and figure of the embryo sloth with membranes.

In 1852 there appeared in the Journal of the Academy his important memoir "Description of the Osteological Characters of a New Genus of Hippopotamus." By a comparison of the skulls in the Museum of the Academy, the author proves that the animal from Liberia not only differs from that of the Nile, as had been previously supposed by Dr. Morton, but that it belongs to a different genus, which he named at first *Chœrodes,* but afterward *Chœropsis,* the former name having been already adopted for an insect. It is an interesting fact that while his opinion of the generic distinction of *Chœropsis* from *Hippopotamus* was not accepted by the zoologists of that day and is questioned by many even now, its correctness has been fully established by the recent researches of one of the highest authorities, Prof. Alphonse Milne Edwards.

Dr. Leidy's contributions to the general or histological anatomy of vertebrates were but few in number. Mention should be made, however, of his communications to the Academy and to the American Journal of Medical Sciences, on the development of the Purkinjean corpuscles of bone, the structure of the intercellular substance of articular cartilage, and the disposition of the sheath of muscular fasciculi. Dr. Leidy, in the paper first mentioned, showed that the bone cells, or Purkinjean corpuscles, are derived from the pre-existing cartilage cells, the canaliculi being prolongations or protrusions of the cell wall. As regards the structure of the intercellular substance of articular cartilage, basing his observations on the fact that the latter fractures in a direction perpendicular to its surface, he showed that it consists of extremely fine, transparent filaments, upon the existence of which depends the disposition of the cells in rows. He also demonstrated that the filaments of fibrous tissue forming the sheath of muscular fasciculi are disposed diagonally around the latter, becoming straight at their rounded extremities. He pointed out the advantage, functionally, of such arrangement, by which the muscular power is conveyed to the parts to be moved without entailing any loss.

As an illustration of the extent and variety of his researches in histology, it may be mentioned that about this period he translated from the German, Gluge's Atlas of Pathological Histology, a standard work at that time.

Dr. Leidy's studies of the structure of the human body were fully set forth in his admirable treatise upon human anatomy, so that he but rarely published any special communications upon that subject. His researches, however, upon the development of the intermaxillary bone in man, the structure and development of the temporal bone, the nature and relations of the crico-thyroid membrane and adjacent muscles of the larynx are well worthy of consideration. To Goethe, great alike as philosopher, poet and naturalist, science is indebted for the discovery of the intermaxillary bone in man. Its recognition, however, at the time Dr. Leidy began his study, had been confined to abnormal conditions due to an arrest of development, as in hare-lip, its exact limits and the period of life in which it occurs as a distinct piece not having been accurately determined. He made it the subject of a special investigation. The result of his study, based upon the examination of a number of human embryos, was embodied in his observations on the existence of the intermaxillary bone, in which not only was its development accurately described, but it was shown that the same law governed the formation of the upper maxillary bones in man as in all other vertebrates.

It would hardly be supposed at the present day, considering all that has been published on the development and structure of the temporal bone, that anything of importance would have been left unsaid. As recently, however, as 1883, Dr. Leidy communicated to "Science" the results of his study of that portion of the skull. He prefaced his description with characteristic modesty by observing that he laid no claim to having made any discoveries. Nevertheless his views as to the development and relations of the auditory plate, the scute, the antrum and attic, based upon beautiful preparations, differ so essentially from those given in systematic treatises that it may be truly said he has thrown a flood of light upon the anatomy of that most complex of bones. It should be mentioned in this connection that while he admits, with Prof. Huxley, the presence of two ossificatory centers in the development of the temporal bone, the proötic and opisthotic, he views the so-called third centre or epiotic bone, not as a distinct centre, but as a continuous out-growth of the posterior semicircular canal.

He was one of the few anatomists who described the vocal membranes of the larynx as being membranes instead of cords. The latter name, most inappropriate and misleading, was originally given to them because it was supposed that the voice was produced in the same manner as sounds are produced by the vibration of strings, whereas the larynx is rather comparable to a reed instrument, such as the oboe.

In an excellent paper, well illustrated, he described accurately the structure and attachments of the crico-thyroid membrane as well as the relations of the adjacent muscles, more particularly of the thyro-arytænoideus, and thyro-epiglottidæus, the superior and inferior arytæus epiglottidæus.

The first edition of the "Elementary Treatise on Human Anatomy" was published in 1861. It is one of the best works ever offered to the medical profession on the subject, and more than fulfilled its author's anticipations of usefulness. The work was prepared, not in the hope that it would supersede the classical treatises already before the profession, but to place in the hands of students and practitioners of medicine a work on human anatomy which, while brief and clear, should be sufficiently complete for all practical purposes. The description of the various organs, illustrated by excellent figures, many of them original, is always lucid and graphic. Especially is this true of the observations upon general histology, usually prefacing the descriptions of great systems such as the muscular, alimentary, nervous systems, etc. One of the striking features of the work is the employment in the text of the English name only for the part to be described, the Latin or other synonyms being given in foot notes, thus greatly simplifying the nomenclature. The work throughout bears the impress of the comparative anatomist, of one as familiar with the structure of an infusorial animalcule as with that of the complex vertebrate.

The variety, extent and exactness of Dr. Leidy's knowledge of nature was unsurpassed, if equalled, by that of any living naturalist. It was this familiarity with all natural objects which invariably impressed those brought in personal contact with him. If some minute infusorian were casually mentioned in conversation, one would have supposed from his remarks that he had devoted his life to the study of the Protozoa; an intestinal worm being the subject of discussion, from his description of its structure, origin and mode of life, it would have been inferred that helminthology was his exclusive specialty. The opportunity of seeing him dissect an insect, mollusk or vertebrate, would soon convince one that he was a most skilful anatomist. A fragment of rock, a plant, a shell submitted to him called forth criticisms worthy of the professional mineralogist, botanist or conchologist.

Profound as was his knowledge of living plants and animals, it can be truly said that his acquaintance with the extinct forms of life was equally so. Indeed it was his great familiarity with the existent types of vegetable and animal life that so eminently qualified him to determine fossil forms.

In the year 1847 Dr. Hiram A. Prout of St. Louis, published in the American Journal of Science and Arts the description of a fossil maxillary bone of *Paleotherium*, from near White River, Nebraska. This communication at once directed the attention of geologists and paleontologists to the Mauvaises Terres.

At about the same time Dr. S. D. Culbertson of Chambersburg, Penna., submitted to the Academy of Natural Sciences of Philadelphia, some fossils sent to him from the Bad Lands of Nebraska by Mr. Alexander Culbertson. These were afterwards presented to the Academy by the collector and described by Dr. Leidy in the Proceedings, together with the paleotheroid form just referred to from the same locality.

The collection of fossils, in the possession of Prof. O'Loghland, of St. Louis, as well as those made in the Bad Lands of Nebraska by Dr. Evans, at the request of Dr. Owen of the Geological Survey of Nebraska and by Captain Van Vliet of the U. S. Army, were also placed at Dr. Leidy's disposal for description in the Proceedings of the Academy. The late Prof. S. F. Baird, fully appreciating the importance of the discoveries, sent Mr. T. A. Culbertson to the Bad Lands of Nebraska. He returned with a most valuable collection of mammalian and chelonian fossils. These specimens, with others obtained from the same locality, were sent to Dr. Leidy by Prof. Baird, who, with his characteristic judgment, remarked that Dr. Leidy, though but thirty years of age, was the only anatomist then in the United States qualified to determine their nature.

The finding of these fossils, together with the appreciation of their value and the recognition of their relations, constitutes a discovery which, if equaled, has never been surpassed in importance by any other contribution to paleontology.

The "Ancient Fauna of Nebraska" appeared in 1853. It contained descriptions of the fossil remains just referred to, together with some previous publications to be mentioned hereafter, and was the beginning of a most brilliant series of paleontological researches. They extended over a period of more than forty years and culminated in discoveries which, together with others made in the same field, are regarded by many as going farther to establish the doctrine of evolution than all the other facts hitherto advanced in favor of that theory. The remains of the extinct animals described in this work excited a great deal of attention when submitted to the Academy, as they were the first fossils brought from the tertiary beds of the West. They were of a more generalized type of structure than those living at the present day, a remarkable feature, especially in the case of the Tertiary mammalian remains discovered, some of which, to a considerable extent, bridged the gap between extinct and recent mammals. These facts, commented upon as so remarkable at the time, afterwards became perfectly intelligible in the light of the theory that the early tertiary mammals must be regarded as the ancestors of those living at the present day.

Among the ancient mammals from the tertiary beds of Nebraska described by Dr. Leidy, may be mentioned *Poëbrotherium*, a ruminant nearly allied to the musk deer and through *Procamelus*, described later by our author, the ancestor of the camel. *Agriochœrus* and *Oreodon*, peculiar ruminants, were especially interesting as filling up the interval between *Anoplotherium* of Cuvier and recent ruminants, as *Zeuglodon*, whose vertebræ were once so common in Alabama as to be used for fences, and which bridges the gap between the carnivora and the cetacea. *Oreodon*, intermediate in its structure between the hog, deer and the camel, appears to have lived in herds inhabiting the whole continent from Nebraska to Oregon. *Archeotherium*, a recent genus of suilline ungulata, was an illustration of the generalized type of mammals living in those early tertiary times combining ruminant with carnivorous characteristics.

The skull and jaws of the horse-like mammal *Anchitherium*, were particularly important as being the remains of a genus hitherto represented in Europe by other parts of the skeleton.

In view of what has since been established regarding the genealogy of the horse, it is interesting to find Dr. Leidy remarking that "it is extraordinary that *Anchitherium* should be so much like *Paleotherium* in the anatomical and physiological construction of its teeth, and yet be so much like the horse in its skeleton." *Titanotherium*, of which the lower-jaws, as already mentioned, were the the first fossils presented to the notice of the world from the great mammalian cemetery of the West, resembles, according to Dr. Leidy, the *Paleotherium* of Cuvier, though much larger than *Paleotherium magnum*. Later researches have shown that *Titanotherium* has affinities with *Limnohyus* and *Paleosyops*, afterwards described by Dr. Leidy, as well with *Brontotherium*.

Two species of *Rhinoceros* were described in the work as having once inhabited the Bad Lands of Nebraska, the largest of the two species being about three-fourths the size of *Rhinoceros Indicus* of the present day.

As an illustration of Dr. Leidy's remarkable knowledge of osteology even at that early date, it may be mentioned that he established this species of extinct Rhinoceros upon a few small fragments of molar teeth, without having even those of a recent Rhinoceros with which to compare them. The correctness of this determination was questioned when the teeth were first brought to the Academy, it being considered incredible that such an animal should have ever lived in Nebraska. His opinion, however, was fully sustained soon afterwards by the discovery of several entire molars together with a complete skull of the animal. Of the remaining mammalia described as occurring in Nebraska at that time should be mentioned *Machairodus*, recognized later as a synonym of *Drepanodon* or the sabre-toothed tiger, which had already been found in France, India and Brazil, and which no doubt preyed upon the herds of *Oreodon* roaming over the country in those remote times, much as the lion and tiger prey upon the deer in Asia and Africa at the present day.

A most striking peculiarity of the paleontology of the Bad Lands of Nebraska, is the fossil turtles to be seen by hundreds particularly in the neighborhood of Bear Creek, which appears to have been at one time a vast lake. All the turtles from this region submitted to Dr. Leidy for determination appear to have been species of *Testudo*.

The "Ancient Fauna of Nebraska" is a very remarkable work not only on account of the admirable descriptions it contains of animals long since extinct whose existence on this continent, as in the case of the rhinoceros, had never been suspected, but particularly in view of the lack of opportunity to compare the fossil remains with those of recent animals. The identification of fossil remains, the determination of their relations and affinities, always present difficulties to the best comparative osteologists even when studied in connection with such magnificent collections as those of the Royal College of Surgeons or of the Jardin des Plantes. The accuracy of Dr. Leidy's work is, therefore, specially worthy of note as he had no material for comparison except that contained in the limited collections of the Academy; yet how comparatively few are the errors his successors have indicated.

The remains of the extinct gigantic sloths that inhabited North America during the quaternary period, and which probably were the ancestors of similar but smaller animals now living in South America, early attracted the attention of American naturalists. As long ago as 1797, Thomas Jefferson, in a communication to the American Philosophical Society, described certain bones discovered in a cave in Green Briar County, Virginia, which he regarded, on account of the claws, as being the remains of a carnivorous animal which he named *Megalonyx*. The bones being subsequently presented to the American Philosophical Society were again described by Dr. Wistar, who, basing his opinion upon the form and arrangement of the bones of the feet, suggested that *Megalonyx* was a kind of Sloth and not a carnivorous animal as Mr. Jefferson had very naturally supposed. An examination by the great paleontologist Cuvier, of casts of these bones sent to him by Mr. Peale, fully confirmed Dr. Wistar's opinion as to the sloth-like nature of *Megalonyx Jeffersoni*, as it was afterwards called by Dr. Harlan. The original specimen described by Mr. Jefferson, now in the Museum of the Academy, together with other remains of *Megalonyx*, *Megatherium*, etc., obtained from Tennessee, Mississippi, Kentucky, Alabama and Georgia, constituted the material upon which was based Dr. Leidy's admirable "Memoir on the Extinct

Sloth Tribe of North America" which appeared, beautifully illustrated, in 1855, two years after the publication of the "Ancient Fauna of Nebraska."

At the time that Dr. Leidy began his researches upon the extinct sloths considerable difference of opinion prevailed as to whether certain bones that had been discovered since the sloth-like nature of *Megalonyx* was satisfactorily determined were the remains of that animal or of one somewhat closely allied. Dr. Leidy showed conclusively that while several of the bones in question were those of *Megalonyx*, many that had hitherto been regarded as such were undoubtedly the remains of other extinct edentata such as *Gnathopsis, Mylodon, Megatherium, Scelidotherium*, etc., the generic and specific characters of *Megalonyx* being clearly indicated as well as those of the other edentata just mentioned, many of which had already been described by Cuvier and Owen. As an illustration of the exactness of Dr. Leidy's determination of the nature of *Megalonyx*, it may be mentioned that in his first description he attributed five toes to the hinder feet as well as to the fore feet, a greater number than is known to belong to any other genus of the Tardigrada. The correctness of this view was fully substantiated the following year by the discovery of remains of *Megalonyx* among which the particular bones of the feet that were missing in the specimens previously described happened to be represented. These were made the subject of some further observations upon the feet of *Megalonyx*.

The extinct fishes discovered in the Devonian deposits of Illinois and Missouri and the Devonian and Carboniferous formations of Pennsylvania now attracted his attention and were made the subject of special communications to the American Philosophical Society and the Academy.

Among these interesting remains from the red sandstone formation of Tioga County, Pennsylvania, discovered by Charles E. Smith, Esq. and described by Dr. Leidy, were those of *Holoptychius Americanus*, a Ganoid fish represented at the present day in our waters by the gar-pike and sturgeon, and those of *Stenacanthus*, a Placoid characterized by its peculiar dorsal spine and supposed to have been allied to the sharks of the present day. Another remarkable and gigantic fish described by Dr. Leidy as living in the seas of these remote times was *Edestus vorax*, the teeth of which, resembling those of *Carcharodon*, are nearly two inches long. These were afterwards regarded as spines, which is also the opinion of Sir Richard Owen. According to the recent researches of Trautschold, however, the parts in question in *Edestus* are really teeth as Dr. Leidy first supposed.

Various genera, *Cochliodus*, *Helodus*, *Chomatodus* and *Ctenoptychius* were also described, and their relations to the living *Cestracion Phillippi* or Port Jackson shark of Australia were pointed out. The jaws of this fish, a relic of the most remote ages and of living Placoids, and resembling most the extinct carboniferous fishes just mentioned, are covered with rounded plates much like a cobblestone pavement, instead of the lancet-shaped teeth so characteristic of the sharks of the present day.

About this period the remains of the Walrus discovered upon the coasts of Virginia and New Jersey, were identified as being of the same species as the recent *Trichecus Rosmarus*, which once lived in great numbers in the Gulf of St. Lawrence. These remains were regarded as those of individuals that had been floated upon fields of ice and ultimately deposited upon our southern coasts, or of such as may be supposed to have migrated to the South during the Glacial epoch.

It is well known that the remains of the Peccary have been found in considerable quantities in the states of Illinois, Kentucky, Iowa, Missouri and Virginia. Dr. Leidy was at one time inclined to think that these remains represented a number of genera and species. A more recent study, however, based upon an examination of the recent Peccaries, which the lack of material had previously rendered impossible, convinced him that the remains hitherto described might all be referred to *Dicotyles compressus*. He adds, however, that if the anatomical characteristics offered be considered subgeneric, then the name *Platygonus compressus*, previously employed, would include all the genera and species.

In the year 1865 there was published in the Smithsonian Contributions to Knowledge one of the most important of Dr. Leidy's paleontological works: the memoir entitled "Cretaceous Reptiles of the United States." Most of the fossil remains constituting the subject of this memoir were obtained from the Green Sand or Marl of New Jersey, so extensively excavated for agricultural purposes. They are preserved in the Museum of the Academy. Among them are those of the extinct crocodile *Thoracosaurus*, closely allied anatomically to the Gavial of the Ganges, the skull of which measures nearly four feet in length and two feet in breadth. Other interesting crocodile-like reptiles described as of the same general character in the work were *Bottosaurus* and *Hyposaurus*. The huge *Cimoliasaurus* and *Discosaurus* measuring sixty feet in length appear to have represented in our waters the *Plesiosaurus* of the English cretaceous seas.

The teeth and some of the bones of the extremities of *Mosasaurus*, an extinct saurian resembling in some respects existing reptiles like the Monitor and Iguana, were also described. In the case of the extremities this was especially important, as few bones that could be identified as such had been discovered among the remains of *Mosasaurus* hitherto described. Indeed Cuvier was so much impressed with the absence of any remains of extremities in the case of the celebrated Mæstricht specimen now preserved in the Jardin des Plantes that at first he was led to doubt whether the animal possessed any limbs. Dr. Leidy also called attention to the remarkable character of the vertebral column of *Mosasaurus*, the co-ossification in the hinder part of the tail and of the chevron bones with the bodies of the vertebræ, a condition previously known only in fishes.

One of the most remarkable reptiles described by Dr. Leidy was *Hadrosaurus Foulkii*, the restoration of which forms a conspicuous object in the Museum of the Academy. It resembles somewhat the *Iguana* and *Cyclura* among existing lizards. This gigantic reptile, the representative during the cretaceous period of North America of the Iguanodon of the Wealden of England, was twenty-eight feet long and, judging from the development of the pelvis and the great difference in the size of the hind as compared with the fore limbs, it probably stood and walked like a bird or a kangaroo, and was provided with a powerful tail like the last named animal. While the femur measured nearly four feet in length and the tibia three feet, the humerus and ulna were only about half those dimensions respectively. *Hadrosaurus* like *Iguanodon* was a vegetable feeder. Its teeth resembled those of the latter but were disposed in rows like a tesselated pavement. One of the most interesting results of the study of the remains of *Hadrosaurus* was the identification of the pubic bone with that described as the clavicle in *Iguanodon*. The determination of the proper relations of this bone was a most important one, leading as it did to the subsequent generalization that the Dinosauria are the ancestors of the birds, the gap between the two groups being filled up by the Struthious birds, such as the ostrich and certain reptile-like birds and bird-like reptiles since discovered. Among the other reptilian remains discovered in the marl of New Jersey many were recognized as being those of turtles such as *Chelone, Emys* and *Trionyx*. *Bothremys Cookii* found near Barnsboro, of especial interest as being the first Chelonian skull discovered in the Green sand formation in the United States, was regarded as closely allied to the great turtle of the Amazon, *Podocnemys expansa*.

During the time intervening between the years 1853 and 1866, the able and indefatigable explorer, Dr. F. V. Hayden, made several visits to Nebraska and Dakota, returning each time with large collections of the remains of the extinct animals of that region, those from the vicinity of the Niobrara river being the first obtained. All these fossils were submitted to Dr. Leidy for determination and, together with those previously described in the "Fauna of Nebraska," etc., already referred to, constituted the subject of his great work, "The Extinct Mammalian Fauna of Dakota and Nebraska," which appeared as Volume VII of the Journal of the Academy, in 1869. In this remarkable work over seventy genera with numerous species of extinct mammalia, many of them new to science, were first described. The Carnivora, Pachydermata, Ruminantia, Proboscidea, Rodentia and Insectivora were especially well represented. Remains of the Equine family were most conspicuous.

The vast number of bones from the pliocene deposits of Dakota recognized by Dr. Leidy as being the remains of horses, led him to infer that the North American Continent, during that period, was emphatically the country of the horse, the different forms being then better represented than in the recent fauna of any part of the world. He was specially interested in the relations of the extinct horses to each other and to those of the present day.

His first communication on this subject was made to the Academy in 1847; his last as recently as May, 1890. He made a collection of the skulls, jaws, teeth, bones of the limbs, etc., of the different breeds and ages of recent horses with the view of comparing them with the corresponding parts of the extinct forms. In speaking of the great difficulties experienced when endeavoring to positively identify certain bones as those of one so-called species of horse as distinguished from another, he observes that if the "bones and teeth of the domestic horse, the mule, the ass, the djiggetai, the hemione, the quagga, the daww, and the zebra, were commingled, they might readily be considered as belonging to varieties of a single species," and that the "bones and teeth of the three last named species are so nearly alike that, had they been found in a fossil state in Southern Africa instead of the living animals, they would have been unhesitatingly considered as pretaining to a single species." To this circumstance, so thoroughly appreciated by the author, was due his caution in identifying the remains submitted to him as belonging to any particular species of the horse. Indeed the difficulties are so great in determining to what particular species or genus the remains of extinct horses are to be assigned, that it is impossible to say whether or not the several forms first described by Dr. Leidy, are the same as those subsequently described by others.

Without committing himself to any positive theory of the origin of the horse, it may be said that Dr. Leidy, provisionally at least, regarded the genus *Equus* of the Pliocene period as the descendant of the *Merychippus*, or a similar form, which in turn had descended from *Protohippus* and *Hipparion*, the latter having replaced the *Parahippus* of the Miocene, which had been preceded by the *Anchippus* and *Anchitherium* or similar forms of that same period. As to the origin of *Anchitherium*, it will be remembered, as already mentioned, that in his description of that genus he called attention to the fact that this curious animal resembled *Palæotherium* in the form of its teeth, and the horse in the character of its skeleton.

During the five years that elapsed after the publication of the important work on the extinct mammalia of Nebraska and Dakota just referred to, the remains of a great number of extinct vertebrates had been discovered in the neighborhood of Fort Bridger, Wyoming. These fossils, obtained principally by Drs. Carter and Corson, included the remains of fishes and reptiles as well as those of mammals and were, together with others from the Green River and Sweetwater River deposits of Wyoming and the John Day river of Oregon, submitted to Dr. Leidy for determination. The result of his study was given in his "Contributions to the Extinct Vertebrate Fauna of the Western Territories" published in 1873 by the United States Geological Survey. Among these remains he recognized not only those of extinct animals that he had previously described either in the general works we have referred to or in communications made to the Academy, but also those of many new and interesting forms previously unknown to science. Of these *Uintatherium* was one of the most extraordinary. Its name was derived from that of the Uinta mountains, in the neighborhood of which portions of the skull, jaw and limb bones were found. Its characters were so peculiar and unlike those of any other known animal as to render its ordinal affinities obscure. That great difficulty should have been experienced in determining the nature of *Uintatherium* will not excite surprise when it is remembered that its canine teeth resemble those of the sabre-toothed tiger, its molar teeth those of the tapir, its limbs and feet those of the elephant, while, as subsequently shown, it appears to have been provided with two pairs of horns. This unusual combination of characters is an illustration of how readily a paleontologist may be deceived as to the nature of an extinct animal when fragmentary remains only are in his possession. There can be no doubt that had the skull, jaws, teeth and limbs been found by different paleontologists, as many separate genera would have been described and named. As a matter of fact, when the tusk, the first part of *Uintatherium* discovered, was found by Dr. Corson and submitted to Dr. Leidy's inspection, the latter regarded it, as he himself tells us, as the canine tooth of some large carnivorous animal allied to the sabre-toothed tiger of Brazil, for which he proposed the name *Uintamastix atrox*. The association in the same individual of a tusk-like tooth with two pairs of horns, tapiroid teeth and elephantine limbs would have been deemed impossible by the best comparative osteologist of the day and as violating in every particular the principle of correlation of animal structures as maintained by Cuvier. On the other hand, it is such animals as *Uintatherium* and other similar extinct highly generalized mammalian types that the theory of evolution would lead us to suppose had preceded in time their more specialized descendants of the present day.

This great work was the last of Dr. Leidy's elaborate and important treatises on the paleontology of the Western States and Territories and was regarded by the author, at that time, as his last paleontological work of any kind.

A few years later, however, a collection of fossils from the Phosphate Beds of South Carolina having been placed at the disposal of the author of this memoir, he induced Dr. Leidy to examine the collection with the view of ascertaining if there were among the remains any extinct animals new to science, or of especial interest.

The result of his study of this collection, as well as that of some additional specimens obtained from the same locality and elsewhere, were embodied in his "Description of Vertebrate Remains chiefly from the Phosphate Beds of South Carolina," published in the Journal of the Academy for 1887. Among the remains of extinct animals described in this admirable memoir may be mentioned the teeth of the gigantic sharks, rays and teliosts, the vertebræ, ear-bones and teeth of whales, the bones of the manatee and walrus, the teeth and bones of the elephant, *Megatherium*, horse, tapir, bison, deer, beaver and capybara, many of which were representative of entirely new genera and species.

During the interval elapsing between the publication of the work just referred to, and his death, Dr. Leidy, from time to time as occasion offered, made communications to the Academy on the remains of extinct animals submitted to him for determination. All of these observations are of interest and importance and are marked by the same exactness and accuracy of description, so characteristic of all the work of the great paleontologist.

It will be observed from this necessarily brief resumé of Dr. Leidy's work that he made contributions to the sciences of mineralogy, botany, zoology; general, comparative and human anatomy, and paleontology. Of his numerous scientific communications some were very brief, mere notices; others exhaustive and elaborate treatises. His work, however, whether lengthy or brief was always most exact and accurate. Later investigators in the same fields of research have been able to point out but few errors of interpretation, still fewer of fact. His works are essentially records of facts, often new and of the greatest scientific importance, containing but rarely any generalizations or deductions based upon the same. Possibly no country ever produced a student whose knowledge of nature was at once so accurate and so comprehensive. He was an excellent mineralogist and botanist without claiming to be either, among the highest living authorities on comparative anatomy and zoology, one of the most distinguished helminthologists living, and the equal of any paleontologist at home or abroad.

The following catalogue of volumes, papers and communications published by Dr. Joseph Leidy illustrates the extent, variety and value of his contributions to science :—

Bibliography.

1. On the existence of the sack of the dart and of the dart in several species of North American pneumonobranchiate Mollusks. Boston, Proc. Nat. Hist. Soc. II, 1845, p. 59–60.

2. Notes taken on a visit to White Pond, in Warren Co., New Jersey. Proc. Acad. Nat. Sci. Phila. 1845, pp. 279–281.

3. Anatomical description of the animal of Littorina angulifera Lam. (1845.) Boston, Jour. Nat. Hist. V, 1845–47, pp. 344–347.

4. On several important points in the Anatomy of the human larynx. Amer. Jour. Med. Sci. XII, 1846, pp. 141–143.

5. Remarks upon the Anatomy of the abdominal viscera of the Sloth, Bradypus tridactylis Linn. Proc. Acad. Nat. Sci. Phila. III, 1846, pp. 287–288.

6. On an Entozoon from the thigh of a hog, Trichina spiralis? Proc. Acad. Nat. Sci. Phila. 1846, pp. 107–108.

7. Fecundity of Cryptogamia. Proc. Acad. Nat. Sci. Phila. 1846, p. 195.

8. On the Anatomy of Spectrum femoratum Say. Proc. Acad. Nat. Sci. Phila. III, 1846–47, pp. 80–84.

9. Description of a new genus and species of Entozoa. Proc. Acad. Nat. Sci. Phila. III, 1846–47, pp. 100–101. Ann. Nat. Hist. XIX, 1847, pp. 209–210.

10. On the mechanism which closes the membranous wings of the genus Locusta. Proc. Acad. Nat. Sci. Phila. III, 1846–47, pp. 104–105. Ann. Nat. Hist. XIX, 1847, pp. 214–215.

11. On the situation of the olfactory sense in the terrestrial tribe of the Gasteropodous Mollusca. Proc. Acad. Nat. Sci. Phila. III, 1846–47, pp. 136–137. Ann. Nat. Hist. XX, 1847, pp. 210–211. Silliman's Journ. III, 1847, pp. 434–435.

12. Discovery of crystals in the cellular structure of Parmelia. Proc. Acad. Nat. Sci. Phila. 1847, p. 210.

13. On the Cranium of a New Hollander. Proc. Acad. Nat. Sci. Phila. 1847, p. 217.

14. On an Entozoon from the Pericardium of Helix alternata. Proc. Acad. Nat. Sci. Phila. 1847, pp. 220–221.

15. Request to change the name of an Entozoon from Cryptobia to Cryptoicus. Proc. Acad Nat. Sci. Phila. 1847, p. 239.

16. Remarks on Squatina Dumerili. Proc. Acad. Nat. Sci. Phila. 1847, p. 247.

17. On the fossil Horse of America. Proc. Acad. Nat. Sci. Phila. III, 1846–47, pp. 262–266.

18. Description and Anatomy of a new and curious sub-genus of Planaria. Proc. Acad. Nat. Sci. Phila. III, 1846–47. Ann. Nat. Hist. I, 1848.

19. Description of two new species of Planaria. Proc. Acad. Nat. Sci. Phila. III, 1846–47, pp. 251–252. Ann. Nat. Hist. I, 1848, pp. 78–79.

20. Additional observations on the Fossil Horse of America. Proc. Acad. Nat. Sci. Phila. 1847, pp. 262–266.

21. On a new genus and species of fossil Ruminantia, Poebrotherium Wilsoni. Proc. Acad. Nat. Sci. Phila. III, 1846–47, pp. 322–326. Ann. Nat. Hist. I, 1848, pp. 389–392. Silliman's Journ. V, 1848, pp. 276–279.

22. History and anatomy of the hemipterous genus Belostoma. Journ. Acad. Nat. Sci. Phila. I, 1847–50, pp. 57–67.

23. Miscellanea Zoologica. 1. Description of a new genus and species of Entozoa, Cryptobia helicis. 2. On the mechanism which closes the membranous wings of the genus Locusta. 3. On the situation of the olfactory sense in the terrestrial tribe of the Gasteropodous Mollusca. Journ. Acad. Nat. Sci. Phila. I, 1847–50, pp. 67–70.

24. Descriptions of two species of Distoma with the partial history of one of them. Journ. Acad. Nat. Sci. Phila. I, 1847–50, pp. 301–310.

25. Researches into the comparative structure of the Liver. Am. Jour. Med. Sci. Phila. 1848.

26. On the eye of the Balanus. Silliman's Journ. VI, 1848, p. 136.

27. On the existence of the eye in the perfect Cirrhipoda. Proc. Acad. Nat. Sci. Phila. 1848, pp. 1–2.

28. On some bodies in the Boa-constrictor resembling the Pacinian corpuscles. Proc. Acad. Nat. Sci. Phila. IV, 1848–49, pp. 27–28. Muller's Archiv. 1848, pp. 527–530.

29. On a new fossil genus and species of ruminantoid Pachydermata, Merycoidodon Culbertsonii. Proc. Acad. Nat. Sci. Phila. IV, 1848–49, pp. 47–50.

30. Remarks on the hair of a Hottentot boy brought to Phila. by Capt. Chase. Proc. Acad. Nat. Sci. Phila. 1848, p. 7.

31. Observations on the development of bone, the structure of articular cartilage, and on the relation of the areolar tissue with muscle and tendon. Proc. Acad. Nat. Sci. Phila. IV, 1848–49, pp. 116–117.

32. Observations on the existence of the intermaxillary bone in the embryo of the human subject. Proc. Acad. Nat. Sci. Phila. IV, 1848–49, pp. 145–147.

33. Tapirus Americanus fossilis. Proc. Acad. Nat. Sci. Phila, IV, 1848–49, pp. 180–183.

34. On the existence of Entophyta in healthy animals, as a natural condition. Proc. Acad. Nat. Sci. Phila. IV, 1848–49, pp. 225–233. Ann. Nat. Hist. V, 1850, pp. 71–76.

35. On the intimate structure and history of the articular cartilages. Am. Jour. Med. Sci. Phila. 1849.

36. On some new genera and species of Entozoa. Proc. Acad. Nat. Sci. Phila. IV, 1848–49, pp. 229–233. Ann. Nat. Hist. V, 1850, pp. 314–317.

37. Observations on the characters and intimate structure of the odoriferous glands of the Invertebrata. Proc. Acad. Nat. Sci. Phila. IV, 1848–49, pp. 234–236.

38. Descriptions of new genera and species of Entophyta. Proc. Acad. Nat. Sci. Phila. IV, 1848–49, pp. 249–250.

39. On the intimate structure and history of the articular cartilages. Amer. Journ. Med. Sci. XVII, 1849, pp. 277–294. Ann. Nat. Hist. IV, 1849, pp. 156–158.

40. On the development of the Purkinjean corpuscle in bone. Ann. Nat. Hist. IX, 1849, pp. 74–75.

41. On the arrangement of the areolar sheath of muscular fascicule, and its relation to the tendon. Ann. Nat. Hist. IV, 1849, pp. 158–159.

42. Internal anatomy of Corydalus cornutus, in its three stages of existence. 1848. Boston, Mem. Amer. Acad. IV, 1849, pp. 162–168.

43. Descriptions (accompanied by drawings) of new genera and species Entophyta. Proc. Acad. Nat. Sci. Phila. 1849, pp. 249–250.

44. Notice of certain peculiar bodies observed in the human subject. Amer. Journ. Med. Sci. XX, 1850, pp. 89–91.

45. Notice on the formation of some crystalline bodies in collodion. American Journ. Pharm. XVI. 1850, pp. 24–26.

46. On the characters and intimate structure of the odoriferous glands of the Invertebrata. Ann. Nat. Hist. V, 1850, pp. 154–156.

47. Nyctotherus, a new genus of Polygastrica allied to Plesconia. Ann. Nat. Hist. V, 1850, pp 158–159.

48. On crystalline bodies in tissues of plants. Proc. Acad. Nat. Sci. Phila. 1850, pp. 32–33.

49. On Rhinoceros occidentalis. Proc. Acad. Nat. Sci. Phila. 1850, p. 119.

50. Descriptions of new Entophyta growing within animals. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 35–36. Ann. Nat. Hist. VII, 1851, pp. 236–237.

51. Observations on two new genera of mammalian fossils, Eucrotaphus Jacksoni and Archæotherium Mortoni. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 90–94.

52. Contributions to Helminthology. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 96–98. (Six separate papers.)

53. Notes on the development of the Gordius aquaticus. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 98–100.

54. Two new species of infusorial Entozoa. Proc. Acad. Nat. Sci. Phila. V, 1850–51, p. 100.

55. Description of some Nematoid Entozoa infesting Insects. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 100–102.

56. Descriptions of three Filariæ. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 117–119.
57. On the nettling organs of the Hydra. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 119–121.
58. On some fossil Mammalian remains. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 121–122.
59. Descriptions of new genera of Vermes. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 124–126.
60. Descriptions of new species of Entozoa. Proc. Acad. Nat. Sci. Phila. V. 1850–51, pp. 155–156.
61. On a Fossil Tortoise Stylemys Nebrascensis. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 172–173.
62. Contributions to Helminthology. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 205–209, 224–227, 239–244, 284–290, 349–351.
63. On fossil remains of Ruminant ungulates from Nebraska. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 237–239.
64. On the genus Plumatella Bosc. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 261–263.
65. On Cristatella Cuv. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 265–266.
66. Corrections and additions to former papers on Helminthology. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 284–290.
67. On the fossil remains of Balaena palæatlantica and B. prisca, from the Miocene formation of Virginia. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 308–309.
68. On some American fresh water Polyzoa. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 320–322.
69. On some fossil Reptilian and Mammalian remains. Proc. Acad. Nat. Sci. Phila. V, 1850–51, pp. 325–330.
70. Description of some American Anellida abranchia. Journ. Acad. Nat. Sci. Phila. II, 1850–54, pp. 43–50.
71. Description of a new species of Crocodile from the Miocene of Virginia. Journ. Acad. Nat. Sci. Phila. II, 1850–54, pp. 135–138.
72. On the osteology of the head of Hippopotamus, and a description of the osteological characters of a new genus of Hippopotamidæ. Journ. Acad. Nat. Sci. Phila. II, 1850–54, pp. 207–224.
73. On Bathygnathus borealis, an extinct Saurian of the new Red Sandstone of Prince Edward Island. Journ. Acad. Nat. Sci. Phila. II, 1850–54, pp. 327–330.
74. Special Anatomy of the Gasteropoda of the United States. Terrest. Moll. of U. S. (Binney) I, 1851, pp. 198–260, pls. I–XVI.
75. Zoological Researches. Silliman's Journ. XI, 1851, pp. 274–275.
76. On some fragments of Palæotherium Proutii. Proc. Acad. Nat. Sci. Phila. 1851, pp. 170–171.
77. On the transplantation of Animal Tissues. Proc. Acad. Nat. Sci. Phila. 1851, p. 201.
78. On Fungous growth in the Mole-cricket, two papers. Proc. Acad. Nat. Sci. Phila. 1851, pp. 204, 210–211.
79. On the introduction of cancerous matter into the integument of the frog. Proc. Acad. Nat. Sci. Phila. 1851, p. 212.
80. On fungous disease in Cicada septemdecim. Proc. Acad. Nat. Sci. Phila. 1851, p. 235.
81. On the Gordiaceæ. Proc. Acad. Nat. Sci. Phila. 1851, pp. 262–263, 275.
82. Report upon some fossil Mammalia and Chelonia from Nebraska. Smithsonian Reports, 1852, pp. 63–65.
83. Remarks on a fossil vertebra from Ouachita, La. Proc. Acad. Nat. Sci. Phila. 1852, p. 52.
84. On the osteology of Hippopotamus. Proc. Acad. Nat. Sci. Phila. 1852, pp. 52–53.

85. On fossil Tortoises from Nebraska. Proc. Acad. Nat. Sci. Phila. 1852, p. 59.

86. On red snow from the Arctic regions. Proc. Acad. Nat. Sci. Phila. 1852, p. 59.

87. On two crania of extinct species of Ox. Proc. Acad. Nat. Sci. Phila. 1852, p. 71.

88. On the Honey Ant of Mexico. Proc. Acad. Nat. Sci. Phila. 1852, p. 72.

89. Reference to a fossil tooth of a Tapir. Proc. Acad. Nat. Sci. Phila. 1852, p. 106.

90. Remarks on the fossil Ox. Proc. Acad. Nat. Sci. Phila. 1852, p. 117.

91. Remarks on some fossil teeth of a Rhinoceros from Nebraska. Proc. Acad. Nat. Sci. Phila. 1852, p. 2.

92. On a Fossil Turtle from Nebraska. Proc. Acad. Nat. Sci. Phila. 1852, p. 34.

93. On a new species of fossil Delphinus and a new Saurian Thoracosaurus grandis. Proc. Acad. Nat. Sci. Phila. VI, 1852–53, p. 35.

94. Ursus amplidens, new fossil species. Proc. Acad. Nat. Sci. Phila. VI, 1852–53, p. 303.

95. On some fossil Cetacean remains. Proc. Acad. Nat. Sci. Phila. VI, 1852–53, pp. 377–378.

96. Description of the remains of extinct Mammalia and Chelonia from Nebraska Territory, collected during the Geological Survey under the direction of Dr. David Dale Owen. Rept. of Geol. Surv. of Wisconsin, Iowa and Minnesota, D. D. Owen, 1852, pp. 540–572.

97. On the organization of the genus Gregarina Dufour, 1851. Amer. Phil. Soc. Trans. X, 1853, pp. 233–240.

98. Some observations on Nematoidea imperfecta, and descriptions of three parasitic Infusoria. Amer. Phil. Soc. Trans. X, 1853, pp. 241–244.

99. Description of an extinct species of American Lion, Felis atrox, 1852. Amer. Phil. Soc. Trans. X, 1853, pp. 319–322.

100. A memoir on the extinct Dicotylinæ of America, 1852. Amer. Phil. Soc. Trans. X, 1853, pp. 323–344.

101. A Flora and Fauna within Living Animals, 1851. Smithson. Contrib. V, 1853.

102. Memoir on the extinct species of American Ox, 1852. Smithson. Contrib. V, 1853.

103. Remarks on various fossil teeth. Proc. Acad. Nat. Sci. Phila. 1853, p. 241.

104. On some fossil fragments from Natchez Miss. Proc. Acad. Nat. Sci. Phila. 1853, p. 303.

105. Remarks on a collection of Fossil Mammalia and Chelonia from the Mauvaises Terres of Nebraska. Proc. Acad. Nat. Sci. Phila. 1853, pp. 392–394.

106. Character explained of nodular bodies found in the tails and fins of fishes from Cold Pond, N. H. Proc. Acad. Nat. Sci. Phila. 1853, p. 433.

107. Lecture introductory to the course of Anatomy delivered in the University of Pennsylvania. 8vo T. Phila. 1853, pp. 1–22.

108. The ancient Fauna of Nebraska; or a description of remains of extinct Mammalia and Chelonia, from the Mauvaises Terres of Nebraska, 1852. Smithsonian Contrib. VI, 1854, pp. 392–394.

109. On Brimosaurus grandis, n. g. Proc. Acad. Nat. Sci. Phila. VII, 1854, p. 72.

110. On Bison latifrons. Proc. Acad. Nat. Sci. Phila. VII, 1854, p. 89.

111. On Dinictis filina. Proc. Acad. Nat. Sci. Phila. 1854, p. 127.

112. On Prof. Lindley's review of "A fauna and flora within living animals." Proc. Acad. Nat. Sci. Phila. 1854, pp. 128–129.

113. On Hydrachna. Proc. Acad. Nat. Sci. Phila. 1854, p. 202.

114. Hippodon and Merycodus, new fossil genera indicated. Proc. Acad. Nat. Sci. Phila. VII, 1854–55, p. 90.

115. Synopsis of extinct Mammalia, the remains of which have been discovered in the eocene formations of Nebraska. Proc. Acad. Nat. Sci. Phila. VII, 1854–55, pp. 156–158.

116. Description of a fossil apparently indicating an extinct species of the Camel tribe. Proc. Acad. Nat. Sci. Phila. VII, 1854–55, pp. 172–173.

117. On Urnatella gracilis and a new species of Plumatella. Proc. Acad. Nat. Sci. Phila. VII, 1854–55, pp. 191–192.

118. Notice of some fossil bones discovered by Mr. Francis A. Lincke, in the banks of the Ohio River, Indiana. Proc. Acad. Nat. Sci. Phila. VII, 1854–55, pp. 199–201.

119. Remarks on the question of the identity of Bootherium cavifrons with Oribos moschatus or O. maximus. Proc. Acad. Nat. Sci. Phila. VII, 1854–55, pp. 209–210.

120. Indications of twelve species of Fossil Fishes from New Jersey and S. Carolina. Proc. Acad. Nat. Sci. Phila. VII, 1854–55, pp. 395–397.

121. Indications of five species, with two new genera, of extinct Fishes. Proc. Acad. Nat. Sci. Phila, VII, 1854–55, p. 414.

122. Notices of some Tape Worms. Proc. Acad. Nat. Sci. Phila. VII, 854–55, pp. 443–444.

123. A memoir on the extinct Sloth Tribe of North America, 1853. Smithson. Contrib. VII, 1855.

124. On a so-called fossil man. Proc. Acad. Nat. Sci. Phila. 1855, p. 340.

125. Contributions toward a knowledge of the Marine Invertebrate Fauna of the coasts of Rhode Island and New Jersey. Journ. Acad. Nat. Sci. Phila. III, 1855–58, pp. 135–152.

126. Descriptions of some remains of Fishes from the Carboniferous and Devonian Formations of the United States. Journ. Acad. Nat. Sci. Phila. III, 1855–58, pp. 159–165.

127. Descriptions of some remains of extinct Mammalia. Journ. Acad. Nat. Sci. Phila. III, 1855–58, pp. 166–171.

128. Descriptions of two Ichthyodorulites. Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp. 11–12. Silliman's Journ. XXI, 1856, pp. 421–422.

129. A Synopsis of Entozoa and some of the Ecto-congeners. Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp. 42–58.

130. Notices of some remains of extinct Mammalia, discovered by Dr. F. V. Hayden in the Bad Lands of Nebraska. Proc. Acad. Nat. Sci Phila. VIII, 1856, pp. 59–60.

131. Notices of remains of extinct Reptiles and Fishes, discovered by Dr. F. V. Hayden in the Bad Lands of the Judith River, Nebraska Territory. Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp. 72–76. Silliman's Journ. XXI, 1856, pp. 422–423.

132. Notices of remains of extinct Mammalia, discovered by Dr. F. V. Hayden, in Nebraska Territory. Proc. Acad. Nat. Sci. Phila VIII, 1856, pp. 88-90.

133. Notices of the remains of a species of Seal, from the post-pliocene deposit of the Ottawa River. Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp. 90–91.

134. Notices of several genera of extinct Mammalia, previously less perfectly characterized. Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp. 91–92.

135. Notices of some remains of extinct Vertebrated Animals. Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp. 162–165.

136. Notices of some remains of extinct Vertebrated Animals of New Jersey, collected by Prof. Cook. Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp. 220–221.

137. Notices of remains of extinct Vertebrated Animals, discovered by Professor E. Emmons. Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp. 255–256. Silliman's Journ XXIII, 1857, pp. 271–272.

138. Notices of some remains of Fishes, discovered by Dr. John E. Evans. Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp. 256–257.

139. Notices of remains of two species of Seals. Proc. Acad. Nat. Sci. Phila. VIII, 1856, p. 265.

140. Remarks on certain extinct species of Fishes. Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp. 301–302.

141. Notices of remains of extinct Turtles of New Jersey, collected by Prof. Cook. Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp 303–304.

142. Notices of extinct Vertebrata, discovered by Dr. F. V. Hayden, during the expedition to the Sioux country. Proc. Acad. Nat. Sci. Phila. VIII, 1856, pp. 311–312.

143. List of extinct Vertebrata, the remains of which have been discovered in the region of the Missouri river; with remarks on their geological age. Proc. Acad. Nat. Sci. Phila. IX, 1857, pp. 89–91.

144. Notices of some remains of extinct Fishes. Proc. Acad. Nat. Sci. Phila. IX, 1857, pp. 167–168.

145. Remark on a large species of Gordius and larva of Œstrus. Proc. Acad. Nat. Sci. Phila. IX, 1857, p. 204.

146. On a boring Sponge. Silliman's Journ. XXIII, 1857, pp. 281–282.

147. Observations on Entozoa found in the Naiades. Proc. Acad. Nat. Sci. Phila. 1857, p. 18.

148. On Coprolites and Shales with Posidoniæ. Proc. Acad. Nat. Sci. Phila. 1857, p. 149.

149. On New Red Sandstone fossils from the Gwynnedd Tunnel, North Penna. R. Road. Proc. Acad. Nat. Sci. Phila. 1857, p. 150.

150. Rectificationof the references of the extinct Mammalian genera of Nebraska. Proc. Acad. Nat. Sci. Phila. 1857, pp. 175–176.

151. On the dentition of the Mosasaurus. Proc. Acad. Nat. Sci. Phila. 1857, p. 176.

152. On Oecanthus. Proc. Acad. Nat. Sci. Phila. 1857, p. 177.

153. On a curious animalcule on stones and dead plants in the Schuylkill and Delaware Rivers. Proc. Acad. Nat. Sci. Phila. 1857, p. 204.

154. Observations on the introduction of the Camel into North America. Proc. Acad. Nat. Sci. Phila. 1857, p. 210.

155. Notices of remains of extinct Vertebrata, from the Valley of the Niobrara River, collected during the Exploring expedition of 1857, in Nebraska, by Dr. F. V. Hayden. Proc. Acad. Nat. Sci. Phila. X, 1858, pp. 20–29.

156. Contributions to Helminthology. Proc. Acad. Nat. Sci. Phila. X, 1858, pp. 110–112.

157. On Urnatella gracilis. Proc. Acad. Nat. Sci. Phila. 1858, p. 1.

158. Remarks on Fossil Mammalia from Nebraska. Proc. Acad. Nat. Sci. Phila. 1858, p. 7.

159. Notice of Remains of extinct vertebrata from the valley of the Niobrara River. Proc. Acad. Nat. Sci. Phila. 1858, p. 11.

160. Remarks on a cast of a Mastodon tooth. Proc. Acad. Nat. Sci. Phila. 1858, p. 12.

161. Remarks on fossil remains from Nebraska. Proc. Acad. Nat. Sci. Phila. 1858, pp. 89–90.

162. Remarks on Chrysalides of the canker worm. Proc. Acad. Nat. Sci. Phila. 1858, p. 137.

163. Remarks on Rhyncodemus sylvaticus. Proc. Acad. Nat. Sci. Phila. 1858, pp. 171–172.

164. Remarks on a specimen of Cryolite. Proc. Acad. Nat. Sci. Phila. 1858, p. 177.

165. Remarks on Antler of Reindeer. Proc. Acad. Nat. Sci. Phila. 1858, p. 179.

166. Remarks on Polyzoa. Proc. Acad. Nat. Sci. Phila. 1858, pp. 188–190.

167. Remarks on Hadrosaurus Foulkii. Proc. Acad. Nat. Sci. Phila. 1858, pp. 215–218.

168. Valedictory address to the class of Medical Graduates at the University of Pennsylvania. March 27, 1858, pp. 1–32.

169. Lecture introductory to the course on Anatomy in the University of Pennsylvania for the session of 1858–59, 8voT. Phila. 1859, pp. 1–24.

170. Observations on three kinds of dipterous larvæ from man. Proc. Acad. Nat. Sci. Phila. XI, 1859, pp. 7–8.

171. On Manayunkia speciosa. Proc. Acad. Nat. Sci. Phila. 1859, p. 2.

172. On Hystracanthus arcuatus and Cladodus occidentalis. Proc. Acad. Nat. Sci. Phila. 1859, p. 3.

173. Remarks on tooth of Mastodon and bones of Mosasaurus. Proc. Acad. Nat. Sci. Phila. 1859, pp. 91–92.

174. Remarks on teeth of Clepsysaurus, Eurydorus serridens and Compsosaurus, from Phœnixville tunnel, Chester Co. Proc. Acad. Nat. Sci. Phila. 1859, p. 110.

175. Remarks on fossils from Bethany, Va., and also from the Green Sand, Monmouth Co., N. J. Proc. Acad. Nat. Sci. Phila. 1859, p. 110.

176. Remarks on Ossite from Sombrero, W. I. on skull of Ursus Americanus from the drift, Claiborne, Miss. Proc. Acad. Nat. Sci. Phila. 1859, p. 111.

177. Remarks on fragment of jaw of Mosasaurus. Proc. Acad. Nat. Sci. Phila. 1859, p. 150.

178. On specimens of Palæotrochus from sub-silurian strata. Proc. Acad. Nat. Sci. Phila. 1859, p. 150.

179. Remarks on Dromatherium sylvestre and other fossils from Chatham Co., N. C. Proc Acad. Nat. Sci. Phila. 1859, p. 162.

180. Remarks on antler of the Reindeer found at Sing-Sing, and remarks on Freija Americana from Newport. Proc. Acad. Nat. Sci. Phila. 1859, p. 194.

181. On the seat of the vesicating principle of Lytta vittata. Proc. Acad. Nat. Sci. Phila. 1859. p. 256.

182. Introductory lecture to the course of Anatomy delivered in the University of Pennsylvania, Oct. 11, 1859. 8vo T. Phila. 1859, pp. 1–23.

183. Notices of remains of the Walrus, discovered on the coast of the United States, 1856. Amer. Phil. Soc. Trans. XI, 1860, pp. 83–87.

184. Descriptions of the remains of fishes from the carboniferous limestone of Illinois and Missouri, 1856. Amer. Phil. Soc. Trans. XI, 1860, pp. 87–90.

185. Remarks on Saurocephalus and its allies, 1856. Amer. Phil. Soc. Trans. XI, 1860. pp. 91–95.

186. Observations on the extinct Peccary of North America; being a sequel to "A memoir on the extinct Dicotylinæ of America," 1856. Amer. Phil. Soc. Trans. XI, 1860, pp. 97–105.

187. Remarks on the structure of the feet of Megalonyx, 1856. Amer. Phil. Soc. Trans. XI, 1860. pp. 107–108.

188. Extinct Vertebrata from the Judith River and great lignite formations of Nebraska. Amer. Phil. Soc. Trans. XI, 1860, pp. 139–154.

189. Remarks on Albertite. Proc. Acad. Nat. Sci. Phila. 1860, p. 54.

190. Remarks on Hyalonema mirabilis. Proc. Acad. Nat. Sci. Phila. 1860, p. 85.

191. Remarks on experiments with Trichina spiralis. Proc. Acad. Nat. Sci. Phila. 1860, p. 96.

192. Notice of specimen of Hyla. Proc. Acad. Nat. Sci. Phila. 1860, p. 305.

193. Remarks on fossil teeth of Hippotherium from Washington County, Texas. Proc. Acad. Nat. Sci. Phila. 1860, p 416.

194. Remarks on an extinct Peccary from Dr. D. D. Owen. Proc. Acad. Nat. Sci. Phila. 1860, p. 416.

195. An Elementary Treatise on Human Anatomy, with three-hundred and ninety-two illustrations, pp. I–XXIV, 17–663. Phila. 1861. Second Edition of same, with four-hundred and ninety five illustrations, pp. 1–950, Phila. 1889.

196. On the discovery of lignite at the border of the new red sandstone on Plymouth Creek. Proc. Acad. Nat Sci. Phila. 1861, p. 77.

197. Remarks on certain minerals found in or near the city. Proc. Acad. Nat. Sci. Phila. 1862, p. 507.

198. Remarks on a female Phalangopsis. Proc. Acad. Nat. Sci. Phila. 1863, p. 212.

199. Cretaceous reptiles of the United States, 1864. Smithsonian Reports, 1864, pp. 66–73. Smithsonian Contrib. XIV, 1865, (*Art. 6*). Geol. Mag. V. 1868, pp. 432–435.

200. Fossil remains of Horses from California. Proc. Acad. Nat. Sci. Phila. 1865, p. 94.

201. Fossil remains of Rhinoceros from Texas and California. Proc. Acad. Nat. Sci. Phila. 1865, pp. 176–177.

202. Observations on the existence of a boring sponge during the cretaceous period. Proc. Acad. Nat. Sci. Phila. 1865, p. 95.

203. Observations on a Kjökkenmödding at Cape Henlopen. Proc. Acad. Nat. Sci. Phila. 1865, p. 95.

204. Remarks on a fœtal Acanthias Americanus. Proc. Acad. Nat. Sci. Phila. 1865, p. 175.

205. Observations on Cryolite. Proc. Acad. Nat. Phila. 1865, p. 181.

206. Remarks on specimens of Oolitic Phosphates of Lime and Alumina. Proc. Acad. Nat. Sci. Phila. 1865, p. 181.

207. On bones and stone implements from Guano deposits in the Island of Orchilla. Proc. Acad. Nat. Sci. Phila. 1865, pp. 181–183.

208. Observations on Indian relics. Proc. Acad. Nat. Sci. Phila. 1866, p. 1.

209. Remarks on a phalanx of an extinct reptile. Proc. Acad. Nat. Sci. Phila. 1866, p. 9.

210. Remarks on cancer of liver in Turkey and on Trichina. Proc. Acad. Nat. Sci. Phila. 1866, p. 9.

211. Remarks on human relics at Petite Anse, La. Proc. Acad. Nat. Sci. Phila. 1866, p. 109.

212. Remarks on fossils presented June 5th. Proc. Acad. Nat. Sci. Phila. 1866, p. 237.

213. Observations on the Kitchen Middens of Cape Henlopen. Proc. Acad. Nat. Sci. Phila. 1866, pp. 290–291.

214. On Fossil bones from Mauvaises Terres, Nebraska. Proc. Acad. Nat. Sci. Phila. 1866, p. 345.

215. Remarks on the skull of Bison latifrons. Proc. Acad. Nat. Sci. Phila. 1867, p. 85.

216. Exhibition of the skull of Geomys bursarius. Proc. Acad. Nat. Sci. Phila. 1867, p. 97.

217. Of an antique copper hammer. Proc. Acad. Nat. Sci. Phila. 1867, p. 97.

218. Of the skull of Castoroides Ohioensis. Proc. Acad. Nat. Sci. Phila. 1867, p. 97.

219. Of specimens of black horn-stone. Proc. Acad. Nat. Sci. Phila. 1867, p. 125.

220. Notices of some Vertebrate remains from Hardin Co., Texas. Proc. Acad. Nat. Sci. Phila. 1868, pp. 174–176.

221. Indication of an Elotherium in California. Proc. Acad. Nat. Sci. Phila. 1868, p. 177.

222. Notices of some Reptilian remains from Nevada. Proc. Acad. Nat. Sci. Phila. 1868, pp. 177–178.

223. Notices of some Vertebrate remains from the West Indian Islands. Proc. Acad. Nat. Sci. Phila 1868, pp. 178 180.

224. Notices of some remains of horses. Proc. Acad. Nat. Sci. Phila. 1868, p. 195.

225. Notices of some extinct Cetaceans. Proc. Acad. Nat. Sci. Phila. 1868, pp. 196–197.

226. Remarks on a jaw fragment of Megalosaurus. Proc. Acad. Nat. Sci. Phila. 1868, pp. 197–199.

227. Remarks on Conosaurus Gibbes. Proc. Acad. Nat. Sci. Phila. 1868, pp. 200–202.

228. Notices of American species of Ptychodus. Proc. Acad. Nat. Sci. Phila. 1868, pp. 205–208.

229. Notices of some American Leeches. Proc. Acad. Nat. Sci. Phila. 1868 pp. 229–230.

230. Notices of some remains of extinct Pachyderms: Dicotyles nasutus, Anchippus Texanus, Anchippodus riparius, Lophiodon occidentalis. Proc. Acad. Nat. Sci. Phila. 1868, pp. 230–233.

231. Notices of some remains of extinct Insectivora from Dakota. Proc. Acad. Nat. Sci. Phila. 1868, pp. 315–316.

232. Description of Wolffia Columbiana. Proc. Acad. Nat. Sci. Phila. 1868, pp. 6–7.

233. Description of a new sponge: Pheronema Annæ. Proc. Acad. Nat. Sci. Phila., Biol. and Micr. Section, 1868, pp. 9–11.

234. Remarks on Sombrero Guano. Proc. Acad. Nat. Sci. Phila. 1868, pp. 156–157.

235. On the food of the shad. Proc. Acad. Nat. Sci. Phila. 1868, p. 228.

236. On supposed Coprolites from the Huronian slates of Minnesota. Proc. Acad. Nat. Sci. Phila. 1868, pp. 302–303.

237. On the iridescence of opals. Proc. Acad Nat. Sci. Phila. 1868, p. 303.

238. On asterism in Mica. Proc. Acad. Nat. Sci. Phila. 1868. p. 313.

239. On photograph of fossil bones from Topeka, Kansas. Proc. Acad. Nat. Sci. Phila. 1868, p. 315.

240. On the extinct Mammalia of Dakota and Nebraska, including an account of some allied forms from other localities. Acad. Nat. Sci. Phila. Journ. VII, 1869, pp. 23–362.

241. Synopsis of extinct Mammalia of North America. Acad. Nat. Sci. Phila. Journ. VII, 1869, pp. 363–472.

242. Notices of some extinct Vertebrates from Wyoming and Dakota. Proc. Acad. Nat. Sci. Phila. 1869, pp. 63–67.

243. Elasmosaurus platyurus Cope. Amer. Journ. Sci. XLIX, 1870, p. 392.

244. Fossil Sivatherium from Colorado Megacerops coloradensis. Proc. Acad. Nat. Sci. Phila. 1870, pp. 1–13.

245. Remarks on Poicilopleuron valens, Baptemys Wyomingensis, Emys Stevensonianus and other fossils, from Middle Park, Colorado. Proc. Acad. Nat. Sci. Phila. 1870, pp. 3–5.

246. On Reptilian remains from the cretaceous formation near Fort Wallace, Kansas. Proc. Acad. Nat. Sci. Phila. 1870. pp. 9–10.

247. On a fossil mandible from near Fort Bridger, Wyoming. Proc. Acad. Nat. Sci. Phila. 1870, pp. 10–11.

248. Remarks on Xiphactinus audax and other Ichthyodorulites. Proc. Acad. Nat. Sci. Phila. 1870, pp. 12–13.

249. Remarks on Asteracanthus siderius. Proc. Acad. Nat. Sci. Phila. 1870, p. 13.

250. On Hadrosaurus and its allies. Proc. Acad. Nat. Sci. Phila. 1870, p. 67–68.

251. Descriptions of Oncobatis pentagonus and Mylocyprinus robustus. Proc. Acad. Nat. Sci. Phila. 1870, pp. 69–71.

252. On a new species of leech from near Philadelphia. Proc. Acad. Nat. Sci. Phila. 1870, pp. 89–90

253. On Mastodon remains of the Warren Museum and the Cambridge University Museum. Proc. Acad. Nat. Sci. Phila. 1870, pp. 96–99.

254. On Crocodilus Elliotti. Proc. Acad. Nat Sci. Phila. 1870, pp. 100, 122.

255. On Urnatella, a genus of ciliated polyps of the family Pedicellinidae. Proc. Acad. Nat. Sci. Phila. 1870, pp. 100–102. Ann. Mag. Nat. Hist. VII, 1871, pp. 309–312.

256. On some fossils from the Sweet Water River, Wyoming Territory. Proc. Acad. Nat. Sci. Phila. 1870, pp. 109–110.

257. Description of a new species of Oreodon: O. superbus. Proc. Acad. Nat. Sci. Phila. 1870, pp. 111–112.

258. On Anchitherium Condoni and Cordylophora Americana. Proc. Acad. Nat. Sci. Phila. 1870, pp. 112–113.

259. Descriptions of Palæosyops paludosus, Microsus cuspidatus and Notharctus tenebrosus. Proc. Acad. Nat. Sci. Phila. 1870, pp. 113–114.

260. Descriptions of Graphiodon vinearius, a fossil reptile. Proc. Acad. Nat. Sci. Phila. 1870, p. 122.

261. Reptilian remains from Wyoming; Emys Jeanesi, E. Haydeni, Bæna arenosa. Proc. Acad. Nat. Sci. Phila. 1870, pp. 123–124.

262. Fossil remains of a Lacertian, discovered near Granger: Saniwa ensidens. Proc. Acad. Nat. Sci. Phila. 1870, pp. 124–125.

263. Fossil fragment of the lower jaw of a small pachyderm; Lophiotherium sylvaticum. Proc. Acad. Nat. Sci. Phila. 1870, p. 126.

264. On the humerus of a sloth resembling Mylodon robustus and on Dromotherium sylvestre. Proc. Acad. Nat. Sci. Phila. 1870, pp. 8–9.

265. On specimens of vertebral bodies from the New Jersey green sand. Proc. Acad. Nat. Sci. Phila. 1870, p. 10.

266. On Ichthyodorulites. Proc. Acad. Nat. Sci. Phila. 1870, pp. 12–13.

267. On fossil remains from Illinois. Proc. Acad. Nat. Sci. Phila. 1870, p. 13.

268. On Discosaurus and its allies. Proc. Acad. Nat. Sci. Phila. 1870, pp. 18–22.

269. On the internal organs of generation of a hog. Proc. Acad. Nat. Sci. Phila. 1870, p. 65.

270. On fossil bones from Dakota and Nebraska. Proc. Acad. Nat. Sci. Phila. 1870, p. 65–66.

271. On fossil remains from Idaho, Utah and Oregon. Proc. Acad. Nat. Sci. Phila. 1870, pp. 67–68.

272. On Anguillulidæ. Proc. Acad. Nat. Sci. Phila. 1870, pp. 68–69.

273. On fossils from the vicinity of Burlington, Kansas, and from the Rocky Mts. Proc. Acad. Nat. Sci. Phila. 1870, p. 69.

274. On the relations of European and American fauna. Proc. Acad. Nat. Sci. Phila. 1870, pp. 72–73.

275. On a jaw fragment of Ovibos cavifrons. Proc. Acad. Nat. Sci. Phila. 1870, p. 73.

276. On Nothosaurops occiduus. Proc. Acad. Nat. Sci. Phila. 1870, p. 74.

277. On leeches. Proc. Acad. Nat. Sci. Phila. 1870, pp. 89–90.

278. On Mastodon remains. Proc. Acad. Nat. Sci. Phila. 1870, pp. 96–99.

279. On fossil remains in the Museum of Amherst College. Proc. Acad Nat. Sci. Phila. 1870, p. 98.

280. On fossils from Bridge Creek, Oregon. Proc. Acad. Nat. Sci. Phila. 1870, pp. 111–113.

281. On Cordylophora. Proc. Acad. Nat. Sci. Phila. 1870, p. 113.

282. On fossils from Church Buttes, Wyoming Territory. Proc. Acad. Nat. Sci. Phila. 1870, pp. 113–114.

283. On fossils found under Table Mountain, Cal. Proc. Acad. Nat. Sci. Phila. 1870, pp. 125–126.

284. Exhibition of the lower jaw of an aged man, and a wood carving from St. Paul de Loando. Proc. Acad. Nat. Sci. Phila. 1870, p. 133.

285. On the reversed viscera of a human subject. Proc. Acad. Nat. Sci. Phiia. 1870, p. 134.

286. Remarks on some curious Sponges. Amer. Nat. IV, 1871, pp. 17–22.

287. On Tænia mediocanellata. Proc. Acad. Nat. Sci. 1871, pp. 53–55.

288. On Some extinct Turtles from Wyoming Territory. Proc. Acad. Nat. Sci. Phila. 1870, pp. 102–103.

289. Remains of extinct Mammals from Wyoming. Proc. Acad. Nat. Sci. Phila. 1871, pp. 113-116.

290. Remains of Palæosyops from Fort Bridger. Proc. Acad. Nat. Sci. Phila. 1871, p. 118.

291. Remarks on a fossil Testudo from Wyoming. Proc. Acad. Nat. Sci. Phila. 1871, p. 154.

292. Remarks on supposed fossil Turtle Eggs. Proc. Acad. Nat. Sci. Phila. 1871, pp. 154–155.

293. Fossils from Wyoming. Proc. Acad. Nat. Sci. Phila. 1871, p. 197.

294. Remarks on fossil vertebrates from Wyoming. Proc. Acad. Nat. Sci. Phila. 1871, pp. 228–229.

295. Notice of some extinct Rodents from Wyoming, and description of Mysops minimus. Proc. Acad. Nat. Sci. Phila. 1871, pp. 230–232.

296. Remarks on the Minerals of Mount Mica. Proc. Acad. Nat. Sci. Phila. 1871, pp. 245–247.

297. Remarks on Fossils from Oregon; Hadrohyus supremus, Rhinoceros pacificus. Stylemys Oregonensis. Proc. Acad. Nat. Sci. Phila. 1871, pp. 247–248.

298 Notice of a new Tape-worm; Dibothrium cordiceps. Proc. Acad. Nat. Phila. 1881, pp. 305–307.

299. On a small collection of fossils from California. Proc. Acad. Nat. Sci. Phila. 1871, p. 50.

300. On Polydactylism in a horse. Proc. Acad. Nat. Sci. Phila. 1871, p. 112.

301. On remains of Mastodon and Horse in North Carolina. Proc. Acad. Nat. Sci. Phila. 1871, p. 113.

302. Remarks on the Garnets of Green's Creek, Delaware Co. Proc. Acad. Nat. Sci. Phila. 1871, p. 155.

303. Remarks on Mastodon, etc. of California. Proc. Acad. Nat. Sci. Phila. 1871, pp. 198–199.

304. Note on Anchitherium. Proc. Acad. Sci. Phila. 1871, p. 199.

305. Remarks on fossil vertebrates from Wyoming. Proc. Acad. Nat. Sci. Phila. 1871, pp. 228–229.

306. Flies as means of communicating contagious diseases. Proc. Acad. Nat. Sci. Phila. 1871, p. 297.

307. On some new species of fossil mammalia from Wyoming; Palæosyops humilis, Uintatherium robustum, Uintamastix atrox. Amer. Journ. Sci. IV, 1872, pp. 239–240. Proc. Acad. Nat. Sci. Phila. 1872, pp. 167–169.

308. Notices of Corundum. Proc. Acad. Nat. Sci. Phila. 1872, p. 19.

309. Remarks on fossils from Wyoming. Proc. Acad. Nat. Sci. Phila. 1872, pp. 19–21.

310. Remarks on some extinct Mammals. Proc. Acad. Nat. Sci. Phila. 1872, pp. 37–38.

311. Remarks on some extinct Vertebrates; Felis augustus, Oligosimus grandævus, Tylosteus ornatus. Proc. Acad. Nat. Sci. Phila. 1872, pp. 38–40.

312. On a new genus of extinct Turtles. Proc. Acad. Nat. Sci. Phila. 1872, p. 162.

313. On some remains of cretaceous fishes; Otodus divaricatus, Oxyrhina extenta, Acrodus humilis, Pycnodus faba. Proc. Acad. Nat. Sci. Phila. 1872, pp. 162–164.

314. On Artemia salina from Salt Lake, Utah. Proc. Acad. Nat. Sci. Phila. 1872, pp. 164–166.

315. Remarks on the habits of an Ant. Proc. Acad. Nat. Sci. Phila. 1872, p. 218.

316. Remarks on mineral springs, etc. of Wyoming and Utah. Proc. Acad. Nat. Sci. Phila. 1872, pp. 218–220.

317. Notice of a corundum mine in Pennsylvania. Proc. Acad. Nat. Sci. Phila. 1872. pp. 238–239.

318. Remarks on fossil Mammals from Wyoming; Uintatherium robustum, Palæosyops major. Proc. Acad. Nat. Sci. Phila. 1872, pp. 240–242.

319. Remarks on chipped stones from Wyoming. Proc. Acad. Nat. Sci. Phila. 1872, pp. 242–243.

320. Remarks on fossils from Wyoming; Palæosyops junior, Uintacyon edax, U. vorax, Chameleo pristinus. Proc. Acad. Nat. Sci. Phila. 1872, p. 277.

321. On a Mite in the Ear of an Ox. Proc. Acad. Nat. Sci. Phila, 1872. pp. 9–10.

322. Note on Gamasus of the Ox. Proc. Acad. Nat. Sci. Phila. 1872, p. 138.

323. Remarks on Mastodon from New Mexico. Proc. Acad. Nat. Sci. Phila. 1872, p. 142.

324. Remarks on fossil shark teeth. Proc. Acad. Nat. Sci. Phila. 1872, p. 166.

325. Remarks on the action of wind and sand on rocks. Proc. Acad. Nat. Sci. Phila. 1872, p. 243.

326. CONTRIBUTIONS TO THE EXTINCT FAUNA OF THE WESTERN TERRITORIES. Rept. U. S. Geol. Sur. of Ter. (Hayden), I, 1873, pp. 1–358, pls. I–XXXVII.

327. Notice of fossil Vertebrates from the Miocene of Virginia. Proc. Acad. Nat. Sci. Phila. 1873, p. 15.

328. Notice of remains of fishes in Bridger Tertiary formation of Wyoming. Proc. Acad. Nat. Sci. Phila. 1873, pp. 97–99.

329. Remarks on the occurrence of an extinct Hog in America. Proc. Acad. Nat. Sci. Phila. 1873, p. 207.

330. Remarks on extinct Mammals in California. Proc. Acad. Nat. Sci. Phila. 1873, pp. 259–260.

331. Fungus Parasite on a Mouse. Proc. Acad. Nat. Sci. Phila. 1873, pp. 260–261.

332. On Distoma hepaticum. Proc. Acad. Nat. Sci. Phila. 1873, pp. 364–365.

333. Remarks on fossil Elephant teeth. Proc. Acad. Nat. Sci. Phila. pp. 416–417.

334. On circulatory movement in Vaucheria. Proc. Acad. Nat. Sci. Phila. 1873, p. 420.

335. On Iron Pyrites in Coal. Proc. Acad. Nat. Sci. Phila. 1873, p. 257.

336. On a specimen of Mus rattus. Proc. Acad. Nat. Sci. Phila. 1873, p. 257.

337. On Dufrenite. Proc. Acad. Nat. Sci. Phila. 1873, p. 257.

338. On Lingula in a fish of the Susquehanna. Proc. Acad. Nat. Sci. Phila. 1873, p. 415–416.

339. Remarks on Hydra. Proc. Acad. Nat. Sci. Phila. 1874, p. 10.

340. Remarks on Protozoa. Proc. Acad. Nat. Sci. Phila. 1874, p. 13.

341. On the Mode of Growth of Desmids. Proc. Acad. Nat. Sci. Phila. 1874, p. 15.

342. On Actinophrys sol. Proc. Acad. Nat. Sci. Phila. 1874, p. 23.

343. Note on the Enemies of Difflugia. Proc. Acad. Nat. Sci. Phila. 1874, p. 75.

344. Remarks on a supposed Compound derived from Leather. Proc. Acad. Nat. Sci. Phila. 1874, p. 75.

345. Notices of some New Fresh-water Rhizopods. Proc. Acad. Nat. Sci. Phila. 1874, p. 77.

346. Notices of some Fresh-water and Terrestrial Rhizopods. Proc. Acad. Nat. Sci. Phila. 1874, pp. 86–88.

347. Remarks on the Revivification of Rotifer vulgaris. Proc. Acad. Nat. Sci. Phila. 1874, pp. 88–89.

348. On Pectinatella magnifica. Proc. Acad. Nat. Sci. Phila. 1874, p. 139.

349. On a Parasitic Worm of the House-fly. Proc. Acad. Nat. Sci. Phila. 1874, p. 139.

350. Notices of some Fresh Water Infusoria. Proc. Acad. Nat. Sci. Phila. 1874, p. 140.

351. Notice of a remarkable Amœba. Proc. Acad. Nat. Sci. Phila. 1874, pp. 142–143.

352. On the Mode in which Amœba swallows its Food. Proc. Acad. Nat. Sci. Phila. 1874, p. 143.

353. On the Motive Power of Diatoms. Proc. Acad. Nat. Sci. Phila. 1874, p. 143.

354. Remarks on Sponges. Proc. Acad. Nat. Sci. Phila. 1874, p. 144.

355. Notices of some Rhizopods. Proc. Acad. Nat. Sci. Phila. 1874, pp. 155–157.
356. Note on Dryocampa. Proc. Acad. Nat. Sci. Phila. 1874, p. 160.
357. Notice of remains of Titanotherium. Proc. Acad. Nat. Sci. Phila. 1874, pp. 165–166.
358. Note of Rhizopods. Proc. Acad. Nat. Sci. Phila. 1874, pp. 166–168.
359. On Supposed Spermaries in Amœba. Proc. Acad. Nat. Sci. Phila. 1874, p. 168.
360. On Specific Gravity. Proc. Acad. Nat. Sci. Phila. 1874, p. 218.
361. Remarks on Fossils presented. Proc. Acad. Nat. Sci. Phila. 1874, pp. 223–224.
362. Notices of Rhizopods. Proc. Acad. Nat. Sci. Phila. 1874, pp. 225–227.
363. Description of vertebrate remains chiefly from the Phosphate Beds of South Carolina. Jour. Acad. Nat. Sci. VIII, 1874–81, pp. 209–261.
364. The Parasites of the Termites. Jour. Acad. Nat. Sci. Phila. VIII, 1874–81, pp. 425–447.
365. Remarks on Bathygnathus borealis. Jour. Acad. Nat. Sci. Phila. VIII, 1874–81, pp. 449–451.
366. On a Fungus in a Flamingo. Proc. Acad. Nat. Sci. Phila. 1875, pp. 11–12.
367. Notes on some Parasitic Worms. Proc. Acad. Nat. Sci. Phila. 1875, pp. 14–16.
368. Notes on some Parasitic Worms. Proc. Acad. Nat. Sci. Phila. 1875, pp. 17–18.
369. Remarks on some marine Rhizopods. Proc. Acad. Nat. Sci. Phila. 1875, pp. 73–76.
370. Remarks on a Coal Fossil, etc. Proc. Acad. Nat. Sci. Phila. 1875, p. 120.
371. Remarks on Elephant Remains. Proc. Acad. Nat. Sci. Phila. 1875. p. 121.
372. On a Curious Rhizopod. Proc. Acad. Nat. Sci. Phila. 1875, p. 124.
373. On Psorospherms in a Mallard Duck. Proc. Acad. Nat. Sci. Phila. 1875, p. 125.
374. On a Mouthless Fish. Proc. Acad. Nat. Sci. Phila. 1875, pp. 125–126.
375. On Ouramoeba. Proc. Acad. Nat. Sci. Phila. 1875, pp. 126–127.
376. On Mermis acuminata. Proc. Acad. Nat. Sci. Phila. 1875, p. 400.
377. Remarks on Rhizopods. Proc. Acad. Nat. Sci. Phila. 1875, pp. 413–415.
378. Quercus heterophylla. Proc. Acad. Nat. Sci. Phila. 1875, p. 415.
379. On Petalodus. Proc. Acad. Nat. Sci. Phila. 1876, p. 9.
380. Mastodon andium. Proc. Acad. Nat. Sci. Phila. 1876, p. 38.
381. Remarks on Arcella, etc. Proc. Acad. Nat. Sci. Phila. 1876, pp. 54–58.
382. Remarks on Fossils from the Ashley Phosphate Beds. Proc. Acad. Nat. Sci. Phila. 1876, pp. 80–81, 86–87.
383. Fish Remains of the Mesozoic Red Shales. Proc. Acad. Nat. Sci. Phila. 1876. p. 81.
384. Remarks on Fossils from the Ashley Phosphate Beds. Proc. Acad. Nat. Sci. Phila. 1876, pp. 86–87.
385. Remarks on Vertebrate Fossils from the Phosphate Beds of S. Carolina. Proc. Acad. Nat. Sci. Phila. 1876, pp. 114–115.
386. Remarks on the Rhizopod Genus Nebela. Proc. Acad. Nat. Sci. Phila. 1876, pp. 115–119.
387. Bituminous Sediment of the Schuylkill River. Proc. Acad. Nat. Sci. Phila. 1876, p. 193.
388. Remarks on the Structure of Precious Opal. Proc. Acad. Nat. Sci. Phila. 1876, pp. 195–197.
389. Observations on Rhizopods. Proc. Acad. Nat. Sci. Phila. 1876, p. 197.
390. On Ozocerite. Proc. Acad. Nat. Sci. Phila. 1876, p. 325.
391. On Hyraceum. Proc. Acad. Nat. Sci. Phila. 1876, p. 325.
392. Impurities in Drinking Water. Proc. Acad. Nat. Sci. Phila. 1877, p. 20.
393. On Eozoon. Proc. Acad. Nat. Sci. Phila. 1877, p. 20.

394. On the Diaphragm. Proc. Acad. Nat. Sci. Phila. 1877, p. 20.

395. Remarks on the Yellow Ant. Proc. Acad. Nat. Sci. Phila 1877, p. 145.

396. On Intestinal Parasites of Termes flavipes. Proc. Acad. Nat. Sci. Phila. 1877, pp. 146–149.

397. Remarks on Gregarines. Proc. Acad. Nat. Sci. Phila. 1877, pp. 196–198.

398. On Chilomonas. Proc. Acad. Nat. Sci. Phila. 1877. p. 198.

399. On Flukes infesting Mollusks. Proc. Acad. Nat. Sci. Phila. 1877, p. 200.

400. Remarks on some Parasitic Infusoria. Proc. Acad. Nat. Sci. Phila. 1877, pp. 259–260.

401. Remarks on the Seventeen-Year Locust, the Hessian Fly and a Chelifer. Proc. Acad. Nat. Sci. Phila. 1877, pp. 260–261.

402. Birth of a Rhizopod. Proc. Acad. Nat. Sci. 1877, pp. 261–265.

403. On the Bed-bug and its Allies. Proc. Acad. Nat. Sci. Phila. 1877, p. 284.

404. On the Feeding of Dinamœba. Proc. Acad. Nat. Sci. Phila. 1877, pp. 288–290.

405. Concretions resembling Bones. Proc. Acad. Nat. Sci. Phila. 1877, p. 290.

406. Apparent Discriminative Power in the Selection of Food by a Heliozoon. Proc. Acad. Nat. Sci. Phila. 1877, pp. 291–292.

407. Remarks on Rhizopods and Notice of a New Form. Proc. Acad. Nat. Sci. Phila. 1877, pp. 293–294.

408. On Fossil Fishes. Proc. Acad. Nat. Sci. Phila. 1877, pp. 294.

409. Remarks on Ants. Proc. Acad. Nat. Sci. Phila. 1877, pp. 304–305.

410. Remarks on the American Species of Difflugia. Proc. Acad. Nat. Sci. Phila. 1877, pp. 306–308.

411. Circumspection of Ants. Proc. Acad. Nat. Sci. Phila. 1877, p. 320.

412. Rhizopods in an Apple Tree. Proc. Acad. Nat. Sci. Phila. 1877, p. 321.

413. On Citrine or Yellow Quartz. Proc. Acad. Nat. Sci. Phila. 1878, p. 40.

414. On Hippopotamus Tusk. Proc. Acad. Nat. Sci. Phila. 1878, p. 99.

415. On Amœba. Proc. Acad. Nat. Sci. Phila. 1878, p. 99.

416. A Louse of the Pelican. Proc. Acad. Nat. Sci. Phila. 1878, 100–101.

417. On Parasitic Worms in the Shad. Proc. Acad. Nat. Sci. Phila. 1878, p. 171.

418. Species of Euglypha, Trinema, Pamphagus and Cyphoderia, with Synonyma and Descriptions of New Forms. Proc. Acad. Nat. Sci. Phila. 1878, pp. 171–173.

419. Foraminifera of the Coast of New Jersey. Proc. Acad. Nat. Sci. Phila. 1878, p. 292.

420. On the Black Mildew of Walls. Proc. Acad. Nat. Sci. Phila. 1878, p. 331.

421. Remarks on Mactra. Proc. Acad. Nat. Sci. Phila. 1878, pp. 332–333.

422. Foraminiferous Shells of our Coast. Proc. Acad. Nat. Sci. Phila. 1878, p. 336.

423. On Crustaceans at Cape May, N. J. Proc. Acad. Nat. Sci. Phila. 1878, pp. 336–337.

424. Notice of a Tetrarhynchus. Proc. Acad. Nat. Sci. Phila. 1878, p. 340.

425. On Donax fossar. Proc. Acad. Nat. Sci. Phila. 1878, pp. 382–383.

426. Notices of Gordius in the Cockroach and Leech. Proc. Acad. Nat. Sci. Phila. 1878, pp. 383–384.

427. On Tænia mediocanellata. Proc. Acad. Nat. Sci. Phila. 1878, p. 405.

428. Fresh-Water Rhizopods of North America. Rept. U. S. Geol. Surv. of Ter. (Hayden), XII, 1879, pp. i–ix, 1–324, pls. I–XLVIII.

429. On Gordius and on some Parasites of the Rat. Proc. Acad. Nat. Sci. Phila. 1879, pp. 10–11.

430. Fossil Remains of a Caribou. Proc. Acad. Nat. Sci. Phila. 1879, pp. 32–33.

431. On Rhizopods occurring in Sphagnum. Proc. Acad. Nat. Sci. Phila. 1879, pp. 162–163.

432. Fossil Foot Tracks of the Anthracite Coal Measures. Proc. Acad. Nat. Sci. Phila. 1879, pp. 164–165.

433. Explosion of a Diamond. Proc. Acad. Nat. Sci. Phila. 1879, p. 195.
434. Remarks on Orgyia. Proc. Acad. Nat. Sci. Phila. 1879, pp. 195–196.
435. Notices of some Animals on the coast of New Jersey. Proc. Acad. Nat. Sci. Phila. 1879, pp. 198–199.
436. On Cristatella Idæ. Proc. Acad. Nat. Sci. Phila. 1879, pp. 203–204.
437. On Amœba Blattæ. Proc. Acad. Nat. Sci. Phila. 1879, pp. 204–205.
438. Wards Natural Science Establishment. Proc. Acad. Nat. Sci. Phila. 1879, pp. 208–209.
439. Notice of the Cruel Thread Worm, Filaria immitis of the Dog. Proc. Acad. Nat. Sci. Phila. 1880, pp. 10–12.
440. On a Filaria Reported to have come from a Man. Proc. Acad. Nat. Sci. Phila. 1880, pp. 130–131.
441. Remarks on Pond Life. Proc. Acad. Nat. Sci. Phila. 1880, pp. 156–158.
442. Rhizopods in the Mosses of the Summit of Roane Mountain, N. Carolina. Proc. Acad. Nat. Sci. Phila. 1880, pp. 333–340.
443. Bone Caves of Pennsylvania. Proc. Acad. Nat. Sci. Phila. 1880, pp. 346–349.
444. Rhizopods as Food for Young Fishes. Proc. Acad. Nat. Sci. 1881, pp. 9–10.
445. Remarks on some Rock Specimens. Proc. Acad. Nat. Sci. Phila. 1882, pp. 10–12.
446. Filaria of the Black Bass. Proc. Acad. Nat. Sci. Phila. 1882, p. 69.
447. On Tourmalines. Proc. Acad. Nat. Nat. Sci. Phila. 1882, pp. 71–73.
448. On Balanoglossus, etc. Proc. Acad. Nat. Sci. Phila. 1882, p. 93.
449. Scolithus in Gravel. Proc. Acad. Nat. Sci. Phila. 1882, p. 93.
450. On Sagitta, etc. Proc. Acad. Nat. Sci. Phila. 1882, pp. 102–103.
451. On some Entozoa of Birds. Proc. Acad. Nat. Sci. Phila. 1882, p. 109.
452. On a Coprolite and a pebble resembling an Indian hammer. Proc. Acad. Nat. Sci. Phila. 1882, pp. 109–110.
453. On Bacillus Anthracis. Proc. Acad. Nat. Sci. Phila. 1882, p. 145.
454. On Enchytraeus, Distichopus and their parasites. Proc. Acad. Nat. Sci. Phila. 1882, pp. 145–148.
455. The Yellow Ant with its flocks of Aphis and Coccus. Proc. Acad. Nat. Sci. Phila. 1882, p. 148.
456. Colorless Garnet and Tourmaline. Proc. Acad. Nat. Sci. Phila. 1882, p. 149.
457. On Balanus, etc. at Bass Rocks, Mass. Proc. Acad. Nat. Sci. Phila. 1882, pp. 224–225.
458. On the Tobacco Worm, etc. Proc. Acad. Nat. Sci. Phila. 1882, pp. 237–238.
459. Rotifera without Rotary Organs. Proc. Acad. Nat. Sci. Phila. 1882, pp. 243–250.
460. A new Infusorian belonging to the genus Pyxicola. Proc. Acad. Nat. Sci. Phila. 1882, pp. 252–253.
461. Actinosphærium Eichhornii. Proc. Acad. Nat. Sci. Phila. 1882, pp. 260–261.
462. On Topaz and Biotite. Proc. Acad. Nat. Sci. Phila. 1882, p. 261.
463. On Actinosphærium, etc. Proc. Acad. Nat. Sci. Phila. 1882, pp. 261–262.
464. On Tubularia, etc. from Atlantic City. Proc. Acad. Nat. Sci. Phila. 1882, p. 262.
465. On Remains of Horses. Proc. Acad. Nat. Sci. Phila. 1882, pp. 290–291.
466. On an Extinct Peccary. Proc. Acad. Nat. Sci. Phila. 1882, pp. 301–302.
467. On the Reproduction and Parasites of Anodonta fluviatilis. Proc. Acad. Nat. Sci. Phila. 1883, pp. 44–46.
468. Pediculus vestimenti. Proc. Acad. Nat. Sci. Phila. 1883, p. 46.
469. A Flint Nodule from the Green Sand of New Jersey. Proc. Acad. Nat. Sci. Phila. 1883, p. 76.
470. A Social Heliozoan. Proc. Acad. Nat. Sci. Phila. 1883, pp. 95–96.

471. Mineralogical Notes. Proc. Acad. Nat. Sci. Phila. 1883, p. 202.
472. Manayunkia speciosa. Proc. Acad. Nat. Sci. Phila. 1883, pp. 204–212.
473. On Manayunkia. Proc. Acad. Nat. Sci. Phila. 1883, p. 203.
474. A study of the Temporal Bone. Science, I, 1883, pp. 380–385, 475–477, 506–7.
475. Crystals in the Bark of Trees. Science, II, 1883, pp. 707–8.
476. Urnatella gracilis, a fresh-water Polyzoan. Jour. Acad. Nat. Sci. Phila. IX, 1884, pp. 5–16.
477. Ant infected with a Fungus. Proc. Acad. Nat. Sci. Phila. 1884, p. 9.
478. Cassiterite from Black Hills, Dakota. Proc. Acad. Nat. Sci. Phila. 1884, p. 9.
479. The New Jersey Coast after the storm of Jan. 8, 1884. Proc. Acad. Nat. Sci. Phila. 1884, pp. 12–13.
480. Fossil Bones from Louisiana. Proc. Acad. Nat. Sci. Phila. 1884, p. 22.
481. Foraminifera in the Drift of Minnesota. Proc. Acad. Nat Sci. Phila. 1884, pp. 22–23.
482. Distoma and Filariae. Proc. Acad. Nat. Sci. Phila. 1884, pp. 47–48.
483. Dictyophora as Apsilus vorax. Proc. Acad. Nat. Sci. Phila. 1884, pp. 50–51.
484. On Eumeces chalcides. Proc. Acad. Nat. Sci. Phila. 1884, p. 66.
485. Vertebrate Fossils from Florida. Proc. Acad. Nat. Sci. Phila. 1884, pp. 118–119.
486. A Rare Human Tape Worm. Proc. Acad. Nat. Sci. Phila. 1884, p. 137.
487. Pentastomum proboscideum. Proc. Acad. Nat. Sci. Phila. 1884, p. 140.
488. Organisms in Ice. Proc. Acad. Nat. Sci. Phila. 1884, p. 260.
489. On some Parasitic Worms of Birds. Proc. Acad. Nat. Sci. Phila. 1885, pp. 9–11.
490. Rhinoceros and Hippotherium from Florida. Proc. Acad. Nat. Sci. Phila. 1885, pp. 32–33.
491. Remarks on Mylodon. Proc. Acad. Nat. Sci. Phila. 1885, pp. 49–51.
492. Bothriocephalus in a Trout. Proc. Acad. Nat. Sci. Phila. 1885, pp. 122–123.
493. Worms in Ice. Proc. Acad. Nat. Sci. Phila. 1885, pp. 408–409.
494. An address on evolution and the pathological importance of lower forms of life. Therapeutic Gazette, Detroit, 1886.
495. Mastodon and Llama from Florida. Proc. Acad. Nat. Sci. Phila. 1886, pp. 11–12.
496. Extinct Boar from Florida. Proc. Acad. Nat. Sci. Phila. 1886, pp. 37–38.
497. Caries in the Mastodon. Proc. Acad. Nat. Sci. Phila. 1886, p. 38.
498. On Amia and its probable Tænia. Proc. Acad. Nat. Sci. Phila. 1886, pp. 62–63.
499. Toxodon and other remains from Nicaragua. Proc. Acad. Nat. Sci. Phila. 1886, 275–277.
500. Notices on Nematoid Worms. Proc. Acad. Nat. Sci. Phila. 1886, pp. 308–313.
501. Remarks on Parasites and Scorpions. Trans. Col. Phys. Phila. 3rd. Ser. VIII, 1886, pp. 441–443.
502. Notice of some Parasitic Worms. Proc. Acad. Nat. Sci. Phila. 1887, pp. 20–24.
503. Parasite of a Bat. Proc. Acad. Nat. Sci. Phila. 1887, p. 38.
504. Asplanchna Ebbesbornii. Proc. Acad. Nat. Sci. Phila. 1887, p. 157.
505. Fossil Bones from Florida. Proc. Acad. Nat. Sci. Phila. 1887, pp. 309–310.
506. Remarks on Hydra. Proc. Acad. Nat. Sci. Phila. 1887, pp. 310–313.
507. Bot-larvæ in the Terrapin. Proc. Acad. Nat. Sci. Phila. 1887, pp. 393–394.
508. Tape-worms in Birds. Journ. Comp. Med. and Surg. VIII, 1887, pp. 1–11.

509. On a Fossil of the Puma. Proc. Acad. Nat. Sci. Phila. 1888, pp. 9–10.
510. Chætopterus from Florida. Proc. Acad. Nat. Sci. Phila. 1888, 73–74.
511. Criolana feasting on the Edible Crab. Proc. Acad. Nat. Sci. Phila. 1888, p. 80.
512. On Bopyrus palæmoneticola. Proc. Acad. Nat. Sci. Phila. 1888, p. 80.
513. Note on Lepas fascicularis. Proc. Acad. Nat. Sci. Phila. 1888, pp. 80–81.
514. Reputed Tape-Worm in a Cucumber. Proc. Acad. Nat. Sci. Phila. 1888, p. 81.
515. Habit of Cirolana concharum. Proc. Acad. Nat. Sci. Phila. 1888, pp. 124–125.
516. Parasites of the Striped Bass. Proc. Acad. Nat. Sci. Phila. 1888, p. 125.
517. Tremotodes of the Muskrat. Proc. Acad. Nat. Sci. Phila. 1888, p. 126.
518. Entozoa of the Terrapin. Proc. Acad. Nat. Sci. Phila. 1888, pp. 127–128.
519. A Crustacean Parasite of the Red Snapper. Proc. Acad. Nat. Sci. Phila. 1888, pp. 138–139.
520. Distinctive characters of Odontaspis littoralis. Proc. Acad. Nat. Sci. Phila. 1888, pp. 162–164.
521. Parasitic Crustacea. Proc. Acad. Nat. Sci. Phila. 1888, p. 165.
522. Parasites of the Rock Fish. Proc. Acad. Nat. Sci. Phila. 1888, pp. 166–167.
523. Louse of the Pelican. Proc. Acad. Nat. Sci. Phila. 1888, pp. 167–168.
524. Parasites of the Pickerel. Proc. Acad. Nat. Sci. Phila. 1888, p. 169.
525. Megalonyx Jeffersonii. Proc. Acad. Nat. Sci. Phila. 1888, p. 273.
526. Anomalies of the Human Skull. Proc. Acad. Nat. Sci. Phila. 1888, p. 273.
527. Remarks on the Fauna of Beach Haven, N. J. Proc. Acad. Nat. Sci. Phila. 1888, pp. 329–333.
528. Food of Barnacles. Proc. Acad. Nat. Sci. Phila. 1888, pp. 431–432.
529. Parasites of the Shad and Herring. Journ. Comp. Med. and Surg. IX, 1888, pp. 211–215.
530. On several Gregarines, and a singular mode of conjugation of one of them. Proc. Acad. Nat. Sci. Phila. 1889, pp. 9–11.
531. The Sabre-Toothed Tiger of Florida. Proc. Acad. Nat. Sci. Phila. 1889, pp. 29–31.
532. Note on Gonyleptes and Solpuga. Proc. Acad. Nat. Sci. Phila. 1889, p. 45.
533. The Boring Sponge, Cliona. Proc. Acad. Nat. Sci. Phila. 1889, 70–75.
534. A Parasitic Copepod. Proc. Acad. Nat. Sci. Phila. 1889, p. 95.
535. Fossil Vertebrates from Florida. Proc. Acad. Nat. Sci. Phila. 1889, pp. 96–97.
536. Notice of some fossil human bones. Trans. Wagner Free Inst. Sci. II, 1889, pp. 9–12.
537. Description of Mammalian remains from a rock-crevice Florida. Trans. Wagner Free Inst. Sci. II, 1889, pp. 13–17.
538. Description of Vertebrate remains from Peace Creek, Florida. Trans. Wagner Free Inst. Sci. II, 1889, pp. 19–31.
539. Notice of some Mammalian remains from the Salt Mine of Petite Anse, Louisiana. Trans. Wagner Free Inst. Sci. II, 1889, pp. 33–40.
540. On Platygonus, an extinct genus allied to the Peccaries. Trans. Wagner Free Inst. Sci. II, 1889, pp. 41–50.
541. Remarks on the nature of organic species. Trans. Wagner Free. Inst. Sci. II, 1889, pp. 51–53.
542. Hypoderas in the Little Blue Heron. Proc. Acad. Nat. Sci. Phila. 1890. p. 63.
543. Notice of an Ichneumon Fly. Proc. Acad. Nat. Sci. Phila. 1890, p. 63.
544. Fossil Vertebrates from Florida. Proc. Acad. Nat. Sci. Phila. 1890, pp. 64–65.

545. Hippotherium and Rhinoceros from Florida. Proc. Acad. Nat. Sci. Phila. 1890, pp. 182–183.

546. Mastodon and Capybara of South Carolina. Proc. Acad. Nat. Sci. Phila. 1890, pp. 184–185.

547. Remarks on Tics. Proc. Acad. Nat. Sci. Phila. 1890, pp. 278–280.

548. Parasites of Mola rotunda. Proc. Acad. Nat. Sci. Phila. 1890, pp. 281–282.

549. Beroe on the New Jersey Coast. Proc. Acad. Nat. Sci. Phila. 1890, pp. 341–342.

550. Remarks on Velella. Proc. Acad. Nat. Sci. Phila. 1890, pp. 408–409.

551. Notices of Entozoa. Proc. Acad. Nat. Sci. Phila. 1890, pp. 410–418.

552. Note on the Boring Sponge of the Oyster. Proc. Acad. Nat. Sci. Phila. 1891, p. 122.

553. Notice of some Entozoa. Proc. Acad. Nat. Sci. Phila. 1891, 234–236.

NEW AMERICAN MYXOMYCETES.

GEO. A. REX, M. D.

Physarum nucleatum.

Sporangia exactly spherical, about ·5 mm. in diameter, stipitate, erect or slightly nodding; wall of sporangium membranaceous, rupturing irregularly, generally thickly studded with rounded, white lime granules.

Stipes from 1 to 1·5 mm. in height, subulate, yellowish-white, longitudinally rugose. Columella wanting; capillitium composed of a very closely meshed net of delicate snow-white tubules with minute round or rounded white granules of lime at the intersections. In the center of the capillitium net, there is usually a conspicuous mass of lime generally forming a shining white ball, not continuous with the stipe, although sometimes having a prolongation downward toward it, this ball being rarely supplanted by a closely compacted mass of irregular lime granules holding the same relative position. Spores 6–7 μ. in diam., brown violet in color; epispores delicately spinulose, although apparently smooth when examined under medium power lenses.

Fairmount Park, Philadelphia.

This species most nearly resembles in appearance and habit of growth *Phys. Petersii* B. & C. var. *Farlowi* Rost., but may be distinguished from it by the absence of a columella, by the central ball of lime and the very small rounded lime granules in the meshes of the capillitium. Exceptionally the lime granules of the sporangium wall are sparse or absent entirely, in which case the wall has a silvery or coppery metallic lustre.

Physarum penetrale.

Sporangia erect, stipitate, generally ellipsoidal or pyriform, rarely globose, from ·3 × ·5 mm. to ·5 × ·7 mm. in diameter. Sporangium walls membranaceous, semitransparent, studded sparsely with rounded, pale yellow or yellow-gray lime granules, rupturing to the base into from two to four segments. Stipes very variable, from ·5 to 2 mm. in height, slender, subulate, longitudinally rugose, flattened laterally toward the base, translucent, dull red or golden red in color.

Columella formed by a continuation of the stipe penetrating the sporangium to about four-fifths its height, reddish-yellow in color, slender, tapering to a wedge-shaped end. Capillitium composed of a closely and irregularly meshed reticulation of delicate white tubules with a variable number of obtuse angled or irregularly rounded, pale yellow granules of lime at the intersections. Spores 6–6·5 μ. in diameter, brown in mass, delicately spinulose, although apparently smooth under lenses of medium power.

Fairmount Park, Phila., Adirondack Mts., N. Y., White Mts., N. H., Rangeley, Maine and Ohio (A. P. Morgan).

The leading characteristic of this species is its columella, which is longer than that of any described *Physarum*. It is a true columella and not a mere aggregation or columella-like mass of lime granules, such as may be found in many species of *Physarum*.

Chondrioderma aculeatum.

Sporangia sessile, lenticular or hemispherical, flattened above, and concave, sometimes umbilicate, below. Walls of sporangia double, separated by a well marked interspace; external wall dusky or yellowish-white, papyraceous, wrinkled when dry, ultimately cracking and rupturing irregularly; internal wall thin, membranaceous, semi-transparent, grayish, rarely iridescent.

Columella irregular, sometimes small and hardly evident; upper surface rugose with ridges or thickenings, the edges of which bristle with well marked spine-like processes.

Columella and inner surface of base of sporangium uniformly nut brown in color. Capillitium pure white, scanty, composed of simple, sparsely branched sinuous threads attached to the spines of the columella in a slightly fasciculate manner, and radiating thence to the inner wall of the sporangium.

Spores dark violet, 12–13 μ. in diameter, spinulose under medium powers.

Bar Harbor, Me; Adirondack Mts., N. Y.

This species is a true *Diderma* analogous to *C. difforme* and *C. testaceum* but is sufficiently distinguished by its tough parchment-like external wall and its spinose columella.

Stemonitis Webberi.

Sporangia gregarious, standing on a common hypothallus, erect, stipitate, more or less cylindrical, obtuse, sometimes slightly clavate, sometimes recurved at the apex, 10–12 mm. in height including stipes.

Stipes black, shining, about 2 mm. high. Columella central, running nearly to the apex where it subdivides into several branches.

Capillitium composed of widely separated radial threads of a brown violet color, originating by triangular plasmodic expansions at the point of attachment to the columella, connecting with each other by lateral branches given off close to the columella, often forming a second series of expansions at the junctions, then running to the surface where they branch and form a delicate surface net-work of a pale brown color with large irregularly oblong meshes, varying from 40 to 160 μ. in length. Terminal and recurved portion of surface net-work, frequently composed of thickened threads which unite with the terminal branches of the columella forming an irregular plexus.

Spores 7–8 μ. in diameter, ferruginous color in mass, with thick, delicately spinulose epispores which are apparently smooth under lenses of medium power.

Manhattan, Kansas, H. J. Webber.

This is a well marked species with distinctive characters. The meshes of the surface net-work are larger than those of any species yet described. It is still further distinguished from *Stemonitis splendens* Rost. or any allied species by its ferruginous colored spores and pale, delicate surface capillitium.

Stemonitis Virginiensis.

Sporangia erect, stipitate, gregarious, growing on a common hypothallus, usually found in small isolated clusters, occasionally, however, in continuous masses, from 3–3·5 mm. in height, including stipes, about ·5 mm. in width, cylindrical or elongated ovate, rounded at apex or terminating in a short blunt point, and often umbilicate at the base.

Stipes averaging 1·3 mm. in length, black and shining. Columella central, running to the apex where it joins the capillitium by several terminal branches.

Capillitium composed of an intricate net-work of numerous slender, dark brown, flexuous threads orginating in the columella and joined together by numerous arcuate lateral branches, terminating in a surface net parallel to the walls of the sporangium ; meshes of the surface net irregular in shape, 6–12 μ. in diameter, often evanescent in the upper part of the sporangium, breaking away by the dispersion of the spores. Spores umber brown in mass, 5·5 to 6·5 μ. in diameter, epispores conspicuously reticulated with about 10–12 reticulations to the hemisphere.

Allegheny Mts., Virginia.

This species resembles in its general appearance, *Comatricha typhina* Roth. The threads composing the meshes of the surface net often have dark bulbous thickenings of about twice their usual diameter, occurring irregularly in their course or at their intersections. The spores are beautifully and clearly sculptured with deep reticulations, which can be determined readily with a lens of medium power. The species may be distinguished from *S. dictyospora*, by its more strongly marked spore, the smaller size of its sporangia and its comatricha-like habit of growth.

Stemonitis nigrescens.

Sporangia gregarious, standing on a common hypothallus, erect, more or less cylindrical, entire height with stipe about 4 mm.

Stipes ·5 mm. long, black.

Columella central, running to apex of sporangium, then subdividing into several branches. Capillitium, violet black in the center, arcuate, flexuous, forming a loose meshed central reticulation which becomes dark violet as it nears the surface. Surface net-work, complete and characteristic of the genus only on the lower third of the sporangium, being usually irregular in the middle portion and evanescent or falling away with the spores toward the apex. When perfect, the meshes of the surface net vary from 12–20 μ. in diameter.

Spores 8 μ. in diameter, nearly black in mass, deep blackish violet singly under a microscope. Epispores thick, sharply and prominently spinulose with a quite moderate amplification.

Fairmount Park, Philadelphia.

This species is noteworthy for its comparatively short stipes, its very spinulose spores and its black or nearly black color, the slight violet tint being only apparent on close inspection, especially in fresh, moist specimens. It is a species which illustrates the difficulty of determination in a case where the diagnostic characters of two adjoining genera apparently blend together. Although characters of both *Stemonitis* and *Comatricha* are to be found in it, yet those of the former genus seem to predominate and the species is, therefore, so referred. Such borderland species as this and *Comatricha subcæspitosa* Pk., seem to point to the necessity for a revision of the boundary lines between the two genera, which, in these examples, are practically narrowed down to the question of the degree of the parallelism of the surface net to the walls of the sporangium.

Comatricha irregularis.

Sporangia gregarious, standing on a common hypothallus, semi-erect, drooping, total height with stipes 3·5 to 7 mm. usually about 4 mm., very irregular and variable in outline and size, either irregularly cylindrical distorted by one or more nodulose swellings, or irregularly elongated conical or ovate, or cylindrical and flattened laterally with longitudinal grooves on the flattened sides, or occasionally regularly cylindrical.

Stipes black, slender, usually equalling the length of the sporangia but varying from one-half to twice their length.

Columella central, slender, flexuous, running to the apex where it branches and joins the capillitium. Capillitium composed of arcuate threads which radiate from the columella and are joined together forming a central irregular reticulation of large, coarse loops or meshes, at first brown, then becoming paler and more slender as they approach the surface, finally forming an irregular exterior reticulation of delicate, pure white or colorless threads which terminate on the surface everywhere in free ends.

Peripheral capillitium very evanescent.

Spores dark brown in mass, from 7–8 μ. in diameter. Epispores thick, warted, with dark rounded warts.

Fairmount Park, Philadelphia; New Jersey (Ellis); Ohio (Morgan).

Although this species has the general habit of growth of *Stemonitis*, I have not been able, in any of the specimens which I have examined, to detect even a fragment of the characteristic surface net-work of that genus.

The peripheral branches of the capillitium are pure white, giving under a reflector a frosted or hoary appearance strongly contrasting with the darker threads beneath. They are exceedingly delicate, breaking away easily with the spores which seem to have more tendency to agglutination than those of other species.

Cribraria violacea.

Sporangia stipitate, erect or slightly nodding, total height with stipe ·5 mm. to 1 mm., dark violet with a metallic sheen, ellipsoidal or ovoid, rarely globose. Stipes ·3 to ·5 mm. high, slender, subulate, longitudinally rugose, dark blackish-violet becoming black at the base.

Sporangium wall formed of a pale violet membrane, thickly studded with dark violet plasmodic granules, externally wrinkled, entire for two-thirds or more of its basal portion forming a permanent receptacle, the upper third being in effect lacerated into irregularly shaped fragments, which are joined by a few simple threads forming a sparse irregular net-work. Exceptionally the apical portion is nearly entire, being simply perforated with three or four oval or rounded openings.

Spores 8 μ. in diameter, dark violet-red color in mass, but pale red under the microscope, epispores thick, delicately but clearly warted, though apparently smooth under medium powers.

Fairmount Park, Philadelphia, Adirondack Mts., N. Y. and Manhattan, Kansas (W. T. Swingle).

This species originates from a deep violet-black plasmodium. As usually found, it is diminutive, rivalling *Cribraria microscopica* B. & C. Its marked characters are its color, its proportionally large receptacle and its large delicately spinulose spores which are not exceeded or probably equalled in size by those of any recorded *Cribraria*.

Cribraria languescens.

Sporangia scattered, drooping, spherical ·25 to ·35 mm. in diameter. Receptacle about one-third of the periphery of the sporangium, red-brown, shining, minutely striate with granular lines, serrated more or less regularly about the margin.

Net-work red-brown, composed of simple threads with polygonal knots, having usually five or six angles and straight or only slightly concave sides, forming more or less triangular interspaces at the intersections. Stipes about 2·5 to 3 mm. high, slender, subulate, dark red-brown, somewhat sinuous or wavy, longitudinally rugose. Spores when recent, dull red in mass, becoming paler in time, averaging 6 μ. in diameter.

Shawangunk and Adirondack Mts., N. Y.

The excessive variability which characterizes the genus *Cribraria* is especially shown by the group of species having net-works with angular knots at the intersections. The type species of Schrader have served their purpose so well for nearly a century that all later monographers have continued them without question and with few additions to their numbers. There is, however, in American specimens at least, a steady and well marked intergradation between these central types, evolving an infinite number of variations which serve to confuse and perplex the student.

There are also many intermediate types, some of which are quite as constant and possess quite as marked an individuality as the Schraderian types, which cannot legitimately be referred to them even as varieties. The species just described may be cited as an example. I have found specimens of it several years apart, growing in widely different habitats and yet the specific characters are constant in all cases. In its scattered and solitary growth, its tall slender stipes and relaxed habit, it resembles *C. microcarpa*, in its net-work it approaches *C. tenella*, and its spores have the color of the paler forms of *C. purpurea.*

With all of these resemblances, however, it has a marked individuality.

Trichia Andersoni.

Sporangia sessile, closely aggregated in clusters, globose, flattened, sometimes a little elongated, usually ·4–·5 mm. in diameter. Walls of sporangia sometimes roughened or corrugated showing under the lens fine lines or striæ radiating from local centers. Color of the unbroken sporangia dark olivaceous.

Capillitium composed of cylindrical elaters of a deep orange yellow color, 3·75 μ. in diameter, provided with four spirals winding evenly and closely, without or with very narrow interspaces.

Ends of elaters tapering, 18 μ. long, the outer half being smooth or free from spirals. Spores greenish-yellow or olivaceous 11–12 μ. in diameter, delicately spinulose, but apparently smooth under medium power lenses.

Sand Couleé, Montana, F. W. Anderson.

This *Trichia* presents a strong contrast between its olivaceous spores and its deep orange capillitium. It differs from the *Trichia chrysosperma* group of sessile aggregate Trichias, in the absence of interspiral or longitudinal filaments.

Hemiarcyria obscura.

Sporangia sessile, scattered, globose, or elongated globose slightly curved, dusky or brownish-red in color, inconspicuous, ·4 to 1 mm. in length by about ·4 mm. in width.

Capillitium of a dull brick red color, composed of a sparingly branched, loose meshed net-work with few or no free ends. Tubes of capillitium slender, uniform, without expansions, 2·5 mm. in diameter, provided with seven or eight spirals winding evenly with narrow interspaces, faint and inconspicuous under medium power lenses.

Spores 10–10.5 μ. delicately warted and of a pale lemon-yellow color.

Sand Couleé, Montana, F. W. Anderson.

The noteworthy features in this *Hemiarcyria* are the slender and faintly marked capillitium and the strong contrast in color, as in the preceding species, between the spores and capillitium.

Hemiarcyria longifila.

Sporangia simple, stipitate, erect, golden-yellow in color, globose-turbinate or pyriform, rupturing irregularly at the top leaving a short funnel-shaped receptacle. Sporangium wall thin, translucent, shining. Height of sporangium, including stipe, averaging 1·3 mm. Stipes dark red-brown, longitudinally rugose. Capillitium composed usually of single long threads, not branched or very sparingly branched. These threads are doubled in their course into a succession of loops which are usually twisted upon themselves, the whole expanding upon the rupture of the sporangium wall into an elongated tangled mass.

Tubes of capillitium 3·5–4 μ. in diameter, provided usually with four spirals sparsely spinulose with short, sharp spines, winding evenly and regularly and separated by wide interspaces two or three times their width; adjoining spirals connected by conspicuous longitudinal filaments.

Capillitium and spores concolorous, being orange-yellow in mass.

Spores delicately warted, 9–10 μ. in diameter.

Fairmount Park, Philadelphia.

Externally this species resembles *Hemiarcyria clavata* Pers. and has probably often been mistaken for it. The capillitium, however, in its structural details and habit of growth is widely different. The partial untwisting of the loops of the capillitium by drying, after the rupture of the sporangium, causes it to be projected and elongated, sometimes two or three times the length of the sporangium. In this particular it resembles *Hemiarcyria rubiformis,* but the mass of capillitium is not nearly so dense.

Hemiarcyria Varneyi.

Sporangia stipitate, erect, elongated ovate, about 1 mm. high including stipes. Sporangium wall evanescent above, breaking away at maturity leaving a shallow cup-like receptacle at the base.

Stipes short, ·2 mm. or less in height, dull brown. Capillitium dull ochre, attached to the center of the receptacle, elongated, forming a closely meshed reticulation, having numerous short, slightly clavate free ends which proceed from the peripheral meshes.

Tubes of capillitium 3·2–3·5 μ. wide, provided with seven or eight spirals winding unevenly with interspaces averaging the width of a spiral. The free ends and the external loops of the capillitium from which they proceed, spinulose with short, blunt spines attached to the spirals. Spores 6·25 μ. in diameter, pale, smooth.

Kansas, Miss May Varney (com. W. T. Swingle).

This species must be referred to the comprehensive genus *Hemiarcyria* by reason of the spiral structure of its capillitium ; in all other respects, it resembles the genus *Arcyria* and would unhesitatingly be referred to it, without a microscopic examination of the threads. The habit of growth of the sporangium with its evanescent upper wall and permanent saucer-like base, the close mesh of the capillitium net, and the small, smooth, thin walled spores are all characteristic of the genus *Arcyria.*

Together with the neighboring American species *Hemiarcyria stipata* Swz. which has an analogous structure, it properly forms a separate subsection of the genus.

DIANEMA Nov. Gen.

Sporangia simple or plasmodiocarpous with membranaceous non-calcareous walls.

Capillitium composed of threads without characteristic thickenings, running entirely across the sporangium, attached both to the base and to the opposite wall, and not joined together to form a net-work.

Dianema Harveyi.

Sporangia sessile, generally rounded or cushion-shaped, flattened above, averaging about 1 mm. in diameter, ·35 mm. in height, sometimes elongated and bent into an irregular horse-shoe-shape, color gold bronze, with a metallic lustre. Sporangium walls membranaceous, thin, translucent, containing no trace of lime, rupturing irregularly.

Capillitium and spores concolorous, being brownish-yellow in mass.

Capillitium composed of numerous slender threads from 1·5 to 2 μ. in diameter, not connected with each other, simple, without free branches but often forked two or three times near their origin or insertion, nearly parallel, taut, running from base to the top of the sporangium. Spores 8 μ. in diameter, pale yellow under a microscope, delicately spinulose, but apparently smooth under medium power lenses.

Orono, Maine, F. L. Harvey.

This is in some respects an anomalous genus which it is difficult to classify satisfactorily. In the structural relation of the capillitium to the sporangium walls, it is analogous to the sessile species of the Didymiaceæ, but it lacks the violaceous colored spores and the calcareous external walls characteristic of that family.

It is most nearly allied to the Perichænaceæ by reason of the color of its spores and its simple unmarked capillitium, but cannot correctly be classified with that family, at least in the classification of recent monographers without some modification of their definition of the family limitations.

At present it stands as a single representative of a new and separate family adjoining the Perichænaceæ in the order Calonemeæ Rost.

It has been deemed advisable in the present paper, to specify approximately the amplification used in the foregoing descriptions of the sculpturing of the spores and capillitium of the species represented, in order to prevent errors in determination.

By medium power lenses, therefore, such lenses are meant as the one-quarter or one-fifth inch objectives in common use, which will give an amplification with a one inch ocular, of from 400 to 500 diameters.

JULY 7.

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

Twenty-five persons present.

The death of Richard M. Schomburg, a correspondent, March 24, 1891, was announced.

JULY 14.

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

Twenty-two persons present.

JULY 21.

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

Sixteen persons present.

A paper entitled "The Summer Birds of Harvey's Lake, Luzerne Co., Penna., with remarks on the Faunal Position of the Region," by Witmer Stone, was presented for publication.

JULY 28.

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

Thirteen persons present.

John L. Kinsey and Charles W. Dulles, M. D. were elected members.

The following was ordered to be printed:—

DESCRIPTION OF A NEW SPECIES OF VAMPYROPS.

BY HARRISON ALLEN, M. D.

Vampyrops zarhinus, sp. nov.

Horizontal portion of nose-leaf free-projecting; upper lip crossed by a row of small warts. Outer margin of the tragus scarcely serrate and bears a single tooth at the upper border of the well-defined notch. The tip scarcely acuminate. The auricle moderately elongate, shorter than the head, external basal lobe rounded with a sharply inverted border anteriorly.

Fur dark brown above, lighter shade of brown beneath. The dorsal aspect of forearm covered with short hair. Two lateral white head stripes are present. A faint median napal white stripe is discernible which disappears between the shoulders, and a trace only again seen for a short distance farther down. Interfemoral membrane excised on a level with the distal third of the tibia. Back of thigh, and leg hairy; a thin sparse growth seen on the dorsum of the interfemoral membrane. The first phalanx of the third digit over one-half the length of the second; the third phalanx twice the length of the second. In other respects as in *V. lineatus*.

The manal formula[1] is as follows:

1st interspace, 3mm., 2nd interspace, 17 mm., 3rd interspace, 25 mm. Difference between 2nd and 3rd, 8 mm. Forearm, 37 mm.

Skull 22 mm. long; greatest breadth (bi-auricular), 10½ mm.; least width (at proencephalon), 6 mm. Mesopterygoid fossa narrow, acuminate; pterygoid produced in a distinct spine; angular process of the mandible practically nil, posterior border of the coronoid process concave.

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[1] I proposed the term manal formula for the widths of the spaces between the metacarpal bones at the distal ends when the wing is extended—as compared with the length of the forearm—in 1890. (See Proc. Amer. Philosoph. Soc. xxvii, Jan. 23rd.) This formula has been found by me to be of value in distinguishing species in a group in which many of the best characters are not found on the periphery. It has been suggested to me that this term should be "manual" instead of "manal." I avoided the term "manual" since the significance uniformly attached to this adjective forbad in my judgment its employment in this new connection, and that it was permissible to slightly modify the spelling of the word. If, however, such a course be found inadmissible the word "pteral" may be substituted.

Teeth. The maxillary incisors much smaller than in *V. lineatus*, without notch on cutting edge, converging but not touching; the interval between them equalling that between the rudimental lateral incisor and the canine. First premolar not touching second premolar, compressed from before backward. Second premolar with well defined denticle on posterior border. Canine with a narrow groove on posterior surface just outside axis of tooth-row; first molar smaller than second; no disposition for basis of paracone and metacone to join protocone, but the grinding surface is broad and simple; protocone and hypocone are rudimental, scarcely raised above the gum. The paracone sending caliciform lines about the base of the metacone limb and partially enclosing it. The characters of the second molar quite as first. The third molar in tooth row, and about one-fourth the size of the second molar,—rudiments of protocone, paracone and metacone being discernible.

The mandibular incisors with intervals between the teeth and between third tooth and canine. The canine and premolar much as in *V. lineatus*; the posterior border of the paracone of the second premolar is distinguished by being crenulated. The canine as high as the second premolar. The molars are more rudimental than those of *V. lineatus*. The last molar is not acuminate as in this species, but is flat and, relatively to the size of the second molar, is much larger, being indeed one-third the size of the second and relatively larger than in *V. lineatus*. The molar teeth throughout with disposition to marginal cusps,—the grinding surface being smooth and concave.

Measurements.

		MM.
Head and body (from crown of head to base of tail),		43½
Length of arm,		21
Length of forearm,		37
First digit	Length of first metacarpal bone,	3
	Length of first phalanx,	5
Second digit	Length of second metacarpal bone,	28
	Length of first phalanx,	3½
Third digit	Length of third metacarpal bone,	37
	Length of first phalanx,	13
	Length of second phalanx,	21
	Length of third phalanx,	10½

		MM.
Fourth digit	Length of fourth metacarpal bone,	35
	Length of first phalanx,	11
	Length of second phalanx,	13
Fifth digit	Length of fifth metacarpal bone,	36
	Length of first phalanx,	8
	Length of second phalanx,	11
Length of head,		14
Height of ear,		13
Height of tragus,		5
Length of thigh,		10
Length of tibia,		13
Length of foot,		10

One adult female (gravid) in alcohol. Mus. Comp. Zool. Cambridge, Mass. Habitat Brazil. Collected by Thayer expedition.

I am indebted to Prof. Alexander Agassiz for the opportunity of studying this form.

V. zarhinus agrees with *V. vittatus, V. infuscus*, and *V. lineatus* in the possession of three molars in the upper jaw, but is smaller than any of these species, since the forearm is but 35 mm. long and the distance from the front of the canine to the back of the second molar is but 7 mm. It resembles *V. infuscus* in the indistinct dorsal stripe but is distinguished therefrom by the presence of well defined facial stripes. In the rudimental angular process of the lower jaw and the long pointed mesopterygoid fossa, *V. zarhinus* is readily distinguished from *V. lineatus* the only other species which I have examined. In none of the species, even including the aberrant *V. carraciolae* Thomas, are the incisor teeth as wide apart as in *V. zarhinus* and in this respect it recalls the species of *Chiroderma.*

The rudimental condition of the angular process of the mandible if found to be a constant character in all the species of *Vampyrops* will serve to distinguish this genus from its ally *Chiroderma* in which the process examined is of immense size, quite as large, indeed, as in *Brachyphylla.*

Remarks on Vampyrops lineatus. The only other species of the genus with which I am familiar is *V. lineatus.* In this form the nose-leaf is not free and projecting at the horizontal portion; the auricle is more deeply emarginate than in *V. zarhinus* and is without the incurvation of the anterior part of the basal lobe. The tragus is more distinctly crenulate and has a much smaller basal notch. The notch in the interfemoral membrane is on a line with the proximal third of the femur.

The manal formula is widely different. It is as follows:

2nd interspace, 5 mm., 3rd interspace, 20 mm., 4th interspace, 36 mm. Difference between 3rd and 4th, 16 mm. Forearm, 48 mm.

Skull. The greatest length, 25 mm.; greatest width, 10 mm.; least width, 6½ mm.; distance from front of maxillary canine to posterior border of second molar, 9 mm.; angular process much larger than in *V. zarhinus*, but smaller than in any other stenodermatous genus examined.[1] Mesopterygoid fossa broad, rounded at anterior end; pterygoid not produced; posterior border of coronoid process not concave.

The following embrace the more important measurements of *V. lineatus*:

		MM.
Head and body (from crown of head to base of tail),		57
Length of forearm,		48
Third digit	Length of first phalanx,	18
	Length of second phalanx,	23
	Length of third phalanx,	15
Fourth digit	Length of first phalanx,	13½
	Length of second phalanx,	16
Fifth digit	Length of first phalanx,	19½
	Length of second phalanx,	12
Length of head,		27
Height of ear,		17
Height of tragus,		
Length of thigh,		15
Length of tibia,		17
Length of foot,		10

Teeth of V. lineatus. Incisor teeth with notch on cutting edge not touching each other or the canines; proportions much as in *V. zarhinus* but the centrals somewhat wider and larger. First premolar compressed from before backward, in contact with oblique posterior border of the canine; proportions as in *V. zarhinus.* Second premolar with broad denticle on posterior border. Maxillary molars with markings about base of metacone more distinct than in *V. zarhinus.* The palatal aspect of paracone fretted. The first molar with large conical protoconid; paraconid rudimental, not differentiated from

[1] This list includes all the genera excepting Pygoderma, Ametrida and Stenoderma.

the conspicuous lingual cingulum, a sharply projected anterior basal lobe continuous with commissure (overlapping the crown of the second premolar in part) forms the anterior border of the tooth. To the outer side of the lingual cingulum, *i. e.*, on the grinding face of crown, are two nodules in position of metaconid; hypoconid inconspicuous; entoconid conspicuous, cusp-like and joined by a high posterior commissure. The second molar with opposed protoconid and paraconid followed by a deep posterior prolongation with a cresent-like posterior border which is accentuated on lingual side to form a cusp (entoconid).

Remarks on Chiroderma. Since Mr. Oldfield Thomas (Am. Mag. Nat. Hist. Vol. IV, 1889) has claimed that *Chiroderma* is not distinct from *Vampyrops*, an examination of the dentition of *C. Salvini* was substituted with the following result: The maxillary incisors with slender cylindroid centrals which are four times the length of the laterals end without notched free edges. Canines as long as the combined length of the molars (measured from buccal aspect) and delicately fluted on the posterior surface. First premolar about one-fourth the size of the second and contiguous with canine. An interval is defined between the premolars; the second premolar is with well developed basal cusps both anteriorly and posteriorly, but is without denticle on the posterior border.

The first molar. The thickened conjoined base of the sectorial paracone and metacone contiguous with the base of the protocone on the grinding surface of the tooth; no basal development in metacone such as is seen in *Vampyrops;* hypocone reduced to a depressed rudiment without cusp. Protocone robust, cuspidate, twice the height of the same in *Vampyrops.*

The second molar. The base of the paracone and metacone not conjoined or touching the base of the protocone; hypocone absent; first mandibular premolar rudimental, flat, scarcely raised above the gum line, touching canine but not second premolar. The second premolar long, prominent, almost as high as the canine,—a sharp ledge-like cingulum at base anteriorly. Paraconid large, trenchant and deeply fluted on anterior surface; hypoconid much lower than it but also trenchant. The rest of the tooth broad, low, flat, without raised border in region of the entoconid.

Last molar with protoconid larger than the paraconid. A commissure extends from the protoconid to be continuous with the lingual cingulum. Paraconid not developed from cingulum; hypoconid simple but well defined, conoidal ; entoconid well developed. An unnamed nodule on posterior border of the tooth at the buccal side of the entoconid.

The molars throughout with cusps directly on the grinding surface, *i. e*,, not confined to the margins. The cranium is in like manner distinct from *Vampyrops* in the great size of the angular process of the mandible.

In my judgment differences from *Vampyrops* of the kind denoted in the above description are sufficient to separate *Chiroderma* from other Sternoderms, until the shapes of the molar teeth shall be shown to have less taxonomic value in this group than in others of the order. The disposition to dorsal elongation of the anterior nasal aperture is a feature so unusual that it should have also weight in distinguishing *Chiroderma* even after acknowledging that the cleft disappears in old individuals.

AUGUST 4.

Mr. CHAS. ROBERTS in the chair.

Sixteen persons present.

AUGUST 11.

Mr. CHAS. MORRIS in the chair.

Eleven persons present.

AUGUST 18.

Mr. CHAS. MORRIS in the chair.

Sixteen persons present.

AUGUST 25.

Mr. CHAS. MORRIS in the chair.

Seventeen persons present.

Mollusca from Nantucket, Mass.—MR. H. A. PILSBRY exhibited four trays and one bottle of land and fresh-water mollusks collected by Dr. Harrison Allen in Nantucket, and stated that with the exception of *Helix hortensis* no land or fresh-water shells had heretofore been reported from that island.

The species collected are as follows: *Helix hortensis, Zonites* (*Hyalinia*) *arboreus, Limnæa columella* var. and a small species of the bivalve *Pisidium.* The two latter are typically fresh-water mollusks. *Helix hortensis* has been lately regarded by some conchologists as a native American, not an importation from Europe as all earlier students of our shells supposed. There is much evidence in favor of this view. Dr. W. H. Dall in conversation with the speaker has stated that the shells have been found in pre-historic shell-heaps (kitchen-middings) on the Maine coast, at considerable depths. The genitalia of specimens collected alive in Nantucket by Dr. Allen seem to agree very closely with the figures of German and English specimens given by Schmidt and Ashford. They have the characteristic dart-sack, the mucus or multifid glands composed of four long cœcæ, etc. *Zonites arboreus* is not different from specimens of that species found over the greater part of North America. The specimens referred to *Limnæa columella* are very small, slender, excessively fragile, and are beautifully decussated by spiral striæ and growth-lines, which cut the surface into little squares. Whorls 3½, length 8·2, width 4·2 mill.; length of aperture 5·6, width 3 mm.; color light brown. It is probably a local race, as I have seen none like them from the mainland.

The *Pisidium* is a small form which I have not identified specifically. A specimen of *Ancylus* found by Dr. Allen was lost.

Geological Features of the Meteoric Iron Locality in Arizona.—Dr. A. E. Foote described the remarkable geological features of the locality where he had found meteoric iron containing diamonds, an unreported communication on which had been made by Prof. G. A. Koenig before the Academy at the meeting of June 23rd, 1891.

Nearly all the small meteoric fragments were found at a point about ten miles southeast from Cañon Diablo near the base of a nearly circular elevation which strikingly resembles an old crater and is known locally as "Crater Mountain." He believed this to to be the same as Sunset Knoll figured on the topographical sheets of the U. S. Geological Survey. It is 185 miles due north from Tucson and 300 miles west of Albuquerque. The signet iron was discovered about 30 miles from Tucson.

This elevation, according to the Survey, rises 432 feet above the plain. Its center is occupied by a cavity nearly three-quarters of a mile in diameter, the sides of which are so steep that animals which have descended into it have been unable to escape and have left their bleached bones at the bottom, which seemed to be from fifty to one hundred feet below the surrounding plain. The rocks which form the rim of the so-called "crater" are sandstone and limestone and are uplifted on all sides at an almost uniform angle of from thirty-five to forty degrees. A careful search, however, failed to reveal any lava, obsidian or other volcanic production.

Prof. Gilbert had suggested that this so-called "crater" was like the depressions on the surface of the moon produced by the impact of an enormous meteoric mass. This view had been supported by other gentlemen, one of whom said that the diamonds at Kimberly probably came from the decomposition of meteorites that had produced the depressions in which the precious stones are found.

Hemiarcyria clavata Pers.—Dr. Geo. H. Rex described the structure of the capillitium of *Hemiarcyria clavata,* illustrating his remarks by a mounted slide under the microscope. As most of the descriptions of the Mycetozoa have been drawn from examinations made with objectives of moderate powers, many very interesting and unexpected results in the study of even familiar and well known species may be obtained by the use of homogeneous immersion or other higher power objectives.

As an example of one of the surprises of this kind, the speaker instanced the common *Hemiarcyria clavata* Pers.

The monographers of the Mycetozoa have described the capillitium of this species as being composed of a network of tubes having five smooth spiral thickenings wound evenly around them, at intervals equal to about three times the width of the spirals. The speaker had examined specimens from many American localities and found in every case that the spirals were not smooth but were really fringed by a single row of upright, cylindric-clavate, sometimes capitate processes of an exceedingly transparent, plasmodic structure, which followed the median line of the spirals and projected rigidly from it.

These processes equal in height the diameter of the spirals, and are quite transparent, but can be better seen by aniline staining. They stand in rank closely together, on some specimens being distinct and separate, while on others they are so closely ranged that the bases seem almost to be joined together, the clavate or capitate ends, however, being distinct. The speaker had examined only American specimens and therefore was not prepared to state that this peculiarity of structure was universal.

This condition is distinct from that existing in *Hemiarcyria leiocarpa* Cke., a closely allied species in which the few scattered spines on the spirals are very different in size and character.

September 1.

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

Twenty-two persons present.

Leidy Memorial Meeting. Through an oversight a serious omission occurs in the record of the meeting held May 12, on the occasion of the death of Dr. Joseph Leidy, late President of the Academy. The first paper read was by Dr. William Hunt, who wrote of the personal history and character of the deceased President. The absence of Dr. Hunt's name from the list of those who read papers on the occasion is the more to be regretted as his contribution was prepared with loving appreciation and knowledge of his life-long friend.

September 8.

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

Seventy-five persons present.

North Greenland Expedition. Preliminary reports were read from Messrs Peary, Sharp and Heilprin of the operations of the Expedition fitted out under the auspices of the Academy for the exploration of Greenland, which sailed from Brooklyn, June 6th, at 5 P. M. Detailed accounts of the scientific observations made during the voyage will be published in the Proceedings of a later date.

September 15.

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

Three hundred and ninety-eight persons present.

The Ornithological Section reported its organization with the following officers:—

Director, Spencer F. Trotter, M. D.
Vice-Director, George S. Morris.
Recorder, Samuel N. Rhoads.
Treasurer, Isaac C. Martindale.

Secretary, Charles E. Ridenour.
Conservator, Witmer Stone.

The third Monday of each month was selected as the time of meeting.

PROF. HEILPRIN made the first of a series of communications on the physiography of Greenland which was followed by an exhibition by means of lantern and screen, of photographs taken during the expedition by DR. BENJAMIN SHARP.

SEPTEMBER 22.

Rev. HENRY C. MCCOOK, D. D., Vice-President, in the chair.

One hundred and eighty-three persons present.

SEPTEMBER 29.

MR. JOHN H. REDFIELD in the chair.

Seventy-three persons present.

The death of Dr. John G. Lee, a member, September 9, was announced.

Messrs Angelo Heilprin, J. P. Lesley, Persifor Frazer, Wm. B. Scott and Benjamin Smith Lyman were appointed as the Committee on the Hayden Memorial Geological Award.

Dr. Wm. E. Hughes and Dr. John MacFarlane were elected members.

The following were ordered to be printed:—

NOTES ON SOME LITTLE KNOWN AMERICAN FOSSIL TORTOISES.

BY DR. G. BAUR.

1. COMPSEMYS Leidy.

The genus *Compsemys* was established by Prof. Leidy[1] in 1856 on a vertebral and costal bone of a tortoise from the Laramie formation of the Judith River. The only character given at that time, was: "The free surface of all the bones is thickly studded with granular tubercles, which give to it a shagreened appearance, differing from anything observed in recent turtles." The type of the genus is *Compsemys victus* Leidy. It was figured by Prof. Leidy[2] three years later, in the Transactions of the American Philosophical Society. Prof. Cope[3] adopted this genus and referred to it *Emys obscurus* Leidy, published at the same time with *Compsemys victus*. In 1875 he added *Compsemys ogmius* Cope from the Milk River.[4]

In 1876 Prof. Cope[5] established two more species from the Laramie of Montana, under the names of *Compsemys imbricarius*, and *C. variolosus*. All the species described to this date were from the Laramie Formation. In 1877 a new species of *Compsemys* was described by Prof. Cope[6] from the Jurassic Beds of Colorado, under the name of *Compsemys plicatulus*.

The remains of this species were found with those of Dinosaurs by Mr. C. W. Lucas of Canyon City, Colorado; they represent the oldest American tortoise. The species was based on "portions of both carapace and plastron of several individuals."

So far the genus *Compsemys* was only known from the carapace and plastron, from which its characters were taken; "tortoises with

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[1] Leidy, Joseph. Notices of extinct Vertebrata discovered by Dr. F. V. Hayden, during the expedition to the Sioux country, under the command of Lieut. G. K. Warren. Proc. Acad. Nat. Sci. Phila., vol. viii, 1856, p. 312, Phila., 1857.

[2] Leidy, Joseph. Extinct Vertebrata from the Judith River and great Lignite Formations of Nebraska. Trans. Am. Philos. Soc. 1859, p. 152, pl. xi., figs. 5, 6, 7.

[3] Cope, E. D. Synopsis of the Extinct Batrachia and Reptilia of North America. Trans. Am. Philos. Soc., vol. xiv, Phila., 1870, p. 124.

[4] Cope, E. D. The Vertebrata of the Cretaceous Formations of the West. Washington, 1875, p. 91.

[5] Cope, E. D. Descriptions of some Vertebrate Remains from the Fort Union Beds of Montana, Paleontol. Bulletin, No. 22, p. 10 (published Nov. 13, 1876), also Proc. Ac. Nat. Sci. Phil., 1876.

[6] Cope, E. D. On Reptilian Remains from the Dakota Beds of Colorado, Paleont. Bulletin, No. 26 (November 21, 1877), pp. 195, 196, reprinted from American Philos. Soc. xvii, 1877, pp, 195, 196.

marginal bones completely united with solid plastron, and the usual dermal scuta, and which differ from *Emys* in their Trionyx-like sculpture." Cope, p. 195.

In 1886, I began my researches on the Testudinata; lately I have examined the collections of the Academy of Natural Sciences of Philadelphia and the Smithsonian Institution, containing the types of Prof. Leidy; also the collection of Prof. Cope who permitted me to study his types at different times with the greatest liberality. The result of my examination is, that *Compsemys* proves to be a member of the Pleurosternidæ, having the pelvis free from carapace and plastron, a complete mesoplastron and a continuous series of neural bones; having also infra-marginals and an intergular. The extensive material of *Compsemys plicatulus* Cope, in the Peabody Museum from the Jurassic of Como, Wyoming, the same locality which yielded the numerous mammals and dinosaurs, was examined at the same time. *Compsemys plicatulus* was found to be a very abundant form in this horizon and it was possible to study nearly all the parts of the skeleton. Of the Laramie forms nothing but the shell is known so far, and this shows all the characters of the Jurassic form; it is therefore impossible, at present, to separate the Laramie and Jurassic tortoises generically from each other. The Laramie form very often has all the elements of the carapace and plastron so strongly united, that the sutures, especially on the plastron, cannot be distinguished. In a short note on the classification of the Testudinata,[7] I have given the principal characters of the generalized sub-order Amphichelydia, Lydekker. These characters were gained from the study of the Jurassic form *Compsemys plicatulus* Cope. They are: "Nasals free; a squamoso-parietal arch; descending processes of prefrontals joining vomer; stapes in an open groove of the quadrate; pterygoids narrow in the middle, without wing-like lateral expansions, separating quadrate and basisphenoid; epipterygoid well developed and free; dentary bones distinct. Cervical vertebræ with well developed transverse processes, more in front of vertebra, with single articular faces, biconcave; dorsal vertebræ, sacral vertebræ, with well-developed ribs; ribs of sacral vertebræ connected with centrum and neuroid. Pelvis not anchylosed to the carapace and plastron. Epiplastra in contact with hyoplastra, entoplastron oval or rhomboidal; a complete series of peripheralia connected with the ribs."

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[7] Baur, G. On the Classification of the Testudinata. American Naturalist, June, 1890, pp. 530–536.

Shortly after this a note appeared by Prof. Marsh[8] in the August number of the American Journal of Science, entitled: "Notice of Some Extinct Testudinata."

In this paper *Compsemys plicatulus* appears under a new generic and specific name: *Glyptops ornatus*, Marsh. The skull, as figured in Pl. VII, fig. 1, gives only an idea of the general shape. The description is given in the following words: "A striking feature of this skull is that its entire external surface is elaborately sculptured. This character, hitherto unknown in the Testudinata, has suggested the name proposed.

"In its general features, this skull resembles that of *Chelydra serpentina* Linn. It is wedge-shaped in form, when seen from above. The orbits are small, and well in front. The nasal opening is directed upward, rather than forward. The premaxillaries project downward in front into a tooth-like beak. The nasals appear to be distinct. The maxillaries are deeply grooved below, but show no indications of true teeth. The skull is roofed over posteriorly, as in *Chelone*, and some other sea-turtles.

"There is a posttemporal arch. The occipital condyle is nearly round, and has a deep pit in the center. The condyle is formed entirely of the basioccipital, as the thin exoccipital plates do not reach the articular surface. The basioccipital processes are prominent and directed backward. The pterygoids separate the quadrates and the basisphenoid. At their union with each other, they are much constricted, but expand in front. The quadrate is stout and curved, and its articular face is deeply notched.

"The lower jaws referred to this species are slender and much less sculptured than the skull. The dentary bones unite at the symphysis by a short, open suture and form a sharp, elevated point to meet the decurved tooth-like beak above. The upper border is quite sharp, and fits well into the deep alveolar sulcus of the maxillary."

The Skull.

I shall go now successively over those characters which are not quite correct. It is an interesting and important fact that the sculpturing of the skull agrees *exactly* with the sculpturing of the carapace and plastron. The nasals are distinct and meet in the

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[8] Marsh, O. C. Notice of some Extinct Testudinata. Am. Journ. Sc., vol. XL, August, 1890, pp. 177–179, pl. VII, VIII.

median line; the same character I have observed in the skull of *Toxochelys* from the Cretaceous of Kansas.

Prof. Marsh says the maxillaries show no indications of true teeth; but they show no indications of teeth whatever and are not different in this respect from any other Testudinata living or extinct.

It is stated that "the skull is roofed over posteriorly, as in *Chelone* and some other sea-turtles." It is a character of *all* the sea-turtles (Pinnata) to have the skull roofed over.

"There is a post-temporal arch." I do not know what Professor Marsh wants to express by this.

"The occipital condyle is nearly round and has a deep pit in the center." This pit is very common among the Testudinata and is found always where the basioccipital meets the exoccipitals. The statement that "the condyle is formed entirely of the basioccipital" is incorrect. The exoccipitals take part in the formation of the condyle just as in *Chelydra*. If Professor Marsh means by "exoccipital plates," the upper part of the exoccipital, he is right in the statement that they do not reach the articular surface. They do not reach this surface in any of the Testudinata.

I shall now give some supplementary remarks on the same skull.

At first it must be stated that the sutures are very difficult to distinguish, and that I was unable to define them on the upper part of the skull, with the exception of the nasals and the median suture. As stated before, the whole skull is sculptured like the shell. It is somewhat compressed laterally behind, and is therefore broader than shown in Prof. Marsh's figure. Seen from the side it resembles very much the skull of *Chelydra*, but is even more emarginated in the region where the jugal meets the quadratojugal. The whole palatal aspect agrees with *Chelydra*; the foramina palatina are very large. The petrosal is not produced in front. The orbit is not closed behind by bone, but is open. The skull as a whole shows characters which we expect to find in the ancestors of Cryptodira and Pleurodira.

The quadrate resembles mostly that of the Pinnata, the whole arrangement of palate, pterygoid, basisphenoid is that of the Cryptodira, the presence of the epipterygoid is also a character of the Cryptodira and so is the union of the descending processes of the prefrontal with the vomer. But the free nasals, the suturally united dentary bones, and the absence of the production[1] of the petrosal are characteristic of the Pleurodira.

[1] This production is only absent in *Dermochelys* among the Cryptodira.

The Cryptodira developed from the Amphichelydia of which *Compsemys* is the best known member, by the union of the nasals with the prefrontals; the union of the dentary bones, and the development of the production on the petrosal. The Pleurodira developed from the Amphichelydia, by the lateral expansion of the pterygoid bones, the reduction of the posterior process of these bones, resulting in the non-separation of quadrates and basi-sphenoid, by the disappearance of the union between vomer and descending processes of prefrontals, and the disappearance of the epipterygoid as a separate element.

I have now to discuss the other parts of the skeleton.

Carapace and Plastron.

Prof. Marsh thinks that the carapace represented in Plate VII, fig. 2 was not found with the "skull, and may possibly represent a distinct form." There is not the slightest proof of the latter statement. First, as mentioned above, the skull shows exactly the same (not similar, Marsh) sculpture as the shell; and second all the numerous remains of tortoises from this locality belong to the genus *Compsemys*, and probably to the same species, *Compsemys plicatulus*, Cope.

I. *Dermal Shields or Scutes.* (*Scuta.*)*

a. Carapace.
Vertebral-scutes.
Lateral-scutes.
Supramarginal-scutes (among living Testudinata only in *Macrochelys*).

b. Disc.
Marginal-scutes, the front one generally called nuchal shield, I called *cervical*, to distinguish it from the underlying bone (nuchal-bone). The posterior one, if single, I called *caudal*-scute.

c. Plastron.
Intergulare (ia).
Gularia.
Brachialia.
Pectoralia.
Abdominalia.
Femoralia.
Analia.
Interanale (only in Cheloniidae).
Inframarginalia (Axillare, Inguinale).
Submarginalia (only seen in a great number of a young *Chelonia* spec. from the Galapagos Islands [Am. Nat., May, 1890, p. 487]).

II. *Dermal Ossifications.*

a. Carapace.
Neuralia.
Postneuralia (the elements between the last neural and the pygale).
Pleuralia (generally called costal bones).

b. Disc.
Peripheralia (generally called marginal bones), nuchale, pygale.

*I have adopted the above nomenclature for the dermal shields and dermal ossifications of the carapace and plastron of the Testudinata. (Zool. Anz., No. 285, 1888.)

c. PLASTRON.
Epiplastron=clavicle+dermal ossification.
Endoplastron=interclavicle+dermal ossification.
Hyoplastron, Mesoplastron, Hypoplastron, Xiphiplastron } =abdominal ribs+dermal ossification.

In the figure of the carapace given by Prof. Marsh no indication of the impressions of dermal shields is to be seen. I may state, that the shields become indistinct in old individuals, but can generally be seen on the peripherals (marginals). There is a distinct cervical (nuchal) in this genus, the vertebral shields are very broad. There are eight neuralia and two post-neuralia all touching each other and preventing the pleuralia from meeting in the middle line. In the drawing given by Prof. Marsh, which is partially restored, only one postneural is given, but in other specimens two such elements are present. Pleurale has a sharp edge on its lower side as in Pleurodira and some Cryptodira. The hyoplastron is united to the first pleural bones by gomphosis; there is a distinct groove for the union with this element; the hypoplastron reaches the pleurale 5 and 6; on the union of both a short but deep groove for the end of the hypoplastron is found. The plastron is united with the carapace by gomphosis, and reaches from pleur. 2 to pleurale 8. The ends of the ribs project a little over the end of the pleuralia.

The plastron is rounded behind, and only very little emarginated. The median end of the right mesoplastron is not so broad as that of the left one; and both the mesoplastra become attenuated at the middle. The Xiphiplastron shows a small pit for the reception of the pubis. The dermal shields agree essentially with Pleurosternon.

THE VERTEBRÆ.

1. *Cervicals.* The most remarkable fact in the cervical vertebræ is that they are bicœlous; like the Pleurodira, they have single articular faces and show no ginglymoid articulations like the Cryptodira and Trionychia. In a former paper[1] I have tabulated the different modifications found in the living Testudinata; it is very much to be regretted that so very little or hardly anything is known about the condition found in the older fossil forms. *Chitracephalus* Dollo has all the cervicals preserved, but nothing is published yet about the condition of the articular faces, which probably show some interesting points and may help to explain the arrangement

[1] Bauer, G. Revision meiner Mittheilungen im Zoologischen Anzeiger mit Nachtraegen. (Die Halswirbel der Testudinata.) Zool. Anz. No. 306, 1889.

seen in the Trionychia. The splendid specimens of *Idiochelys* in the Museum of Lyons (France), also have the cervicals preserved, but we know nothing about their structure.

In the living Testudinata we find the following conditions :—

I. Ginglymoid-articulations absent.

a. Only one vertebra biconvex, the *second;* all the following concavo-convex : *Podocnemididae,*[1] *Sternothaeridae.*

b. Two vertebræ biconvex, the *fifth* and the *eighth;* 2–4 convex-concave, 6 concave-convex, 7 biconcave: *Chelyiidae.*

II. Ginglymoid-articulations present.

a. Only one vertebra biconvex.

1. The *second,* Dermatemydidae.[2]
2. The *third,* Staurotypidae, Cinosternidae.
3. The *fourth,* Chelydridae, Cheloniidae, Dermochelyiidæ.
4. The *fifth,* one specimen of *Chelonia Mydas,* in the Natural History Mus., Brussels.
5. The *sixth;* not known.
6. The *seventh;* not known.
7. The *eighth;* not known in this group but one specimen of *Testudo Leithii* in the Peabody Mus. shows this condition.

b. Two vertebræ biconvex; one of these is always the eighth; the other may be

1. The *second,* one specimen of one of the Testudinidae, species not defined (Vaillant).
2. The *third,* Testudinidae, part, Emydidae part.
3. The *fourth,* Testudinidae, part, Emydidae part, Platysternidae.
4. The *fifth,* a single specimen of *Testudo tabulata* Walb. (Smithsonian Institution.)
5. The *sixth,* not known.
6. The *seventh;* impossible.

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[1] The saddle-shaped articular faces of some cervicals in the Podocnemididae (*Podocnemis, Peltocephalus*) described by me (Zool. Anz. No. 298, 1888 and Amer. Naturalist, May, 1890, pp. 482–484) have to be considered as derived from a form like *Erymnochelys* and the Sternothaeridae (*Sternothaerus, Pelomedusa*).

[2] This condition I have also observed in a single specimen of the Cinosternidae, *C. flavescens.*

c. All vertebræ convex-concave: *Trionychia*.[1]

d. All vertebræ concave-convex: *Pyxis*.

From this list we see, that in all living Testudinata the posterior articular face of the eighth cervical (the Trionychia perhaps excepted) is convex; the anterior face of the first dorsal, therefore, concave. In *Compsemys* the first dorsal has this face also concave; we ought to expect, therefore, that the eighth cervical has the posterior articular face convex, but this is not the case. In the vertebra which I consider the eighth the posterior articular face consists of two portions. The upper one which corresponds to the original central part is slightly concave, the lower one which extends to the median keel on the lower side of the vertebra is convex. The tendency is there to form a convex articular face, but the original concave condition is still visible. The anterior face is slightly concave. The neuroids are elevated, the postzygapophyses are horizontal, very near together but not confluent. In the seventh cervical we have similar conditions, but the articular faces are more concave than in the eighth. There are two other vertebræ which I consider as the second and third, both are biconcave, but the neuroids are not elevated. In all these vertebræ the zygapophyses are horizontal; the lower side of the vertebræ are provided with a keel; the diapophyses are well developed and are not placed entirely in the middle,[2] but more in front; there is no neurocentral suture. All these conditions agree more with the Pleurodira than with the Cryptodira. It may be possible that the vertebræ between the third and seventh may be of different condition, but this is not probable, because even the 8th

[1] It is a very remarkable fact, that in *Trionyx foveatus* Leidy, from the Laramie, of which I have worked out and studied a nearly complete specimen in the Peabody Museum, collected by J. B. Hatcher, the cervicals show exactly the same condition as in the living forms; even the posterior face of the 8th cervical is of the same nature. It is probable that this face has been convex in the more ancient types, as in all living Testudinata, or it may have been concave as in the Amphichelydia. The Trionychia are a very old type, which has undergone hardly any morphological changes since the Laramie in which formation they make their appearance. I am unable to find any generic difference in the splendid Laramie species, from the living American forms of *Trionyx*. If the skull is known it may prove to be different, but shell, vertebræ and limbs do not allow a generic separation. I may mention here the interesting fact, that the Trionychia are found to-day in rivers and also lakes in which we also find the old representatives of fishes. In North America, the Trionychia are met together with *Lepidosteus*, *Amia*, *Spatularia*; in Africa with *Polypterus* and *Calamoichthys*; in Asia with *Psephurus*. Already in the Laramie we find the Trionychia together with Ginglymodi. Another similar case we see in the geographical distribution of the Pleurodira and Dipnoi; South America, Africa, Australia; and we may perhaps yet find representatives of the Dipnoi or other ancient groups in Papua.

[2] I have seen a similar case in *Peltocephalus tracaxa* Spix.

cervical, which in all living Testudinata has the posterior face convex, shows distinct traces of concavity.

The dorsals, sacrals and caudals. There are ten dorsals and two sacrals, the number of the caudals is not known.

The first dorsal is entirely pleurodiran ; all the dorsals have well developed ribs which unite with the pleurals ; the rib-heads are well developed. The tenth dorsal also has a rib, which broadens distally and is suturally united to the eighth pleural which contains the rib of the ninth dorsal. The rib of the tenth dorsal is often found free from the eighth pleural, and in this case this pleural contains a deep groove for the rib. The rib of the tenth dorsal reaches only to the lower middle of the eighth pleural. On the broad distal face of the tenth rib the ilium stands, exactly as in the Emydidae and Testudinidae. The neuralia are only loosely attached to the corresponding neuroids of the dorsals. All the neuroids are suturally united to each other. The two sacrals have well-developed ribs which are connected with both the centrum and the neuroids. In the first sacral the anterior and posterior neurapophyses are well developed, allowing not only a motion between the sacrum and the last dorsal, but also some motion between the two sacrals ; the same we find in the Chelydridae. The first sacral is flat behind. I do not know the condition of the caudals.

From this description it results that the arrangement of the posterior dorsals and sacrals is entirely Cryptodiran and not Pleurodiran. To understand this more fully I give a synopsis of the different condition of the posterior dorsals and the sacrals in the Cryptodira, Pleurodira and Trionychia.

I. CRYPTODIRA.

1. Cheloniidae ; ribs of tenth dorsal well developed ; either (distally) suturally united with the eighth pleural (*Chelonia*) or free (*Thalassochelys*).

Dermochelyidae ribs of tenth dorsal developed ; free.

Chelydridae ; ribs of tenth dorsal generally absent.[1]

[1] In one case I have seen a rib on one side, in another case the ribs were present on both sides but only distally ossified. In the latter case a distinct sutural union took place with the eighth pleural and the ribs even reached the eleventh peripheral, forming a little groove there for union. In the same specimen, 676 of the Peabody Museum, the pygal was divided by a median suture. This case is interesting. Rütimeyer states that in *Platychelys* a distinct face is seen on the eighth pleural for the ilium, but this face which extends over to the eleventh peripheral, is probably nothing but the face for the union of the pleuroid of the tenth dorsal.

STAUROTYPIDAE; ribs of tenth dorsal absent.[2]

CINOSTERNIDAE; ribs of tenth dorsal absent.[2]

DERMATEMYDIDAE; ribs of tenth dorsal present, free.

PLATYSTERNIDAE; ribs of tenth dorsal present, suturally united with eighth pleural.

EMYDIDAE; ribs of tenth dorsal present, suturally united with eighth pleural.

TESTUDINIDAE; ribs of tenth dorsal present, suturally united with eighth pleural.

ADOCIDAE; ribs of tenth dorsal present, suturally united with eighth pleural.

II. PLEURODIRA.

STERNOTHAERIDAE; ribs of tenth dorsal present, suturally united with eighth pleural.

PODOCNEMIDIDAE; ribs of tenth dorsal present, suturally united with eighth pleural.

CHELYIIDAE; ribs of tenth dorsal present, suturally united with eighth pleural.

III. TRIONYCHIA.

TRIONYCHIDAE; ribs of tenth dorsal present, or absent, when present free.

The oldest condition seems to be a free rib on the tenth dorsal; this may become suturally united with the eighth pleural and become reduced secondarily afterwards; or it may become reduced before its union with the eighth pleural.

In the condition of the sacral vertebræ *Compsemys* agrees with the Cryptodira. I have shown in a previous communication,[3] that the sacrum of the Pleurodira has undergone great reductions, and that the sacral vertebræ have at last partially become caudals.

Nothing of this kind is to be seen in *Compsemys*, which agrees in the construction of the sacrum with the Cryptodira.

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[2] In none of the Staurotypidae or Cinosternidae have I observed a rib on the tenth dorsal; in these two families, which are very close together and ought to be considered as subfamilies of a single family, to which also the Anostirinae belong, the rib-heads of the eighth pleural are always absent, so that the eighth pleural is in no connection with the tenth dorsal. This is a secondary condition, for in *Pseudotrionyx*, Dollo, which probably also belongs to this group, the rib-heads are still present.

[3] Baur, G. Osteologische Notizen über Reptilien. (Fortsetzung III.) Zool. Anz., No. 285, 1888.

We see that the vertebræ of *Compsemys* also combine characters of both the Pleurodira and Cryptodira. The Cryptodira developed by changing the condition of the cervicals; the Pleurodira by changing that of the sacrals.

The Shoulder-girdle.

The scapula and coracoid of different individuals are preserved. The scapula resembles the same element in Chelydra, but has a more slender neck. The coracoid is very much broadened distally, as in *Chelys* and some other Pleurodira and the Testudinidae. I may add here some words on the morphology of the scapula of the Testudinata. There has always been much difference of opinion about this element. The scapula consists, as is well known, of two branches. The upper one generally called scapula s. s., and the lower one, which is either regarded as precoracoid (Huxley, Parker, Gegenbaur, etc.) or as clavicle (Goette, Wiedersheim, Hoffman). That it cannot represent the clavicle is clear; because this element is contained in the epi-plastron of the plastron as I have shown definitely by the comparison of the Stegocephalia, Proganosauria and Testudinata.[1]

It remains to examine now whether it represents the precoracoid or whether it is a secondary formation of the scapula.

It is well known that we find a very similar scapula among the Plesiosauria; a step to this condition is also seen in *Metriorhynchus*, as described by Dr. Hulke in a late volume of the Proc. of the Zoological Society, which I have not at hand at present. In *Metriorhynchus* the ventral element of the scapula, which I have called proscapula,[2] is very well developed; but it is nothing but a process of the scapula. If this process becomes larger we have the conditions of the Plesiosauria and Testudinata.[3] This seems to be the only reasonable explanation. It cannot represent the precoracoid, the opinion of Huxley, Gegenbaur, Parker and others. The precoracoid, when it is free and at all recognizable, is placed between the true coracoid and the scapula outside the acetabulum, in the formation of which it may take part or not. In this condition we find it in the Monotremata and the Theromora. If the element

[1] Baur, G. Palæohatteria Credner and the Proganosauria, Am. Journ. Sc. Arts, vol. xxxvii, April, 1889, p. 312.

[2] In Zittel, Handbuch der Palaeontologie, Vol. III, p. 509.

[3] In the oldest Plesiosauria, *Nothosaurus*, *Lariosaurus*, the lower part of the scapula is also very little developed.

called precoracoid by Huxley and the others would represent really this bone, it would have a position entirely different; it would not be placed between the coracoid and scapula outside the acetabulum, but inside of it. The ventral process of the scapula in Testudinata and Plesiosauria, which I have named proscapula, seems to be, therefore, nothing but a secondary evolution.

The Pelvis.

All the elements of the pelvis are preserved in different individuals. The ilium resembles very much that in *Baëna arenosa* Leidy. It has the same posterior process as this form.

The pubis has a very massive pectineal process which stands on the xiphiplastron, the true pubis is a slender element meeting that of the other side in the middle line. The ischium is *larger* than the pubis, so that at first sight the two bones are easily confounded. The posterior process of the ischium is greatly developed and on the union of this process with the true ischium this element rests on the xiphiplastron. The branches of the ischium meet in the median line but are not united with the pubis. In structure the pelvis of *Compsemys* is between that of *Chelydra* and *Chelys*. The ancestors of *Chelys*, which had the pelvis free from carapace and plastron, must have been very much like *Compsemys* in this regard.

The Fore Limbs.

The fore limbs are long and resemble the elements of the Emydidae. The humerus is not so much curved as in the Pleurodira and resembles in shape that bone in *Terrapene;* an ectepicondylar foramen is present. The hand must have been very much like that of the Emydidae.

The hind limbs were of the same character, so far as known; the femur agreeing with the Emydidae; whether four or five claws were present cannot be stated at present.

Conclusions. From the foregoing descriptions we see that *Compsemys* is wonderfully mixed in its characters. It is half Pleurodiran half Cryptodiran. The group Amphichelydia to which it belongs must be considered as ancestral to both Cryptodira and Pleurodira. The Cryptodira developed through modification of the cervicals and the plastron; the mesoplastron disappeared successively, and in some forms also the intergular and inframarginals. The Pinnata still contain these elements, but there is no trace of a mesoplastron left.

The Dermatemydidae retain the inframarginals which become very much reduced in the Chelydridae, Staurotypidae and Cinosternidae; but none of these forms have preserved a mesoplastron. The extinct Adocidae, which belong to the same group, have lost the mesoplastron as early as in the Cretaceous, but the Jurassic *Platychelis*, which is probably an ancestor of these forms, still contains a vestige of this element. Another branch is represented by the Platysternidae, Emydidae and Testudinidae.

The Pleurodira developed from the Amphichelydia, through specialization of the head and the carapace and plastron. One of the living forms retained the complete mesoplastron (*Sternothaerus*); in others it became reduced, *Pelomedusa, Podocnemididae;* in others, Chelyiidae, it disappeared entirely. The inframarginals must have been reduced very early, for in none of the living forms do we find these elements; the intergular is always retained. A true Pleurodiran is present already in the Cretaceous of New Jersey, *Taphrosphys* Cope, which is identical, with very little doubt, with *Bothremys* Leidy.

The early history of the Testudinata remains as dark as before, even the oldest form we know, *Proganochelys*, which may be identical perhaps with *Chelytherium* of H. v. Meyer, gives no clue. It is a typical tortoise. It may have been, in its skull and cervicals, like *Compsemys*, but we have to wait for new material for the solution of this question. A very peculiar circumstance in the Testudinata is the small number of presacral vertebræ. The original number is eighteen; eight cervicals, ten dorsals. There is only one reptile with this number, all others have higher numbers; this reptile is the Triassic (?) *Pareiosaurus* Owen, from South Africa. Here we have also 18 presacral vertebræ. It may be that the Pareiosauria, which are a highly developed group, and the Testudinata have a common ancestor, but such ideas are nothing but speculations, which may fall at any time after a new discovery has been made. Whether we may find some day true tortoises with teeth, or whether the ancestors of the tortoises had already lost these elements, is another question, which cannot be answered to-day. The oldest skull of any tortoise we know to-day shows no indication whatever of teeth. Something which looks like an indication of the former existence of teeth is seen in *Bothremys* of Leidy, of which I have examined the type. In this form we have deep grooves in the upper and lower jaw which look very much like roots of alveoles of a large tusk;

they are very much deeper than is represented in the figure given by Prof. Leidy. This genus belongs to a peculiar family of the Pleurodira with the following characters:

BOTHREMYDIDAE; *Vomer well developed; no free nasal bones, dentaries co-ossified, small mesoplastron present* (*in Taphrosphys, fide Cope*).

This family shows characters of the Podocnemididae and Chelyidae; like the true Pleurodira it has no descending processes of the prefrontals meeting the vomer, notwithstanding this element is present. It has no free epipterygoid and there is no production of the petrosal. In the lower jaw only the dentary bones which are firmly co-ossified, and the coronoid, which takes part in the formation of the large "alveole," just as the palate takes part in the upper jaw, are free; all the other bones are united without trace of suture, a condition present in the Podocnemididae. From such a condition to one in which the lower jaw consists only of one bony complex on each side, as seen in the Mammalia and probably the Theromora, is only a small step.

THE AFFINITIES OF COMPSEMYS.

As already stated by Prof. Marsh on my authority, *Compsemys* resembles *Helochelys* from the Cretaceous Greensand, and *Pleurosternum* from the Purbeck. Of both I have examined the types in the British and Munich Museums.

PLEUROSTERNUM has the xiphiplastrals deeply notched; in *Compsemys* and *Helochelys* the plastron is rounded behind.

PLEUROSTERNUM has no nuchal shield (cervicale), in *Compsemys* and *Helochelys* this element is present.

PLEUROSTERNUM has the mesoplastron not attenuated in the middle, as in *Compsemys*, and the union of the two elements is different from that in *Compsemys*.

HELOCHELYS has the impressions of the dermal shields very well marked, in *Compsemys* they are not distinct.[1]

The future may show that these three forms are all members of the same genus to which the name *Pleurosternum*, being the oldest, would have to be applied; but at present I think it better to accept the three genera, placing them in one family, the Pleurosternidae, as defined by Mr. R. Lydekker.[2]

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[1] The shoulder girdle and pelvis seem to be very much alike in *Compsemys* and *Pleurosternum*.

[2] Lydekker, R., Catalogue of the Fossil Reptilia and Amphibia in the British Museum, Part III, p. 205; also Quart. Journ. Geol. Soc., 1889, p. 518, has described these parts in *Pleurosternum*.

Compsemys is very nearly related to the Tertiary genus *Baëna*, which has probably to be considered as its direct successor.

2. BAENA.

This genus of which *Baëna arenosa* Leidy is the type was established by Leidy in 1870. (Proc. Acad. Nat. Sci. Phila., p. 123; 1871; p. 228.) It is fully described and figured by Leidy in his Contributions to the Extinct Vertebrate Fauna of the Western Territories, Washington, 1873, pp. 160–169. Pl. XIII, figs. 1–3, XV, figs. 1–5, Pl. XVI, figs. 8–9. According to Leidy "It partook of characters of the snappers or Chelydroids, the terrapins or Emydoids, and the sea-turtles or Chelonoids." The principal characters given by Leidy are, the "two pairs of gular scute areas, which together with the other scute areas, made seven pairs to the plaston;" the presence of inframarginal scutes; and the obliteration of the sutures in the shell. To this character Prof. Cope[1] added the presence of a mesoplastron, and referred Leidy's *Chisternon*, so far characterized by the presence of this bone, to *Baëna*. He also stated, that in three species he observed five costal scuta instead of four. "The accessory one is anterior, and is taken from the usual first costal and first vertebral, both of which are contracted in consequence." Prof. Cope remarks, that "this character is unique in the order Testudinata," but it is to be found in *Lepidochelys*, (*Colpochelys*), *Thalassochelys*, and *Eurysternum*. He also states that the double intergular exists in *Tropidemys* of Rütimeyer. This is not correct; it is found in *Plesiochelys*. The presence of fourteen marginal scuta is probably coincident with the increase of the costal scuta; we find the same in *Lepidochelys* and *Thalassochelys*. In regard to the affinities Prof. Cope says: "The affinities of this genus are complex and interesting. It would be a Pleurodire, but for the fact that the pelvis is not co-ossified with the plastron; nevertheless, there are rudiments of this union in the form of a shallow pit on each side." *Baëna* is placed in a special family "Baënidae," with the characters:—Plastron uniting with the costal bones of the carapace by suture, with ascending axillary and inguinal buttresses; inter-sternal bones [mesoplastra] present; intergular scuta; caudal vertebræ opisthocœlous.

This family is adopted by Boulenger (Encyclopædia Brit., 9th ed., vol. 23, 1888, p. 457) with the following definition: "Plastral bones eleven, mesoplastra being present. Nuchal bone without

[1] Cope E. D. The Vertebrata of the Tertiary Formations of the West, Book I, Washington, 1884, pp. 144–146.

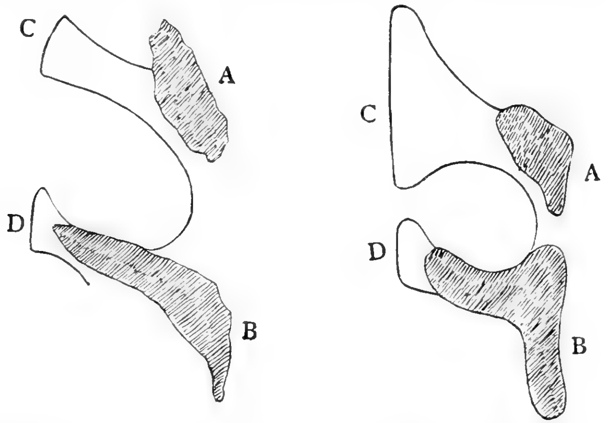
costiform processes. Carapace with epidermic scutes. Caudal vertebræ opisthocœlous."

I have studied, through the kindness of Dr. Brown Goode and Mr. Fred. A. Lucas, the type specimen of *Baëna arenosa* Leidy, now in the Smithsonian Institution. Different parts, which were still in the rock, were worked out more fully and some new points could be made out. *Baëna* proved to be nearly related to the older Laramie *Compsemys*, of which it seems to be the direct successor. The mesoplastra are more reduced, only meeting in a point in the middle line. The sutures in the carapace and plastron disappear in old specimens as in the older Laramie forms; this of course cannot be considered as a generic character, as we find the same in *Terrapene Carolina* L. in old specimens. The plastron is thickened across the axillary and inguinal region, agreeing thus with the Laramie and Jurassic *Compsemys.* The carapace is emarginated behind as described by Leidy and Cope. The dorsal vertebræ are co-ossified with each other. There are eight pleuralia very much as in *Chelydra;* the rib-heads, however, are not so long as in this genus. The third dorsal forms a sharp keel below, which also extends to the second and fourth. The tenth dorsal has a distinct rib, which is suturally united distally with the eighth pleural. The posterior face of this vertebra is deeply concave, and the center is entirely circular. The hypoplastron extends far inside between the fifth and sixth pleurals, very much as in *Chelys;* and it is probable that *Baëna* was a good swimmer. The sternal chambers are very much more developed than in *Compsemys.* The first sacral is very little convex in front, flat behind with a trifling indication of concavity. The second sacral is flat in front, concave behind. The first and second sacrals have well developed zygapophyses; the sacral ribs are united to both centrum and neuroid.

I am glad to be able to correct a gross blunder which I made some time ago. In my paper on the systematic position of *Meiolania* Owen (Ann. Mag. Nat. Hist., Jan., 1889, p. 58), I made the following remark: "All Testudinata have the second sacral vertebra convex behind. There is no exception whatever. Prof. Leidy, it is true, states that 'the posterior articular surface of the second (sacral) centrum is concave' in *Baëna.* But this is not correct: what Prof. Leidy describes as the posterior articular surface of the second, is the anterior of the first sacral vertebra. The second sacral vertebra of *Baëna* is convex behind, as in all other Testudinata."

To this idea, which is entirely wrong, I was brought by the figure given by Prof. Leidy, not by examination of the specimen. Now, after an examination of the original, I find that Prof. Leidy is absolutely correct in his statements; *the posterior articular face of the second sacral is really concave,* and the caudal vertebræ, therefore, have probably all been convex-concave or opisthocœlian. If no bicœlian vertebra appeared, it is probable that in *Compsemys,* which is not known yet in this regard, we will find the same condition.

The pelvis is directly referable to that of *Compsemys,* but is a step in advance towards the Pleurodiran type of structure. The pectineal process is short but massive, directed downwards where it meets the xiphiplastron. The inner branch of the pubis (the true pubis) is broader than in *Compsemys.* The ischium shows distally a curved rough face, which touches the xiphiplastron; there is only a step to sutural union. The ilium is figured by Leidy. The sacral ribs are touching the upper anterior part of the ilium; they are suturally united to each other at this end, the first sacral rib forming the principal portion for the attachment with the ilium. There is a small tubercle on the outer and anterior side of the ilium similar to that seen in the Cinosternidae, but very much smaller.



The sketch gives the ends of pubis and ischium meeting the plastron in *Chelys* and *Baëna.* In *Chelys* the impression of pubis and ischium on the xiphiplastron are separated considerably from each other. In *Baëna* there is a special process extending forward, with the tendency to join the impression of the pectineal process of the pubis.

Nothing is known about the skull and cervicals of *Baëna.* So far I think it best to leave *Baëna* in a special family Baënidae, nearly related to the Pleurosternidae, as proposed by Mr. Lydekker.[1] I believe that the Baënidae belong to a distinct branch of this family, which died out without leaving any successors. It is probable that the Chelydridae developed from forms similar to *Platychelys;* in which the mesoplastron was reduced more and more, until it disappeared; and in which the union between carapace and plastron became looser, until it became ligamentary. That all forms of Tortoise in which the carapace and plastron are united by ligament (*Trionychia* included) are derived from forms which had these parts united by suture, there can be no longer any doubt.

3. ADOCUS Cope.

The genus *Adocus* was established by Prof. Cope in 1868, Proc. Ac. Nat. Sci. Phila., with *Emys beatus* Leidy from the Cretaceous Greensand as type. The character was (Synopsis Batr. and Rept., p. 232). "Anterior and posterior lobe of the plastron abbreviated, narrowed, and not emarginate. Eight paired sternal bones; twelve sternal scuta, the humerals extending anteriorly, the pectorals and gulars both small. A series of plates, "intermarginals, within the marginals, in the sternal bridge. Rib-heads, *i. e.,* the capitula, wanting in the species whose costals have been examined."

To this genus is also referred Leidy's genus *Baptemys* (Synopsis, p. 233), but in the Tertiary vertebrata it appears under the name of *Dermatemys.* I have examined the type of *Adocus beatus* Leidy from the Cretaceous of New Jersey, and can say that it agrees entirely with the specimens figured by Prof. Marsh (l. c.) under the new name *Adocus punctatus.*

The specimen figured by Prof. Marsh was put together by me; it is an absolutely complete shell, both carapace and plastron in splendid condition, and I am very sorry that the latter has not been figured by Prof. Marsh. I give now the characters of *Adocus:* anterior (especially) and posterior ribs of plastron abbreviated, a little narrowed, not emarginate. Eight paired plastrals, twelve sternal shields. Inframarginals as in Pleurodira, not reaching median suture; but intergular divided by a median line. Carapace not emarginate in front, seven neural bones; the seventh separated from the sixth by the intervening seventh and eighth pleurals; one post-neural. Vertebral shields 2–5, longer than wide; costals 2–4, broader than

[1] Lydekker R. Cat. Foss. Rept. Brit. Mus., Part III, London, 1889, p. 205.

long; costals 1, extending over the peripherals; costals 2–4, placed entirely on the pleurals, cervical shield very small. Rib-heads of pleuralia very short, resembling somewhat those in the Cinosternidae. Dorsal 10, with a well-developed rib which is suturally united distally with the eighth pleural; pelvis free from carapace and plastron.[1]

Baptemys Leidy is a distinct genus related to *Adocus;* it differs by the presence of a complete series of neural bones from both *Dermatemys* and *Adocus;* from *Adocus* it differs besides in the entirely different arrangement of the costal shields. The nuchal has a lateral process, the hyoplastron stands between periph. 2 and 3 and is only very little connected with the first pleural. It may be characterized in this way:—

Anterior and posterior lobe of plastron abbreviated and much narrower, not emarginate. Eight paired plastrals, probably twelve sternal shields; inframarginals. Carapace not emarginate in front. A complete series of neural bones. All costal shields extending over peripheral bones.

Agomphus Cope (*Amphiemys* Cope)[2] belongs also to this group and is near *Adocus.* It contains the stoutest tortoises known; the bones of the plastron of a specimen about a foot long may be nearly an inch thick. In all essential characters it agrees with *Adocus,* but the anterior and posterior lobes of the plastron are even more narrowed than in *Baptemys,* the cervical shield is more developed as in *Adocus,* the nuchal has costiform processes which reach to the second peripheral, piercing the first; something similar we see in *Dermatemys.* The sternal bridge is shorter than in *Adocus;* it reaches from the fourth to the eighth peripheral. In all these three forms eleven peripheralia are present.

The only living form that can be compared with these tortoises is the Central American genus *Dermatemys,*[3] which represents a

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[1] I once believed that the ilium was suturally united to the eighth pleural, but the suture was only the suture for the rib of the tenth dorsal.

[2] Cope E. D. A new species of Adocidae from the Tertiary of Georgia Pal. Bullet., 25, p. 2–4. Baur, G., Osteologische Notizen über Reptilien. Fortsetz. 4, Zool. Ang., 291, 1888.

[3] This genus is rare in museums, especially in the form of skeletons; the only complete skeleton I know of is preserved in the Zoological Museum of Basel; the Academy of Natural Sciences of Philadelphia is in possession of a skull; the Smithsonian Institution of shells of various ages; but I do not know of a single complete skeleton in this country; there is also no skeleton in the British Museum,

distinct family. But this genus shows considerable differences in the plastron. It is much emarginate behind, and the arrangement of the dermal shields is also different. I follow, therefore, Prof. Cope in adopting his family name Adocidae for this group.

This family may be characterized thus: *Adocidae;* Anterior and posterior lobes of plastron more or less attenuated and shortened, never emarginate behind. Twelve pairs of plastral scutes; inframarginals; no mesoplastron; neural bones complete or interrupted behind. Pelvis free from carapace and plastron.

as far as I know. This genus is very common in some parts of Central America, especially Guatemala; but all my numerous efforts to get specimens from there have been so far without success. A similar rare Central American genus is *Staurotypus*, of which I know complete skeletons only from Stuttgart, Basel and the British Museum at London.

THE SUMMER BIRDS OF HARVEY'S LAKE, LUZERNE CO., PENNA., WITH REMARKS ON THE FAUNAL POSITION OF THE REGION.

BY WITMER STONE.

The present paper is based upon field notes made during a collecting trip to Harvey's Lake in the mountains of Pennsylvania, June 15th to 20th, 1891. The trip was undertaken with a view to ascertaining what species of birds passed the summer in this part of the Alleghanies and to determine what faunal belts were here represented. I am greatly indebted to my friend Mr. Stewardson Brown with whom I made the trip, for assistance in various ways.

Harvey's Lake is situated in the northern portion of Luzerne Co., Pennsylvania, just south of the main ridge of the Alleghanies, some nine miles north of the valley of the east branch of the Susquehanna River. The lake has an elevation of 1250 ft. above the sea level while the mountains immediately around it rise 100 to 150 ft. higher. The sheet of water is irregular in shape about eight miles in circumference and somewhat over two miles in length.

The eastern side is thickly wooded with hemlock forests while the western banks have been cleared in many places for some distance back from the lake. Several low meadows and swamps extend back between the tracts of deep wood, which, together with the recent clearings furnish variety to the surroundings. The country about the lake seems divisible into three districts as regards the character of the birds.

(I.) First the deep hemlock wood which is interspersed with Birch, Linden, Aspen and Sugar Maple with an undergrowth of Laurel and Viburnum. Here were found the Hairy and Pileated Woodpeckers; Wood Pewee, Scarlet Tanager, Red-eyed Vireo, Golden-crowned Thrush; Black-throated Blue, Black-throated Green, Blackburnian and Magnolia Warblers, Winter Wren, Brown Creeper and Hermit Thrush, while on the edges of the thick wood were the Junco, Canada Warbler and Wood Thrush.

The Hermits far outnumbered the Wood Thrushes and as a rule occupied the higher and deeper portions of the forest while the latter frequented the immediate border of the lake. Sometimes, however, they could be heard singing almost side by side.

(II.) The second district includes the open ground and old clearings on the edge of the lake and about the houses, and was characterized by the presence of the Pewee, Song Sparrow, Chipping Sparrow, Yellow Warbler, Crested Fly-catcher, Kingbird, Baltimore Oriole, Goldfinch, Indigo Bird, Cedar Bird, Barn Swallow, Catbird and Robin. Of these the first four were the most abundant while many of the others were represented by only a few pairs.

(III.) The third district comprises the clearings which occupy mainly the lower country extending back from the meadows, though in some places they reach well up among the higher hills and are steadily encroaching on the forest. Here the most prominent species were the Mourning Dove, Towhee, Chestnut-sided and Black and White Warblers, Maryland Yellow-throat and House Wren, while a few Flickers, Brown Thrashers and a single pair of Chats were seen.

As all the birds found at the time at which this trip was taken may safely be regarded as breeding and settled for the summer, the distribution of the various species furnishes one of the best means of ascertaining the faunal areas or life zones which are represented about the lake. The difference in elevation between the lake itself and the tops of the ridges immediately surrounding it is so slight that it is not possible to draw a line at any altitude which would indicate a division between a higher or boreal and a lower or more southern faunal belt, though on the southern slope of the mountains the limitation of certain species to higher and others to lower altitudes would undoubtedly be apparent. The fauna about the lake is, however, by no means homogeneous throughout and both northern and southern elements are present, but the former seem restricted to the deep hemlock forest and the latter to the open clearings.

The region as a whole may be considered as situated in what is known as the Alleghanian faunal belt, with a strong tinge of the Canadian fauna in the deep forest and a slight Carolinian element in the lower clearings.

Of the whole number of birds which came under our notice, twenty-nine, or rather more than half of the species, have a wide distribution during the breeding season and occur throughout the Carolinian, Alleghanian and Canadian zones, so that their presence is of no special significance in studying the faunal position of this region.

Of the remainder, eight are characteristic of the Canadian fauna: Junco, Black-throated Blue, Canadian, Blackburnian and Magnolia Warblers, Winter Wren, Brown Creeper and Hermit Thrush.

Four are common to the Canadian and Alleghanian zones but breed no farther south: Yellow-bellied Sapsucker, Chestnut-sided and Black-throated Green Warblers, and Black-capped Chickadee.

Twelve do not breed north of the Alleghanian zone, many of them being decidedly more typical of the Carolinian: Mourning Dove, Black-billed Cuckoo, Whip-poor-will, Baltimore Oriole, Field Sparrow, Towhee, Indigo Bird, Scarlet Tanager, Catbird, Brown Thrasher, House Wren and Wood Thrush.

Many of these were represented by only a few pairs and the Tanager was the only species which could be said to be abundant. But one species, the Yellow-breasted Chat, was typical of the Carolinian fauna and but a single pair was found.

As regards the number of individuals, the more northern species, or those included in the first two lists, far outranked those of the last list, so that although the number of species seems nearly equal, the boreal element was really more prominent than would appear from the lists.[1]

Upon examination of the flora of the region about Harvey's Lake we also find a marked boreal element. It is difficult, however, to designate which species are characteristic of the Canadian zone and which of the Alleghanian as the limits of the distribution of plants are much less clearly defined than is the case with birds.

The most characteristic plants which distinguish this mountain region from the Carolinian belt which occupies the southeastern portion of Pennsylvania are:

Anemone acutiloba.	*Geum rivale.*
Coptis trifolia.	*Lonicera ciliata.*
Actæa alba.	*Sambucus pubens.*

[1] It should be noted that the species given in the first list as representing the Canadian element are not the most typical species of this fauna. In reply to an inquiry regarding their breeding range, Dr. J. A. Allen writes me that they all "breed sporadically below what we regard as the southern border of the Canadian fauna and may be considered rather more southerly in breeding range than some of the other Canadian species. At the same time they are not to be regarded as Alleghanian, at least where they occur in numbers." The same fact is true in regard to the plants, as will be seen below. Many of those most typical of the Canadian flora are absent while there are at the same time a number that are hardly to be considered as Alleghanian.

Viola rotundifolia.
Viola canadensis.
Oxalis acetosella.
Acer pennsylvanicum.
Tiarella cordifolia.
Ribes lacustre.
Circæa alpina.
Rubus strigosus.
Rubus odoratus.
Rubus triflorus.
Prunus pennsylvanica.
Ilex monticola.
Viburnum lantanoides.
Pyrola secunda.
Populus grandidentata.
Populus tremuloides.
Betula lutea.
Habenaria orbiculata.
Clintonia borealis.
Trillium erectum.
Trillium erythrocarpum.
Streptopus roseus.
Taxus baccata canadensis.

A few of these, such as *Coptis trifolia, Viola canadensis, Tiarella cordifolia, Ribes lacustre, Circæa alpina, Trillium erectum* and *Trillium erythrocarpum,* are mentioned by Dr. Merriam in his provisional list of plants characteristic of a Canadian flora[1] (Mammals of the Adirondacks p. 26) but most of the others are doubtless to be considered as Alleghanian.

Many of the plants most typical of the Canadian flora, including the Black Spruce (*Abies nigra*) which with *Abies fraseri* seems so clearly to mark the limits of the Canadian belt in the lower Alleghanies[2], were entirely absent about Harvey's Lake.

On the whole the character of the flora seems to but substantiate the conclusions already reached from a study of the birds, namely that the Harvey's Lake region must be considered as situated in the Alleghanian zone with, however, a very strong tinge of Canadian forms. Doubtless in the higher parts of the North Mountain just over the Wyoming County line, still more pronounced Canadian elements would be found in the flora and fauna, and the same may be said of the Pocono Mountain farther east, where the plants are decidedly more boreal. On the mountain slopes to the south of Harvey's Lake on the other hand, the southern elements will be found to increase as one approaches the valley of the Susquehanna. A list of the birds observed in the vicinity of Harvey's Lake during our stay follows, with brief notes as to their occurrence and abundance.

[1] A few of the plants given in Dr. Merriam's list are common through Southeastern Pennsylvania and New Jersey and can hardly be considered as typically Canadian; such as *Impatiens pallida, Pyrola rotundifolia, Orchis spectabilis, Cypripedium acaule and Smilacina bifolia.*

[2] See Brewster, on the birds of the North Carolina Mountains Auk. Vol. III, p. 97.

1. **Philohela minor** (Gmel.). Woodcock.

One seen in the open clearings.

2. **Actitis macularia** (Linn.). Spotted Sandpiper.

A few on the shores of the lake.

3. **Bonasa umbellus** (Linn.). Ruffed Grouse.

Rather common with young, on the edge of the wood.

4. **Zenaidura macroura** (Linn.).

Common about clearings.

5. **Accipiter velox** (Wils.). Sharp-shinned Hawk.

One or two seen.

6. **Haliæetus leucocephalus** (Linn.). Bald Eagle.

One seen.

7. **Coccyzus erythrophthalmus** (Wils.). Black-billed Cuckoo.

One full fledged young bird was shot near the lake.

8. **Dryobates villosus** (Linn.). Hairy Woodpecker.

The most common woodpecker in the forest region.

9. **Dryobates pubescens** (Linn.). Downy Woodpecker.

A few in the open ground about houses.

10. **Syphyrapicus varius** (Linn.). Yellow-bellied Sapsucker.

One pair breeding on the edge of the thick wood in a low swampy locality.

11. **Ceophlœus pileatus** (Linn.). Pileated Woodpecker.

Common in the heavy timber but very wary and hard to approach.

12. **Colaptes auratus** (Linn.). Flicker.

A few seen in the clearings.

13. **Antrostomus vociferus** (Wils.). Whip-poor-will.

Several were heard about the lake.

14. **Trochilus colubris** Linn. Hummingbird.

Seen several times among the hemlocks and in clearings.

15. **Tyrannus tyrannus** (Linn.). Kingbird.

Several pairs in the open ground.

16. **Myiarchus crinitus** (Linn.). Crested Flycatcher.

A few seen about houses.

17. **Sayornis phoebe** (Lath.). Pewee.

Common all around the lake.

18. **Contopus virens** (Linn.). Wood Pewee.

Very common on the edge of the forest.

19. **Cyanocitta cristata** (Linn.). Blue Jay.

Rather common.

20. **Corvus americanus** Aud. American Crow.

A few along the lake shore.

21. **Agelaius phœniceus** (Linn.). Red-winged Blackbird.

One or two pairs in the marsh at the southern end of the lake.

22. **Icterus galbula** (Linn.). Baltimore Oriole.

Only one pair seen, in open ground about houses.

23. **Spinus tristis** (Linn.). Gold Finch.

Several pairs in open ground.

24. **Spizella socialis** (Wis.). Chipping Sparrow.

Common in open ground.

25. **Spizella pusilla** (Wils.). Field Sparrow.

One or two in open fields.

26. **Junco hyemalis** (Linn.). Slate-colored Junco, or "Snow Bird."

Found mostly on the edge of the forest, but sometimes in the deeper parts. Did not seem very abundant during our stay, though Mr. Brown who visited the locality again on July 4th says that they were then much more numerous.

27. **Melospiza fasciata** (Gmel.). Song Sparrow.

Abundant in open ground.

28. **Pipilo erythrophthalmus** (Linn.). Towhee.

Common in the clearings.

29. **Passerina cyanea** (Linn.). Indigo Bird.

Several pairs in open ground near the lake.

30. **Piranga erythromelas** Vieill. Scarlet Tanager.

Abundant throughout the hemlock woods, singing all day long.

31. **Chelidon erythrogaster** (Bodd.). Barn Swallow.

A few pairs seen about houses.

32. **Ampelis cedrorum** (Vieill.). Cedar Waxwing.

Saw a few small flocks.

33. **Vireo olivaceus** (Linn.). Red-eyed Vireo.

Abundant throughout the forest.

34. **Mniotilta varia** (Linn.). Black and White Warbler.

Common in woods and clearings.

35. **Dendroica æstiva** (Gmel.). Yellow Warbler.

Common on the borders of the lake but seen nowhere else.

36. **Dendroica cærulescens** (Gmel.). Black-throated Blue Warbler.

Common but found only in the hemlock forest.

37. **Dendroica maculosa** (Gmel.). Magnolia Warbler.

Rather common in the hemlocks.

38. **Dendroica pennsylvanica** (Linn.). Chestnut-sided Warbler.

Abundant in the clearings.

39. **Dendroica blackburniæ** (Gmel.). Blackburnian Warbler.

Apparently common but restricted to the hemlocks.

40. **Dendroica virens** (Gmel.). Black-throated Green Warbler.

Rather common in the thick hemlock forest.

41. **Seiurus aurocapillus** (Linn.). Golden-crowned Thrush.

Abundant throughout the forest region.

42. **Geothlypis trichas** (Linn.). Maryland Yellow-throat.

Common but confined to the clearings and open ground.

43. **Icteria virens** (Linn.). Yellow-breasted Chat.

One pair was found in the clearings about a mile southeast of the lake. It was quite interesting to hear this southern species singing on one side of the road while on the other side at the same altitude and not 150 yards away, where the hemlock forests had not yet succumbed to the lumberman's axe, could be heard the song of the Hermit Thrush and the clear trills of the Winter Wren. There are probably but few instances where the breeding ranges of these northern and southern species approach so closely.

44. **Sylvania canadensis** (Linn.). Canadian Warbler.

Quite common in low, swampy ground on the edges of the forest.

45. **Galeoscoptes carolinensis** (Linn.). Catbird.

Rather common in open ground.

46. **Harporhynchus rufus** (Linn.). Brown Thrasher.

One or two seen in the clearings.

47. **Troglodytes aedon** (Vieill.). House Wren.

Rather common in the open ground and clearings.

48. **Troglodytes hiemalis** (Vieill.). Winter Wren.

Common throughout the hemlock forest, singing continually.

49. **Certhia familiaris americana** (Bonap.). Brown Creeper.

Rather common in the forest region.

50. **Sitta carolinensis** (Lath.). White-breasted Nuthatch.

One or two seen.

51. **Parus atricapillus** (Linn.). Black-capped Chickadee.

Common throughout. The difference between the note of this bird and its southern representative, *P. carolinensis*, at the breeding season is very striking and, as suggested by Mr. Brewster, ought to forever settle the question of their distinctness. I have been unable to find any *P. atricapillus* in those parts of Pennsylvania and New Jersey lying south of the mountains except during autumn, winter and early spring, and I do not think that it breeds in these sections.

52. **Turdus mustelinus** (Gmel.). Wood Thrush.

Found only on the edge of the hemlock wood, not common.

53. **Turdus aonalaschkæ pallasii** (Cab.). Hermit Thrush.

Common. Found mostly in the deeper parts of the forest.

54. **Merula migratoria** (Linn.). Robin.

A few pairs about houses, not common.

October 6.

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

Three hundred and seventy-four persons present.

Papers under the following titles were presented for publication :—

"Reptiles and Batrachians of Northern Yucatan." By J. E. Ives.

"A study of the fossil Avifauna of the Equus Bed of the Oregon Desert." By R. W. Shufeldt.

The death of Charles A. Kingsbury, M. D., a member, Oct. 3, 1891, was announced.

October 13.

Mr. Charles Morris in the chair.

Thirty-nine persons present.

October 20.

Mr. Charles Morris in the chair.

Thirty-six persons present.

The death of Mr. George Heuston, a member, September 4, 1891, was announced.

The Committee on the Hayden Memorial Geological Award reported in favor of presenting the medal and the interest arising from the fund to Professor Edward Drinker Cope in recognition of his distinguished services to paleontological science.

October 27.

Mr. Charles Morris in the chair.

Forty-two persons present.

The following papers were presented for publication :—

"Preliminary notice of some minerals from the Serpentine Rocks near Easton." By John Eyerman.

"The Birds of Southeastern Texas and Southern Arizona observed during May, June and July 1891." By Samuel N. Rhoads.

The following were elected members:—J. Harris Reed, H. L. Willoughby, W. L. Zuill, Frank M. Day, Wm. L. Baily and Miss E. Cartlege.

The following was ordered to be printed:—

CATALOGUE OF THE CORVIDÆ, PARADISEIDÆ AND ORIOLIDÆ IN THE COLLECTION OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

BY WITMER STONE.

The family *Corvidæ* as generally understood is a somewhat heterogeneous group leading by gradations from the typical Crows to several other families as the *Paradiseidæ*, *Laniidæ* and *Sturnidæ*; so that it is a difficult matter to decide just what forms should be included within its limits.

In the following catalogue I have excluded the Australian Piping Crows (*Gymnorhininæ.*) Most of them seem to belong with the Shrikes and though *Strepera* approaches the *Corvidæ* it is better to keep it with the other genera than to divide the group as has been done by some authors.

The remaining forms may be arranged in four sub-families:—I. *Dendrocittinæ* the Tree Crows, which seem to lead up to *Pica;* II. *Garrulinæ* the Magpies and Jays; *Pica* representing one extreme and *Garrulus* the other; here are included the great series of Jays of North and South America, and a similar group (*Cissa* and *Urocissa*) from Asia; *Cyanopolius* seems to be intermediate between these and *Pica*. III. *Corvinæ,* the Crows and Nutcrackers, along with the aberrant genus *Picathartes*. IV. *Fregilinæ,* the Choughs, an isolated group which appears to be approaching extinction.

The *Corvidæ* in the Academy collection are represented by 434 specimens, including 109 species and subspecies and 6 types. The whole number of species in the family as here restricted is about 160. The species in the following list are followed by the localities from which the Academy has specimens.

CORVIDÆ.

Dendrocittinæ.

CRYPTORHINA AFRA (Linn.). Senegal.

CRYPSIRHINA VARIANS (Lath.). Java and Sumatra.

PLATYSMURUS LEUCOPTERUS (Temm.). Java and Sumatra.

PLATYSMURUS ATERRIMUS (Temm.).

One specimen with no locality indicated.

DENDROCITTA RUFA (Scop.).

A series from India, Rivoli collection.

Dendrocitta frontalis McClell. India.

Dendrocitta leucogastra Gould. India.

Dendrocitta himalayensis Blyth. India.

Dendrocitta occipitalis (Mull.). Sumatra.

Garrulinæ.

Pica mauritanica Malh.

Male and female from Algeria, Rivoli collection.

Pica pica (Linn.).

Specimens from India, China and Japan. It is quite likely that some of these may represent distinct races but I cannot decide without a larger series.

Pica pica hudsonica (Sab.).

Several specimens from the Columbia river by J. K. Townsend.

Pica nuttalli Aud.

California, and Columbia river, the latter from the Townsend collection.

Cyanopolius cyanus (Pall.). Japan.

Cyanopolius cooki Bp. Spain.

Cissa chinensis (Bodd.). India.

Cissa chinensis minor (Cab.).

One specimen of this race, probably from Sumatra. It is much smaller than the Indian bird, and differs in the markings of the secondaries, the black subterminal band being restricted to a spot on the outer web, while the white terminal band runs but a very little way up the inner web. This may, however, be due to age.

Cissa thalassina Temm. Java.

Cissa ornata (Wagl.).

One specimen of this peculiar species, procured from Verreaux.

Urocissa occipitalis (Blyth.). India.

Urocissa erythrorhyncha (Gm.).

One worn specimen which seems to belong to this species.

Urocissa flavirostris (Blyth.)

Several specimens from India.

Calocitta formosa (Swains.).

Several from Mexico, also one from Bell's collection labelled California, which is no doubt an error.

Calocitta colliei (Vig.). Acapulco, Mexico.

Psilorhinus morio (Wagl.).

Several specimens from Mexico, including one with a prominent gray malar patch.

Psilorhinus mexicanus Rüpp.

Two specimens from Nicaragua in the Abbott collection of skins and several mounted specimens including the form described as *P. cyanogenys* by Sharpe but which seems to be merely an individual variation of *P. mexicanus.* (For full discussion of this subject see Stone, Proc. Phila. Acad. 1891, p. 94. "On the Genus *Psilorhinus*.")

The type of *Corvus vociferus* Cabot (from Yucatan) which proves to be a *Psilorhinus* is also in the collection and may be distinct from *P. mexicanus,* as it exhibits several peculiar characters. (See the article just referred to.)

Uroleuca cyanoleuca (Max.).

One specimen from Brazil. This bird seems to be a derivitive of the *Cyanocorax* stock, with a square tail, the general resemblance between it and *C. affinis* is striking.

Cyanocorax chrysops (Vieill.). Brazil.

Cyanocorax affinis Peltz. Bogota.

Cyanocorax cayanus (Linn.). Guiana.

Cyanocorax cyanopogon (Max.). Brazil.

Cyanocorax mystacalis (Geoff.). Ecuador.

Cyanocorax heilprini Gentry.

Type of the species, "Rio Negro, S. America." This specimen (described by Mr. Gentry, Proc. Phila. Acad. 1885, p. 90.) seems to remain unique. As stated by its describer it unites the characters of the two groups in which the species may be arranged, having under parts for the most part dark purplish and the tail having a white terminal band. It seems to me that we may have in this bird a case parallel to that of *Helminthophila leucobronchialis,* the peculiar hybrid warbler of North America. At any rate a hybrid between such species as *Cyanocorax cyanomelas* and *C. cyanopogon* or *C. cayanus* would, I think, be very near to *C. heilprini* and the apparent extreme rarity of the latter would seem to strengthen the theory of its hybrid origin.

Cyanocorax cyanomelas (Vieill.). S. America.

Cyanocorax violaceus DuBus.

Several specimens from the Rivoli collection including the type of *C. harrisii* Cassin.

Cyanocorax cæruleus (Vieill.). Brazil.

Cyanocorax ornatus (Less.).

Jalapa Mexico from the D'Oca collection, XANTHOURA YNCAS (Bodd.) Bogota.

XANTHOURA YNCAS CÆRULEOCEPHALA (DuBois).

One specimen without locality.

XANTHOURA LUXUOSA (Less.). Mexico.

CISSOLOPHA SANBLASIANA (Lafr.).

Two specimens from the Rivoli collection, one of which has the bill yellow.

CISSOLOPHA BEECHEII (Vig.).

Several specimens from Mexico and one labelled "California" doubtless an error.

CISSOLOPHA YUCATANICA (DuBois).

CISSOLOPHA MELANOCYANEA (Hartl.). Coban, Vera Paz.

CYANOLYCA ARMILLATA (Gray). Columbia.

CYANOLYCA TURCOSA (Bp.). Bogota.

CYANOLYCA VIRIDICYANEA (D'Orb.). Yungas, Bolivia.

CYANOLYCA NANA (DuBus).

Two specimens from Jalapa, Mexico, D'Oca collection.

APHELOCOMA FLORIDANA (Bartr.). Florida.

APHELOCOMA WOODHOUSEI (Baird.).

Collected by Dr. T. C. Henry, on the Rio Grande, New Mexico.

APHELOCOMA CALIFORNICA (Vig.).

Specimens from California, also one collected by J. K. Townsend, Columbia river.

APHELOCOMA SIEBERII (Wagl.). Jalapa, Mexico.

APHELOCOMA SIEBERII ARIZONAE (Ridgw.).

Arizona, Rhoads collection.

APHELOCOMA UNICOLOR (DuBus).

Specimens from Mexico, D'Oca and Pease collections, also the type of *Cyanocorax concolor* Cassin.

CYANOCITTA CRISTATA (Linn.).

Various parts of eastern United States and Canada.

CYANOCITTA CRISTATA FLORINCOLA (Coues.).

Florida, Baker and Rhoads collections.

CYANOCITTA STELLERI (Gm.).

One specimen from Alaska and others with no locality. Some specimens seem nearly intermediate between this and the subspecies *frontalis* but this may be due to change of color from exposure to the light.

CYANOCITTA STELLERI FRONTALIS (Ridgw.). California.

Cyanocitta stelleri macrolopha (Baird.). New Mexico and Arizona.

Cyanocitta stelleri diademata (Bonap.). Mexico.

Cyanocitta stelleri coronata (Sw.).

Jalapa, Mexico, from the D'Oca collection.

Perisoreus infaustus (Linn.).

Several specimens from the Rivoli collection.

Perisoreus canadensis (Linn.). North America.

Garrulus glandarius (Linn.). Europe.

Garrulus japonicus (Schl.). Japan.

Garrulus brandti Everm.

One specimen from the Altai Mts.

Garrulus cervicalis Bonap. Algeria.

Garrulus bispecularis Vig. Himalayas.

Garrulus lanceolatus Vig. Himalayas.

Platylophus galericulatus (Cuv.).

Three adult specimens from Java.

Platylophus coronata (Raffl.).

Adults and young from Sumatra.

Corvinæ.

Picathartes gymnocephalus (Temm.)

One male specimen in fine state of preservation from Guinea, West Africa. This specimen is from the Rivoli collection and the stand bears the following "individu type de la planche de temminck," "preparé par Verreaux."

Gymnocorax senex (Less.).

One specimen from New Guinea.

Corvultur albicollis (Lath.).

Three specimens from South Africa.

Corvultur crassirostris (Rupp.).

Two specimens from Africa.

Corvus frugilegus Linn. France.

Corvus pastinator Gould. Japan.

Corvus capensis Licht. Africa.

Corvus corax Linn.

Several specimens probably from Europe.

Corvus corax sinuatus (Wagl.).

There are five specimens of American Ravens in the collection, one from Kansas, two from California and two from New Jersey, these last from Mr. Cassin's collection.

Corvus hawaiensis Peale.

Two specimens, the types of this interesting species, collected in the Sandwich Islands by J. K. Townsend.

Corvus cryptoleucus Conch. Laredo, Texas.

Corvus affinis Rüpp.

Corvus macrorhynchus Wagl.

Specimens from Himalayas, Java and Sumatra. I cannot make the presence or absence of white bases to the feathers accord with the localities, and have, therefore, not endeavored to distinguish the continental race *levaillanti* from the island form.

Corvus macrorhynchus japonensis Bp. Japan.

Corvus philippinus Bp. Philippines.

Corvus enca (Horsf.).

Several specimens without localities.

Corvus enca violaceus (Bp.). Ceram.

Corvus coronoides Vig. & Horsf.

Six specimens from Gould's collection; from W. Australia, New South Wales, Pt. Essington and Tasmania. Mr. Sharpe recognizes two species of Australian crows in his Catalogue, the principal difference between them being in the color of the eye. Mr. Gould's specimens bears no data on this point, and as I can find no constant differences in their measurements or coloration I refer them all to *coronoides*.

Corvus corone Linn.

A series from Europe and also one labelled, Japan.

Corvus americanus Aud.

A series from New Jersey and Pennsylvania including one of a nearly uniform light gray and another with part of the wings pure white.

Corvus americanus floridanus Baird.

Florida, Rhoads collection.

Corvus caurinus Baird.

Specimens from Washington and Sitka, Alaska.

Corvus mexicanus Gm. Western Mexico.

Corvus ossifragus Wils. Pennsylvania.

Corvus leucognaphalus Daud.

A series from St. Domingo, W. L. Abbott collection.

Corvus monedula Linn. France.

Corvus neglectus Schl. Japan.

Corvus dauuricus Pall. China.

Corvus cornix Linn.

Specimens from France and Egypt and an interesting melanistic form from Italy. The latter is doubtless the result of hybridization between this species and *C. corone* as they are well known to interbreed.

Corvus scapulatus Daud.

Specimens from various parts of Africa and Madagascar.

Corvus torquatus Less.

Three specimens doubtless from South Africa although they bear no labels.

Picicorvus columbianus (Wils.). Western U. S.

Cyanocephalus cyanocephalus (Wied.).

Specimens collected by Dr. T. C. Henry in New Mexico and by F. L. Kern on Fremont's Expedition, 1846.

Nucifraga caryocatactes (Linn.).

Nucifraga hemispila Vig. India.

Nucifraga multipunctata Gould. India.

Fregilinæ.

Coracia gracula (Linn.). Abyssinia.

Pyrrhocorax pyrrhocorax (Linn.).

Several specimens, without locality.

PARADISEIDÆ.

The Academy collection contains 79 specimens of Birds of Paradise representing 25 species and includes three types. The whole number of species now recognized is about 45.

I. Epimachinæ.

Ptilorhis paradisea Sw.

A series from New South Wales, Gould collection.

Ptilorhis victoriæ Gould.

One specimen, labelled Australia.

Ptilorhis magnifica (Vieill.).

Three specimens two of which are the types of *Ptilorhis wilsoni* Ogden (Proc. Phila. Acad. 1875, p. 451). Dr. Ogden afterwards states (op. cit. 1876, p. 182) that the feet upon which he founded one of his characters belonged to another bird. It is strange that this was not noticed before as the birds are distinctly labelled " les pattes sont du Cassicus persicus." With regard to the extent of metallic feathers on the neck and breast, I think that this is merely due to the manner of mounting; the specimen of *P. magnifica* is poorly stuffed and the breast feathers are laid over one another in several layers while in the specimens described as *P. wilsoni* they are separated as far as possible and naturally cover a much greater space and the breasts are well filled out, which makes quite a contrast.

SELEUCIDES ALBA (Gm.). Three males. New Guinea.

EPIMACHUS SPECIOSUS (Bodd.).

Three males and one female. New Guinea.

Paradiseinæ.

ASTRAPIA NIGRA (Gm.).

Male and female. New Guinea.

PARADIGALLA CARUNCULATA (Eyd. & Soul.). New Guinea.

PAROTIA SEFILATA (Penn.). Two males. New Guinea.

LOPHORHINA SUPERBA (Penn.).

One male. New Guinea.

PARADISEA APODA Linn. Several males.

PARADISEA MINOR Shaw.

A series of males and females from New Guinea.

PARADISEA SANGUINEA Shaw. One male.

CICINNURUS REGIUS (Linn.).

Three males and one female probably from New Guinea.

DIPHYLLODES MAGNIFICA (Penn.).

Three males from New Guinea.

SCHLEGELIA WILSONI Cass.

One male, the type of the species. This specimen is thought by Mr. Sclater to be also the type of Bonaparte's *Diphyllodes respublica*, and this name has frequently been used for the bird. Mr. Sharpe in his "Catalogue of Birds" refers Bonaparte's name to the *Rhipidornis gulielmi-tertii* (Meyer), and thus adds to the complication. It seems to me absolutely impossible to tell what bird Bonaparte intended by his very brief description "fasciculo e plumis elongatis nuchæ rubris" and I think anyone would be justified in passing over such a description as this and adopting for each species the first clear diagnosis which, in the case of the present bird, is that of Cassin.

XANTHOMELUS AUREUS (Linn.). New Guinea.

PHONYGAMA KERAUDRENI Less. Cape York, Australia.

MANUCODIA CHALYBATA (Penn.). New Guinea.

MANUCODIA ATRA (Less.). New Guinea.

Ptilonorhynchinæ.

PTILONORHYCHUS VIOLACEUS (Vieill.).
A series from New South Wales, Gould collection.
AERULŒDUS VIRIDIS (Lath.).
New South Wales, Gould collection.
CHLAMYDODERA MACULATA Gould.
Types from New South Wales, Gould collection.
CHLAMYDODERA NUCHALIS (Jard. & Selb.).
Series from Pt. Essington, Australia, Gould collection.
SERICULUS MELINUS (Lath.).
Series from New South Wales, Gould collection.

ORIOLIDÆ.

The *Oriolidæ*, including the genus *Sphecotheres* which has been placed here by Mr. Wallace and Mr. Sharpe, comprise about 35 species, of which the Academy collection contains 22 represented by 97 specimens including one type.

ORIOLUS ORIOLUS (Linn.).
A series of 14 specimens from Europe and Africa.
ORIOLUS KUNDOO Sykes.
A series from India, Boys collection.
ORIOLUS AURATUS Vieill.
A series from Africa.
ORIOLUS TENUIROSTRIS Blyth. India.
ORIOLUS MACULATUS Vieill.
Two specimens without locality.
ORIOLUS CHINENSIS Linn.
Four specimens from the Philippines.
ORIOLUS MELANOCEPHALUS Linn. India.
ORIOLUS MONACHUS (Gm.). Abyssinia.
ORIOLUS LARVATUS Licht.
A series from Cape of Good Hope.
ORIOLUS BRACHYRHYNCHUS Swains.
Several specimens from W. Africa collected by Du Chaillu.
ORIOLUS NIGRIPENNIS Verr.
West Africa collected by Du Chaillu.
ORIOLUS XANTHONOTUS Horsf. Java.
ORIOLUS FLAVICINCTUS (King.).
Pt. Essington and Green Hill Island, Australia, Gould collection.
ORIOLUS VIRIDIFUSCUS (Heine.). Timor.
ORIOLUS STRIATUS (Quoy & Gaim.). New Guinea.

Oriolus bouruensis (Quoy & Gaim.). Bouru.

Oriolus viridis (Lath.).

Five from Rivoli collection and three from New South Wales, Gould collection.

Oriolus affinis Gould.

The validity of this species is doubted by Sharpe in his Catalogue of Birds, as the British Museum at that time had no specimens. It is undoubtedly distinct from the other Australian species as is clearly shown by the four type specimens in the Academy collection from Pt. Essington. The differences which distinguish this species from *O. viridis* are exactly as stated by Gould. The average length of bill (exposed) is in *O. affinis* 1·28 ins., and in *O. viridis* 1·03 ins. The wing in *O. affinis* measures 5·65 ins., and in *O. viridis* 5·90 ins.

Sphecotheres maxillaris (Lath.).

Three specimens from New South Wales, Gould collection.

Sphecotheres flaviventris Gould.

One specimen from Cape York, Australia, which probably came from Gould. It bears a label giving in addition to the locality, etc. "*Sphecotheres* new sp." so it may be the type of the species.

Sphecotheres viridis Vieill.

Two specimens from Timor.

NOVEMBER 3.

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

Forty persons present.

A paper entitled "On a new genus of Vespertilionidæ," by Harrison Allen, M. D., was presented for publication.

The Influence exerted by the Tongue on the Positions of the Teeth.—DR. HARRISON ALLEN invited attention to the influence exerted by the tongue in determining shapes and relations of the teeth. In hypertrophy of the tongue in the human subject it has been found that the lower teeth are thrown forward and are widely separated from each other. It is reasonable to infer that in lower animals where the tongue is used for prehension that a similar inclination in the tongue to change the teeth to a horizontal, from a vertical position, takes place. In some of the more remarkable examples of the use of the tongue, as for example in the Edentata, the teeth are widely separated from each other, and in most forms are entirely absent from the front of the jaws. Dr. Allen remarked that in the Cheiroptera a similar tendency as above expressed appears to operate. In slender-jawed, long-tongued types, as exemplified in the genera *Macroglossa* and *Glossophaga*, the teeth are imperfectly developed in the front of the upper jaw and nearly concealed by mucous membrane, while laterally compressed and widely separated from each other on the sides. In the genus *Rhynchonycteris* the front upper teeth are reduced to minute filiform movable organs which would appear to have no value in the seizing or the preparing of food, but in all probability are simply performing the offices of organs of touch and as such are used at times when the tongue is protruded to determine possibly its course and direction.

NOVEMBER 10.

Mr. GAVIN W. HART in the chair.

Thirty-six persons present.

On Bows and Arrows and other Implements found among the Arctic Highlanders.—DRS. BENJAMIN SHARP and WILLIAM E. HUGHES exhibited some bows and arrows which they had collected while on the West Greenland Expedition of 1891. As far as they had examined the literature these articles had not been before found in the possession of the Arctic Highlanders. The Nares Expedition obtained an imperfect arrow from one of the deserted settlements. The quiver exhibited contained the bow and arrows. It was made of seal-skin, from which the hair had been removed. The two main pouches, the shorter containing the arrows and the longer containing the bow, were united by a flat piece of skin to which was attached a small pocket to hold seal-carriers, etc. A sling to carry the whole was made of raw hide, to which was attached a small handle of wood. The pouch containing the bow was open and allowed the end to protrude. It measured twenty-seven inches in length. That for the arrows had a movable cap to keep the arrows from slipping out and measured with the latter twenty-one inches. The small pocket was about six inches square.

The bow consisted of seven pieces. Three pieces formed the length and were made of the antler of the reindeer. On each side of joints made by placing the long pieces together, were lashed two pieces of bone. On the outside (the outer curvature of the bow when strung) was a long thin piece and inside a short thick piece. The lashings were of sinew placed over the joint. The ends of the long piece outside, which extended much over the short piece inside, were secured by a few turns of sinew around the antler portion. On the outside were secured about twelve pieces of plaited sinew, which served to strengthen the bow when bent. When the bow was strung, the outer surface presented three curves, one concave on each side of the middle convex one. The bow was unstrung by pulling the cord, which consisted of raw-hide, around toward the outer curvature, so that when the operation was complete the string bent the bow in a direction opposite to that when strung. The length of the bow measured on the string was thirty-one inches; the two end pieces of antler, eleven and a half inches; middle piece of antler, eight inches; outer piece of bone over the joint, six inches; inner piece, two and a half inches,

The arrows were of four kinds, but all had wooden shafts. The commonest kind (*a*) had the head of one piece of iron or steel, probably a knife blade, the handle having been pounded down thin and driven into the wood of the shaft, with an outside seizing of sinew, made from the muscular coat of the stomach of the walrus. The head in this form of arrow was oval. On one such arrow, secured by Dr. R. N. Keely, was stamped "Dr. Hayes, 1860," and was without doubt made from a knife-blade. Another kind of arrow (*b*), was but a modification of the first, the head had been broken from the "neck" and then riveted or lashed fast to it. A third kind of arrow (*c*), was similar to the first, except that the head was of ivory instead of iron, and lashed to the shaft by two bevelled edges. The fourth kind of arrow (*d*), represented a type quite different from any of the others. It consisted of three parts:—the wooden shaft, a bone neck, in which was inserted and riveted a triangular piece of iron or steel. Measurements of the arrows:—the (*a*) pattern measured seventeen to eighteen inches in length; wooden shafts, twelve to fifteen inches; breadth of head, three quarters of an inch; (*b*) pattern (one arrow), length twenty-three inches; shaft, seventeen inches; length of leaf of head, two inches; breadth of same, three quarters of an inch; (*c*) pattern, length, seventeen and one quarter inches; shaft, thirteen and three quarter inches; ivory head, four and three quarter inches; breadth of head, one half of an inch; lap of bevel, three quarters of an inch; (*d*) pattern, length, twenty-eight inches; shaft, fifteen inches; bone neck, six inches; length of iron head, one and a half inches; breadth at base, seven-eighths of an inch; one and a half inches lost in lap of bevel and set of the head.

Some of the arrows were feathered, but not all; never more than two feathers, about five inches in length being lashed to the shaft. These lay flat to the shaft, which at this end in all the arrows was flattened. When the arrow was about to be discharged the plane of the feathers would be parallel to that of the string. At the notch of all of the iron-headed arrows and some of the ivory tipped ones, there was a seizing of sinew to keep them from splitting. The release was what is known as Mediterranean release, three fingers being placed on the string, and the arrow held between the first and second. In all probability the bow and arrow are used only in hunting the reindeer, many antlers and skins of which were observed in the possession of the natives.

A child's bow was also exhibited, measuring on the string ten and three quarter inches. This had only a single curve and was strung by a piece of sinew.

Two bow drills, such as are used by the natives to drill bone and ivory were also exhibited. The bow of one of these (*a*) was made of a curved piece of ivory, the other (*b*) of the rib of the reindeer. One drill (*a'*) was made of a thick piece of wood, in one end of which was inserted an awl; the other end was pointed. When the native showed how this was used he held the end opposite the awl in his mouth, moving the bow with his right hand and holding the bone to be drilled in his left. The other drill (*b'*) was pointed as the first, but the awl was inserted in a piece of bone and this lashed to the wooden handle. There was in addition in one of the drill outfits (*b*), a piece of ivory (*b''*) which fitted conveniently in the hand, or could be held in the mouth. On one side a cavity made to receive the drill, so that greater pressure could be exerted thereon. Length of ivory bow (*a*) measured on the chord of the arc was twelve and a quarter inches; the drill (*a'*), nine and three quarter inches; wooden part, eight and three quarter inches. Length of bone bow (*b*), fifteen and a half inches; bone part three inches, from which the awl projected one inch. The ivory hand piece for drill was three and one quarter inches long by one and a quarter inches broad. The depth of the cavity was one half inch.

Dr. Sharp also described a kayak procured at Cape York. He called attention to the difference of the model of this one and that of one procured at Godhaven. The kayaks of Danish Greenland, as is well known, are pointed at both ends and have a marked sheer, the bow and stern both peaking considerably; they are also rounded on the bottom and deck. The Cape York boat is constructed as are other kayaks, of a frame of wood over which is stretched a covering of seal-skins sewed together, the hair first having been removed. The workmanship on the Cape York boat was much more clumsy and heavier than on those of Danish Greenland. The bow, which was the highest part, was pointed, and rose but little from the general line of the boat, and from here it sloped gradually to the stern, which was rounded and its end did not rise above the level of the deck, in fact the boat had no sheer. The boat was much broader in proportion than the Danish ones and distinctly flat-bottomed, the deck also was very nearly flat. The hatch, or "man hole," was polyhedral instead of being circular, and as far as the party could determine no apron, such as used by all the Danish Greenlandeis, was employed. In fact the model was similar to the kayaks in use by the Esquimos of British America.

The entire length of the boat was eighteen feet and one inch, and fourteen feet on the keel; from the bow to the forward part of the hatch was nine feet and eight inches; length of hatch, two feet; from after part of the hatch to the end of the stern, six feet and five inches. The sides, amidships, were nearly parallel, and measured in breadth about one foot and nine inches. The perpendicular depth at end of keel forward, which was two feet aft of the point of the bow was twelve and a half inches; half way between the bow and hatch, eleven inches; at half way between hatch and stern, nine inches, and at the after end of the keel two feet forward of the end of the stern, five and a half inches.

The Danish kayak is broadest forward of the hatch, and from here it tapers both to the bow and stern. The kayak has not, heretofore, been mentioned by explorers as being in use among the Arctic Highlanders. This term is restricted to those natives living on the shores of Greenland at and north of Cape York to Etah, near the southern edge of the Humboldt glacier. They, however, have the word kayak in their vocabulary, and their possession of boats probably depends on their supply of wood. Dr. Kane's guide, Hans Friederick, remained with the Arctic Highlanders and married one of their people. The winter following was severe and he and his wife were so pressed for food that they were compelled to eat the kayak which he had brought from Danish Greenland. The two kayaks observed at Ittiblu or Netlik in Barden's Bay, approached the model of the Danish Greenland boat, and it is probable that they are made after the model of the boat which was in the possession of Hans Friederick.

Dr. Hughes spoke of an ivory model of a kayak which he had seen in the museum at St. John's, Newfoundland, on the return of the West Greenland Expedition. It had been brought from Lancaster Sound by Captain Jackman, who presented it to the museum. Its shape was similar to that of the Cape York kayak, as well as of those of British America, having the broad rounded stern and flat bottom and deck.

NOVEMBER 17.

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

Thirty-four persons present.

A paper entitled "On new and hitherto unfigured Japanese Mollusks," by H. A. Pilsbry was presented for publication.

The deaths of S. R. Knight M. D., a member, November 13 and of John C. Jay, a correspondent, November 15, were announced,

A New Meteoric Iron from Garrett County, Maryland.—DR. A. E. FOOTE announced the discovery of a new meteoric iron from Garrett county, Md., about twelve miles from the P. O. of Lonaconing, not far from the boundary of Pennsylvania. It was ploughed up about three or four years ago by a boy in a field. According to an analysis by Dr. Koenig it contains over eleven per cent. of nickel and cobalt, the proportion of cobalt being very high.

It is one of the best octahedral etching irons known, being even more characteristic than most of those that have been used for printing directly on paper. Besides the striking reticulated octahedral structure it shows a large number of secondary lines regularly disposed with reference to the principal marking. These I believe to be similar to those described by Prof. J. Lawrence Smith, in a Wisconsin meteorite, under the name of Laphamite markings. The original weight was forty-five ounces, but it has been reduced by analysis, cutting, polishing, etc., to thirty-six and a half ounces. The locality is especially interesting as being one of the very few discovered in the middle or eastern states.

The following is Prof. J. Lawrence Smith's description of the Laphamite markings on the Wisconsin iron, which would apply equally well to the Garrett County Siderite, "The Widmannstättian figures are (*a*), bright metallic, with convex ends and sides; (*b*), of a darker color are the other markings, usually smaller, and with the sides and ends concave.

The material of which these dark figures are composed seems to have enveloped the lighter colored portion, which serves to make the dark lines so beautifully conspicuous. A good pocket-glass will show that the dark figures are striated with lines at right angles to the bounding surfaces. When the figure is nearly square the lines extend from each of the four sides, but when much elongated, they are parallel to the longer sides. Often these lines do not reach the middle of the figure, where only a confused crystallization can be detected. In the interior of the elongated figures the lines are quite irregular, often running together, and showing a striking resemblance to woody fiber. The nature of these markings may be easily understood. They indicate the axes of minute columnar crystals, which tend to assume a position at right angles to the surface on cooling."

The Newest Species of West Indian Land Shells.—Mr. H. A. Pilsbry exhibited specimens of *Helix* lately received, among them *Helix Caymanensis* Maynard, from Little Cayman island. *Helix Maynardi*, a new species, was described as follows:

H. (Plagioptycha) Maynardi. Shell nearly-covered umbilicate, depressed, rather thin. Spire slightly convex, apex obtuse. Surface sculptured with prominent thread-like striæ in the direction of growth lines; pale fleshy-whitish, having a supra-peripheral chestnut zone and numerous bands of a lighter brown both above and below. Whorls $4\frac{1}{2}$, convex, the first smooth; sutures impressed; last whorl rounded at the periphery, deeply descending in front. Aperture transversely oval, oblique; outer lip slightly expanded, slightly thickened within; baso-columellar lip reflexed, nearly straight, the columella thickened by a strong callus within, which is more or less truncated below. Alt. 8, greater diam. $13\frac{2}{3}$, lesser 12 mill.

Bahamas.

This is one of those species lying between *Plagioptycha* and *Hemitrochus*. It resembles the form described by me as *H. Brownii* in the surface-sculpture, which is decidedly coarse, as in *H. Albersi*. The brown bands of the surface are visible on the face of the thickened and slightly expanded lip.

Helix (Hemitrochus) xanthophaes. Shell small, subglobose, solid, narrowly rimate. Spire low-conoid, the apex obtuse. Surface shining, having irregular growth-lines more conspicuous just below the suture. Streaked with reddish-chestnut on a pale isabelline ground, having an inconspicuous paler line at the periphery and a dark band just above it, the latter sometimes obsolete. Whorls 4, separated by slightly impressed sutures, the last whorl obtusely angular at the periphery, slightly descending in front. Aperture half-round, oblique; peristome not in the least reflected, thickened within. Columella steeply sloping, straight, forming an obtuse angle with the basal margin; its upper two thirds forming a triangular reflexed plate nearly concealing the umbilicus.

Alt. $6\frac{1}{4}$, greater diam. 8, lesser $7\frac{1}{3}$ mill.

Inagua, Bahamas.

This is the smallest species yet known of the *Hemitrochus* group of Helices. It has the same general coloring as the var. of *H. varians* figured by Dr. A. Binney in Terr. Moll. III. pl. xlvi, lowest fig., but the streaks are of a rich reddish-chestnut. It is, in coloring, very similar to the form of *H. Milleri* which I have figured on pl. 32, fig. 40 of the Manual of Conchology, 2d series, vol. V. From this species, which is its nearest ally, the *H. xanthophaës* is distinguished by its much smaller size, smoother surface, more flatly and angularly reflexed columella, etc.

Specimens of a new *Macrochlamys* were exhibited and described as follows:

MACROCHLAMYS STEARNSI, n. sp. Shell depressed, very bright and polished, straw-colored, subopaque. Surface polished, the growth lines not conspicuous. Spire but little raised, almost plane, consisting of 4 whorls, the last one very rapidly widening. Base convex, concave at the axis. Suture narrowly margined below. Aperture wide-lunar, oblique, silvery-white inside, the white extending to within about 3 mm. of the acute, thin lip edge. Umbilicus very narrowly perforated, the perforation half-covered by a small triangular reflection of the columella.

Alt. 7, greater diam. 13, lesser diam. 10½ mm.; oblique alt. of aperture 7, width 8 mm.

Habitat, Kalgan, North China. (Frederick Stearns, 1891.)

NOVEMBER 24.

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

Forty-nine persons present.

A paper entitled "On a Fin-back Whale (Balænoptera) recently stranded on the New Jersey Coast," by Edw. D. Cope, was presented for publication.

The death of John Turner, a member, August 19, was announced.

Chapter I of the By-Laws was amended by the addition of Article X:—"No member shall be eligible to the office of President for more than four consecutive years."

Richard Rossmässler, Elizabeth Head and Harriet Head were elected members.

The following were ordered to be printed:—

REPTILES AND BATRACHIANS FROM NORTHERN YUCATAN AND MEXICO.

BY J. E. IVES.

The reptiles and batrachians enumerated in this paper were collected in the northwestern portion of Yucatan and in the lowlands and highlands of southeastern Mexico during the early months of 1890 by the Academy's Expedition to these regions. The Expedition was in charge of Professor Angelo Heilprin, and the writer, who was one of its members, is indebted to him for the opportunity of working up the herpetological collection.

The portion of Yucatan visited by the Expedition has a dry limestone soil, and the vegetation is consequently more or less dwarfed. The months of February and March, when it was visited, form part of the dry season and very little terrestrial life was apparent. The lizards, however, were an exception to this condition of things, being fairly abundant. There are no streams or rivers in Northern Yucatan, the only sources of water supply being natural or artificial cisterns in the limestone rock in which the rain water is collected. It is therefore not a good place for the development of batrachian life. The two species of frogs and one of the species of toads collected, were found near artificial water-tanks on haciendas.

The varied character of the southeastern portion of Mexico proper is too well known for it to be necessary to say anything in regard to it.

A sketch map of the northern portion of Yucatan, published by Mr. H. A. Pilsbry in his paper on the land and fresh water mollusks collected by the Expedition, on page 310 of this volume, shows the localities at which specimens were collected.

The author wishes to express his thanks to Professor E. D. Cope for his kind aid in the identification of some of the species enumerated.

YUCATAN.

Chelonia mydas L.

A skull found on the beach at Progreso.

This species is captured in large numbers for commercial purposes by the fishermen of Progreso.

Thalassochelys caretta L.

A large skull from the beach at Progreso.

Sceloporus torquatus Wiegmann, var. **mucronatus** Cope.

A female from Tekanto.

Sceloporus variabilis Gray.

A male from the Port of Silam.

Cnemidophorus sexlineatus L.

A female from Tunkas.

The dorsal scales are much smaller than in any specimens of this species in the collection of the Academy, being only about half the size. The white bands are very narrow and very sharply defined. The median dorsal area which is usually either partly or wholly of a lighter color than the adjacent areas between the light bands on either side of it, is of the same color as these, i. e., nearly black. This median dorsal area is also narrower than in the specimens which I have examined, being of the same width as the areas, between the second and third bands, on either side of it. There are faint traces of a light band along the middle of this area. The unusually dark coloration of the back is continued upon the head and the dorsal surface of the base of the tail as dark olive. The head is narrower in the region of the nasals and internasal, and slightly longer than in the specimens which I have examined. There are also seven or eight superciliaries instead of five or six. It is 50 mm. long from the end of the snout to the vent, and 160 mm. from the end of the snout to the end of the tail.

Ctenosaurus cycluroides (Wiegmann) Bocourt.

Four specimens of this species which is common throughout the dry limestone country of northwestern Yucatan were collected at Tekanto. They agree with the *C. cycluroides* of Bocourt[1] which is very likely merely a variety of his *C. completa*[2]. It is probable that they represent the same form as the specimen from Yucatan identified by Professor Cope in 1866 as *C. pectinata* of Wiegmann[3].

Anolis, sp?

A female from Tekanto, allied *A. cupreus* Hallowell.

Anolis acutirostris, n. sp.

Head rather acute; from snout to ear slightly longer than tibia; about once and a half times as long as broad; forehead slightly concave; frontal ridges very short; a few scales on the snout

1. Miss. Sci. Mex. pp. 143—145.
2. Id. pp. 145 and 146.
3. Proc. Acad. Nat. Sci. Phila., 1866, p. 124.

keeled; eyes large; scales of the supraorbital semicircles of moderate size, keeled, separated by two or three rows of scales; nine or ten enlarged supraocular scales, in two longitudinal rows anteriorly and three posteriorly, the posterior ones keeled; the second scale of the inner row of the supra-oculars much enlarged, separated from the supraorbital by a row of small scales; occipital smaller than the ear opening, separated from the supraorbitals by four or five series of scales; loreal rows seven; seven upper labials to below the center of the eye, ear opening large, vertically oval. Gular appendage moderately developed in male; gular scales smooth. Body not compressed. No dorso-nuchal fold. Dorsal scales sub-hexagonal, juxtaposed, those along the vertebral line the largest and keeled, passing gradually into the much smaller granular scales of the flanks; ventrals much larger than the dorsals, sub-circular, feebly keeled. The adpressed hind limb reaches half way between the eye and the nostril; 13 or 14 lamellæ under phalanges II and III of the fourth toe. Tail subcylindrical; covered with large, equal, strongly keeled scales.

Grayish above, with a pinkish tinge. A few scattered blotches of brown on the anterior portion of the back. Upper surface of the snout brown. Lower surfaces white, becoming a light brown on the under surface of the head and limbs. Limbs and tail with dorsal surface irregularly banded with darker. Dorsal and ventral surfaces of the body with a metallic lustre.

	mm.
Length of head (from end of snout to ear-opening),	10.5.
Width of head,	7.
Length of body (from ear-opening to vent),	27.
Length of fore-limb,	16.
Length of hind-limb,	32.
Length of tibia,	9.

A male, collected at Citilpech.

This species is allied to *Anolis cupreus* Hallowell, from Central America.

Dryophis fulgidus Daudin.

A single specimen from the ruins of Labna, near Tabi.

Leptognathus brevifacies Cope, Proc. Acad. Nat. Sci. Phila., 1866, p. 127.

A single specimen from Citilpech.

Rana virescens (Kalm) Cope, **Rana halecina** Kalm. Var. **austricola** Cope, Bull. U. S. Nat. Mus. 34, p. 398–399, 1889.

A specimen collected near a water tank on a hacienda, near Izamal, Yucatan, apparently belongs to this variety of *Rana virescens*. The dorsal surface is dark grayish brown with still darker color markings; the ventral surface white, more or less mottled with brown. Mottlings very close on the throat, more scattered on the under surface of the limbs, and very faint on the belly. Color markings of the dorsal surface very similar to variety *brachycephala* Cope. Dorsal surface of the head and the anterior portion of the back darker than rest of the body, almost obliterating the color markings of this region. Head large, broader than long; breadth to length as five to four; contained three times in the length of the body. Diameter of tympanum about two-thirds of the diameter of the orbit. Inter-orbital space about two-thirds as wide as an upper eyelid. First finger longer than the second. Two phalanges of the fourth toe free. Extended hind limb reaching a little beyond the tip of the snout. Vocal vesicle present.

Leptodactylus labialis Cope.

Cystignathus labialis Cope, Proc. Amer. Philos. Soc. Vol. XVII, p. 90, and Vol. XVIII, p. 269.

Leptodactylus caliginosus Brocchi, Miss. Sci. Mex., Batr. pp. 17 and 18, Pl. V. fig 1.

Four specimens obtained near a water trough on a hacienda near Tekanto, Yucatan. They closely resemble the specimen figured by Brocchi under the name of *Leptodactylus caliginosus*. There are two irregular series of spots between the lateral glandular folds upon the dorsal surface, which are more or less confluent. The adpressed hind limb reaches to the eye, or between the eye and the nostril.

Bufo marinus L.

Single specimen from the court-yard of a house at Ticul.

Bufo valliceps Wiegmann.

Three specimens collected near a water-tank on a hacienda near Tekanto.

In these specimens, which measure from 56 to 66 mm. from tip of snout to vent, the inter-orbital space is not much broader than the upper eyelid.

Mexico.

? **Sceloporus gratiosus** Baird & Girard.

A young specimen from San Andres Chalchicomula, on the Mexican plateau at the base of Orizaba (8200 feet.)

Sceloporus microlepidotus Gray.

Three males from an elevation of 13,000 feet on the volcano of Orizaba.

A male from the gardens of Chapultepec, near the city of Mexico.

A young specimen from a height of 11,200 feet on Iztaccihuatl.

Sceloporus scalaris Gray.

Four males and two females from Peñon, east of the city of Mexico.

Sceloporus variabilis Gray.

A male from the town of Orizaba.

Anolis sp?

A small specimen, labeled "Mexico."

Phrynosoma Douglassi Bell.

A young specimen from Zumpango.

Eutænia insigniarum Cope, Proc. Am. Phil. Soc. Vol. XXII, p. 172.

Two specimens from Lake Chalco, and two from Lake Patzcuaro.

The specimens show that this species is somewhat variable. In one of the specimens from Lake Patzcuaro there is a well defined dorsal band of the width of three scales. In the other specimen from the same locality and in those from Lake Chalco, it is more or less imperfect. The lateral band also appears to be more or less variable; in one of the specimens from Lake Chalco, being obliterated

The following notes in regard to the specimens will illustrate their variable features. It will be observed that the specimen showing the greatest amount of variation (No. 4) is a female. Possibly the varietal characters of this specimen may be generally characteristic of the female of this species.

(1) From Lake Patzcuaro.

Total length 1000 mm; of tail 240 mm.

Gastrosteges 162. Urosteges 77.

Dorsal line faintly indicated. Three scales wide; lateral line more or less imperfect. Male.

(2) From Lake Patzcuaro.

Total length 905 mm; of tail 215 mm.

Gastrosteges 165. Urosteges 77.

Dorsal line well marked, three scales wide; lateral line imperfectly developed. Male.

(3) From Lake Chalco.

Total length 780 mm; of tail 170 mm.

Gastrosteges 170. Urosteges 78.

Dorsal line indistinct, indicated by a band of three to five lighter scales; lateral line well marked. Male.

(4) From Lake Chalco.

Total length 900 mm; of tail 195 mm.

Gastrosteges 157. Urosteges 67.

Dorsal line not to be distinguished except by the absence of any dark markings upon the three rows of dorsal scales, upon which it is found when present; lateral line obliterated by the irregular dark markings of the sides. Female.

Streptophorus Sebæ Duméril et Bibron.

One specimen from the forest of San Juan.

Bufo Monksiæ Cope.

Three specimens from Zumpango, about 19 mm. in length.

Rana Montezumæ Baird.

One specimen from the plateau.

Amblystoma Mexicanum Shaw.
Siredon Mexicanum Shaw.

Numerous specimens of the Axolotl were obtained at Lake Chalco.

PRELIMINARY NOTICE OF SOME MINERALS FROM THE SERPENTINE BELT, NEAR EASTON, PENNSYLVANIA.

BY JOHN EYERMAN.

The serpentine belt and contact rocks have already supplied no less than twenty-one mineral species and varieties, many of which occur very sparingly and are represented, perhaps, by a half dozen specimens of each. This belt appears in Warren County, N. J., and crossing the Delaware River about one-quarter of a mile north of Easton, extends south-westerly, a distance of three miles, thinning out at both ends. The southern contact of the belt is a grayish-blue limestone of uncertain age, no determination having been attempted on account of the absence of fossils; it seems probable, however, that it belongs either to the *Chazy* or *Calciferous*. The north contact of the belt is formed by a ridge of syenite and gneiss, this ridge forming the Weygatt Mt., which nowhere along the entire extent of three miles attains a greater base width than 2500 to 3000 feet. North of this ridge is seen the same limestone, which forms the southern contact of the serpentine belt.

The following minerals were all found in very limited quantities, so that an extended account must be reserved for some future time, only qualitative determinations being made on account of this lack of sufficient material.

Hydromagnesite: This occurs as a beautiful snow-white incrustation on the talc-serpentine rocks near the supposed south contact.

Graphite: In small flakes, it is found disseminated through the talc-serpentine rocks at several localities along the belt. It is also found on quartz at Marble Hill, N. J., one mile north of Phillipsburg.

Topaz: A few small prisms of this mineral have been found near the north contact along the Delaware River. Color, dirty cream-yellow, almost transparent.

Chalcopyrite: A small sphenoid of this mineral was observed associated with malachite, imbedded in the calciferous talc.

Pyrite: Cubic forms of this sulphide of iron are quite abundantly disseminated throughout the talc-serpentine at many places along the belt.

Pseudomorphs: Some interesting forms of limonite and turgite pseudomorphous after cubic pyrite have been found associated with the pyrite. A peculiar bronze colored mineral, also apparently after pyrite, was observed, but unfortunately not in sufficient quantity for determination.

Calcite: Some beautiful specimens of the variety Iceland spar were obtained at Sherrer's old quarry, on the Delaware River road. This locality has also furnished some silky-white specimens of aragonite.

Muscovite: This mica has been found in considerable quantities at two localities (both in the *Archaean*) one near Low's Hollow, N. J., six miles north-east of Easton and on the Lehigh Mt., one mile from Bethlehem, Pa.

Orthoclase: This feldspar has been found at three localities in the Archaean, (*a*) near Low's Hollow, N. J., (*b*) on the Weygatt Mt. north of Easton, (*c*) near Redington, six miles from Easton, associated with allanite and tourmaline.

DECEMBER 1.

Rev. H. C. McCOOK, Vice-President, in the chair.

Forty-seven persons present.

A paper entitled "Echinoderms and Crustaceans collected by the West Greenland Expedition," by J. E. Ives, was presented for publication.

DECEMBER 8.

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

Fifty-two persons present.

A paper entitled "On some new Unionidæ," by H. A. Pilsbry, was presented for publication.

The death of Dom Pedro de Alcantara, Emperor of Brazil, a correspondent, the 6th inst., was announced.

Change of Name of a Genus of Bats.—Dr. Harrison Allen proposed that the name *Vesperus* should be restricted to the Lepidoptera and that the genus of bats that has heretofore been known by this name be in future designated as the genus *Adelonycteris.*

DECEMBER 15.

Dr. CHARLES SCHAEFFER in the chair.

Twenty-seven persons present.

DECEMBER 22.

Dr. GEO. H. HORN in the chair.

Twenty-eight persons present.

A paper entitled "Contributions to the Life-Histories of Plants, No. VII," by Thomas Meehan, was presented for publication.

The death of Henry C. Gibson, a member, the 20th inst., was announced.

DECEMBER 29.

Rev. H. C. McCOOK, D. D., Vice-President, in the chair.

The following were ordered to be printed:—

A NEW GENUS OF VESPERTILIONIDÆ.

BY HARRISON ALLEN, M. D.

Through the courtesy of Dr. J. A. Allen I have recently had an opportunity of examining the type of *Histiotus maculatus* which was described by him in the Bull. Am. Mus. Nat. Hist. III, No. 2, p. 195, Feb. 20th, 1891.

Dr. Allen believed that this striking form belonged to *Histiotus* on the ground that the shape of the ears and of the muzzle, as well as the disposition of the membranes, were of the same general type while the teeth were the same in number. In my opinion these statements require modification. A minute first upper premolar is to be seen in the rather large space between the canine and the second premolar, thus separating Dr. Allen's species from *Histiotus*, in which a single upper premolar is present. Together with this peculiarity I find that the general characters of the skull, the teeth and the wing membrane are like those of *Corynorhinus*. Indeed, it may be said to be a Plecotian genus without muzzle processes,[1] and since with these peculiarities the new form possesses but two premolars in the lower jaw, it is quite distinct. I, therefore, propose to describe it as follows:

EUDERMA nov. gen.

Ears three-fourths length of the forearm, broad at tip, united by a small membrane. Internal basal lobe well defined. Internal basal ridge extends nearly the entire length of the auricle. External border simple, entire, without scallops. The external basal lobe well defined, simple, not recurved, hairy on outer surface. Auricle greatly constricted opposite base of tragus to which it is attached; no external basal ridge. Tragus elongate but scarcely narrowed at tip, little more than one-third the length of the auricle, straight or slightly convex on inner border, moderately convex on outer border; basal notch shallow indeterminate, no basal lobe. Muzzle simple, depressed in middle; glands on the side rudimental not club shaped; nostril entire oval without cornu.

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[1] Dr. Allen informs me that he had no opportunity of comparing this species with *Corynorhinus* and naturally inferred that it was in alliance with the well-known big eared bat from South America.

The auricle is marked with numerous transverse striæ at outer two-thirds excluding the tip. The inner border and tip fringed with short hair, a sparse growth occupies the inner surface of the auricle from the inner border of the internal basal ridge.

Membranes. The thumb disposed to be flexed, the membrane extending to the base of the first phalanx. A distinct hem extends between the thumb and second digit. The second digital interspace 3 mm. wide. Metacarpal bones distinct on palmar aspect. Palmar folds at fifth metacarpal two in number. The terminal cartilage of the fourth digit axial. Foot one-seventh of the length of the fore-arm. Tail as long as the forearm, tip exsert.

The markings on the membranes are as follows. In the fourth interspace the predigital nerve arises midway along the fifth metacarpal and the post digital from the distal fourth of the fourth metacarpal bone. Oblique tibial lines four in number. The inter-femoral membrane entire, ample, marked by ten well-defined complete transverse lines. Intercostals twelve in number ranging obliquely outward and upward.

Fur. The admirable description by Dr. Allen may be supplemented as follows: Black and white hues arranged in a manner unique in Cheiroptera. Dorsum with fur of a prevailing black—the hair being uniformly long and unicolored excepting at the base of the ears, over the shoulder blades, and at the rump, where the hair is white. The clumps on the ear are unicolored; those on the shoulder blades have hair with basal half, black; that on the rump is intermingled with black but otherwise the hair is as on the shoulder blades. The nape of the neck, crown and base of the ears, where they join the crown, of a more rusty black than that of the dorsum generally. This arrangement is limited by the low band which unites the ears, the face is sparsely covered with blackish hairs, the lips at the sides are whiskered; the spaces about the eyes are naked. The under surface of the body with white as its prevailing color, the basal portion of the fur everywhere being black excepting where the large ear extends down on the side of the neck. In this region, viz. (the upper half of the neck), the hair is pure white and unicolored and continuous above with the basal ear clumps. The lower half of the side of neck is black throughout. A faint white line extends across the shoulder to unite the clumps on the shoulder blades to that of the ventre. The fur otherwise black at basal two-thirds, apical third, white. The arm at its basal third, black. The extent of the white portion diminishes from above downward. Membranes everywhere naked.

Skull. Brain-case, low, quadrate, the height one-half the bimastoid diameter. The metencephalon as long as mesencephalon and pro-encephalon. Sagittal crest rudimentary, does not extend beyond a line answering to the middle of the zygoma—the remaining portions of the posterior temporal crest widely separated—the anterior not defined. Dorsum of face-vertex with a shallow concavity which is not sharply defined; orbit with inflated inner wall and rugose elevated upper border; lachrymal tubercle marked. Infra-orbital canal short; the foramen on line with interval between second premolar and first molar. Line of the upper margin of the anterior nasal aperture if produced would intersect the second premolar; tympanic bone apparently incomplete above.

The paroccipital process bold, trenchant; sterno-mastoid impression deeply concave; mastoid composed entirely of the squamosal element. Zygoma quite as in *Corynorhinus*—the squamosal part twice as wide as maxillary; spheno-palatine foramen present, of large size. Occipital crest trenchant. Tympanic bone greatly inflated, equals one-third the length of the skull, not touching basi-occipital, or basisphenoid; excavate anteriorly. It extends to a line which answers to the middle of the glenoid cavity. The mesopterygoid fossa as long as one-third the distance from the posterior palatal border to the incisors. The sphenoidal foramen is at the bottom of a deep recess. The coronoid process is round, small, raised scarcely one-third the height of the ascending ramus; lower border of the horizontal ramus near the angle slightly concave. The angle is raised from the plane on which the mandible rests. Atlas with large foramen for vertebral artery which rests on a mere thread of bone; transverse process semicircular without spine. In common with other cervical vertebræ the tubercle on anterior surface of body is marked. Ribs twelve in number. Both presternum and mesosternum keeled. Scapula much as in *Corynorhinus*. It was mutilated in the single specimen examined.

Upper teeth. Incisors contiguous, slightly inclined toward the median line, but the lateral tooth separated from the canine by a moderate interval. Central incisor cuspidate with a small cuspule projected midway on the posterior surface; a distinct cuspule also arises from the cingulum posteriorly. Lateral incisor one half the size of the central, and cuspidate, with a small cuspule arising from the cingulum on the anterior and a second on the posterior portion. Canine not larger than the second premolar, the buccal surface is abruptly convex. The first premolar is small not wedged in, with complete cingulum. The space between it and canine narrower than that between it and second premolar. The second premolar as long as the canine and slightly fluted. Molars as in *Corynorhinus*.

Lower teeth. Incisors crowded, trifid, i. e., the main cusp possesses a well developed cuspule on each side of the base—the cingulum on the posterior side being large. The first and second teeth overlap for a distance equalling one-half of their diameters. The third incisor retains a posterior cuspule which is larger than the anterior and separated from the main cusp by a wide interval. The canine is small and projects but a slight degree above the incisors. It exhibits a marked cuspule on the cingulum anteriorly.

The premolars are separated by a small interval. The first is smaller than the second, distinctly trifid and contiguous to the canine. The second is much larger and trihedral. The molars as in *Corynorhinus*, the apicies of cusps acicular; the lingual surface of hypoconid is trifid.

NEW AND HITHERTO UNFIGURED JAPANESE MOLLUSKS.

BY H. A. PILSBRY.

The forms noticed below, and illustrated upon the accompanying plates, were collected in Japan by Mr. Frederick Stearns, of Detroit, Michigan, and placed in the writer's hands for study. So rich in animal life are the Japanese waters, that we may still expect novel and beautiful forms of mollusks for many years to come, from that quarter.

The illustrations are due to the liberality of Mr. Stearns.

Thylacodes medusæ n. sp. Pl. XVII, XVIII.

A large species, nearly always living in clusters, attached generally to shells. The young form an irregular spiral, the whorls of which rest prone upon the base of attachment. As the tube increases in diameter it becomes carinated on the lower outer portion, or the part corresponding to the "shoulder" of the whorl in a regularly spiral gasteropod. At this stage the whorls become more laxly coiled, and when not too closely clustered, present the appearance of such planorboid forms as *T. masier* Dh., *T. atra* Rouss, etc. This stage is shown in the cluster pictured on pl. XVI. The subsequent growth is erect and but slightly spiral, the tube generally contracting slightly in diameter, and cylindrical in form. The sculpture consists of narrow longitudinal cords at rather wide intervals, the spaces being occupied by a variable number of threads, (usually three) of which the middle one is larger. Irregular growth-lines crenulate the longitudinals. This sculpture is normally developed upon all sides of the tube. Upon the latter part of the free portion it is often subobsolete.

The aperture is circular in adult shells, at right angles to the tube, and white within. The external surface is of a pale brown tint.

No internal septa were found in numerous broken specimens; and although the shells were apparently alive when collected, no opercula were preserved in them, the absence of this organ being one of the characteristics of *Thylacodes*.

The dimensions may be seen in the figures, which are of natural size. The diameter of the tubes at the aperture averages 13 mm.

The embryonic shell, at the time it becomes attached, is bulimiform, glossy and smooth; lying upon its side. The first whorl formed after attachment takes place is perfectly planorboid, showing the nuclear shell in the center.

Locality, Saruga Coast, Japan.

This species differs from *Vermetus imbricatus* Dkr.[1] in lacking the imbricating growth-striæ of that form.

V. imbricatus as figured by Dunker is a planorboid form, like *V. masier* Dh., *atra* Rouss, etc., but it may possibly be an immature shell.

T. medusæ is apparently allied to *V. polyphragmus* Sassi, *V. dentiferus* Lam. and *V. novæ-hollandiæ* Rouss., but it differs from them in having the sculpture developed over the whole circumference of the tube, not confined to its upper surface, or the part corresponding to the base of the shell in ordinary gasteropods, as it is in those species.

The literature of *Vermetidæ* is in a most confused state at present, the labors of Mörch being as remarkable for their obscurity as for their extent, and that is considerable.

Terebra Stearnsii n. sp. Pl. XIX, fig. 5.

Shell very large, slender and elongated. 22 whorls remaining in the specimen described, the upper portion, comprising probably about one-fourth of the entire length, being broken off. The whorls are flattened, having a narrow but prominent shoulder immediately below the sutures, causing the spire to appear narrowly terraced. The sculpture on the body-whorl consists of a narrow, deeply impressed spiral groove, revolving at one-third of the distance between suture and peripheral angle, another less impressed groove below it at the lower third, the spaces limited by these two grooves being smooth save for slight growth-lines. Midway between the lower groove mentioned and the peripheral angle there is a still deeper groove, with one or two impressed spiral lines on each side of it. The base has numerous (about 15) unequal spiral grooves.

The color is soiled whitish with a series of brown spots upon the middle and lower part of each whorl. The aperture is small; columella not obviously plicate, nearly vertical above, strongly curving to the left below. Alt. of the decollated specimen 105, greatest breadth 13½ mm.; alt. of aperture 12, breadth 7 mm. Japan; exact locality unknown.

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[1] *V. imbricatus* has been re-named *Thylacodes adamsii* by Mörch, Proc. Zool. Soc. Lond. 1865, p. 99.

Siphonalia fuscolineata Pse. Pl. XIX, fig. 4.

This is placed among the "unfigured and undetermined" species in Tryon's monograph of the genus. It is allied to *S. longirostris* Dkr., but has a longer spire and much smaller aperture.

Two specimens were collected in the Inland Sea of Japan.

Astralium Japonicum Dunker. Pl. XIX, figs. 6, 7, 8.

The specimens of this species collected by Mr. Stearns attain dimensions far exceeding those of the original specimens, the largest measuring 160 mm. diam. The operculum shows this species to belong to the section *Pachypoma* Gray, as that section is restricted in my monograph of *Astralium*.[1] The operculum is excessively like that of *Astralium inequale*, the type and hitherto the only known species of the section *Pachypoma*.

The specimens were collected on the southeast coast of Province of Kii.

It is very probable that *Astralium Wardii* Baker, recently described, is merely a depressed specimen of *A. Japonicum*.

Vola puncticulata Dunker. Pl. XIX, figs. 1, 2, 3.

The specimen is figured to show the characters of this beautiful species when mature. Dunker's original examples, figured in the Ind. Moll. Mar. Jap., pl. xi, figs. 10, 11, being less than half grown. It is perhaps the most beautiful species of *Vola*, a group remarkable for beauty.

Macrochlamys Stearnsii Pilsbry. Pl. XIX, figs. 9, 10, 11.

Figures of this species are here given. The description will be found on p. 457 of this volume.

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[1] Manual of Conchology, X, p. 221, 242, 1888.

A FIN-BACK WHALE (BALÆNOPTERA) RECENTLY STRANDED ON THE NEW JERSEY COAST.

BY E. D. COPE.

In the month of October of the year 1891, the carcass of a fin-back whale came ashore on the beach in front of the town of Ocean City, Cape May County, New Jersey. The attention of some of the members of the Academy of Natural Sciences of Philadelphia having been called to the circumstance, Professor Angelo Heilprin was authorized to take measures to secure the skeleton for the museum of the Academy. He was successful in obtaining possession of the carcass, and with the aid of Dr. S. G. Dixon of the Academy, was enabled to prepare the skeleton for transportation. This work was supervised by Mr. J. C. Ives of the Academy, to whom I am especially indebted for the accompanying description of the external appearance of the monster.

An examination of the animal on the beach, and a subsequent study of the skeleton on the premises of the Academy of Natural Sciences, has shown that it presents characters of considerable interest to the naturalist. Its first ribs are simple, which circumstance refers it to the true genus *Balænoptera* of Gray and Flower, as distinguished from *Sibbaldius* of these authors. Whether the deeply bifurcate rib characteristic of the latter genus is an abnormality or not, as maintained by Prof. Van Beneden, will claim attention at another time. Meanwhile I give the following description of the external characters, drawn up by Mr. J. C. Ives.

"The following measurements were made by Mr. F. W. True and myself. The whale was lying on its back, somewhat turned to the left side and partially buried in the sand. The measurements of the paired organs were made on the right side which was better exposed than the left.

Length from the tip of the snout to the hinder border of the tail along the middle line of the body, 66 ft., 11 in.

From the symphysis of the lower jaw to the angle of the mouth, along the curve, 16 ft., 10 in.

Distance of the ear behind the angle of the mouth, 3 ft., 6 in.

Length of the ear slit, 2½ in.

Length of the flipper along the central line from the shoulder to the tip, 7 ft., 4 in.

Along the lower margin, 8 ft., 3 in.

Along the upper margin, 6 ft.

Greatest width of the flipper, 2 ft., 2 in.

Distance from the anus to the navel, 10 ft.

Distance from the end of the tail to the anus, 20 ft.

Length of the dorsal fin, 1 foot.

Height of the same, 5 in.

Distance of the dorsal fin from the insertion of the flukes of the tail, 12 ft., 5 in.

Distance from the end of the tail to the end of the corrugations on the belly, 28 ft.

Width of the tail across the flukes, 14 ft., 10 in.

There were about 86 corrugations on the belly.

There were no humps behind the dorsal fin nor within eight feet of the dorsal ridge exposed in front of it.

The epidermis of the entire exposed portion with the exception of the under surface of the flippers was purplish slate color, mottled with large blotches of a lighter tint of the same color; on the under surface of the belly these lighter blotches were streaked with white. The under surface of the flippers, i. e., the surface next the body, was white. Nearly all the epidermis of the flukes had been torn off, but it appeared to have been of the general color of the body."

From the preceding it may be learned that the pectoral fin is about one-ninth the total length, and that the dorsal fin marks a point about one-fourth the length from the posterior border of the flukes to the end of the muzzle. In both these characters it agrees with *Balænoptera musculus.* In the dark color of the inferior surface it differs from this species, and agrees with *B. sibbaldii* Gray. In the white color of the internal face of the pectoral it agrees with the specimen described by me, under the name of *Sibbaldius tectirostris,*[1] and differs from the individual described by Professor T. Dwight[2] as *Balænoptera musculus* which came ashore near Boston, Mass. The under side of the pectoral is described as being black in this whale.

An examination of the osteology gives the following results. Vertebræ; C. 7; D. 15; L. 17; C. 23; total 62. Of the cervicals only the axis has an entire vertebrarterial foramen, and this is enclosed by a wide confluence of the diapophysis and parapophysis.

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[1] Proceedings Academy Nat. Sci. Philada. 1869, p. 17.

[2] Memoirs Boston Soc. Nat. History, II, 1871, p. 203.

The diapophyses are distinct in all of the other cervicals, being slightly decurved and rather elongate, but they do not approach the parapophyses. The parapophyses are long on the sixth cervical, but are totally wanting on the seventh. There are fifteen pairs of ribs. Of these the heads of the first pair are absolutely simple; those of the second, third and fourth, have a well developed head, besides the tuberculum. The scapula has the usual antero-posterior elongation, with well developed acromion and coracoid. The humerus still has the head in the distinct epiphysial stage. The phalanges, commencing with the internal digit (no. 2) number, 4–6–5–3. These were carefully preserved by Mr. Ives, and the number is probably correct, with a possibility that there may have been six phalanges in the fourth digit.

The maxillaries and premaxillaries were removed from the skull in order to facilitate their transportation. The former have the acuminate outline of those of *M. musculus,* rather than that of *M. sibbaldii.* The nasal bones have a parallogrammic superior outline, but are very convex in the fore and aft direction, the surface descending forwards. They are flat posteriorly; at the middle the adjacent edges are raised, but at the distal end the external edges are raised, so that the superior surface is concave in the transverse direction. The mandibular ramus is quite convex outwards, and the coronoid process is very elevated. The angle is separated from the condyle by an oblique groove, but it does not project beyond it. The otic bulla is flat on the internal side, and convex on the external side, the convexity separated by a groove from the internal edge.

Measurements.

	cm.
Length of maxillary above, on premaxillary edge;	376
Length from posterior end of maxillary near nasals to posterior angle of squamosal;	150
Width of maxillary at middle;	50.5
Width of premaxillary at middle;	19
Mandibular ramus; length on curve;	500.5
Mandibular ramus; depth of condyle;	37.8
Mandibular ramus; depth at coronoid;	77
Mandibular ramus; depth at middle of length;	33
Mandibular ramus; width at middle of length;	21
Mandibular ramus; depth at distal end;	29

Otic bulla; diameters	longitudinal;	14
	transverse;	7.2
	vertical at meatus;	10
Scapula; diameters	anteroposterior;	97.5
	vertical;	78
Atlas, transverse diameter (total);		83
Axis, centrum diameters	vertical;	27
	transverse;	38
Diameters diaparapophysis	vertical;	40
	transverse;	30
Vertebrarterial canal, diameters	vertical;	15.5
	transverse;	15.5
Seventh cervical; diameters centrum	vertical;	28
	transverse;	35
Tenth dorsal; diameters centrum	vertical;	29
	transverse;	37
Length diapophysis of tenth dorsal;		39
First caudal; diameters centrum	vertical;	36
	transverse;	42
Humerus	length;	47
	long diameter at middle of shaft;	26
Ulna, length;		90.5
Radius, length;		90
Chord of first rib, including extremities;		130

A comparison of the characters of the skeleton above enumerated leads to the following results. The non-union of the diapophyses and parapophyses of the cervical vertebræ posterior to the second, is remarkable in view of the size of the individual. These processes are confluent distally in the adult *Balænoptera musculus* according to authors, as far as the fifth and sometimes sixth cervical inclusive. They are so in three specimens described by Prof. Flower[1], one by Dr. Murie,[2] and two by Dr. Gray.[3] This is even the case with the young specimen of 48 feet in length described by Professor Dwight. In the very young they are distinct throughout. In the two specimens which were stranded on the Orkney Islands, described by Mr. Heddle, which were also about fifty feet long, none of the cervical apophyses were united except those of the axis, as in our

[1] Proc. Zool. Soc. London, 1869, p. 604.

[2] Loc. cit. 1865, p. 210.

[3] Loc. cit. 1856, p. 187.

specimen. On this and other grounds, Dr. J. E. Gray referred these to a species distinct from *B. musculus* under the name of *B. duguidii.*[1] Later authors have not adopted this species. The cervicals are in the same condition in *Sibbaldius tectirostris* from the coast of Maryland. The same structure is persistent in *B. sibbaldii*, in spite of its great dimensions. It is remarkable that the Ocean City specimen, which is about 67 feet long, nearly the adult size of *B. musculus*, should still retain this character of immaturity. It suggests the enquiry whether there may not be a species of fin-back in the Atlantic possessing characters of both the species *B. musculus* and *B. sibbaldii.*

It has been stated already that the phalanges number 4–6–5–3. Professors Flower and Van Beneden give the numbers for *B. musculus* as 2–5–5–3; a noteworthy difference. Professor Dwight's specimen, however, has 4–6–5–2, which comes much nearer to our specimen. The question arises, are the numbers given to *B. musculus* by the authors quoted, derived from defective preparations? The figure in Gervais and Van Beneden's Osteographie des Cétacés,[3] conveys the impression that a phalange or two has been lost from the digit II. Should the numbers given prove to be correct, the increased numbers of phalanges in the American specimens again points to resemblance to *B. sibbaldii*, where Flower gives the numbers as 4–7–7–4.

In conclusion, it appears that the Ocean City whale agrees with *Balænoptera musculus* in the form of the head, number of vertebræ and ribs, proportions of pectoral fin and position of dorsal fin; but that it differs from this species and agrees with *B. sibbaldii* in the size, color, and in structure of the cervical vertebræ; and that it is intermediate between the two, as described by authors, in the numbers of the phalanges of the manus. It remains to be ascertained whether these characters indicate another species, and if so, whether the names *duguidii* or *tectirostris* are applicable to it.

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[1] Catalogue of Seals and Whales in the British Museum, 1866, p. 144.

[2] Loc. cit., p. 158.

[3] Pls. xii and xiii, fig. 20.

ECHINODERMS AND CRUSTACEANS COLLECTED BY THE WEST GREENLAND EXPEDITION OF 1891.

BY J. E. IVES.

The collection of Echinoderms and Crustaceans obtained by the Expedition of the Academy of Natural Sciences to the western coast of Greenland in the summer of 1891, Professor Angelo Heilprin in charge, was made mainly in McCormick Bay, on the southern shore of Prudhoe Land, in Lat. 77° 40′ N., Long. 71° W. where Lieutenant Peary, in command of the North Greenland Expedition, was left in winter quarters. A few specimens were also collected at localities touched at in the journey to and from this place.

The author is indebted to Professor Benjamin Sharp the Zoologist-in-Charge of the Expedition for the opportunity of working up this portion of the collection.

No new forms were found, but the collection is of some interest on account of the specimens having been obtained much further north on the western coast of Greenland than heretofore. It is also worthy of note that the two Isopods, *Atylus carinatus* and *Themisto libellula*, are the prey respectively of the Eider Duck and the Ringed Seal.

So much has been written upon the arctic fauna that it would be superfluous to make any comments upon the distribution of the species collected, but attention may be drawn to the fact that the more that is known of the marine invertebrates of these regions, the more apparent becomes the general homogeneity of the circumboreal fauna. The collections made by the United States Expedition to Point Barrow, Alaska, have confirmed the evidence in this direction already obtained by the various expeditions to the arctic regions of the North Atlantic, and by the "Vega" during its cruise along the northern shores of Russia and Siberia.

ECHINODERMS.

Amphiura Sundevalli Müller and Troschel.

Amphiura Holbölli Lütken.

McCormick Bay. A single specimen dredged in 3 fathoms of water upon Fucus.

Ophioglypha robusta Lyman.[1]
Ophiura squamosa Lütken.
? *Ophiura fasciculata* Forbes.

McCormick Bay. A number of specimens dredged in 3 fathoms of water upon Fucus.

Ophiocten sericeum Forbes.
Ophiocten Kröyeri Lütken.

McCormick Bay. Four specimens dredged in 3 fathoms of water upon Fucus.

Asterias Grönlandica Steenstrup.

McCormick Bay. A single specimen dredged in 3 fathoms of water upon Fucus.

Asterias polaris Müller and Troschel.

Godhavn, Disco Island. A single specimen collected on the beach.

Strongylocentrotus Dröbachiensis Muller.

McCormick Bay. A single young specimen dredged in 3 fathoms of water upon Fucus.

CRUSTACEA.

Arcturus Baffini Sabine.

McCormick Bay. A single specimen collected on the beach.

Anonyx nugax Phipps.

McCormick Bay. Numerous specimens from about 5 fathoms of water.

Gammarus locusta Linn.

McCormick Bay. Numerous specimens from about 5 fathoms of water.

Atylus carinatus Fabricius.

McCormick Bay. Numerous specimens from about 5 fathoms of water.

Disco Bay. Numerous specimens taken from the stomach of an Eider Duck (*Somateria mollissima borealis.*)

[1] It appears to me questionable whether the species described under this name by Dr. Lyman is the same as the species originally described by Ayres. I have, therefore, merely adopted Dr. Lyman's name provisionally to indicate the species he has described.

Themisto libellula Mandt.

Melville Bay. Numerous specimens from the stomach of a Ringed Seal (*Phoca fœtida.*)

Aegina spinifera Bell.

McCormick Bay. A single specimen from about 3 fathoms of water.

The following annual reports were read and referred to the Publication Committee:—

REPORT OF THE RECORDING SECRETARY.

The meetings of the Academy have been held during the year 1891 without intermission. On no occasion, even in midsummer, has there been lack of a quorum. The co-operation of the several Sections of the Academy has been continued on the appointed evenings with gratifying results. The average attendance has been fifty-two as compared with thirty of the year before. The increase has been due to three or four meetings where the attendance ranged from 183 to 398, due to the special interest of the occasion, such as the Leidy memorial addresses and the reports of the Greenland Expedition. Even excluding these, the attendance has been somewhat greater than that of last year, which itself showed a gratifying increase over former years. Such statistics may be worth recording as they indicate a sustained and increasing interest which can only be due to the number and value of the communications presented for the consideration of the meetings. Subjects distributed over the entire field of natural history have been discussed by Messrs. Leidy, Heilprin, Meehan, Chapman, Horn, Ives, Ryder, Sharp, Pilsbry, Allen, Kœnig, McCook, Woolman, English, Foote, Rand, Martindale, Skinner, Rex, Wingate, Ford, Wilson, Peary, Osborn, Cheston Morris, Trotter, Dall, Rothrock, D. G. Brinton, J. B. Brinton, Willcox, Holman, Stiles, Holt, U. C. Smith, Goldsmith, MacFarlane, Bonsal, Cope and Hughes.

One hundred and forty-three pages of the Proceedings for 1890 and 408 of the volume for 1891 have been issued, the former being illustrated by eight plates and the latter by seventeen. During the same period there have been prepared and distributed to subscribers 631 pages, illustrated by 139 colored plates, of the Manual of Conchology under the auspices of the Conchological Section, while 500 pages of entomological matter, illustrated by 20 plates, have been issued by the American Entomological Society and the Entomological Section of the Academy, thus making a total of 1682 pages and 184 plates supplied to subscribers and exchanges during the year by the Academy through its Publication Committee and its Sections. In this department of its work the Academy is therefore far in advance of any other society in America and is equalled by but few elsewhere.

Thirty-nine papers have been presented for publication as follows:—J. E. Ives 4, H. A. Pilsbry 3, Witmer Stone 3, Charles Earle 2, E. D. Cope 2, Harrison Allen 2, R. W. Shufeldt 2, Edward Bancroft 1, H. C. Chapman 1, H. C. Chapman and A. P. Brubaker 1, J. B. Ellis and B. M. Everhart 1, Edw. Goldsmith 1, John Ford 1, Ashdown H. Green 1, Angelo Heilprin 1, H. F. Osborn 1, W. H. Dall and H. A. Pilsbry 1, G. Baur 1, Charles R. Keyes 1, Jos. Leidy 1, F. Lamson Scribner 1, Geo. A. Kœnig 1, O. C. Marsh 1, Thomas Meehan 1, Geo. A. Rex 1, Theodore D. Rand, Wm. W. Jefferis and J. T. M. Cardeza 1, John Eyerman 1 and Samuel N. Rhoads 1.

Thirty-six of these have been accepted for publication in the Proceedings, two for the Journal and one has been returned to the author. It is to be regretted that the limited means at the disposal of the Publication Committee has rendered it necessary to delay the printing of some of the papers reported on favorably. In common with all the departments of the Academy the Publication Committee feels acutely the necessity for increased resources. It is due, not only to the members of the Society but also to our exchanges, from some of whom we receive more than we give, that papers of value presented for publication be issued promptly and with illustrations worthy of the Academy's position in the scientific world. It is true that the volume of Proceedings about being completed will compare favorably with the greater number of those received in exchange, but we are indebted wholly or in part for several of the plates to contributors and others, and it is most desirable that the Publication Fund should be so increased as to place us beyond the necessity for such assistance.

Thirty-nine members and three correspondents have been elected. During the year the deaths of fourteen members and three correspondents have been announced and the resignations of seven members, namely, F. A. Genth, Jr., John T. Montgomery, Mrs. C. Stevenson, Wm. Gerlach, A. G. B. Hinckle, E. Fronani and S. G. M. Montgomery have been accepted, thus leaving an increase of eighteen in the list of active members at the end of the year.

The death of the President, Dr. Joseph Leidy, April 30, entailed a severe loss, not only on this society but on science everywhere. To his modesty and amiability was due the warm personal affection felt for him by all with whom he was placed in intimate association, a feeling but rarely met with except among those united by blood or by close social ties. Engaged as he had been in the uninterrupted service of the Academy as Librarian, Curator and President for nearly half a century, it is evident that only the possession of rare qualities as a man and a scholar could have enabled him to retain the confidence of a varying constituency during such a prolonged period. A memorial meeting, impressive because of the sincerity of the sentiments of esteem and regard expressed, was held May 12th. The personal history of the deceased President was read with loving appreciation by Dr. Wm. Hunt, his intimate associate since early manhood; the various sections of his widely distributed scientific work were reviewed by Dr. Harrison Allen, Dr. H. C. Chapman, Mr. Joseph Willcox, and Dr. James Darrach, his personal character and services to the Academy being commented on by the Recording Secretary.

In consequence of the repetition and overlapping which is unavoidable in such independently prepared papers, it was deemed advisable that a continuous biographical notice should be presented for publication. This duty, on the invitation of the Academy, was admirably performed by Dr. Henry C. Chapman whose intimate knowledge of the man and his work specially fitted him for the appointment. The photogravure portrait published with the memoir admirably represents Dr. Leidy as he was known to the present generation of Academicians, without indicating any of the changes due to the sickness and exhaustion of his last months of life.

As a further mark of respect to his memory the Academy resolved to leave the presidential chair vacant until the end of the year. His curatorship was filled by the election, June 2, of Dr. Henry C. Chapman who was also placed by the Council on the Library Committee.

Mr. Aubrey H. Smith, a member of the Council, having died April 14th, Mr. Chas. E. Smith was elected to fill the vacancy. He was also appointed on the Publication Committee to fill the vacancy caused by the death of Dr. Leidy.

The formation of an Ornithological Section was authorized May 26. It has since been organized with, it is believed, immediate benefit to the department of the Academy with which it is connected.

The Council appointed Messrs. Angelo Heilprin, J. P. Lesley, Persifor Frazer, W. B. Scott and Benjamin Smith Lyman as the

Committee on the Hayden Memorial Geological Award. On the report of this committee the second medal, together with the balance of interest arising from the Fund, was voted by the Academy October 20th, to Edward Drinker Cope in recognition of the value of his services to geological and paleontological science.

Chapter I of the By-Laws was amended by the addition of Article X:—No member shall be eligible to the office of President for more than four consecutive years.

All of which is respectfully submitted.

EDW. J. NOLAN,
Recording Secretary.

REPORT OF CORRESPONDING SECRETARY.

The Corresponding Secretary respectfully reports that during the past year commencing December 1st, 1890, he has received from sixty-eight Societies, Museums, etc., one hundred and thirty-one notices of the receipt of the publications of the Academy; thirty-two notices from Societies, Museums, etc., of the forwarding of their own publications. There has been received twenty applications to exchange publications, for reports, and asking for missing numbers of the Academy's publications. Twenty-five letters on various subjects, together with four invitations to the Academy and its members to participate in congresses, meetings, etc. have been received and answered. Six notices of deaths have been received.

During the year three Correspondents have been elected and notices to that effect have been forwarded to them; the acknowledgement of one of these has been received. Nine certificates of Correspondentship were forwarded to those elected during the past year, four of which have been acknowledged.

Respectfully submitted,

BENJAMIN SHARP,
Corresponding Secretary.

REPORT OF THE LIBRARIAN.

The Librarian respectfully reports that the accessions to the library of the Academy from November 30, 1890, to December 1, 1891, amount to 4335, an increase of 156 over the additions of the preceding year. They were composed of 3858 pamphlets and parts of serials, 440 volumes and 37 maps, photographs, engravings, etc.

We are indebted to the following sources for this supply.—

Societies,	1586
I. V. Williamson Fund,	976
Editors,	949
Authors,	261
U. S. Department of the Interior,	124
Wilson Fund,	80
U. S. Department of Agriculture,	32
State of Pennsylvania,	32
U. S. Department of State,	23
Benj. Smith Lyman,	20
Chas. P. Perot,	20
Thomas Meehan,	14
H. C. Wood Jr.,	12
H. A. Pilsbry,	11
Minister of Public Works in France,	10
Harrison Allen,	10
California State Mining Bureau,	9
U. S. Treasury Department,	9
Government of Australia,	8
Geological Survey of Pennsylvania,	8
Geological Survey of Russia,	7
British Museum,	6
Geological Survey of Canada,	6
Angelo Heilprin,	6
Geological Survey of India,	6
U. S. War Department,	6
Geological Survey of Brazil,	5
Philip P. Calvert,	5
Chas. E. Smith,	4
Chas. M. Betts,	4
Geological Survey of Missouri,	4
J. P. Remington,	4
Kew Gardens,	3
H. C. Chapman,	3
Geological Survey of Finland,	3
Geological Survey of New South Wales,	3
D. B. McCartee,	2
Geological Survey of Minnesota,	2
Alex. Mucklé,	2
Historical Society of Pennsylvania,	2
Witmer Stone,	2
Clark Maxwell Memorial Committee,	2
East Indian Government,	2
U. S. Department of Labor,	2
Canadian Meteorological Service,	1
U. S. Navy Department,	1
Department of Agriculture, Canada,	1
C. W. Reilly,	1
J. H. Redfield,	1
Geological Survey of Kentucky,	1
Frau G. Vom Rath,	1
Henry Skinner,	1
Norwegian Government,	1
Niagara Commissioners,	1
Geological Survey of Portugal,	1
Geological Survey of New Zealand,	1
Geological Survey of Roumania,	1
Adele M. Fielde,	1
U. S. Coast Survey,	1
Illinois Bureau of Labor,	1
W. J. Fox,	1
Geological Survey of New Jersey,	1
Indian Museum,	1
Geological Survey of Texas,	1
Geological Survey of Arkansas,	1
S. G. Dixon,	1
E. C. Knight & Co.,	1
U. S. Commission of Fish and Fisheries,	1

Twenty-six volumes were obtained by special subscription.

They were placed in the several departments of the Library as follows :—

Journals,	3376
Geology,	182
Botany,	173
General Natural History,	81
Entomology,	58
Ornithology,	53
Conchology,	38
Mammalogy,	33
Anatomy and Physiology,	33
Voyages and Travels,	23
Physical Science,	20
Encyclopedias,	19
Mineralogy,	14
Anthropology,	11
Chemistry,	10
Ichthyology,	9
Herpetology,	8
Medicine,	7
Bibliography,	6
Geography,	3
Agriculture,	1
Unclassified, Government Publications, etc.,	177

The subject catalogue of the entire library was completed and arranged early in the year. It has, of course, been since kept up to date, the accessions being carded and arranged immediately on their presentation.

But few volumes have been bound, all the resources of the Library Committee being required for the purchase of books actually needed by the working members of the Academy and for the continuance of subscriptions to serials and periodicals.

Among the more noteworthy additions recorded is a fine set of Edwards' Botanical Register, a much needed journal, procured by special subscriptions received from Messrs. John T. Morris, Stuart Wood, Alex. Biddle, Charles W. Trotter, Charles Schaeffer and Miss Serena Potts, through Mr. Thomas Meehan.

The "Hortus Siccus Gramineus" of Wm. Curtis, published in London in 1802, was presented in two well-preserved volumes by Dr. Charles R. King and being illustrated, not by figures but by the plants themselves, was transferred to the herbarium.

We are indebted to Mr. Edw. C. Pickering for a fine crayon portrait of the late Dr. Charles Pickering, whose early work in connection with the Academy well merits such commemoration.

Another interesting addition to the society's collection of portraits is a fine oil painting of Alex. Lawson, the engraver, who, although never a member of the Academy, was intimately associated with the founders and should be held in grateful remembrance in consequence of the fine plates prepared by him in illustration of Binney's Mollusks and Wilson's Birds. The picture was presented by his daughter, Mrs. Mary Lawson Birckhead.

A pair of globes bequeathed to the Academy by Mrs. Cecilia Barron Fest have also been received and appropriately placed in the library.

It gives me pleasure to acknowledge the efficient assistance rendered in the current work of the year by Mr. William J. Fox.

All of which is respectfully submitted,

Edw. J. Nolan,

Librarian.

REPORT OF THE CURATORS.

The Curators present the following statement of the Curator-in-Charge as their report for the year 1891:—

The Curator-in-Charge respectfully reports that the collections of the Academy are in much the same condition as they were at the time of the preparation of the last annual report; this condition is, in the main, satisfactory so far as the actual state of preservation of the specimens is concerned, but the limitation of space in the Museum no longer permits of that attention being given to proper display and classification which are so desirable, either from the point of view of the mere visitor or of that of the scientist. Attention has been repeatedly called in these reports to this deficiency, but for the time it has seemed impossible to rectify the defect. The surprisingly rapid growth of the collections, giving evidence of continued and increased interest in the workings of the Academy, has of itself been the chief obstacle to systematization, crowding as it does, all space available in the institution. Relief seems near at hand, however. The generous response of the State to the Academy's application for aid, as manifested in two enactments of the Legislature (sessions of 1888–1889 and 1890–1891) each appropriating $50,000 toward the construction of an addition to the present building, has made it possible for the Academy to practically enter upon a scheme of enlargement, and the close of the present year sees completed the "connecting museum" which is to unite the existing building on Logan Square with the main edifice fronting on 19th street, the early erection of which is anxiously looked forward to. This main structure, the completion of which will mark an epoch in the history of the Academy, will cover a surface area of approximately 23,000 square feet, and nearly treble the available space which the institution now has. The total cost of this structure is estimated, from plans already drawn and approved, at about $200,000, toward which the Academy has now in actual funds and subscriptions, conditional and otherwise, upwards of $80,000 (including the last State appropriation of $50,000.) The generous interest of the citizens of Philadelphia, who have always regarded with pride the foremost institution of the kind in this country, encourages the hope that sufficient will be added to this amount during the coming winter to permit the Academy, through the Board of Trustees of the Building Fund, to contract for the construction of the walls and roof immediately on the opening of the building season. This is earnestly to be desired, and it is hoped that no effort will be spared to attain this end. It should be noted that the foundations for the entire edifice have already been laid.

The connecting building which has just been completed contains the new lecture theatre, with a capacity of 500, and a museum hall, well adapted to an exposition of synoptic natural history. For the present, and until further accommodation is afforded, it will be used to display a "State collection"—a collection illustrative, so far as it is possible in the restricted space which is offered, of the natural resources, principally geological and mining, of the State of Pennsylvania.

The acquisition of a hall designed specially for the delivery of lectures is of importance to the Academy, as it permits of that attention being given to one department of the workings of the institution which its limited accommodation has thus far rendered all but impossible. Heretofore all the lectures prepared under the auspices of the Academy have been delivered in the Library Hall or in one of the east rooms prepared specially for class purposes. The various uses to which it has been found necessary to put the latter room, has ultimately thrown all the lectures into the Library Hall, much to the discomfort, at times, of the special workers and students in the Library, and always to the disadvantage, through lack of adaptability, of the lecturer and his audience. The large attendance at some of these lectures—and equally so at some of the regular stated meetings of the Academy when communications of special interest have been announced—has demonstrated the deficiency of seating capacity, and members as well as visitors have sometimes been obliged to forego the proceedings for want of room. This disadvantage the new lecture hall will rectify. Constructed in the form of a theatre, with raised platforms and gallery, it is well adapted to the wants of an average audience.

The additions to the Academy's collection made during the year are of unusual importance, and it is gratifying to be able to report that they cover about equally all departments. The renewed activity which has manifested itself in certain departments which have, for some time back, been in a condition more or less stationary augurs well for a period of prosperity, and it is not too much to hope that this period will be one of the most promising in the history of the institution. Special attention is in this connection called to the report of the Conservator of the Orinthological Section, Mr. Witmer Stone. From this it appears that the Academy has added to its already vast collection of birds upwards of 1200 specimens, many of them now for the first time represented in the museum. The thanks of the Academy are specially due to Mr. Samuel N. Rhoads, who has generously given upwards of 900 birds, representing the avi-fauna of the southern United States from Florida to California. To the members of the Delaware Valley Ornithological Club, an organization of energetic students recently founded for the prosecution of orinthological studies, the Academy is also under obligations for the gift of a superb collection of nests of Pennsylvania birds, numbering 60 pieces; these nests are taken with their accessories, and thus illustrate a full scheme of avian architecture.

With the sanction of the Academy the Orinthological Section has issued circulars asking for the establishment of a permanent endowment fund for the more efficient management of its department; the substantial response which this effort has already met with encourages the belief that before long the full subscription asked for—$25,000—will be received.

In the department of conchology, which continues to be the most fully represented of any in the Academy, and which still takes rank as the first of its kind in the world, the work of classification and rearrangement progresses with the usual vigor, thanks to the labors of the Conservator, Mr. H. A. Pilsbry, and of his co-workers, members of the Conchological Section and of the American Association of Conchologists. The specimens added during the year are comprised in 1710 trays, so that the total collection of shells, now exhibited, numbers 62,700 trays. The work of the American Association of Conchologists in bringing together a complete and select collection of the mollusca, recent and fossil, of the United States, is being rapidly pushed forward, and there are already represented in the new series 334 genera and 751 species, contained in 921 trays. The following statement from the President of the Association, Mr. John H. Campbell, outlines the work of the organization: "The formation of the collection has met with the most enthusiastic support of the members. Freely contributing specimens, they take a pride in sending only such shells as will do credit to the Association, and it is their confident expectation that before many years the collection will be the finest special exhibit of natural history specimens in America, if not in the world. It already contains several types of new species, many fine examples of species of which the Academy's general collection contained only poor or inferior specimens, and by the addition of the fossil to the living species, it introduces a new feature into American museums. The life history of the American mollusca may be traced from the earliest known forms to the living species, as the collection approaches more and more toward completion." The donations to this collection are from 52 collectors, whose names appear in the list of additions to the museum.

The departments of entomology and botany continue to profit by the valuable services of their special Conservators, Dr. Henry Skinner and Mr. John H. Redfield, who, as in past years, contribute their work gratuitously, for the benefit of the Academy. To these gentlemen a debt of gratitude is due for the great amount of time which they give to the care of the special collections under their charge, and for their efforts to obtain new material for them. In this connection also the Curator-in-Charge would refer to the services of Mr. Thomas Meehan, who for years past has assiduously labored toward increasing the Academy's herbarium and supplying the rare botanical works needed for the study of the plants, himself contributing extensively from his own private purse. The appended list of donations to the herbarium indicates the satisfactory condition of the department of botany.

The additions to the collection of minerals have been somewhat less important than during past years, partly due to the fact that the collections have been steadily nearing completion, thereby rendering it more difficult to procure desiderata, and also to the protracted illness of the Conservator of the Wm. S. Vaux collection, Mr. Jacob Binder, which has prevented that attention being given to the collection which it would otherwise have received. The regular Academy collection of minerals continues to receive attention from Mr. W. W. Jefferis, the Conservator of the Mineralogical Section, and from others associated with that Section.

The accessions in the departments of geology and paleontology are referred to in the report of the Professor of Invertebrate Paleontology. It may not be amiss, however, to refer in this place to the acquisition by the Academy's West Greenland Expedition, among other geological material, of a large mass weighing 260 pounds, and of four smaller masses of the famous Ovifak iron, tellurite or meteorite, the nature of which has given rise to so much discussion among chemists and geologists. The largest mass, while very considerably smaller than either of the three blocks which were secured by the Swedish Government in 1871, exceeds in weight by some fifteen pounds, the Nordenskjöld specimen deposited in the

British Museum. No analysis of the Academy's stone has as yet been made, although numerous requests for permission to make such examination have been received. A more detailed, although as yet only preliminary, sketch of the operations of the West Greenland Expedition has been submitted to the Council, and is appended as a special report.

In departments of the Academy other than those that have been specified, the work of arranging and cataloguing has been steadily, though not rapidly, progressing; this work, under the direction of the Curator-in-Charge, has been in the main carried out by his assistant, Mr. J. E. Ives, to whose efforts, also, and to the liberality of Mr. F. Stearns of Detroit, the Academy is indebted for most valuable additions representing the invertebrate (echinoderm and crustacean) faunas of the Japanese and West Indian Seas. Much new material has also been brought from the latter region by Mr. William J. Fox, who, in the interests of the Academy, spent a month in the early part of the year on the island of Jamaica.

Attention has been called in the last report of the Curator-in-Charge to the deficiencies in the Academy's collection of recent mammalia, which is still, if we except the cabinet of archæology, the weakest department of the museum. Thanks however, to the liberality of the Philadelphia Zoological Society, through the Superintendent of the Gardens, Mr. Arthur Erwin Brown, new material is being constantly obtained, much of it of a kind which it would be difficult to duplicate. The osteological collection, which is already the most extensive in the country, is thus being rapidly increased, and it is hoped that before long it will be sufficiently complete to permit of its being separated into a "type" series, similar to the famous Hunterian Collection of the Royal College of Surgeons in London. Apart from the donations which have been received from the Zoological Society, the department of mammalogy has been enriched by a series of skulls of the larger African quadrupeds, from the region of Mount Kilima 'Njaro, the gift of Dr. W. L. Abbott, a member of the Academy, who is at present exploring the northern wilds of India. Among these skulls are a number of rare types of antelopes. The most important accession of the year to the department of mammalogy, is the complete skeleton of Sibbald's whale (*Balænoptera Sibbaldii*), obtained from a carcass, 68 feet in length, stranded on the New Jersey Coast on October first. To the good will of the Mayor and Town Council of Ocean City, assisted by the generosity of Dr. Samuel G. Dixon, the Academy is indebted for this very rare and valuable specimen, the only one of the kind in this country, and one of four specimens contained in the museums of the world. This is the first recorded occurrence of the species in American waters. The specimen in question has been made the subject of study by Prof. Cope, who has contributed a paper on its structure and peculiarities to the Academy's "Proceedings."

The general routine work of the Curator's department has been conducted as in previous years, no broad departure of plan or method having been considered necessary. The entire collection of alcoholics has been examined, and it is a pleasure to be able to state that less than a half-dozen removals have been found necessary.

It is well to call attention to the defective condition of the roof of the museum, which allows of the accumulation of moisture in the walls, and a penetration of the same into some of the wall-cases, thus rotting the labels and otherwise disfiguring the specimens. It has, indeed, been found necessary to empty a few of these cases, and the contents of others would be removed were there space for their arrangement elsewhere. Repeated attempts have been made to repair the defects of the roof, but the form of construction renders it difficult to do so effectively. The increasing leakages, combined with the heavy cost of the repairs, make it probable that a new roof will have to be provided before many years.

Specimens for study have been loaned during the year to Dr. G. Baur, of the Clark University, Worcester, Mass.; to Mr. Chapman, of New York; to Dr. G. Brown Goode, of Washington; and to Profs. W. B. Scott and H. F. Osborn, of Princeton. The Curator-in-Charge reports the loss of two specimens of the chelonian *Cinosternum Pennsylvanicum.*

The Board of Curators as it was constituted at the time of the preparation of the last annual report, had been in existence since the latter part of 1883, a period of seven years. The removal of one of its members, the President of the Academy, Dr. Joseph Leidy, who occupied the position of Curator for a continuous term of forty-four years, and whose death took place on the 30th of April last, left a vacancy in the Board, which was filled by the election (June 2d) of Dr. Henry C. Chapman. It is needless to comment upon the loss to the Academy which the death of its late President and Chairman of the Board of Curators entails; it is sufficient to say that no one had been for a longer period of time actively identified with its interests, and no one has added greater lustre to the galaxy of names with which the history of the institution is illumined.

Respectfully submitted,

ANGELO HEILPRIN,

Curator-in-Charge.

REPORT ON THE OPERATIONS OF THE WEST GREENLAND EXPEDITION.

As leader of the auxiliary party which accompanied the Academy's North Greenland Expedition to the Arctic Regions, I respectfully submit the following preliminary report of operations:

The combined Expedition, under direction of Civil Engineer Robert E. Peary, left Brooklyn, N. Y., on the steam-whaler "Kite" June 6th, arriving at Sidney, Cape Breton, on the 11th of the same month. After shipping 183 tons of coal, in addition to a remaining 144 tons, the "Kite" headed for the coast of Greenland *via* the Strait of Belle Isle, entering the early ice of the Strait, off Greenly Island, on the 15th. On the 19th the ship left the "pack," and sighted the coast of Greenland, somewhat southwest of Cape Desolation, on the night of the 23d. Godhavn or Disco was made on the 27th, and Upernivik on July 1st. No pack ice of any consequence was met with until a position about opposite the Devil's Thumb (Lat. 74° 40′) was reached, late in the afternoon of July 2d. From this day until the 23d, when we had attained a point somewhat westward of Cape York, the Expedition was virtually powerless in the grip of the Melville Bay ice, and it was only by dint of hard effort that it succeeded in making the North Water. It was during one of the many attempts to force a passage through the ice that an unfortunate accident, the breaking of the right leg, befell Mr. Peary (July 11th). The accident was not considered at the time of such a nature as to materially interfere with the prospects of the Expedition. The entrance to Inglefield Gulf, where Mr. Peary had anticipated establishing his winter quarters, was reached on July 24th, but the presence of a continuous ice-sheet prevented entry, and after due consideration a site was selected on the south side of McCormick Bay, just north of Murchison Sound, in approximate Lat. 77° 43′ N. This Bay communicates with the North Water, and is considered one of the most advantageous sites for wintering on the north coast. It is in the midst of a region where game in one form or another is abundant.

After the virtual completion of Mr. Peary's winter house, the party immediately under my charge, consisting of Dr. Benjamin Sharp, Zoologist-in-Charge, Dr. W. H. Burk, botanist, Dr. W. E. Hughes, ornithologist, Dr. J. F. Holt, zoologist, Mr. L. M. Mengel, entomologist, Dr. R. N. Keely, surgeon, Mr. Frazer Ashhurst and Mr. Alex. Kenealy, turned southward, firing the final salute at 5.30 A. M. of the 30th.

On the southern journey much delay was occasioned by fogs and storms, which interfered largely with the operations of the Expedition. Little ice, beyond freely floating or grounded icebergs, was met with in the traverse of Melville Bay. Cape York was left at midnight of Aug. 3d, and Wilcox's Head, south of the Devil's Thumb, sighted about noon of the 5th. That which occupied us three weeks on the northern journey was thus accomplished in about thirty-six hours on the return. The passage of the Waigat, north of Disco Island, was made on the 8th and 9th of August, and Godhavn reached early on the 10th. On August 23d the last day of the contract with the agents of the "Kite," the vessel steamed into St. Johns, Newfoundland. A margin of but a few tons of coal was left on arrival.

The stopping places of the Expedition in Greenland were: Godhavn, Ovifak (southern shore of the island of Disco), Moder Bay (east shore of the same island), Kudlisaet (north shore, on the Waigat), the Swarte Huk (opposite Skalo Island), Upernavik, the Duck Islands, Cape York (a few miles to the east of the actual cape), Saunders Island, Netlik (the Eskimo settlement on Barden Bay), Herbert Island, and the two shores of McCormick Bay. Collections were made at all of these points.

It is as yet impossible to estimate the scientific results of the Expedition, but a cursory examination of the collections that have been brought back encourages the belief that considerable material that is new to science has been obtained, while the bulk of the collections is new to the Academy's museum. Briefly summarized the collections are approximately as follows:

Department of Ethnology:—1 Eskimo skeleton, 22 Eskimo crania, 2 Eskimo kayaks (one from the region of Cape York,) 2 Eskimo sledges, and a variety of implements, utensils, etc., mainly from the tribe of the Arctic Highlanders.

Vertebrate Zoology.—2 young (white) seals—stuffed, 2 Skulls of seals, 1 Polar bear skull, 2 Walrus skulls, 1 Reindeer skull, 1 Blue-fox skull, 154 specimens of birds, and a collection of eggs.

Marine Zoology.—Specimens obtained in dredgings and otherwise—not yet classified.

Entomology.—444 specimens, exclusive of those collected at Cape Breton, distributed as follows: Hymenoptera 25, Coleoptera 4, Diurnal Lepidoptera 106, Moths 143, Diptera 166.

A number of these, as reported by the Conservator of the Entomological Section, are new to science.

Botany.—A nearly complete collection of all the flowering plants, mosses and lichens found in the region.

Geology.—A full suite of rock specimens from all points touched by the Expedition. Noteworthy among these is one of the large iron-stones (meteorite or tellurite) from the famous region of Ovifak, weighing approximately 260 pounds. While a pygmy in comparison with the giant stones which were secured at the same spot by the Swedish Government in 1871, it is yet considerably larger than the well-known Nordenskjöld specimen in the British Museum. The interest, which from their peculiar construction, attaches to these stones, no less than their exceeding rarity in collections, makes the specimen an exceedingly valuable one to the Academy's museum. The Expedition was further successful in finding a number of other fragments and blocks together aggregating several pounds in weight.

It should be noted that no case of serious illness occurred on the Expedition.

Respectfully submitted,

ANGELO HEILPRIN,

Leader of the West Greenland Expedition A. N. S.

REPORT OF THE BIOLOGICAL AND MICROSCOPICAL SECTION.

During the year 1891 this Section has held eighteen meetings.

Three new members have been admitted: Miss Mary Schively, Mr. Amos. P. Brown and Mrs. Elizabeth S. Bladen.

The following officers have been elected to serve for the ensuing year:

Director, ... Dr. Benjamin Sharp.
Vice-Director, ... John C. Wilson.

Recorder, ...	Harold Wingate.
Treasurer, ...	Charles P. Perot.
Conservator, ...	Dr. George A. Rex.
Corresponding Secretary, . . .	Dr. Charles Schäffer.

Very respectfully submitted,

HAROLD WINGATE,

Recorder.

REPORT OF THE CONCHOLOGICAL SECTION.

Since the last annual meeting of the Section, specimens have been received from forty-nine sources, to the number of 1710 trays and bottles, a detailed list of which will be found in the "Additions to the Museum." In no year since the acquisition of the A. D. Brown collection in 1887, have there been added so many species new to the Academy, more than 800, or nearly one-half of the total number of additions, being species new to us, and between thirty and forty are species new to science. Most of the latter have been described in the Manual of Conchology, the Proceedings of the Academy, and the Nautilus, during the year.

The more interesting accessions are the series of East Indian land shells purchased by the Section, comprising all of the known species of several genera of Helicidæ and Cyclophoridæ, and nearly all of many other important genera, such as Hypselostoma, Diplommatina, Diaphora, Arinia, Opisthosthoma, etc. Our series of fresh-water shells from the African Lake Tanganika has been almost completed by purchases and donations during the year, only a few species and varieties being still lacking.

Through the liberality of Mr. Frederick Stearns the number of our Japanese marine shells has been greatly augmented, and several interesting new forms have been figured and described in the Proceedings of the Academy and the Manual of Conchology. Dr. H. von Ihering, of Rio Grande do Sul, Brazil, has presented thirty-four species of South American Unionidæ which, with two or three exceptions, are new to the collection.

Mr. Anastasio Alfaro, Director of the National Museum of Costa Rica, has sent to the Conservator an interesting collection of eighty species collected by him in Costa Rica. Dr. J. C. Cox, of Sidney, N. S. Wales, has presented twenty-five species of land shells from

Australia, and through Mr. S. R. Roberts, rare species of Cypreæ and Marginella. Our suites of Australasian shells have also been increased by exchanges and gifts from a number of correspondents, Mr. C. T. Musson, forty-one species; Mr. S. W. Wright, twenty-six species, Mr. Chas. Hedley, and others.

Our suites of American shells have been greatly increased by donations from a large number of correspondents of the Conservator, but more especially by the collections of the American Association of Conchologists.

This collection, formed entirely by members of the Association, and constituting an exhibit of mollusks of the United States only, now occupies nine large table cases. 762 trays of specimens have been added during the year, representing nearly as many species. The officers of the Association, John H. Campbell Esq., President, Mr. John Ford, Vice President, and Mr. C. W. Johnson, Secretary, take entire charge of the mounting and labelling of these specimens. More space is already urgently required for this exhibit, and this need is the more imperative because many species in this collection are being *exhibited* for the first time. The regular series of American fresh-water shells of the Academy being for the most part in drawers, frequently several tiers of trays deep, and consequently very difficult to consult.

More space for the display of the Oriental Helices and the Bulimi is also needed. These groups are now in unsightly and inconvenient heaps on account of the lack of case-room. This confusion could be partly remedied by the use of shallow trays for the drawers, in which a large number of small species could be arranged. This plan has been very successfully adopted by the Conservator in the disposition of several thousand trays of Clausilia, Pupa and Cylindrella; and the members of the Museum Committee earnestly recommend that forty or fifty large drawer-trays be procured for the reception of the species of Stenogyra, the smaller operculates, the geographic suites of American Helices and a portion of the Auriculidæ. This will give room for the proper arrangement of the Helices and Bulimi during another year.

Of the current numbers of the Manual of Conchology four parts of each series have been issued since the last report. The families Acmæidæ Lepetidæ, Patellidæ and Titiscaniidæ have been monographed, and in the second series the groups Geotrochus and part of Cochlostyla. The specimens of each group have been identified and relabelled.

The Conservator has been much assisted by Mrs. Pilsbry, who has neatly mounted the specimens presented and studied during the year, over three thousand five hundred trays in all. Mr. Campbell and other members of the Museum Committee have also rendered valuable aid in the Museum.

Respectfully submitted,

H. A. Pilsbry,

Conservator.

REPORT OF THE ENTOMOLOGICAL SECTION.

Much interest has been taken in the work of the Section during the year. The meetings have been fairly well attended, the highest number present at any one meeting being fifteen and the lowest seven. Verbal communications of interest have been made by a majority of the members and reported in the monthly issues of the Entomological News. Nearly four hundred books and pamphlets have been added to the library, some of which were purchased, the majority, however, being either donated or received in exchange. The collections are all in fairly good condition, much work having been done on them by the Conservator and the members interested in the several orders. Many valuable additions have been made to the cabinet, in all about 1369 specimens. The most important additions were received from the Greenland Expedition and from Mr. W. J. Fox who presented much of the material he collected in Jamaica. Rev. Dr. McCook presented a valuable and accurately named collection of European Ants which will be very useful for comparison. Many specimens were received through the agency of the Entomological News which is published by the Section with the financial aid of the American Entomological Society. Volume two of this journal, consisting of two hundred and fourteen pages with ten plates, has been completed. It has steadily grown both in size and circulation and during the coming year twenty-four pages will be published each month, and each number will be illustrated if possible. At the meeting held December 14th, 1891, the following were elected officers to serve during the coming year:

Director, ... Geo. H. Horn.
Vice-President, ... I. C. Martindale.

Recorder, ...	Henry Skinner.
Conservator, ...	Henry Skinner.
Publication Committee, ...	J. H. Ridings, Philip Laurent.

HENRY SKINNER,
Recorder.

REPORT OF THE BOTANICAL SECTION.

The Vice-Director of the Botanical Section has pleasure in reporting that the growth of the Hebarium, which it has been a satisfaction to record in former years, still continues, as is shown by the statement of the Conservator hereunto attached as part of this report.

Stated meetings have been held regularly during the year, and many matters of interest to botanical science introduced, some of which have appeared in the publications of the Academy.

The Section is out of debt and with a balance in its treasury.

The officers for the ensuing year are:

Director, ...	W. S. W. Ruschenberger, M. D.
Vice-Director, . . .	Thomas Meehan.
Recorder, ...	Charles Schäffer, M. D.
Cor. Sec. and Treasurer, .	Isaac C. Martindale.
Conservator, . . .	John H. Redfield.

Respectfully submitted,
THOMAS MEEHAN,
Vice-Director.

Conservator's Report for 1891.—The Conservator of the Herbarium in presenting his report for the year closing November 30, is enabled to congratulate the Academy and the Section upon the improved condition, constant growth and increasing usefulness of its botanical collections.

The accessions during the year have kept pace with those of former years. The total number of species of Phanerogams and vascular Cryptogams received has been 2,496. Of these, 721 species were new to the Herbarium, representing also 72 genera new to us. 605 species are North American, 1,518 are from tropical America, and 373 from the old world. Of the lower Cryptogams, we have received, Mosses, 171 species; Hepaticæ, 40; Algæ, 120; Lichens, 27; Fungi, 201; in all 559 species, which, added to those above mentioned gives a total of 3,055 species.

In the "Additions to the Museum" will be found the usual detailed list, but we may here specify some accessions of special interest. Prof. Rovirosa has continued his explorations of the flora of the Mexican provinces of Tabasco and Chiapas and has sent us 209 species. Mr. Pringle's collections in the northern provinces of Mexico have contributed 291 species. The collections made by Dr. Thomas Morong in South America during the years 1888 to 1890 have furnished us 350 species, including many new and rare species from the desert of Atacama—and others are on the way. Prof. Leopold Krug, of the Royal Botanical Museum of Berlin, has sent us 446 West Indian species, most of them from Porto Rico, and many of them new to science. John Donnell Smith of Baltimore, has made a second contribution of Guatemalan plants amounting to 161 species most of them collected by himself. The Academy's Expedition to Greenland, under the charge of Prof. Angelo Heilprin, furnished 80 species of phanerogamic plants, besides some Lichens. Frank S. Collins of Malden, Mass., has presented 120 species of marine Algæ from the coasts of New England and of California; and a very complete series of the Sphagnaceæ of New England consisting of 28 species and 88 varieties and forms, named by Carl Warnstof, has been contributed by Edwin Faxon and Edward L. Rand.

The plants received have been carefully poisoned and the North American species, with most of those from tropical America, have been mounted. Heretofore the exotic portion of the Herbarium has received but little of this latter attention, so essential to its permanent preservation, but this year the Academy has enabled us to make a beginning, by supplying the necessary mechanical aid.

Several large collections received in years past, such as the Menke Herbarium, the Lea Herbarium and others await similar treatment and incorporation, but cannot receive it until new quarters shall afford us the necessary space.

The various separate cryptogamic collections received during the Academy's long existence, should be consolidated, excepting the published *exsiccatæ*, which it would be better to retain in library form. As this must be a work of time, a temporary index to the species in each division, is of great importance. Dr. Eckfeldt has given us this aid in regard to the Lichens, and Dr. Ida S. Kellar is now engaged in preparing for us this necessary key to our several collections of marine Algæ. May we not hope for an early completion of similar work upon the Mosses, Hepaticæ and Fungi?

Respectfully submitted,

JOHN H. REDFIELD,

Conservator.

REPORT OF THE MINERALOGICAL AND GEOLOGICAL SECTION.

The meetings of the Section with the Academy have been held regularly every other month during the year, in addition to which several distinct meetings have also been held. The attendance has not been large in numbers, the membership of the Section being quite small, but the interest has been considerable and the additions to the cabinet, while not as great as in some former years, have been satisfactory. The Director regrets to say that there do not seem to be many of the younger members of the Academy interested in mineralogy and geology, so that the membership instead of increasing has decreased.

It is proposed during the spring of 1892 to inaugurate a series of excursions, which it is hoped may serve, not only to interest the members, but also to so attract the attention of others not members that they may be induced to become such.

Respectfully submitted,

THEO. D. RAND,

Director.

REPORT OF THE ORNITHOLOGICAL SECTION.

The Ornithological Section was formally organized Sept. 14th, 1891, permission having been previously granted by the Academy.

The primary objects in organizing the Section were the encouragement of ornithological study at the Academy and the improvement and enlargement of its ornithological collections.

The collection numbering some 30,000 specimens is one of the finest in the world, and is probably the best *general* collection in this country, while the large number of type specimens makes it extremely valuable.

The arrangement of the collection is, however, still in accordance with the ideas of forty years ago. That is to say, nearly all the specimens are mounted and crowded into exhibition cases, where they are not only exposed to light and dust but are very inconvenient for study. Until within the past year or two no provision has been made for a collection of skins such as constitutes the most important part of all the great ornithological collections of to-day.

In consideration of these facts it seems of the greatest importance that the large series of duplicates which now crowd the museum cases should be unmounted, leaving of course enough specimens to illustrate all the various types of bird life, as well as a collection of all the species of North American birds in their different seasonal plumage and a complete series of the birds of Pennsylvania and New Jersey with their nests and eggs. The specimens that are unmounted can be placed in air tight cases of drawers where they will be easily available for study and forever safe from the ravages of insects or exposure to the light. The specimens retained in the museum, on the other hand, can be remounted where it is necessary and the old stands can be renewed or repainted. The exhibition series thus improved will undoubtedly prove much more interesting and instructive than the maze of specimens which is now exhibited and which tends to confuse the general visitor. The space gained by the removal of the duplicates will enable the wall cases to be dispensed with and the amount of light obtained in the gallery will be thus greatly increased. The plan outlined is the one that has been adopted in all the large museums and is everywhere heartily endorsed. During the present year part of the North American collection has been renovated in the way above described and the improvement in its appearance is at once appreciated by those who visit the museum.

In addition to the remounting of 900 specimens of North American birds the Conservator has during the past year identified and catalogued the specimens of Icteridæ contained in the museum numbering 460 specimens and, with the assistance of Mr. Wright, has about finished the cataloguing of the Cærebidæ. The catalogue of the mounted collection now reaches number 3920, the families that have been previously catalogued being the Corvidæ, Paradisæidæ, Oriolidæ, Dicruridæ, Campophagidæ, Muscicapidæ and all the families of Raptores.

The collection of skins has been steadily increasing. Starting in 1888 with the collection of Dr. W. L. Abbott it now numbers upwards of 5000 specimens. Of these 2213 have been relabelled and catalogued and the labelling of the remainder will soon be completed. The cases in which this collection is contained are overcrowded and additional ones are greatly needed to accommodate the new specimens which are received, as well as the duplicates which it is desired to remove from the exhibition cases.

The additions to the ornithological collection since the organization of the Section have been considerable and many of them of great value.

The most important acquisition is the collection of birds of Florida, Texas and Arizona presented by Mr. Samuel N. Rhoads. These specimens, numbering over 900, were collected by Mr. Rhoads during April, May and June, 1891, on a trip through the south and west. Mr. Rhoads took especial pains to obtain specimens of such species as were not before contained in the Academy's collection, and through his efforts the North American series is now much more nearly complete than ever before. In addition to the presentation of this valuable collection Mr. Rhoads has arranged with collectors in the west to furnish desirable specimens to the Academy and has in many ways advanced the interests of the Ornithological Section.

The West Greenland Expedition brought back a collection of 160 specimens of Arctic birds collected by Drs. Wm. E. Hughes and Benjamin Sharp. These included representatives of 33 species many of which are of great interest.

Mrs. J. L. Claghorn presented a collection of African and Asiatic birds numbering 30 specimens among which were several rarities.

The Delaware Valley Ornithological Club which, by permission of the Academy, has been holding its meetings in the building, has given a collection of beautifully preserved nests of Pennsylvania and New Jersey birds numbering 60 specimens. The eggs accompany most of the nests and there are also several artistically mounted groups of birds. It is the intention of the Club to add to this collection from time to time until it shall contain specimens of the nests and eggs of all the birds of this vicinity together with finely mounted groups of the birds themselves.

Among the other specimens received were 18 Florida birds purchased from W. S. Dickinson, 45 specimens of California birds from R. B. Herron and 8 specimens from N. and S. Carolina as well as various specimens presented by Mrs. E. B. Chamberlain, I. N. DeHaven, Everett Palmer, I. C. Martindale, Dr. S. G. Dixon, and the Philadelphia Zoological Society.

Shortly after its organization the Section issued a circular soliciting subscriptions to an Endowment Fund to ensure the permanent welfare of the ornithological collection, the idea being to devote the interest to the employment of a special Curator and to the acquiring of additional specimens. A portion of the sum has already been subscribed and it is hoped that the sum of $10,000 which is wanted for immediate use will soon be raised.

As already mentioned the Delaware Valley Ornithological Club has held its meetings in the Academy during the past year. This has had the effect of drawing the ornithologists of this vicinity to the Academy and awakening an interest in the growth and welfare of its ornithological collection.

At the annual meeting of the Section held December 21st, the following officers were elected :

Director,	Spencer Trotter, M. D.
Vice-Director,	George S. Morris.
Recorder,	Samuel N. Rhoads.
Secretary,	Charles E. Ridenour.
Treasurer,	Isaac C. Martindale.
Conservator,	Witmer Stone.

WITMER STONE,
Conservator.

REPORT OF THE PROFESSOR OF INVERTEBRATE PALEONTOLOGY.

The Professor of Invertebrate Paleontology respectfully reports that the collections in his charge have undergone no material change, beyond increase, since the preparation of his last annual report. The lack of room, from which all departments of the Academy about equally suffer, has prevented any attempt being made toward placing the entire collection into systematic sequence, an arrangement required by the extensive additions of the last few years—nor will there be any opportunity for so doing until the completion of the new building. Much of the material, probably not less than one-fourth, is stored away in drawers, and is in a measure inaccessible. This applies more particularly to the foreign collection, mainly English and French, among which are to be found a large number of the "types" of the earlier geologists and paleontologists. It is needless to comment upon the value of this series and the importance of placing it where it can be readily reached by the student and specialist.

The paleontological material obtained by the Academy's Expedition to Mexico in the early part of 1890, to which reference has been made in the last annual report, has been placed in the museum cases. It forms the basis of two papers by the author, which have been published in the "Proceedings" of the Academy:—"The Geology and Paleontology of the Cretaceous Deposits of Mexico," and "Geological Researches in Yucatan." The material from Yucatan is the first of any consequence that has been obtained from that section of Central America, and establishes the existence in that region of vast Pliocene deposits, synchronous with and representing those of the southern part of the peninsula of Florida.

The usual spring course of lectures in the department of the Professor of Invertebrate Paleontology has been delivered as in previous years (excepting 1890), the lectures, 25 in number, being attended by a class of 35 students.

Respectfully submitted,

ANGELO HEILPRIN,

Professor of Invertebrate Paleontology.

REPORT OF THE PROFESSOR OF ETHNOLOGY AND ARCHÆOLOGY.

The Professor of Ethnology and Archæology submits his annual report upon the course of instruction and the condition of the collections in his department in 1891.

The lectures delivered by him were six in number, free to the public, illustrated with maps and diagrams. The topic treated was the Ethnology of Modern Europe. The attendance was large, and a general interest in the subject appeared to have been fostered.

The collections in this department have not been materially increased during the year. The American Philosophical Society has withdrawn its deposit of the Peale collection. It is believed, however, that as soon as adequate space is provided for the display of objects in Ethnology and Archæology, they can readily be obtained from members of the Academy and their friends.

D. G. BRINTON,
Professor of Ethnology and Archæology.

REPORT OF THE PROFESSOR OF INVERTEBRATE ZOOLOGY.

The Professor of Invertebrate Zoology respectfully reports that he has presented a collection of Anellides, Mollusca and Crustacea collected by him in the Mediterranean, as well as some trays of shells collected in the Caribbees.

During the past year he delivered six lectures on the "Principles of Zoological Philosophy" and one on the "Volcanoes of the West Indian Group," most of which were illustrated by lantern slides.

It is proposed to give a course on general zoology during the coming spring.

Having been appointed Zoologist-in-Charge of the West Greenland Expedition, he spent two months collecting on the shores of North Greenland, a small part only of the collection having as yet been presented. This part consists of the Crustacea, which were collected by himself and Dr. W. E. Hughes, the ornithologist of the Expedition.

The additions to the museum during the past year have been important. Several have been received from F. Stearns of Detroit, Mich. including some new (type) species of Cirripeds and Brachiopods described in the "Proceedings" by H. A. Pilsbry.

The Echinoderms collected by W. J. Fox in Jamaica has been presented. A fine series of Asterias vulgaris from Maine, have been received from Dr. S. G. Dixon.

Respectfully submitted,

BENJAMIN SHARP,
Professor of Invertebrate Zoology.

The election of Officers, Councillors and Members of the Finance Committee, to serve during the year 1892, was held with the following result:—

President, ...	Isaac J. Wistar.
Vice-Presidents, . . .	Rev. Henry C. McCook, D. D.
	Thomas Meehan.
Recording Secretary, . .	Edward J. Nolan, M. D.
Corresponding Secretary, .	Benjamin Sharp, M. D.
Treasurer, ...	Isaac C. Martindale.
Librarian, ...	Edward J. Nolan, M. D.
Curators, ...	W. S. W. Ruschenberger, M. D.
	H. C. Chapman, M. D.
	S. G. Dixon, M. D.
	Angelo Heilprin.
Councillors to serve three years, ...	J. Bernard Brinton, M. D.
	Theodore D. Rand,
	Gavin W. Hart,
	Geo. H. Horn, M. D.
Finance Committee, . .	Chas. P. Perot,
	Chas. Morris,
	Chas. E. Smith,
	Gavin W. Hart,
	Uselma C. Smith.

ELECTIONS DURING 1891.

MEMBERS.

January 27.—Stewardson Brown, Thomas Hewson Bradford, M. D., Amos Peaslee Brown, Edmund E. Reed, Jr., Albert P. Brown, M. D., Geo. C. Evans, Mary S. Holmes.

February 24.—Wm. C. Carrick, Henry T. Coates, Wm. S. Stewart, M. D., Samuel N. Rhoads, Richard D. Barclay.

March 31.—Edgar Strayer, M. D., William D. Robinson, M. D., R. E. Peary, U. S. N., Geo. S. Morris.

April 28.—Edwin Corlies Atkinson, Witmer Stone, Robert P. Morton, John Arschagonni, M. D.

May 26.—George M. Beringer, Joseph Crawford, Arthur Ames Bliss, M. D., William J. McGinty.

June 30.—William J. Serrill, B. Alexander Randall, M. D.

July 28.—John L. Kinsey, Charles W. Dulles, M. D.

Sept. 29.—William E. Hughes, M. D., John Macfarlane, M. D.

October 27.—Elizabeth Cartledge, Frank Miles Day, W. L. Zuill, M. D., Hugh Lausat Willoughby, J. Harris Reed, Wm. L. Baily.

November 24.—Richard Rossmässler, Elizabeth Head, Harriet Head.

CORRESPONDENTS.

April 28.—Charles Otis Whitman, Ph. D., of Worcester, Mass.

June 30.—August Weissmann, of Freiburg, i | B., Elias Metschnikoff, of Dorpat, Russia.

ADDITIONS TO THE MUSEUM.

1891.

ARCHÆOLOGY, ETHNOLOGY, ETC.

Wm. L. Abbott. A collection of African weapons, amulets, bands, etc., from Chaga, region of Mt. Kilima 'Njaro, Africa.

C. W. Riley. Woven straw basket (native manufacture) from the Orange Free State, South Africa.

Benjamin Sharp. Human bone and piece of pottery from a mound in Western Pennsylvania.

Ellen I. Ellison. Laplander's shoes, cap, mitts, etc. from opposite Tromsö, Norway.

West Greenland Expedition, 1891. Twenty-three Eskimo skulls from Greenland. Eskimo skeleton. A collection of Eskimo implements, utensils, etc., including a kayak and sledge from the Arctic Highlanders of Cape York.

MAMMALIA.

Zoological Society of Philadelphia. Mounted specimens of *Armadillo sexcinctus*, *Lemur, sp? Cercopithecus sabæus*, *Macacus inuus*, *Lemur macaco*, *Pithecia monachus*, *Synetheres insidiosus*, *Didelphys philander*. Disarticulated skeletons of *Antilope cervicapra*, *Gulo luscus*, *Cercopithecus callitrichus*, *Felis leo*, *Felis pardus*, *Cynocephalus hamadryas*, *Macacus inuus*, *Oryx leucoryx*, *Cervus dama*, *Lemur macaco*. Skulls of *Antilocapra Americana*, *Gazella dorcas*, *Meles taxus*, *Crossarchus obscurus*, *Erinaceus Europæus*.

Wm. L. Abbott. A collection of skulls and skins from Chaga, region of Mt. Kilima 'Njaro, Africa.

Fred'k Stearns. Alcoholic specimen of *Vesperugo abramus* from Japan.

Henry C. Chapman. Disarticulated skeletons of *Cavia porcellus*.

West Greenland Expedition of 1891. Two young (white) seals. Two skulls of seals; 2 walrus skulls; polar-bear skull; reindeer skull; blue-fox skull.

BIRDS.

Zoological Society of Philadelphia. Skin of *Tinamus, sp? Chionis alba;* disarticulated skeletons of *Grus antiqua*, *Struthio camelus*.

C. W. Riley. Tail of the secretary bird, from the Orange Free State, S. Africa.

S. G. Dixon. Eggs of *Urinator imber;* mounted specimen of *Scotiaptex cinereum* from Rhinelander, Wis.

Benjamin Sharp. Egg of booby (*Sula*. sp?)

Henry C. Chapman. Disarticulated skeleton of *Phœnicopterus ruber*.

Mrs. E. B. Chamberlin. Bald eagle (*Haliætus leucocephalus*) and two eaglets, with nest.

Samuel N. Rhoads. A collection of 940 specimens of birds from Florida, Arizona and Texas, collected by Mr. Rhoads in 1891.

Delaware Valley Ornithological Club of Philadelphia. 15 mounted birds, 54 nests and 170 eggs, presented as the first instalment of a collection of the birds of Pennsylvania and New Jersey, with their nests and eggs, to be given by the members of the Club to the Academy, and to be known as the "Delaware Valley Ornithological Club Collection."

Everett Palmer. Six nests of Pennsylvania birds, with eggs.

Mrs. J. R. Claghorn. Collection of mounted birds, principally African and Asiatic (including fine specimen of *Paradisea apoda.*)

West Greenland Expedition of 1891. 154 specimens of Arctic birds. Collection of eggs of Arctic birds, (not yet placed in collection.)

Reptiles and Amphibians.

C. Coburn. *Alligator Mississippiensis.*

Benjamin Sharp. Six species of snakes, and two species of lizards from the Windward Islands.

L. M. Jelovitz. Four species of snakes from Panama.

Zoological Society of Philadelphia. *Crotalus adamanteus* var. *atrox;* mounted specimen of *Caiman sclerops.*

I. C. Martindale. *Xiphosoma hortulanum,* captured on a logwood vessel from Jamaica.

Witmer Stone. *Chelopus Muhlenbergii,* mounted specimen.

Henry C. Chapman. Disarticulated skeleton of *Alligator Mississippiensis.*

Mexican Expedition, 1890. Skulls of *Chelonia mydas* and *Thalassochelys caretta,* Progreso, Yucatan. Twenty-seven jars of reptiles and amphibians from Yucatan and Mexico.

W. J. Fox. Four jars of lizards from Jamaica; three species of reptiles and amphibians from Jamaica.

Alex McElwee. Tadpoles from Jenkintown, Pa.

Fred'k Stearns. *Diemyctylus pyrogaster,* from Japan.

Samuel G. Dixon. Three species of snakes and one frog from Islesboro, Me.

Fishes.

Fred'k Stearns. Lower jaw of *Cestracion Philippi.*

Miss Edith Ives. *Mustelus hinnulus* and *Sphyrena zygæna,* from Holly Beach, New Jersey.

W. J. Fox. 18 jars of fishes from Jamaica.

Samuel G. Dixon. *Cyclopterus lumpus* from Islesboro, Me.

Recent Invertebrata (excluding Mollusca and Insecta.)

Miss A. Peniston. *Mellita sexforis* from Bermuda.

Abbé Vathelet. Crab from China.

Benjamin Sharp. Collection of invertebrates from the Mediterranean.

Fred'k Stearns. A collection of Echinodermata and Crustacea from Japan; a collection of Echinodermata and Crustacea from the Bahamas, Mauritius, etc.;

Scalpellum Stearnsii (type, Pilsbry), one dry and two alcoholic specimens from Japan; species of *Balanus* from S. E. coast of Japan; a collection of Echinoderms and Crustacea from California.

H. A. Pilsbry. Caddis-fly tubes from Colorado.

Isaac Burk. *Mellita pentapora.*

J. Powell. *Porites astræoides*, from the harbor of Vera Cruz.

P. H. Carpenter. Microscopical preparations of Foraminifera collected by the Expedition of the "Porcupine" and "Lightning," and microscopical preparations of shells made by Dr. W. B. Carpenter to illustrate his British Association reports.

Wm. J. Fox. Four species of Echinoderms, four species of Centipedes, two species of Scorpions, and six jars of worms and sponges from Jamaica.

Gavin W. Hart. Large specimen of *Madrepora palmata* from Jamaica.

W. C. Johnson. *Astropecten articulatus* from St. Augustine, Fla.

John Quigley. *Leptogorgia virgulata* (?) from 25 miles outside of the Delaware Breakwater.

R. W. Sinclair. Two specimens of *Mygale Hentzii.*

W. S. W. Ruschenberger. *Tetraclita porosa* from a whale.

Sam'l G. Dixon. Numerous dried specimens of *Asterias vulgaris* and seven jars of alcoholic invertebrates from Islesboro, Me.

Anastasio Alfaro. Three species of gorgonians and one echinoid from Costa Rica.

Uselma C. Smith. Marine worm from Atlantic City, N. J.

West Greenland Expedition of 1891. A collection of invertebrates (not yet fully classified) from the West Coast of Greenland (furthest point north, approximate Lat. 77° 43′).

Recent Invertebrata (Mollusca).

W. L. Abbott. Fourteen species of shells from Zanzibar.

Academy of Natural Sciences Expedition to Mexico (1890). Twenty-six additional species of land shells not included in last year's report.

Anastasio Alfaro. Eighty species from Costa Rica.

Harrison Allen. Six species from Nantucket.

American Association of Conchologists (presented through Mr. John H. Campbell, President,) 762 trays of American shells, a list of which with names of donors has been published in the *Nautilus*, January to December, 1891. Contributions have been received from the following members: G. W. Lichtenthaler, Bloomington, Ill.; Francisco E. Blanes, Key West, Fla.; E. R. Mayo, Boston, Mass.; Elwood Pleas, Dunreith, Ind.; Henry E. Dore, Portland, Oreg.; Wm. McCormick, Palm Beach, Fla.; John H. Britts, Clinton, Mo.; Dr. Wm. H. De Camp, Grand Rapids, Mich.; F. C. Browne, Framingham, Mass.; Henry Moores, Columbus, O.; O. A. Crandall, Sedalia, Mo.; Geo. W. Dean, Kent, O.; James M. De Laney, Rochester, N. Y.; Mrs. E. V. Gaylord, Detroit, Mich.; I. Greegor, Jacksonville, Fla.; E. H. Harn, Blairsville, Pa.; Wm. J. Fox, Philadelphia; Uselma C. Smith, Philadelphia; John Ford, Philadelphia; W. S. Teator, Upper Red Hook, N. Y.; Dr. W. S. Strode, Bernadotte, Ill.; Geo.

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F. C. Baker. Two species marine shells.

John H. Campbell. Types of *Helix amphizona*, Pilsbry. *Helix luchuana* Sow. and *Helix peliomphala* Pfr.

H. F. Carpenter (through John Ford). *Olivella rosalina* Ducl. from Bermuda, and 3 species of West Indian shells.

Conchological Section, by purchase, 250 species of Oriental land shells, 50 species of marine shells.

D. Coughanour. Seven species of shells from Texas.

J. C. Cox. Twenty-five species of Australian land shells and 3 species of marine shells, including a fine example of *Cypræa decipiens*, and several unfigured and new species.

O. A. Crandall. Five species land shells from Missouri and Arkansas.

W. H. De Camp. Fourteen species from Panama and Michigan.

W. H. Dall. *Eutivela perplexa* Stearns n. sp. and *Acmæa Dalliana* Pilsbry n. sp.

Miss Julie Finch. *Helix albolabris*, a heavy variety, from Chambersburg, Pa.

John Ford. Seventeen species of shells new to the Academy collection.

Wm. J. Fox. One hundred and thirty-five trays of shells and 14 bottles of alcoholic mollusks from Jamaica. 4 trays of shells from New Jersey.

Mrs. C. M. Gaylord (through Mr. Ford). *Triton gibbosus* Brod.

A. W. Harnham. Twenty species of Canadian shells.

W. H. Hatch. *Anodonta* and *Campeloma* from Lake Pulaski, Minn.

Chas. Hedley. Three species of Amnicolidæ from Tasmania.

H. von Ihering. Thirty-four species of shells from Rio Grande do Sul, Brazil, all new to the collection of the Academy.

J. E. Ives. Species from New Jersey.

Chas. W. Johnson. *Fasciolaria distans* and four other Florida shells.

G. W. Lichtenthaler. *Lucapina crenulata*, *Lucapinella callomarginata* and *Goniobasis plicifera* in alcohol.

W. L. MacDaniel (in exchange). Thirty species of Texas Unionidæ.

J. H. Morrison. *Helix nemoralis* from Lexington, Va.

Chas. T. Musson (in exchange). Forty-one species of shells from Australia, mainly new to the collection.

Mrs. M. P. Olney. Fifteen species of California and Sandwich Island shells.

H. A. Pilsbry. Fourteen species of shells, ten being new to the collection.

W. J. Raymond. *Natica elenæ* Recl., Panama.

John Ritchie, Jr. Two species of Helix from S. America, and 6 species from the West Indies, three of them, *H. Ritchieana* Pils., *H. xanthophaes* Pils., *H. Maynardi* Pils., new.

S. R. Roberts. *Potamopyrgus* from New Zealand.

E. W. Roper. Four species of American shells.

Rev. J. Rowell. Three species from California.

W. H. Rush. Thirty-one species from Madeira, Azores and St. Thomas.

Benj. Sharp. Ten species of marine shells from Tobago; 12 species land shells from Tobago and Trindad; 1 alcoholic *Bulimus oblongus.*

B. Shimek. Two species from Iowa.

Mr. C. T. Simpson. *Zonites Simpsonii* Pils., from Indian Territory.

H. Skinner. *Turritella* sp.

U. C. Smith. *Litorina litorea* L., from Atlantic City.

Frederick Stearns. Forty-five species of Japanese shells mostly new to the collection, including the types of ten new species.

V. Sterki. Six species of fresh-water shells, from Ohio.

Witmer Stone. Twenty species of land and fresh-water shells from York Furnace, Pa., Cape May, N. J., etc.

Frank Stout (deceased). Twenty-eight species of shells, new to the Academy collection.

J. W. Velie. Three species of *Limnæidæ* from Mich; 3 sp. marine shells from Florida.

W. H. Weeks. *Helix Jamaicensis* var. and several species from Long Island, New York.

S. W. Wright (in exchange). Twenty six species of New Zealand shells.

L. G. Yates. *Helix Carpenteri* var. *Indioensis* Yates. type of var.

Fossil Vertebrata.

Joseph Jeanes. *Protosphyræna penetrans* from the Cretaceous of Kansas.

James R. McKee. Teeth of *Lamma elegans*, *Carcharodon megalodon*, *Mastodon Americanus*, and *Mastodon, sp?* from Santee Beds, Beaufort Co., S. C.

Lawrence Johnson. Mastodon remains from the State of Pernambuco, Brazil (presented through J. Cheston Morris).

Fossil Invertebrata.

Joseph Willcox. *Cardium laqueatum.* Miocene of St. Mary's, Md.

J. T. Rothrock. Collection of Miocene fossils from the James River, Va.

J. E. Ives. Cephalopod from Henderson's Station, Montgomery Co., Pa. Silurian.

W. W. Jefferis. *Graptolithus ramosus* Hall, from Fort Ann, N. Y.

E. Pleas. *Rimella laqueata* from Claiborne, Ala., and *Pentremites Godonii.*

MINERALS, ROCKS, ETC.

Mineralogical and Geological Section of the Academy. Brochantite from Frisco, Utah; Descloizite and Vanadinite, Georgetown, New Mexico; Vanadinite, Yuma Co., Arizona; Tourmaline, Cornwall, England; Azurite and Malachite, Bisbee, Arizona; Quartz, Alexander Co., N. C.; Calcite, Egremont, England; Ulexite, Nevada; Topaz, Japan; Azurite, Bisbee, Arizona; Chalcopyrite, Falls of French Creek, Pa.; Gadolinite, Bluffton, Texas; Barite, Cornwall, England; Barite, Sterling, Col.

W. W. Jefferis. Peristerite from Perth, Ontario; Calcite Coalfield, Germany; Enstatite, Lancaster Co., Pa.; Cachalong, South Park, Col.; Garnets, Lisbon, N. H.; Quebec Shale; Hudson River Slate from Fort Edward, N. Y.; Quincy Granite; Syenite from North Creek, Adirondack Mountains: Limestone and Graphite, from near Fort Edward, N. Y.; Hallite from Nottingham, Pa.; Chondrodite, from Putman Co., N. Y.; Göthite from Pike's Peak, Colorado; Garnet from Russell, Mass.; Graphite in Calcite from Rogers Rock, Lake George, New York; Garnet Rock from North Creek, Essex Co., N. Y.; Graptolites from Fort Edward, N. Y. and from Fort Ann, N. Y.; Limonite, pseudomorph after Iron Pyrites, from East Whiteland, Chester Co., Pa.

Theodore D. Rand. Corundum from Chester Co., Pa.: Stilbite from Frankford, Phila.; Zinc bloom from Bertha Mine, W. Virginia; Staurolite from Philadelphia; Graphic Granite from Mineral Hill, near Media, Pa.; Oligoclase, W. of Media, Pa.; Asbestus from Lower Merion, Pa.; Picrolite from Richmond, Quebec; Chrysotile from Radnor Sta., Delaware Co., Pa.; Hydromica Schist, 1 mile N. of Paoli Sta., Chester Co., Pa.; Goslarite, Friedensville, Pa.; Millerite in Dolomite, Phila.; Zoisite, Lafayette, Pa.; Limonite, pseudomorph after Magnetite; Clintonite, Amity, N. Y.; Serpentine, pseudomorph after Asbestus, Delaware Co., Pa.; Epidote, Frankford, Phila.; Laumontite, Phila.; Staurolite, Ardmore, Pa.; Hornblende, Phila.; Lignite; Tourmaline, Frankford, Phila.; Randite, Frankford, Phila.; Chrysotile, Devon, Chester Co., Pa.; Iron Pyrites in Lignite; Ivigtite, Ivigtut, Greenland; Hyalite, colored by Uranic oxide, Phila; Hyalite, colored by Uranic oxide, Frankford, Phila.; Lepidomelane, Frankford, Phila.; sandstone, Chester Co., Pa.; Epidote, Frankford, Phila.; Chrysocolla and Allophane, Cornwall, Pa.; Randite, Frankford, Phila.; Chrysotile, Black Lake, Province of Quebec; Torbernite, Phila.; Quartz, pseudomorph after Asbestus, Marple, Delaware Co., Pa.; Garnet, West Phila.; Molybdite and Molybdenite, Frankford, Phila.; Ankerite, E. Caln, Chester Co., Pa.; Chrysotile, Black Lake, Province of Quebec; Fibrolite; Chromite, Blue Hill, Delaware Co., Pa.; Duelite, Lake Co., Cal.; Goslarite, Friedensville, Pa.

Walter Conrad. Gypsum from St. Mary's River, Md.

H. A. Pilsbry. Hematite from (?) Santiago, Cuba.

J. Blodgett Britton. Collection of iron ores.

Henry G. Ives. Apophyllite and Bornite from Frankford, Phila.; Stilbite, Frankford, Phila.; Antholite, Devil's Pool, Wissahickon Creek, Phila.; Anthophyllite, Ridley Township, Delaware Co., Pa.; Aragonite from Jones Mine, Berks Co., Pa.; Epidote from Falls of French Creek, Pa.; Venerite from Jones' Mine, Berks Co., Pa.; Limonite from Chester Springs, Chester Co., Pa.; Melanite Garnets from French Creek Mine, Chester Co., Pa.; Gypsum (Selenite) from Rock Springs, Washington; Albertite from Albert Co., Nova Scotia; Hematite, deposited in a wooden pipe from Eagle Head Mine, Schuylkill Co., Pa.; Heulandite from McKinney's Quarry, Phila.; Calcite from Henderson's Sta., Montgomery Co. Pa.

Geo. M. Stiles. Fragments of Cambrian boulders containing *Scolithus linearis* from a Cutting at Barren Hill, Pa.

E. Goldsmith. "Ringing Rock" (trap) from Bucks Co., Pa.

E. Pleas. Oolites.

W. J. Fox. Red clay from the limestone of Portland, Jamaica.

W. Kennedy, Jr. Porphyry from Scotland and Fulgurites from New Jersey.

F. Lynwood Garrison. Bauxite from Saline Co., Ark.

Henry C. Chapman. Lower Helderberg erratic from Mt. Desert, Me.

Mexican Expedition, 1890. Calcite from the Cave of Calcehtok, Yucatan.

Lewis Woolman. Gypsum from Nuttallburg, Fayette Co., W. Va.

Alex. C. Haverstick. Barite in Siderite Geode from Frostburg, Ind.

PLANTS.

W. W. Jefferis. Ten species of plants from Fort Edward, N. Y.

Benjamin Sharp. Fruit of *Anacardium occidentale L.* (Cashew Nut) from St. Vincent, W. I.

Edward L. Rand, Boston, Mass. One hundred and thirty-nine species of plants from Mount Desert, Maine, and the adjacent islands, being a further portion of a series intended as vouchers for a proposed Flora of Mt. Desert. Also a series illustrative of the Sphagnaceæ of the same district, consisting of twenty species, fifty-six varieties and forms, all named by the specialist Karl Warnstoff.

Edwin Faxon, Jamaica Plains, Mass. A series illustrative of the Sphagnaceæ of New England, consisting of twenty-seven species in eighty-five varieties and forms, named by Warnstoff.

T. V. Munson, Denison, Texas. A series illustrating his classification of the wild grapes of North America, consisting of twenty-four species on forty-four sheets; also five species of foreign grape vines.

Ellis and Everhart. Centuries 26 and 27 of North America Fungi, received in exchange for duplicate Centuries heretofore received from estate of Dr. George A. Martin.

Witmer Stone. *Sida Napæa* Cav, from near York Furnace, York Co., Pa.

José N. Rovirosa. Two hundred and nine species of plants from the States of Tabasco and Chiapas, Mexico.

U. S. Department of Agriculture. Seventy-six species of mosses collected in California by Henry N. Bolander 1864 to 1870, determined by Mrs. Britton; 45 species of mosses, 15 species of lichens and 6 species of ferns collected in Florida by Prof. L. M. Underwood.

Charles R. King, Andalusia, Pa. Hortus Siccus Gramineus, or a collection of one hundred and ten species of British grasses, mounted and bound in two volumes with title pages; issued by William Curtis, London, in 1802.

Roberts LeBoutillier. Thirteen species of tropical orchids from cultivation.

Frank S. Collins, Malden, Mass. One hundred and twenty species of marine Algæ, from coasts of New England and of California.

Miss A. G. Powers, Missionary at Erzeroum, Turkey in Asia. Fifty species of plants from vicinity of Erzeroum.

Geo. W. Holstein, through Thomas Meehan. *Astragalus Reverchoni* Gr. from Shackleford Co., Texas.

John Donnell Smith, Baltimore, Md. One hundred and sixty-one species of plants, collected (mostly by himself) in Guatemala in 1889 and 1890.

Miss Jeanie F. Waddington, through Thos. Meehan. *Cypripedium pubescens* and *Trillium grandiflorum* from Jefferson Co., Ohio.

Sereno Watson, Harvard Herbarium. One hundred and seventy-one species of plants mostly from Central and Northern Asia.

W. L. Abbott. Nut of *Lodoicea Sechellarum*, from the Seychelles Islands.

John McFarlane. *Utricularia gibba* L. from Penn's Grove, N. J.

Mrs. Willis, Dalton, Georgia. *Monotropa uniflora* L. from that place.

Leopold Krug. Royal Botanical Museum, Berlin. Four hundred and forty-six species of West India plants, mostly from Porto Rico and St. Domingo.

H. N. Bellows. Specimens of *Phallus impudicus* in alcohol, from Huntingdon Valley, Montgomery Co., Pa.

A. A. Heller, Lancaster Co., Pa. Twenty-six species of plants mostly from the mountains of North Carolina.

Expedition to Greenland, organized by Academy of natural Sciences, Prof. Angelo Heilprin in charge, Dr. W. H. Burk, Botanist. Eighty species of phanerogamic plants and eleven species of lichens from west coast of Greenland, and twenty species of plants from Sidney, Cape Breton.

N. L. Britton, Columbia College Herbarium. *Clematis Addisonii* Britton and *Anemone trifolia* L. from Virginia. Thirty-one species of Cyperaceæ from British Guiana.

John K. Small. Forty-eight species of plants from Lancaster Co., Pa.

Thos. C. Porter, Lafayette College, Pa. Twenty species of Pennsylvania plants.

Uselma C. Smith. Four species of plants from Florida.

Thomas Meehan. Eighty-seven species of plants from various regions, mostly cultivated exotics. Two hundred and twenty-nine species of plants collected in Paraguay by Dr. Thomas Morong in 1888–1890.

John H. Redfield. One hundred and twenty-one species of plants collected by Dr. Thomas Morong in the desert of Atacama, 1890. 291 species of plants collected by C. G. Pringle in 1890, in the States of Jalisco, Chihuahua, &c., Mexico, in 1890. Four decades (40 species) of Underwood & Cook's N. American Hepaticæ. 185 species of plants collected by A. A. Heller in the mountains of North Carolina in 1890.

Fossil Plants.

Norfolk and Western R. R. Co. Fossil tree trunk from the coal measures of Virginia.

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Terebratella transversa p. 172, line 1, for figs. 8 and 9, read figs. 6 and 7.

Terebratella occidentalis, p. 173, l. 14 for figs. 6 and 7, read figs. 8 and 9.

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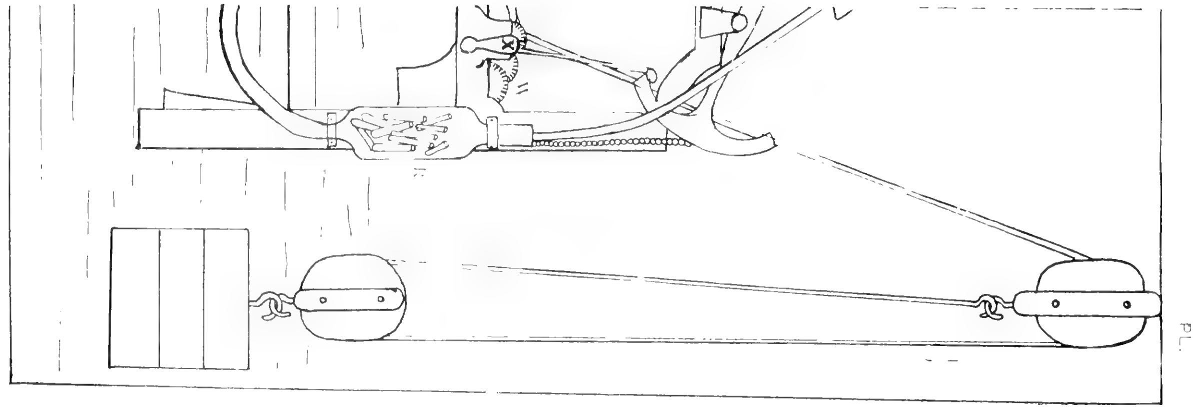

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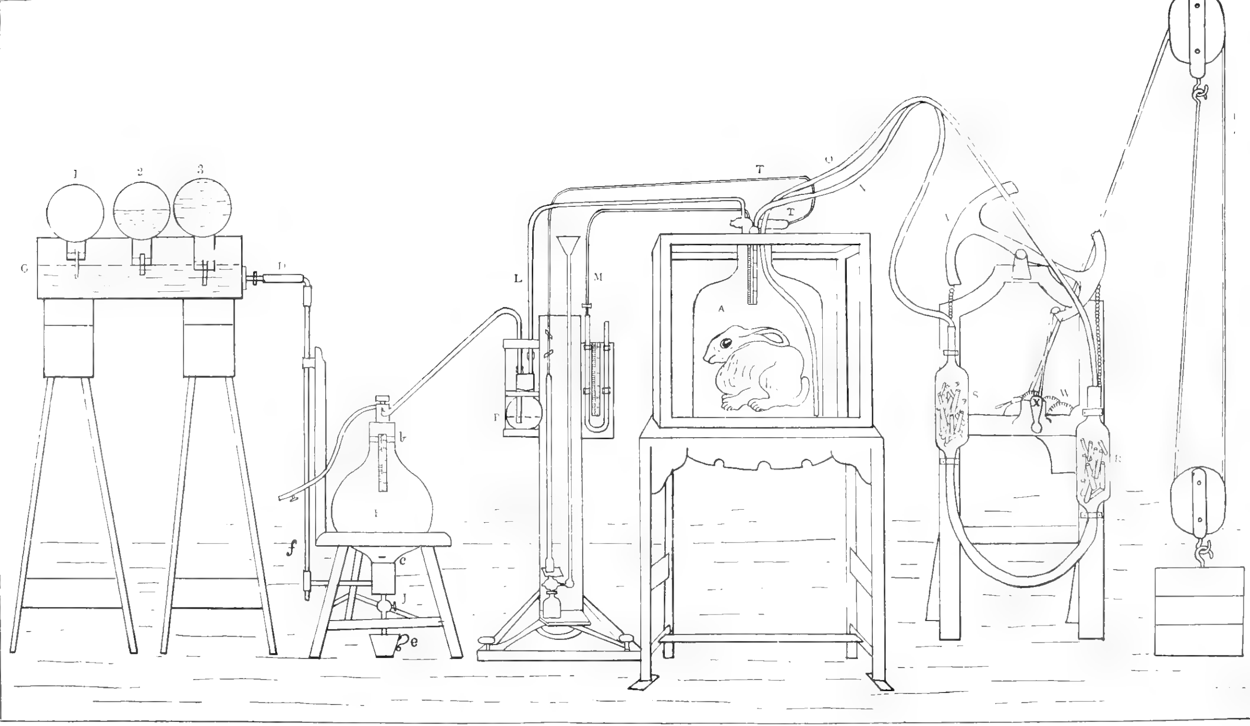

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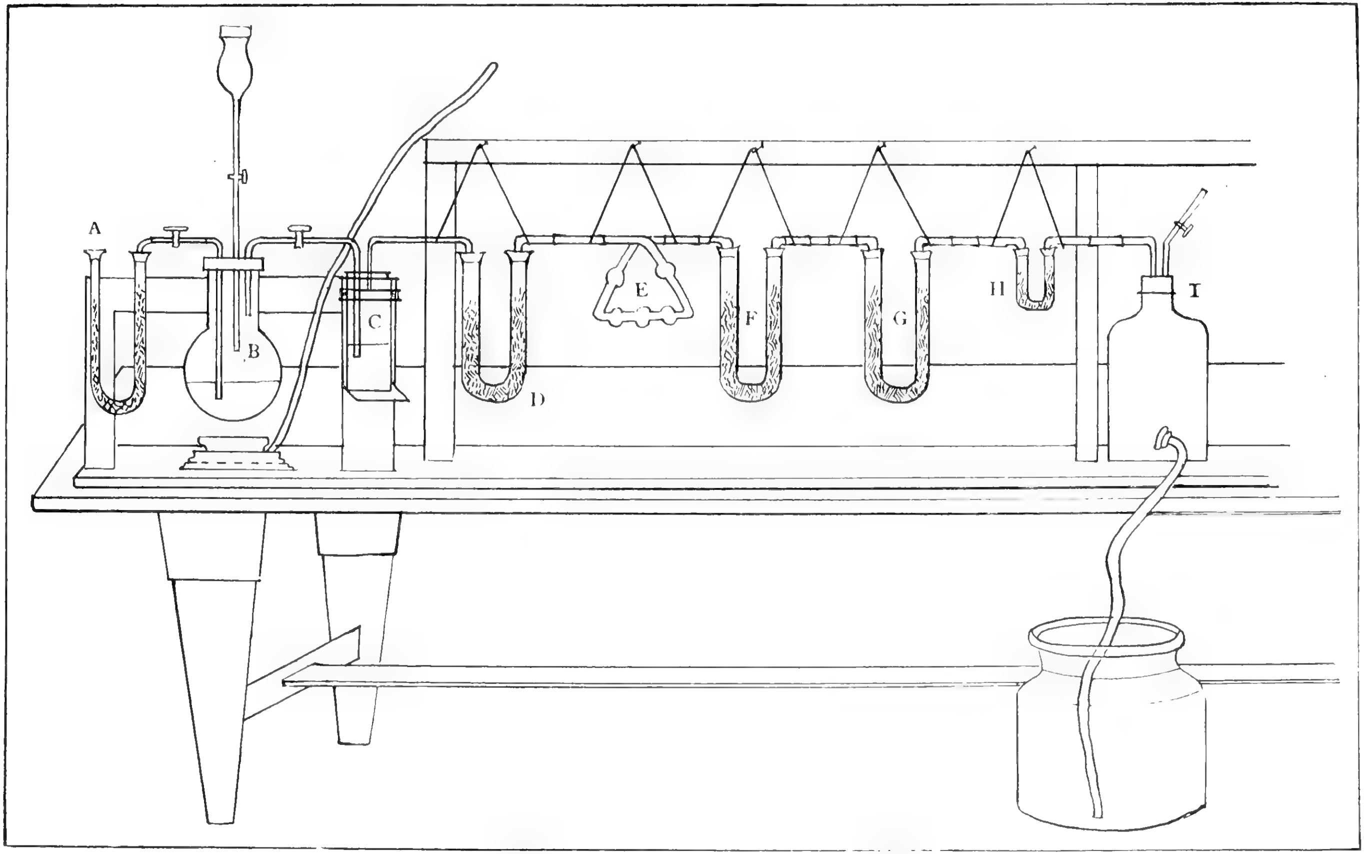

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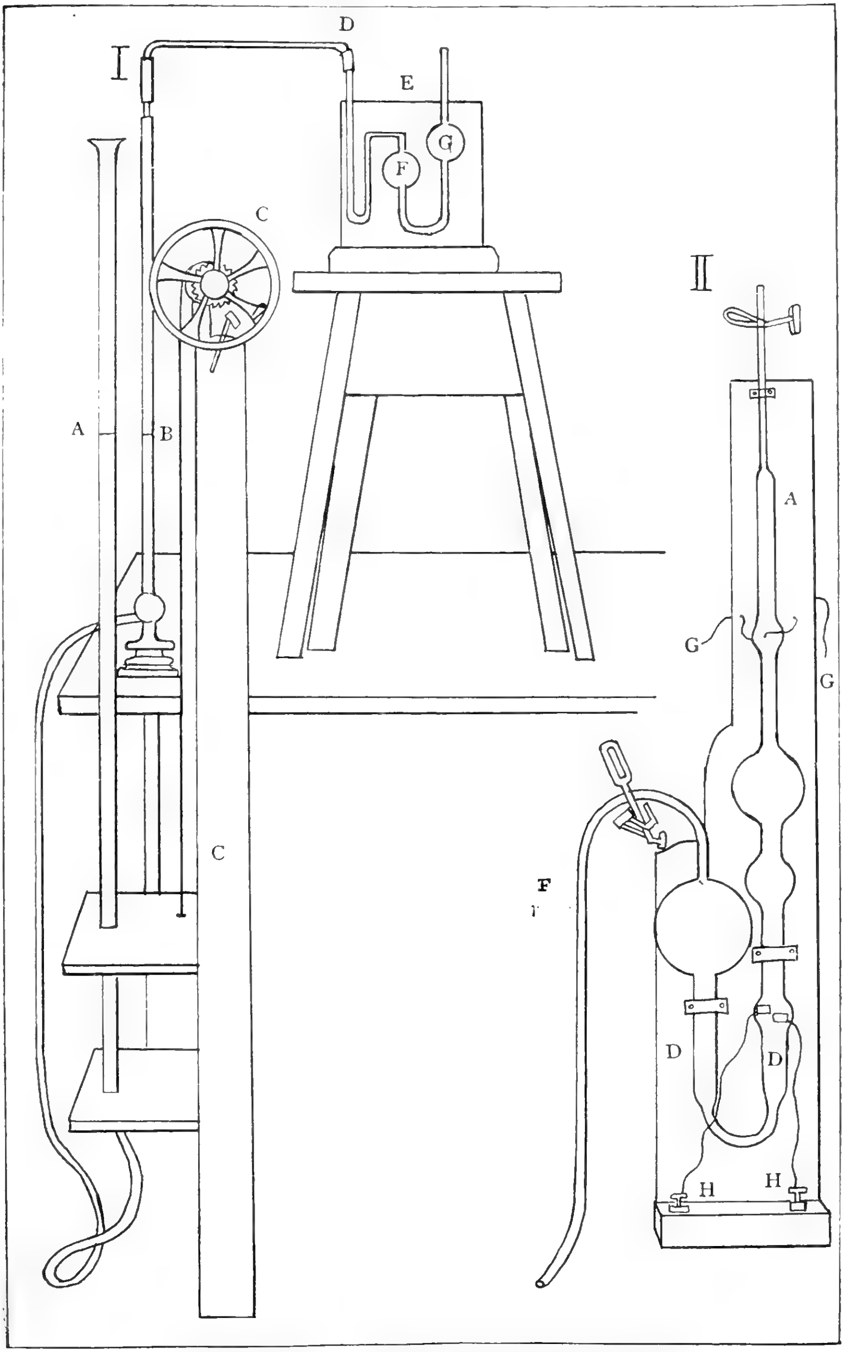

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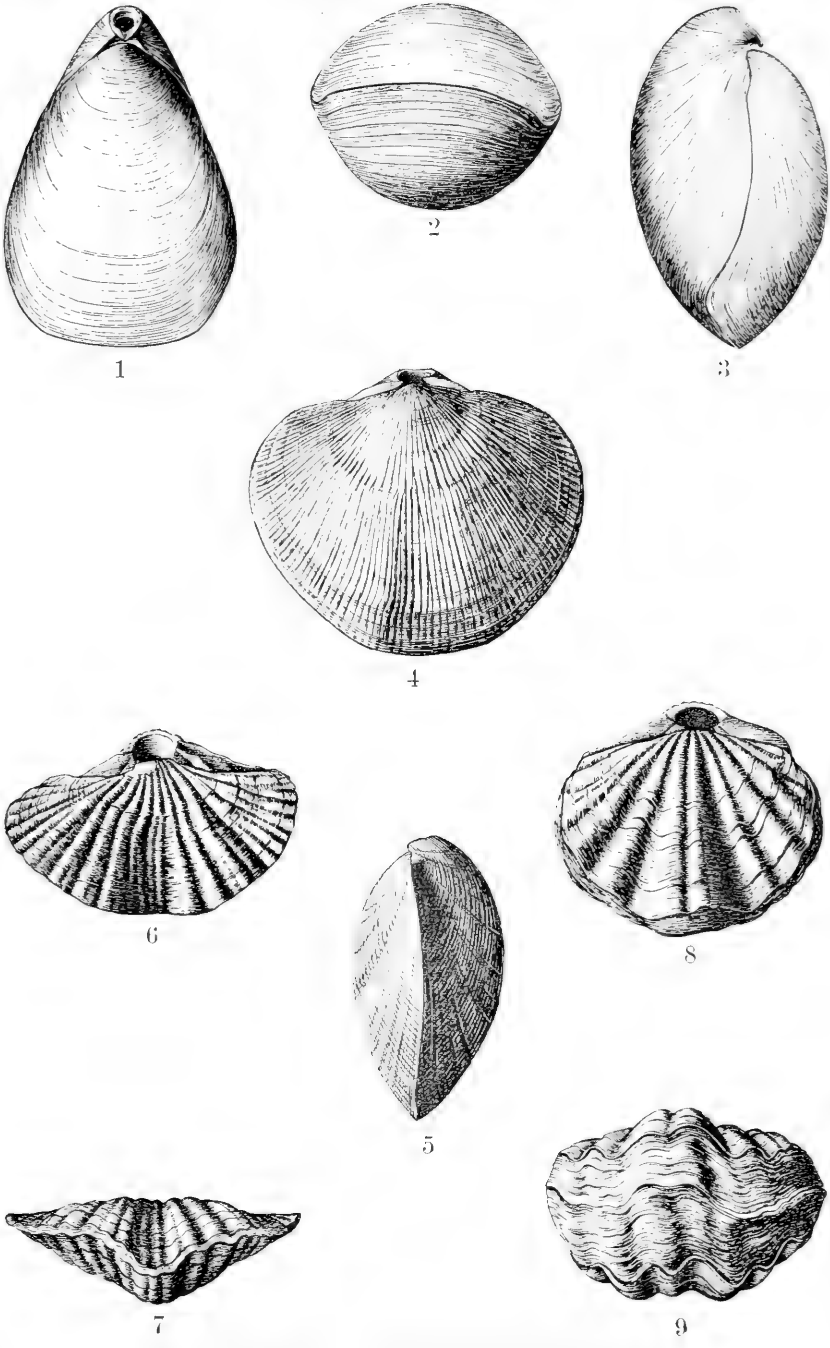

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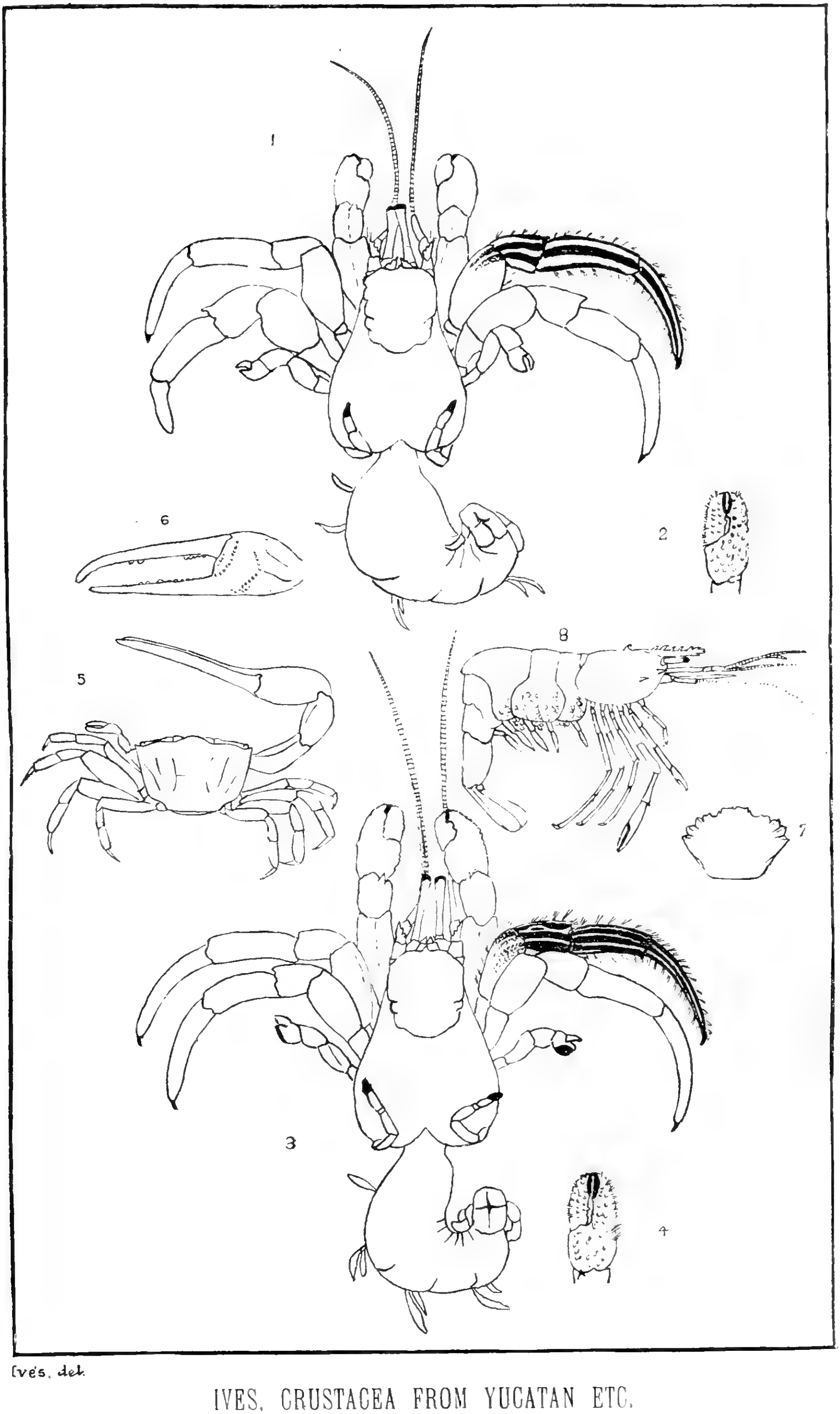

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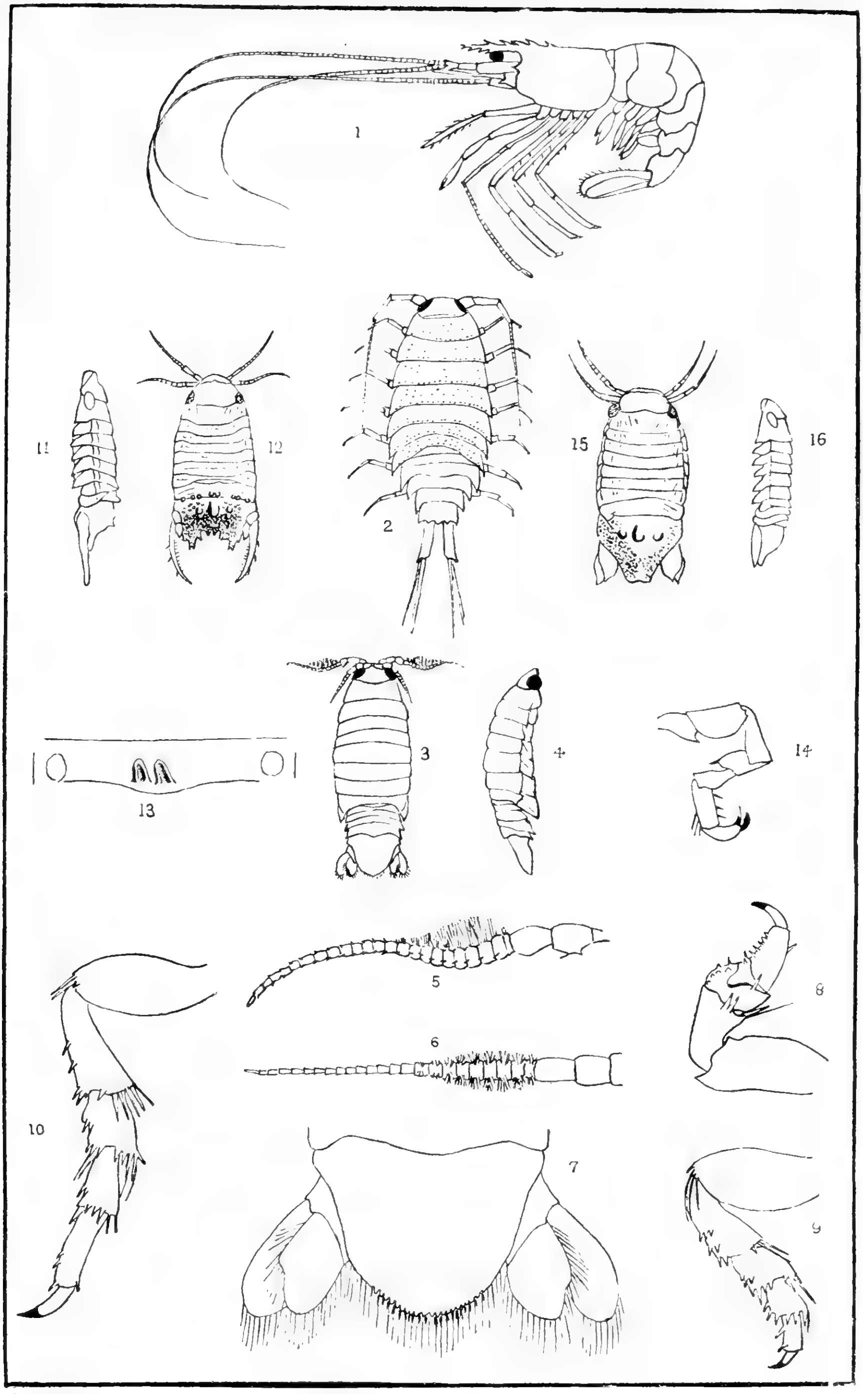

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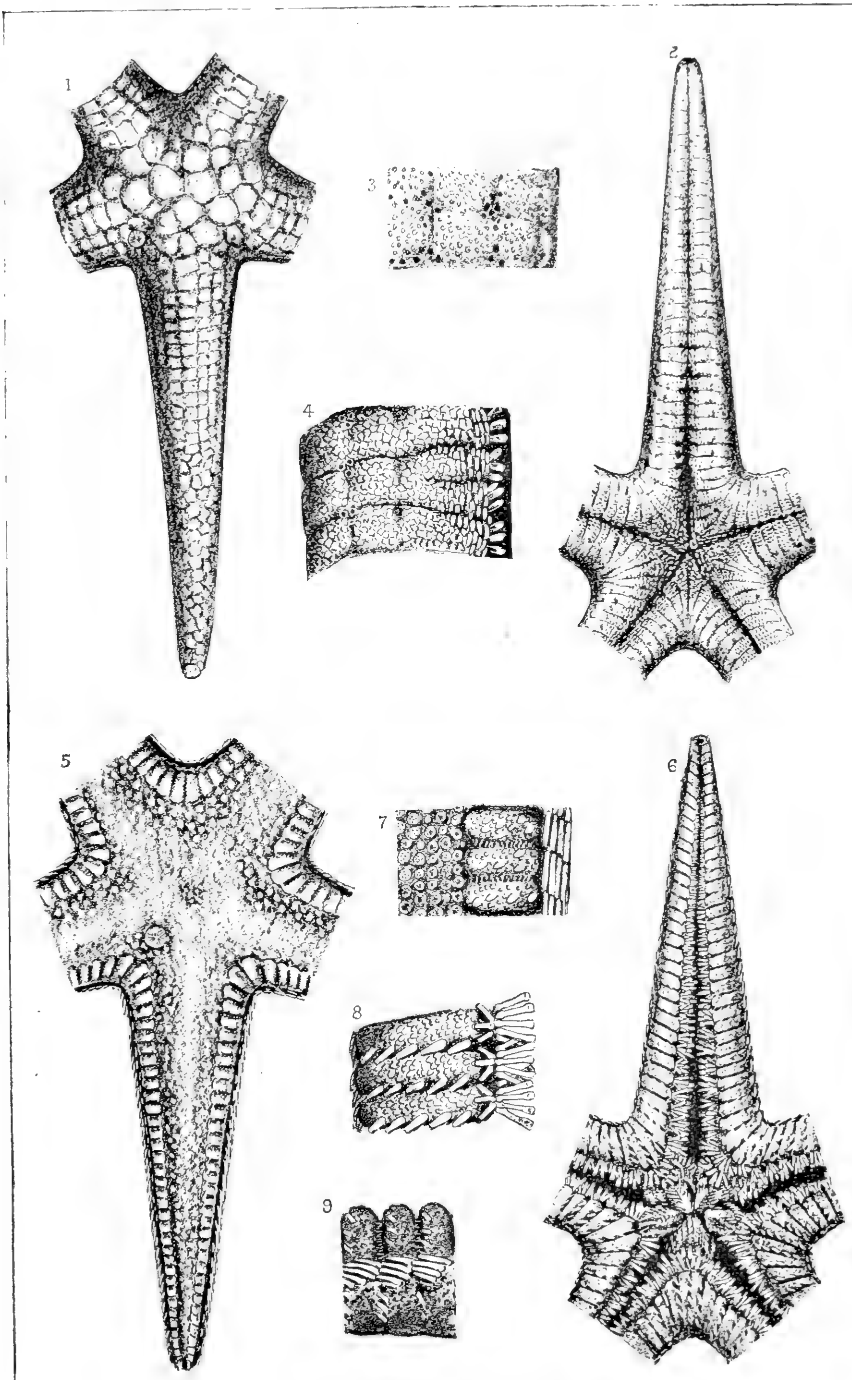

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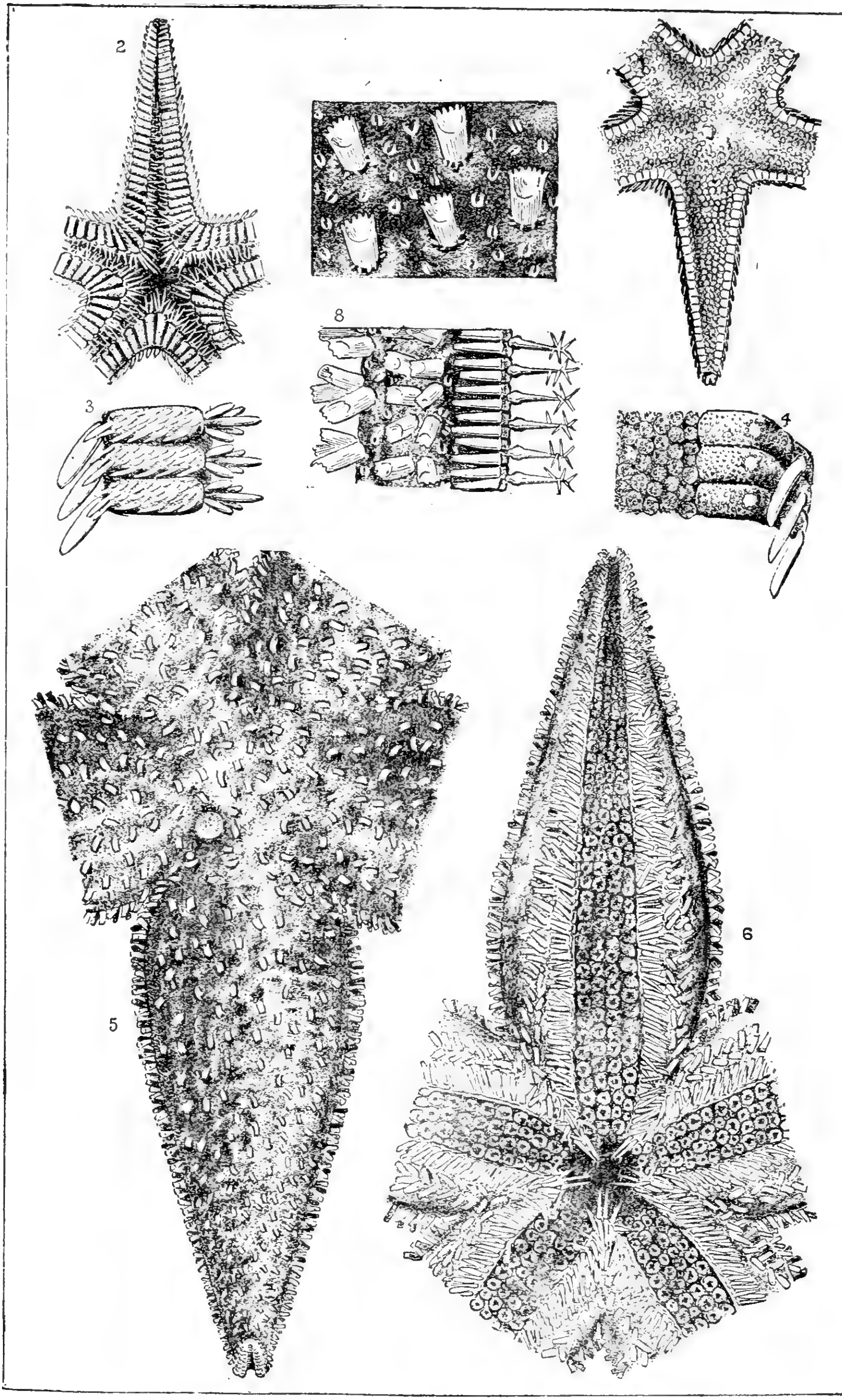

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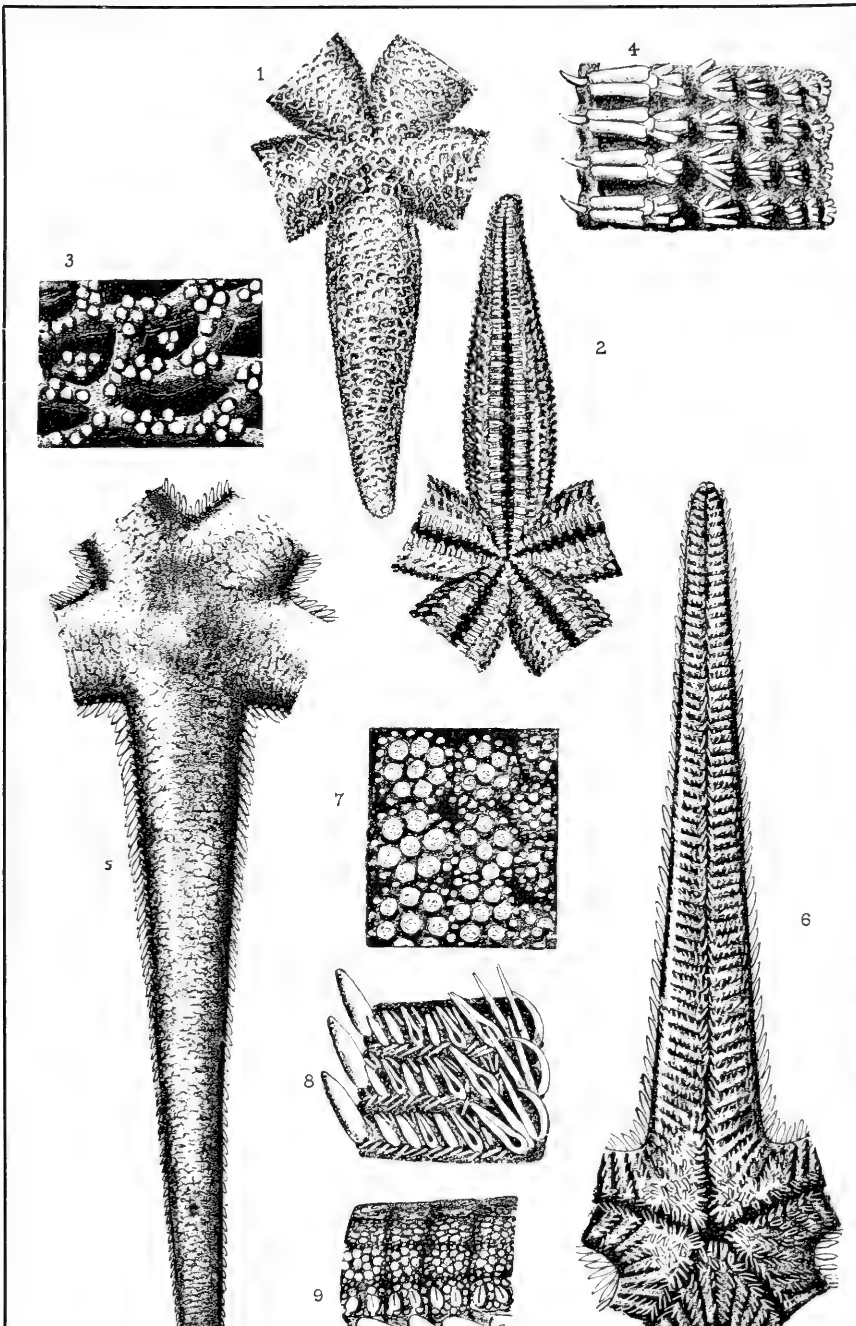

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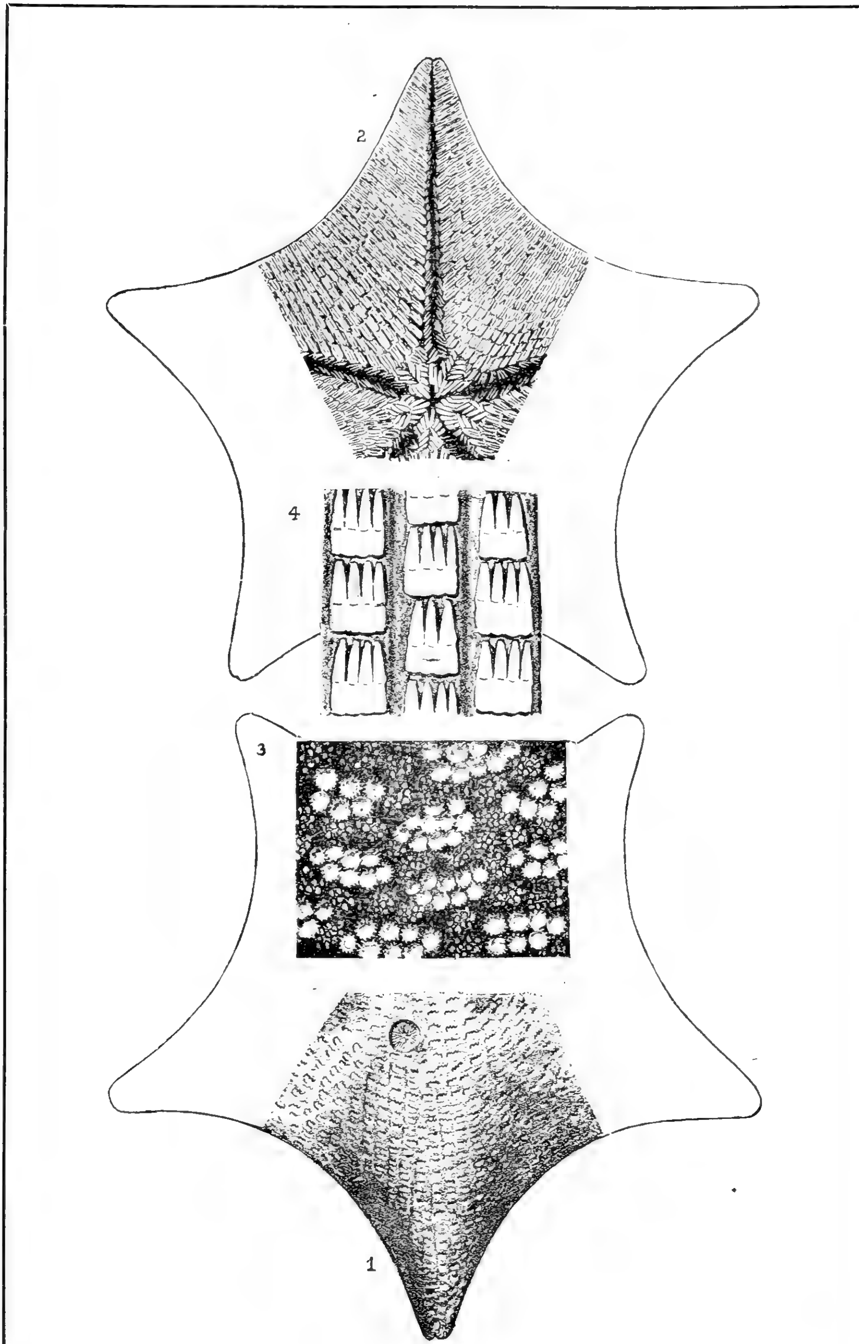

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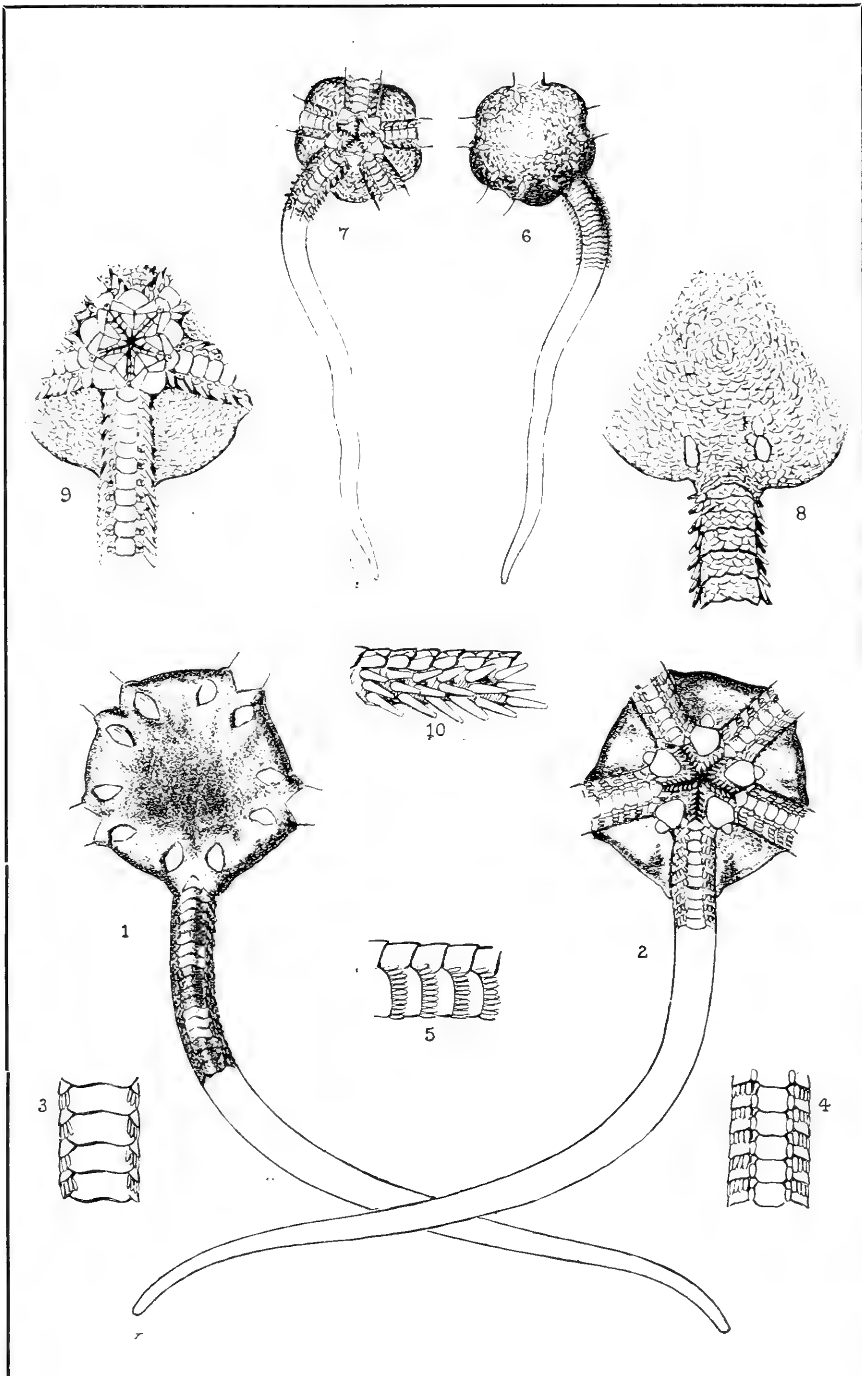

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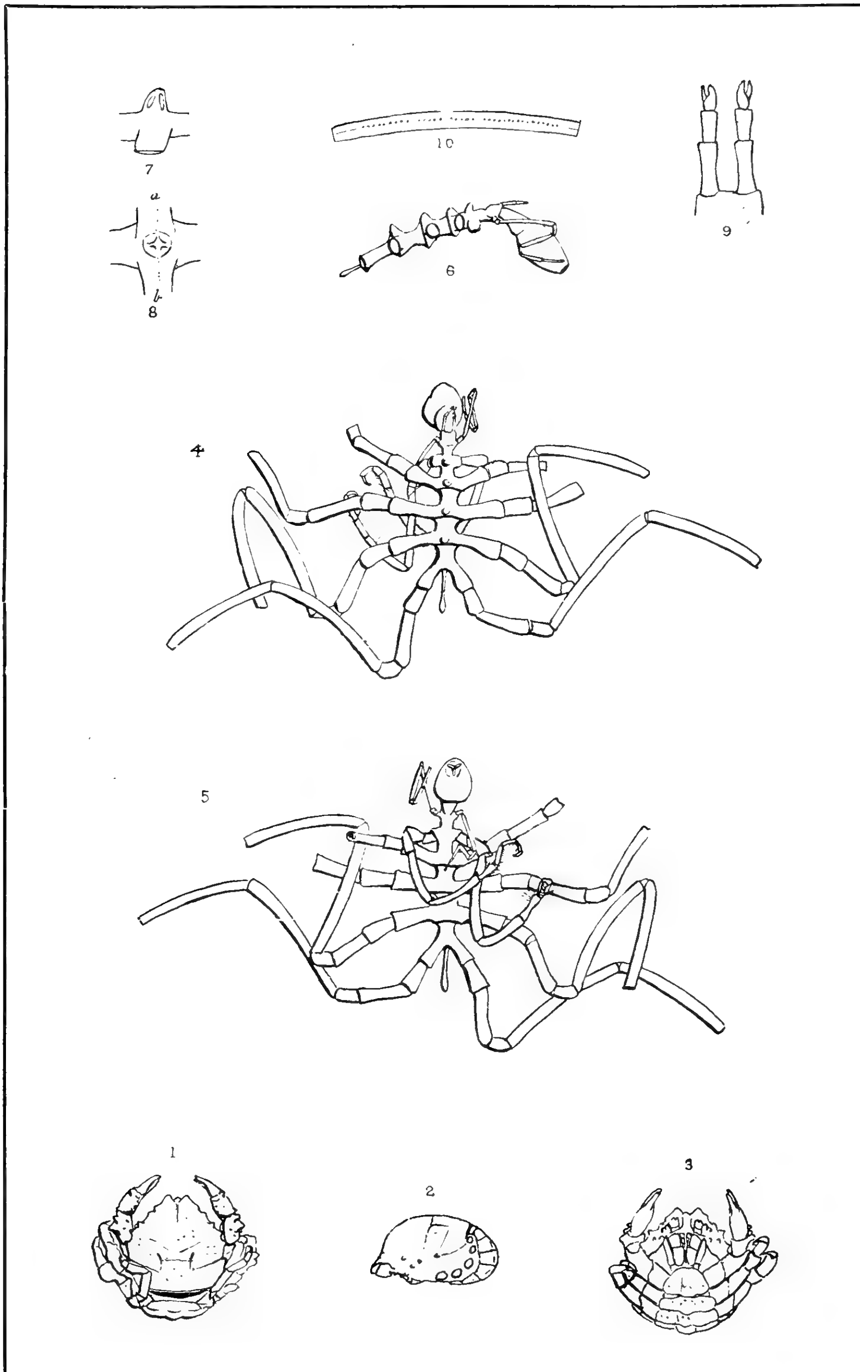

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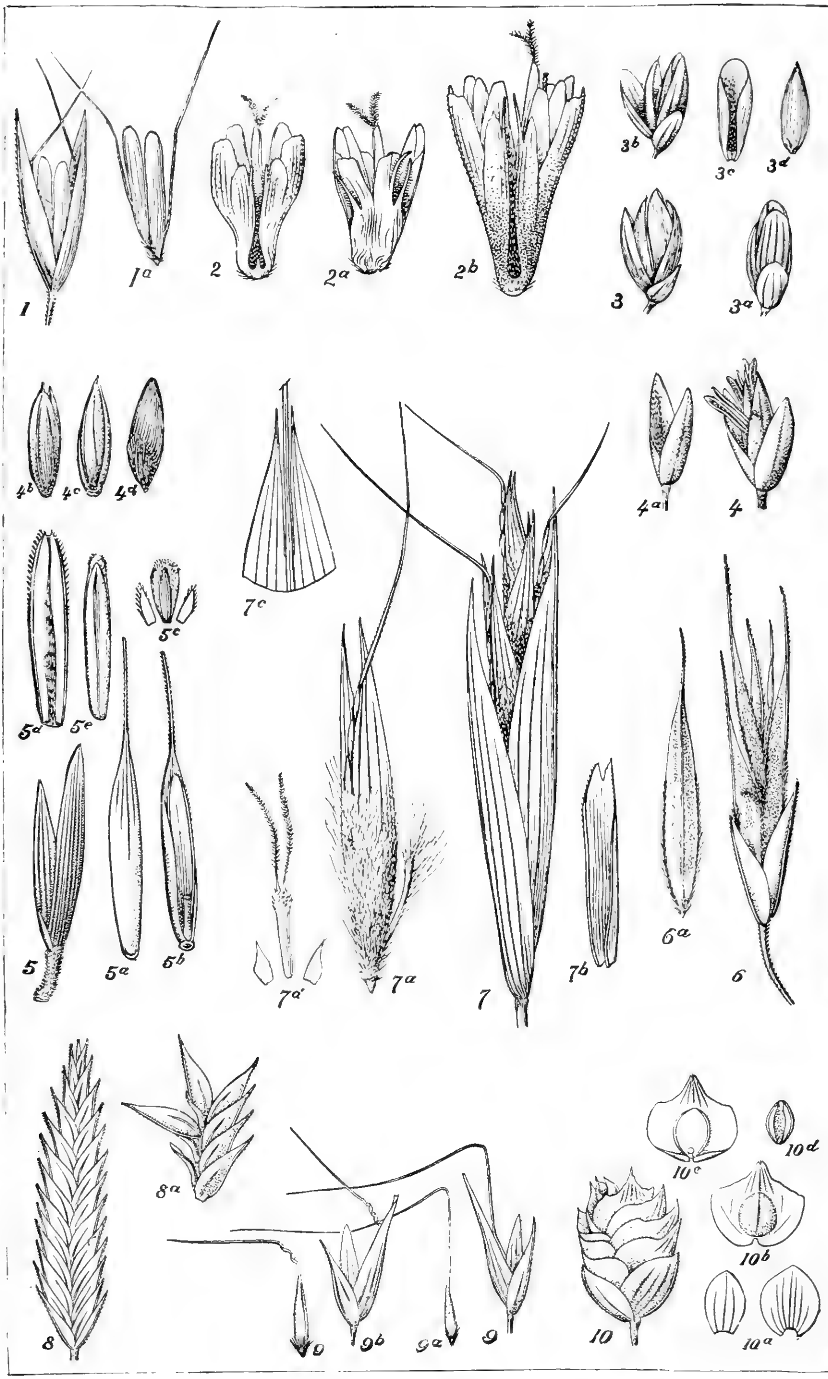

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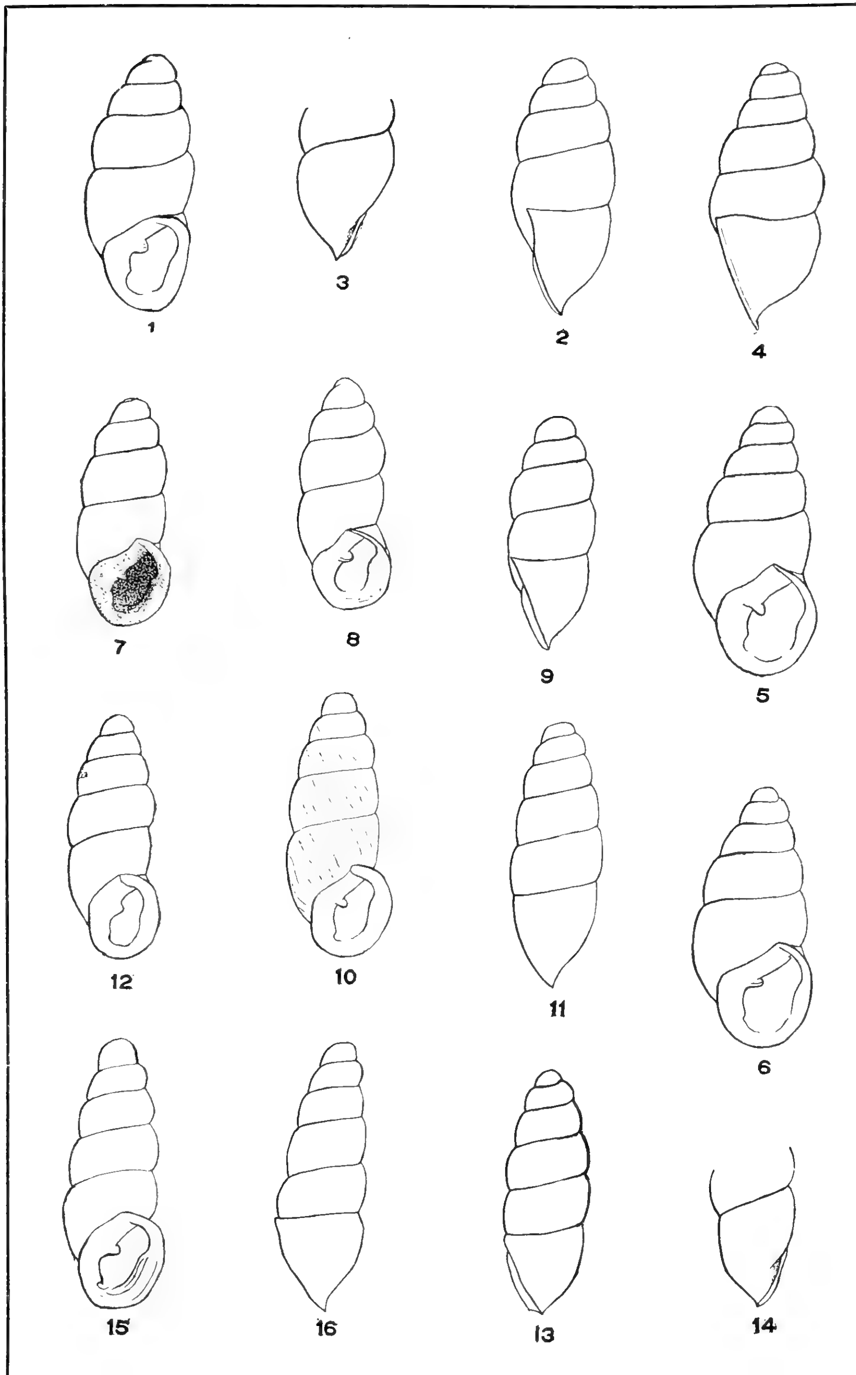

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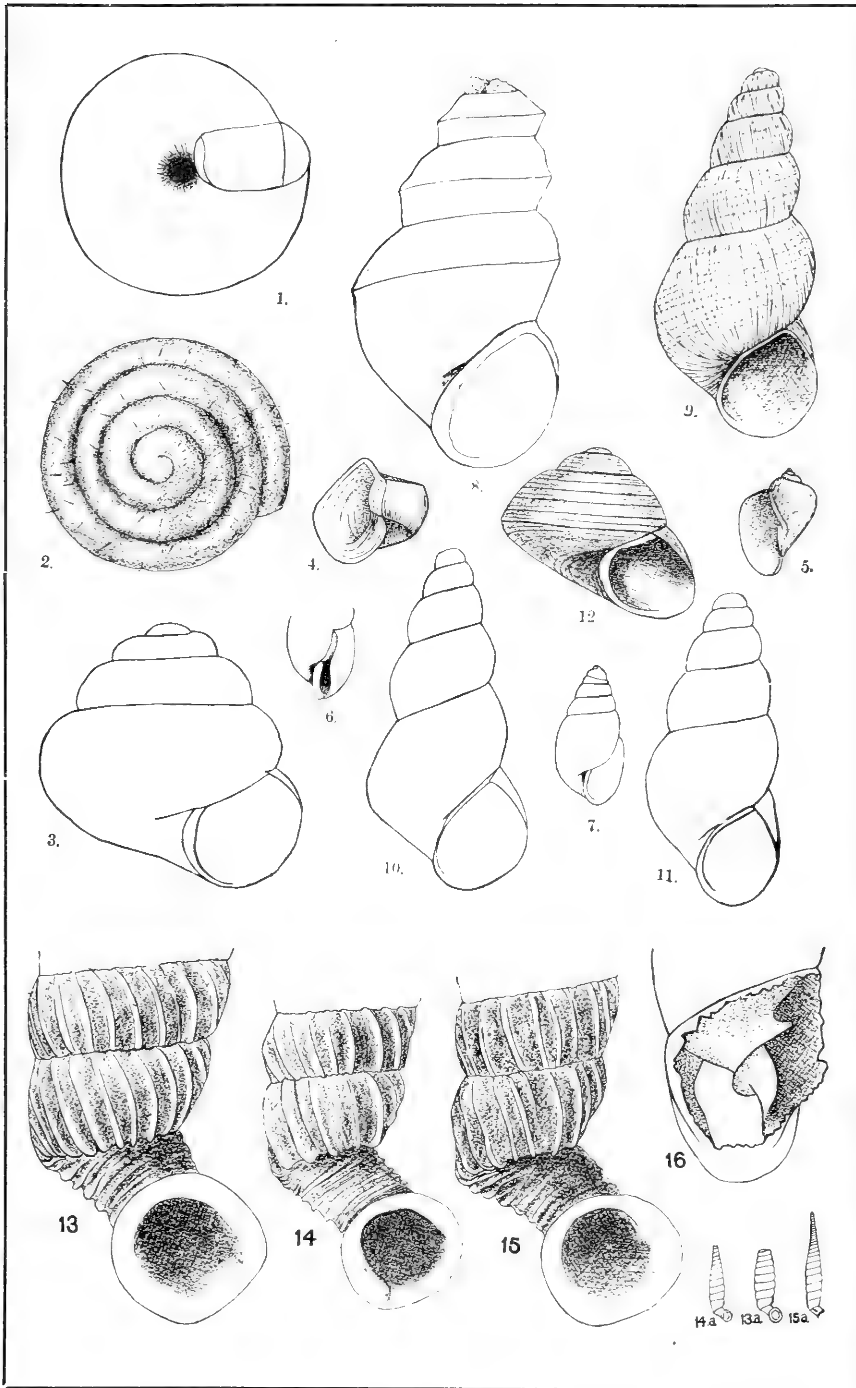

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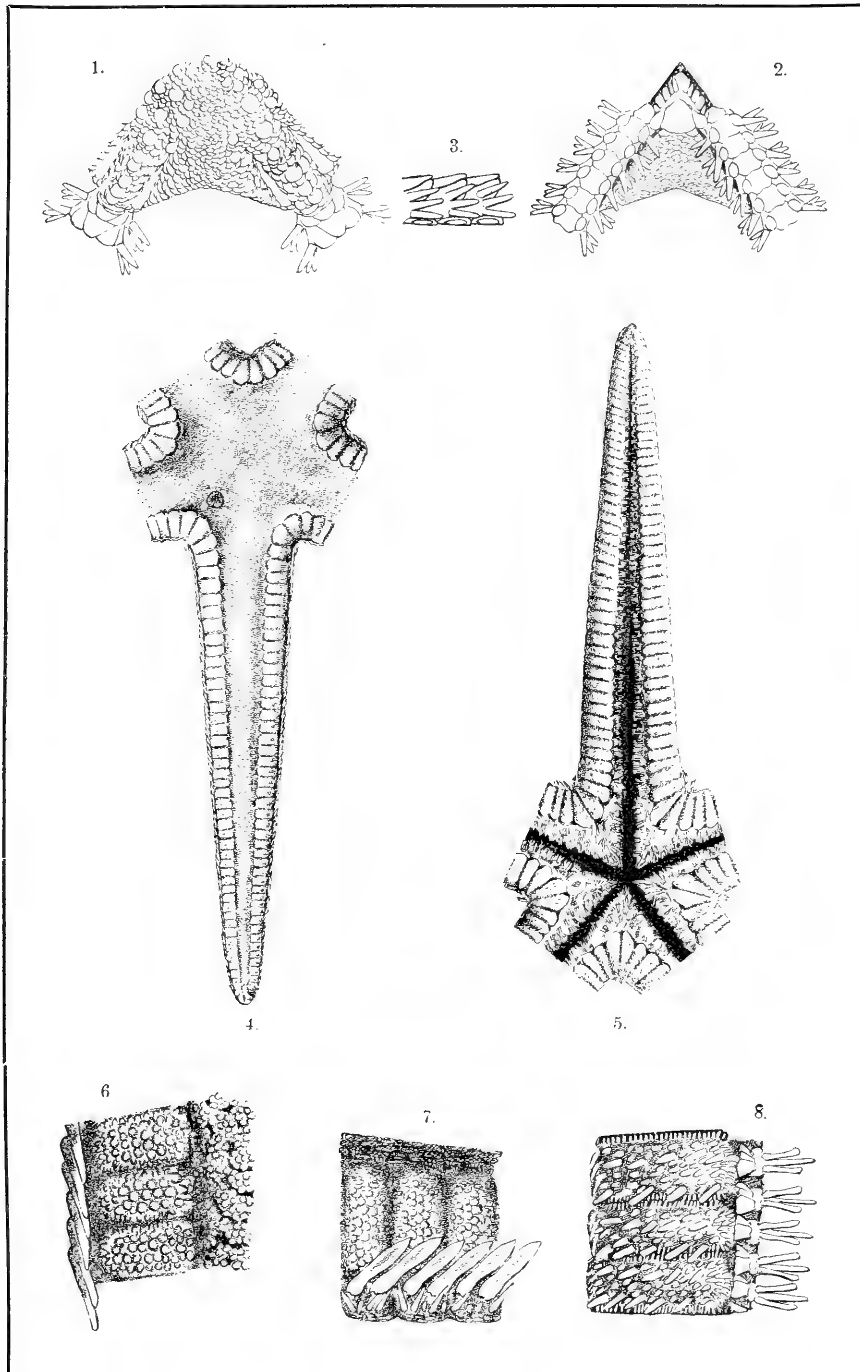

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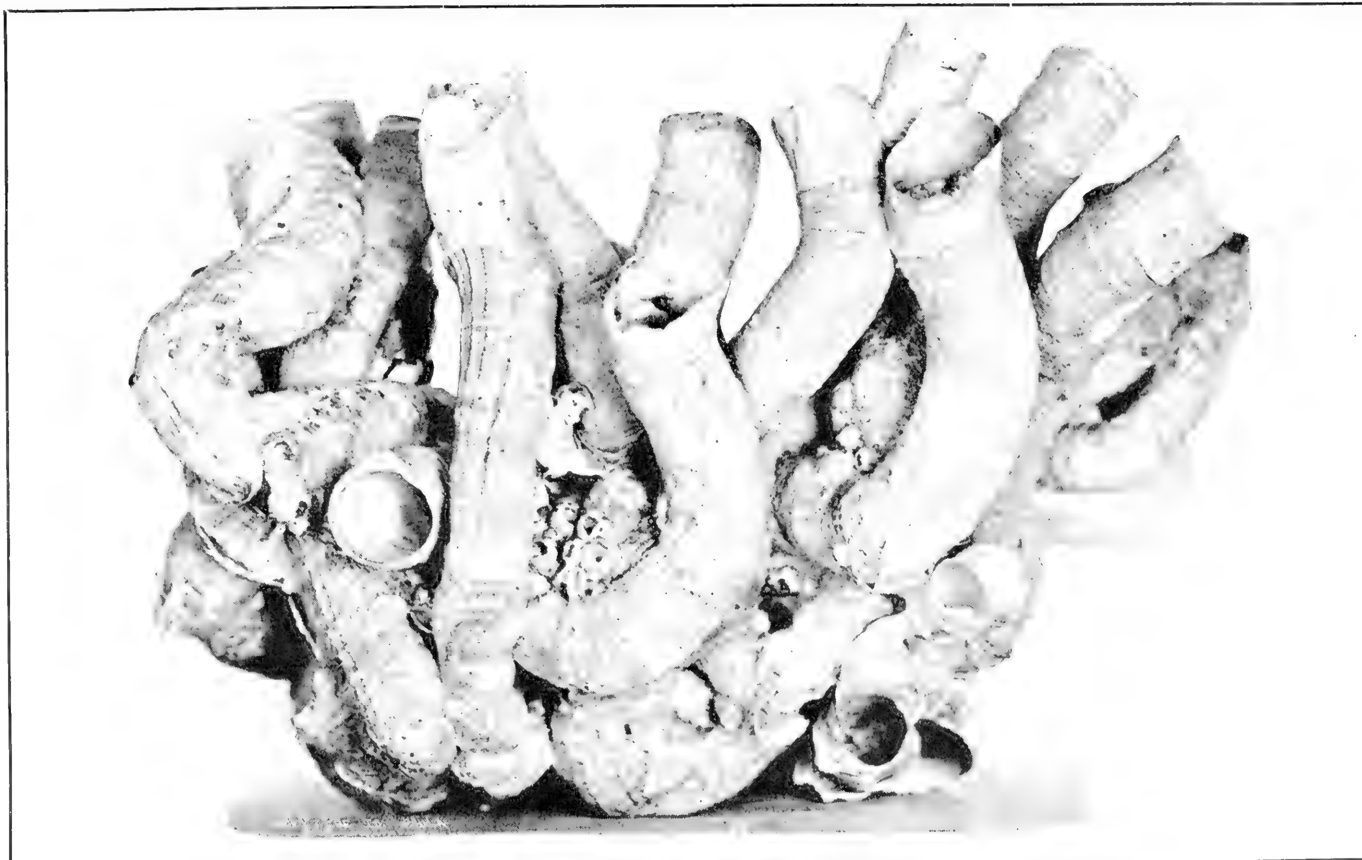

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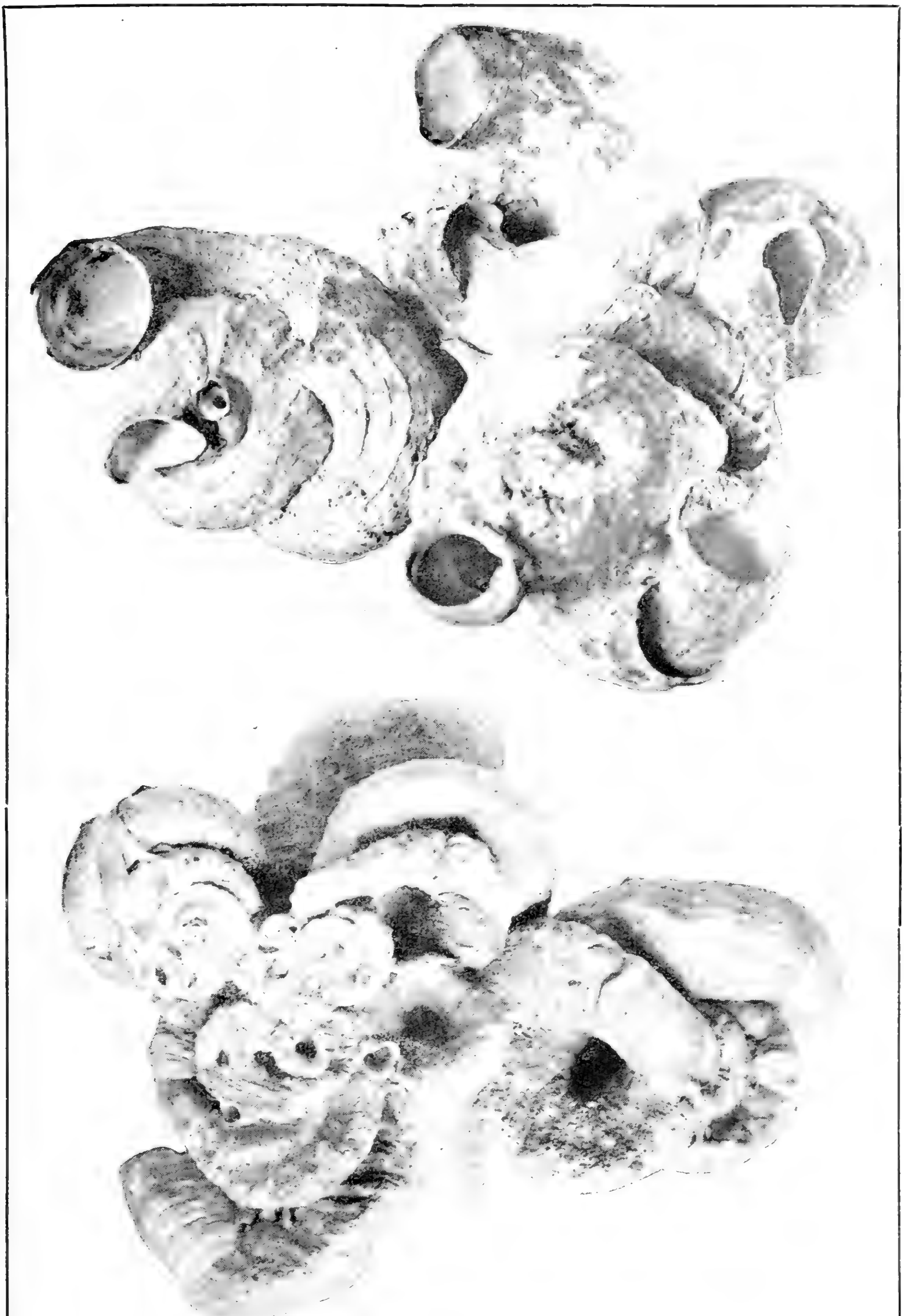

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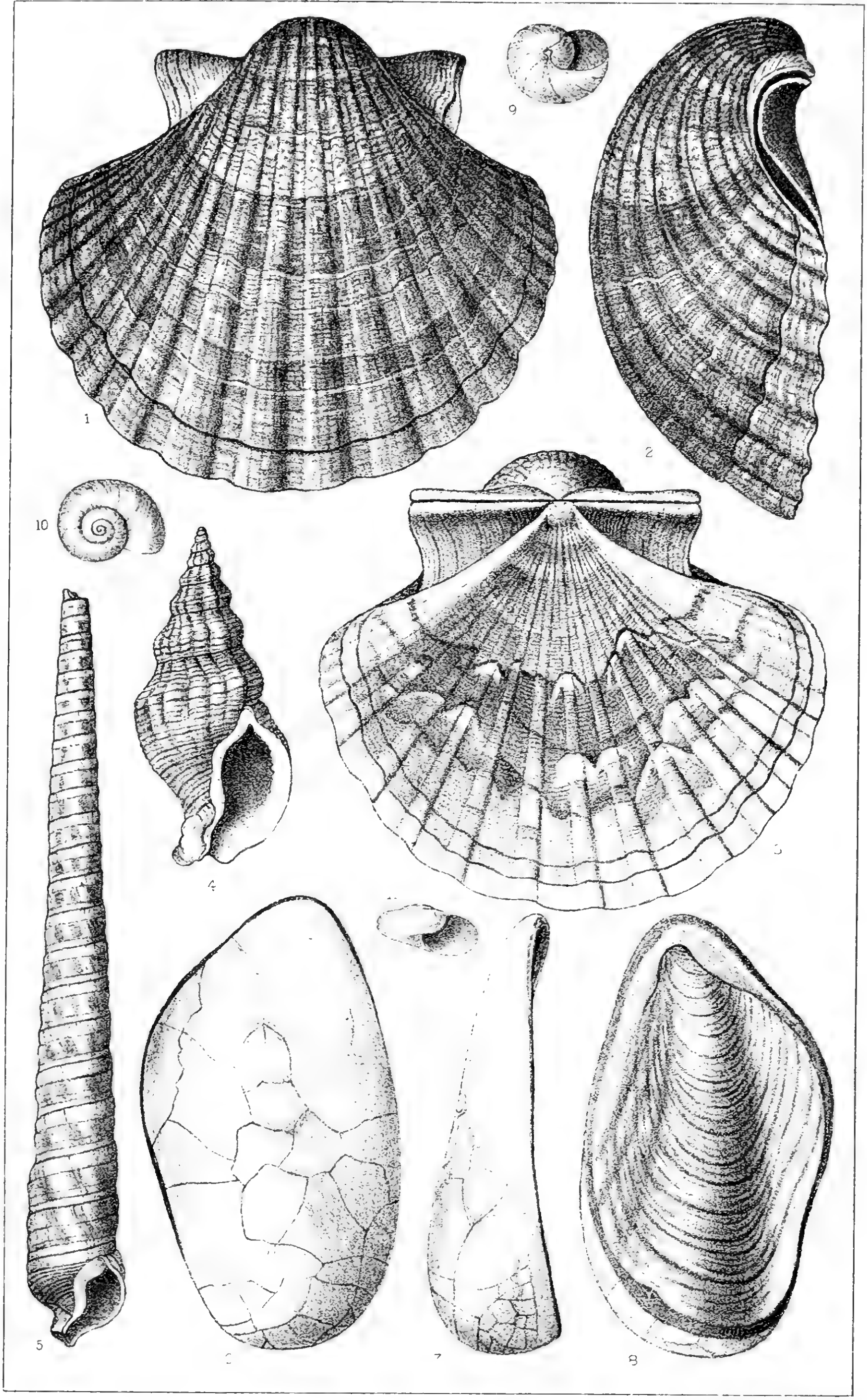

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