1880. 3 1881.

OTTAWA

Field Naturalists' Club

TRANSACTIONS NO. 2.

OTTAWA, CANADA.
PRINTED BY C. W. MITCHELL, "FREE PRESS" OFFICE, 6 TO 10 ELGIN STREET.

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FIELD NATURALISTS' CLUB.

TRANSACTIONS NO. 2.

CONTENTS.

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OTTAWA, CANADA:
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1881.

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Saunders, Wm., *President, Ent. Society of Ontario*, London, Ont.

Hill, A. J., *C.E.*, Camp D., C.P.R., British Columbia.

ANNUAL REPORT.

To the Members of the Ottawa Field Naturalists' Club:

The Council elected by you on the 23rd March, 1880, in presenting a report of the proceedings of the year just expired, can honestly congratulate you on the vigorous condition of the Club, as evidenced by increased membership, enlarged work, and extended reputation.

It was not found necessary since the annual meeting to summon any general meeting of the members for the transaction of business. The Council in fulfilment of their duties, met fifteen times, and many extra meetings were obviated by the early appointment of committees, on whom much of the work devolved.

There were, at the opening of the year, the names of ninety-three persons upon the list of members. Of these persons one is dead, nine have left the city, and three have resigned, leaving eighty remaining. During the year, twenty-two new members joined the Club, so that the list now contains one hundred and two names. Although the increase in membership thus shown is only nine, the actual gain of *bona fide* members is almost double that, there being ninety-two paid-up members, as against seventy-seven in the preceding year.

A third corresponding member has been added to the Club in the person of Mr. A. J. Hill, C.E., at present in British Columbia, who has evinced much interest in the success of the Club, and has sent to the President, for examination, collections of insects and plants, of which some species have proved new to Canada.

The summer excursions were well attended, and were successful in all respects. Four only were held; the fifth, which it was proposed to hold on the 9th October, had to be abandoned on account of wet and inclement weather at that season. The first was held on the 27th of May, when the west side of King's Mountain was visited, and a very pleasant day spent in investigating that favorite locality. The second, on the 24th June, was the best attended excursion yet held by the Club, while the place selected, the Chats Falls, had many attractions. Unfortunately, owing to the time occupied in going and returning, the stay at the falls was so limited that members could obtain but a glimpse of the natural products of the locality. The next excursion was held nearer home, on Saturday afternoon, 24th July. The iron mines of the Chelsea hills were visited, and quite a number, in addition to examining the surface operations, descended into the pits and saw the steam drills at work, the overseer very kindly explaining the various machines and modes of working. On Saturday, the 22nd August, through the kindness of Dr. Wicksteed, who furnished his steam yacht and several boats, the fourth excursion was held to Kettle Island, and the afternoon agreeably spent there. Among the guests present was Prof. Webster, founder of the old Ottawa Natural History Society.

Eight soirees were held during the winter, at which valuable papers were read and interesting objects of natural history were exhibited. The following is the list of papers :—1880—Tuesday, Dec. 7th, Inaugural Address, J. Fletcher, President ; Tuesday, Dec. 21st, The Relations between Literature and Science, W. D. LeSueur, B.A. ; Herbert Spencer's Biology, J. G. Whyte. 1881—Tuesday, Jan. 11th, On some Fungi found at Ottawa, Rev. A. F. Kemp, M.A., LL.D. ; The Chaudiere Gold Fields, R. J. Wicksteed, B.C.L., LL.D. ; Tuesday, Jan. 18th, Meteors and Meteorites, H. Beaumont Small ; Tuesday, Feb. 1st., Notes on some Diatoms found in the Ottawa, Prof. G. Baptie, M.A. ; On some Coleoptera injurious to our Pines, W. H. Harrington ; Friday, Feb. 11th, The Brain—the Gymnasium of the Mind, J. A. Grant, M.D., F.R.C.S,. F.G.S. ; Notes on some Fossils found at Ottawa, W. R. Billings ; Friday, Feb. 25th, Liliaceæ, Lieut.-Col. Wm. White ; On the Study of Botany, J. Martin ; Friday, March 11th, The Fauna and Flora of the North-West Prairies, Prof. John Macoun, F.L.S.

By request of the Ottawa Literary and Scientific Society, the Council undertook the management of a conversazione for that society on the evening of the 7th January. The programme arranged consisted of music, songs and readings, with a brief paper on astronomy by Mr. Dewe, who also, on the conclusion of the meeting, showed to many of those present, through a powerful telescope, the Moon and Saturn. Microscopes were also provided, through which the circulation of blood in a fish's tail, specimens of diatoms, etc., were viewed during an intermission allowed for that purpose.

At the opening soiree, as well as on the programmes, it was announced that, if a sufficient number of members and their friends desired it, elementary lectures upon botany and entomology would be given by the President and Secretary. Shortly afterwards the Literary and Scientific Society determined to organize a course of science classes, and, in order to assist the society, the proposed classes in entomology and botany were included in their course. It was, however, stipulated by Mr. Fletcher and Mr. Harrington, that all members of the Ottawa Field Naturalists' Club should be admitted free of charge to these two classes. The nightly attendance at the classes has been encouraging, and it is hoped that some who are not yet members of this Club will have aroused in them such an interest in the study of natural history as will lead them to become earnest workers, and valuable additions to our strength.

The following donations and exchanges have been received during the year :—From the Smithsonian Institute, fourteen "Bulletins of U.S. National

Museum;" Mr. A. S. Miller, of Cincinnati, "American Palæozoic Fossils," "Cincinnati Quarterly Journal of Science" (three volumes, 1874, 1875 and 1880), and "Contributions to Palæontology" (two pamphlets); The Epping Forest and County of Essex Naturalists' Club, "Transactions" to date (three parts) and 'Rules;" H B. Whitton, Hamilton, "Constitution and By-laws of the Hamilton Association" and "Selenography;" Mr. F. W. Webster, "Notes upon the Food of Predaceous Beetles;" Mr. W. H. Harrington, Vol. X. "Canadian Entomologist," Part I., Vol. I., "American Entomologist," "La Mouche ou La Chrysomele des Patates," and "Some Wood-eaters."

In accordance with a vote passed at the last annual meeting, the Council have caused to be printed the "Transactions" (No. 1) of the Club for the year 1879-1880. Included therein are the list of officers, list of members, rules report of Council, inaugural address, and such papers as dealt with the natural history of this vicinty, or with the original researches of members. These are contained in a well printed pamphlet of sixty-two pages, enriched, through the kindness of Mr. Grignard, by two fine lithographic plates. The Transactions are certainly most creditable to a young club, and have been so recognized and welcomed in every direction, deservedly obtaining for this Club a reputation, to enlarge and retain which will call for well directed and energetic work in the future. Exchange of publications has already been requested by influential societies in Canada, the United States and England, and complimentary notices have appeared in papers and periodicals of these countries. The Club has thus been brought into contact with kindred societies, and henceforth must strive to preserve the good name it has so soon acquired in the scientific world. Five hundred copies were obtained at a cost, including plates, of $78.43. Toward payment of this amount, the sum of $28.54, the balance in hand from 1879-80, was appropriated, and the Council is happy to inform you that the remainder has been defrayed by receipts from the sale of copies, of which 175 are yet held by the Club for future sale or distribution. Your attention is strongly urged to the value of these Transactions, both to individual members and to the Club.

Annexed is the Financial Statement for the year, wherein you will find that, after the settlement of all accounts, the Club is in possession of the extremely satisfactory balance of $55.52.

BALANCE SHEET, 1880-1881.

DR. *The Treasurer in account with Ottawa Field Naturalists' Club.* CR.

To Balance on hand	$ 28 54	By Stationery, Printing, etc.	$ 12 85
Members' Fees	50 50	Excursion Expenses	57 00
Excursion Receipts	63 20	Soiree Expenses	8 50
Soiree Receipts	20 70	Cost of Transactions	78 43
Sales of Transactions	49 36	Balance on hand	55 52
	$212 30		$212 30

15th March, 1881.

W. H. HARRINGTON,
Treasurer.

FIRST SOIREE.

INAUGURAL ADDRESS.

DELIVERED ON TUESDAY, 7TH DECEMBER, 1880, BY JAMES FLETCHER, ESQ., PRESIDENT OF THE O. F. N. C.

Members of the Field Naturalists' Club; Ladies and Gentlemen:

As President it is again my pleasant duty to congratulate you upon the successful termination of another collecting season, and the beginning of a new course of winter meetings. The programme promises to be unusually interesting, and will, I trust, induce a large attendance of the members, as well as of their friends.

Full details of the excursions held by the Club during the summer will be furnished in the Annual Report of the Secretary, and it will be, consequently, unnecessary for me to mention more than some of the most important points with regard to them. The first excursion was held on the 27th May, to the west side of King's Mountain, Chelsea, the rendezvous being in a grove of maple trees at the foot of a lovely little waterfall, which came foaming down the mountain side, among the green ferns and mosses, with fairy-like effect. Two days after this excursion, the Montreal Natural History Society held their annual field-day at Lachute, and it was with much regret that the Council was compelled, on account of the time that would have been occupied in travelling, to abandon the idea of making it a joint excursion of the two clubs, like the one held last year. The second excursion, to the Chats Falls, brought out a large number of members, and was an extremely enjoyable one, notwithstanding a few *contretemps*. The third excursion, to the Baldwin Iron Mines, was very interesting, and our members received much kind attention from all employed there, especially Capt. Simmons, the overseer, who escorted a party down the mine, and explained all the apparatus. On the 24th August the fourth excursion was held, to Kettle Island, Dr. Wicksteed generously placing his steam yacht and four large boats at the disposal of the Club for the purpose. Another excursion, arranged for the 7th October, had to be abandoned on account of unfavorable weather.

During the past year we have published our first Transactions, which are certainly most creditable to the Club, an opinion which has been expressed by other societies in different parts of the country, as well as by several magazines, among others *Science Gossip*, in England, and the *Popular Science Monthly*, in the United States. This number of the Transactions is embellished by two plates beautifully executed by Mr. Grignard; but, I am sorry to say, it does not contain all the papers read before the Club, the Council having decided to publish those only which treated directly of local matters.

To the list of our corresponding members the name of Mr. A. J. Hill, C.E., has been added. This gentleman is now employed on the Canadian Pacific Railway in British Columbia, and has already forwarded to the Club several parcels of plants and boxes of beetles, including some species which had not previously been found in Canada. You will see on the programme that Professor Macoun, another corresponding member, has promised to give us a lecture upon his explorations in the North-West.

I have been able to make a few additions to the Museum of the Ottawa Literary and Scientific Society from the specimens collected by our members, and hope during the winter to receive some more, as the collections of the past season are sorted out.

In last year's Inaugural Address I gave a sketch of the life-history of a plant, and tried to point out some of the interesting features in vegetable life, with the object of inducing some of you, who had not previously done so, to take up botany as a study ; and I am happy to say that a few have joined the botanists of the Club during the summer. With a view of aiding the efforts of these beginners, I propose, if a sufficient number of members express a desire to attend, to give, during the coming winter, a series of elementary lectures upon botany and the way to study it, while Mr. Harrington and myself will be glad to undertake similar lectures on entomology. The number of entomologists in our Club is, I am sorry to say, very small, and yet there is not a single branch in the whole of natural science which affects so directly every member of society, owing to the vital relations that exist between insects and the natural products of the country.

One of the most apparent of the many advantages to be derived from the study of natural history is its tendency to methodize the mind by impressing it with habits of order and exactness, thus producing all the good effects of mathematics and logic without the drudgery which to many is found in connection with those sciences ; and this is peculiarly the case with that portion of natural history which treats of the insect hosts. Their great number and diversity ; their beauty of color and form ; their metamorphoses, complexity of structure and peculiarities of habits, always exactly adapted to the purposes they have to accomplish, unite to give an interest to this delightful pursuit not possessed by many others.

One would suppose that, in a country like Canada, where crops of all kinds suffer so severely from the ravages of insects, the practical value of entomological studies would be duly appreciated, especially by the agricultural community. But, unfortunately, such is not the case, and these "minims of creation" individually so puny and weak, but which, united, form such irresistible forces, are to-day very little more studied, by the people most concerned, than they were fifty years ago. I shall endeavor to show that everything which is generally designated by that expressive word "bug" is not an enemy to be executed at once without a trial. It cannot but be a matter of considerable surprise to any person who turns his attention to the study of entomology to find to what an extent, comparatively speaking, that branch of natural science is neglected by scientific men, for, notwithstanding the large sums of money devoted yearly by wise governments towards its encouragement, and the untiring efforts made by individual students to present it to the masses in a popular form, it must be acknowledged that as yet it is not studied nearly as much as it deserves.

Little attention was paid to natural history previous to the commencement of the last century, although the writings of some of the leading philosophers of antiquity show that it was considered of sufficient importance to receive special study. Aristotle and Pliny, the elder, wrote of insects largely, although, it is true, somewhat erroneously at times. They too often fell into that trap which is still set in the path of modern investigators, namely, allowing their imaginations to carry them away from the truth to build up a previously conceived theory. Speaking of Dr. Leidy, "the most distinguished naturalist of America," a recent writer has said :—"In the performance of his scientific work he has confined himself to the duty of accurately describing what he has seen. He very rarely draws inferences from his accumulated facts, and his innate truthfulness is such as to deter him from theorizing." (*Popular Science Monthly*, V. xvii ; p. 691.) There are few naturalists, probably, to whom similar praise could be given.

The first book published in England on insects alone is said to have been Mouffet's "Theatrum Insectorum," which appeared in the reign of Charles I., after having passed through the hands of five learned doctors, all of whom did something towards its completion, and after having taken about one hundred years to finish. It was owing to the efforts of Ray and Linnæus, ably assisted by their contemporaries Reaumer and DeGeer, that entomology was raised to its proper place among the sciences. Since their time many learned men have fought hard to keep it there, until now "the laugh at entomology is nearly spent, and known professors of the science may meet in open conclave to exchange observations without fear of becoming subjects for a commission *de lunatico inquirendo*, and may now, net in hand, chase their game without themselves being made game of." This, however, was not the case in the last century, for we are told in Kirby and Spence's "Introduction to Entomology" that an attempt was made to set aside the will of a rational woman (Lady Glanville) on the ground of insanity, which was evinced, it was claimed, by her fondness for collecting insects.

Foremost of all the great powers in the prosecution of scientific research is undoubtedly the Government of the United States. Its official publications upon scientific matters are simply magnificent, and the generosity with which it distributes them to institutions and societies, where they can be freely consulted, is worthy of all praise. No one ever need be at a loss for information upon any ordinary scientific point, for on writing to the proper Department in Washington he will receive an answer by the return mail.

By means of the generous assistance of the Ontario Government, the Entomological Society of Ontario is able to put in the hands of all the agriculturalists of the Province information with which they can fight most of the common insect pests, and at the same time learn to determine which among the countless hordes of the insect world may be ranked as allies.

The naturalist founds his studies upon the theory that nothing in nature is useless, and that everything that is must have some special function to perform or it would not exist; it is in tracing up these special adaptations to certain ends that he finds the charm which enables him to carry on the laborious investigations which are often necessary.

As every one knows, vegetable and animal life are the two agents which nature employs to keep up the balance of creation, the one feeding upon or deriving its nutriment from the other. Now, these two agents are, to a certain extent, acted upon and kept in check by their own component parts. Whenever, owing to particularly favorable circumstances, too many seeds of any one species of plant spring up in the same place, they do not all mature, for if they did all would be sickly from want of light and air, and the species would gradually degenerate. Consequently, it is provided that the weaker should be kept down and choked to death to make room for their more robust companions. This is also the case in the animal world, as, for instance, with insects. When, from special circumstances, any one species is abnormally multiplied, it is sure to be attacked and kept in check by some other kind, which itself may be a prey to another species. Plants, through all their stages, from the seed to the decaying leaf, are the orignal source of support to some form of animal life; wherever vegetable life is profuse, there insects abound. The green plant attracts innumerable small insects; these in their turn attract larger carnivorous species, which are again preyed upon by birds and reptiles, and the larger carnivorous animals follow. The flesh feeders, thus depending one upon the other for subsistence, have an ultimate dependence upon vegetable life; therefore, wherever there is the greatest variety of vegetable life there will necessarily be the greatest variety of animals, whether quadrupeds, birds, reptiles or insects.

It is estimated that insects comprise no less than four-fifths of the whole animal kingdom. While there are about 55,000 known species of animals, excluding insects, the number of these amounts to upwards of 200,000. It is therefore manifest that they must perform some very important mission in the economy of nature. "It would be easy," writes the Rev. J. G. Wood, in "Insects Abroad," "to show how the very creatures that are most detested by man, and do him the most direct damage, are indeed, though indirectly, among his best benefactors. Apart from direct benefit or injury to man, the whole of the insect tribes are working towards one purpose, namely, the gradual development of the earth and its resources. The greater number are perpetually destroying that which is effete, in order to make way for something better; while others, whose business seems chiefly to be the killing and eating of their fellow-insects, act as a check to their inordinate increase, and so guard against the danger of their exceeding their proper mission."

I will borrow from the same author two more illustrations of the fact that even those insects which we consider most noxious are, in certain important respects, good friends. What more annoying creature can the mind conceive than the common mosquito? Truly is Beelzebub ("King of the Flies") rightly named if these are types of his subjects. I need hardly remind you of the tortures we all endured at our first excursion; it must be remembered, however, that devouring field-naturalists is not the normal occupation of mosquitoes; their real object is a beneficent one. In the deep dark forests of the tropics the air would be perfectly stagnant, and an enormous development of noisome fevers would be the consequence, if it were not for the motion caused by the wings of these and myriads of other minute creatures. In the larval state, too, they live in water, and feed upon the particles of decaying matter which are too small to be noticed by the larger aquatic animals. Were it not for the presence of these insects, which swarm in vast armies in all stagnant water in warm climates, thus purifying it as well as the atmosphere, such localities would be uninhabitable by any animals higher than reptiles. Again, strange as it may appear at first sight, if it were not for the existence of the many borers and wood-eating insects we could have none of those lovely forests which give so much beauty to our landscapes; and are the source of so much wealth to the country. Let us imagine that all these insects have been destroyed at one fell swoop, and note the consequence. A giant of the forest dies, and in course of time, during some winter storm, is blown down. Where it falls there it lies, and nothing can grow from the space it covers. Time rolls on and tree after tree falls, until the whole ground is covered with the trunks and limbs of fallen trees, and what was once a stately forest, with all its wealth of life, is now a vast wilderness where nothing can grow. How different is the beneficent operation of nature under the present conditions; scarcely has a tree shown signs of declining vigor than the insect hosts are at work. First of all come certain species which pick out any weak point and deposit their eggs there. The larvæ in due time hatch, and, eating into the tree, accelerate its decay. When it dies and falls to the ground it is immediately pounced upon by the large wood-boring beetles, which deposit their eggs upon the bark. These hatch into grubs armed with strong jaws with which they soon bore into and through the trunk, thus rendering it permeable to air and moisture. Smaller beetles and other insects follow in the wake of the larger, and bore out the softened decaying wood, some using it as food, others as materials for their nests. The rapidity of the work of destruction is astonishing, and in an incredibly short time, the giant which had taken hundreds of years to mature is reduced to mere dust, which serves as a fertilizer of the soil, and enables it to produce fresh trees to fill up the gap left by the one which has gone.

It is questionable whether any good results would follow from giving statistics of the amount of damage done by insects at different times, for so enormous are the figures that could they even be appreciated they would not be believed by those who do not make a study of the matter. It was estimated by Mr. B. D. Walsh, a careful observer, that in 1861 the injury caused by insects in the State of Illinois alone amounted to twenty million dollars, and that the damage done by insects in the United States cannot be less than three hundred million dollars annually.

It may not be out of place here to say a few words with reference to scientific nomenclature. There appear very frequently in the different newspapers accounts of the depredations of insects, and, that these may be concise and explicit, it is absolutely necessary that some of the technical terms of Entomology should be used. But this is not pleasing to the agricultural classes, "for," say they, "how do we know what such terms as hymenopterous, coleopterous, or dipterous, which are so frequently applied to insects, mean?"

If they take an interest in their own affairs they should make a point of finding out what these terms mean. No one suffers more from these hosts than they do, and it is ridiculous to think of their remaining inactive spectators when it is in their power to avert, or at least, diminish the evil by following the instructions given in the works of Entomologists. To be in a position to do this they have simply to learn the meaning of about a score, at the most, of classical words. Now let us consider what would be the result of their taking this trouble. in the first place, Entomologists would be led to write brief and popular accounts of their researches, and in the second the farmers themselves might be enabled to furnish to more systematic students, as the result of their own observations, data of the greatest importance. Curtis in his "Farm Insects," expresses himself as follows: "It is a great mistake to suppose that scientific descriptions and nomenclature ought to be employed for the use of those only who are specially engaged in the study of Natural History. If insects be not thus accurately described, and their names learned carefully, the facts noticed by practical observers are generally worthless, and may tend to mislead, by the confusion of one species with another, and the subsequent adoption of improper remedies. It is thus that I have found, in extensive reading on these subjects, that a very large amount of the information given by practical agriculturalists and gardeners has proved valueless in cases where, if the particular species alluded to could only have been identified, it would have been of the greatest value in furthering subsequent investigations."

But why, it may be asked, use Latin and Greek, why not use English Firstly, because English is not spoken in all parts of the globe, while Latin and Greek are the universal languages of the learned in all countries, and secondly, because the very nature of these languages particularly adapts them for the purpose. In Natural History it is frequently necessary to distinguish very different and very approximate forms, and it is of the greatest importance that the difference perceptible to the eye should be explained by precise terms in a concise and readily understood language, and Latin has been unanimously chosen by scientific men. When, however, as is occasionally the case, that tongue is deficient in a characteristic expression, the example of the early writers is followed and application is made to the Greek, which, from the euphony of its words and the fullness of it tones, is well adapted to the construction of permanent names of orders and genera.

There has been great difference of opinion among entomologists as to what orders in the animal world the class INSECTA should include, and perhaps even more upon the division of these orders into sub-orders. As Dr. Packard's "Guide to the Study of Insects" is the only manual we have here, it will be well to follow the plan there presented in drawing a short sketch of the class.

Insects are divided into three orders :—

1. Hexapoda, or true insects, which have six legs, and attain the perfect state, in which they generally possess wings, through a series of stages of existence, or metamorphoses, known by the names of the egg, the larva or caterpillar, the pupa or chrysalis, and the imago or perfect insect. Upon examining the body of a perfect insect, it will be seen that the portions of the body are more distinctly separated than they were during its earlier stages and that now the segments of the body are collected into three chief regions,—the head, the thorax, and the abdomen. It is from this division of the body that the word insect is derived. Aristotle called insects *entoma*, from *entemnein* = to *cut in*, and the Roman writers, following him, called them *insecta*, from *insecare*, which also means to *cut in*, and this name has been adopted by all later authors.

2. Arachnida, or spiders, which have the segments of the body grouped into two regions, and have eight legs, but no wings; they pass through no metamorphoses, but grow by frequent moultings of the skin.

3. Myriapoda, or centipedes, which have the body worm-like, without wings, and the segments not grouped into regions (except in the newly hatched young), have no metamorphoses, and grow by the development of additional rings to the body.

We will turn our attention to the first of these orders. The true insects are divided up into seven sub-orders, according to the structure of their wings, and these again are grouped together into two series, according to their relative

rank and affinities. The first and higher series has the body usually cylindrical, mouth parts more generally formed for sucking; metamophoses complete, larva usually cylindrical, very unlike the adult. The sub-orders embraced by this series are Hymenoptera, Lepidoptera, and Diptera.

The second and lower series, has, usually, the body flattened, mouth parts adapted for biting, metamorphoses complete, larva flattened and often resembling the adult and comprises Coleoptera, Hemiptera, Orthoptera, and Neuroptera.

The three regions into which the segments of the six-legged insects are grouped, are known by the names of the head, the thorax and the abdomen. *The head* carries the special sense organs, as the eye, the mouth, and the antennæ. The eyes are wonderful structures, and are constructed to cover a very large field of vision; they consist, first of all, of two large compound eyes, made up of numerous small six-sided facets, which are so numerous that Leeuwenhoec is said to have counted as many as 8,000 in the eye of a fly, and Strauss 8,820 in that of a cockroach; besides these two compound eyes, there are in many insects two or more simple eyes (*ocelli*) arranged across the forehead, they can be easily seen in the common Humble Bee. There are some insects which have only *ocelli* and even some with no eyes at all.

The principal organs of the mouth are six in number, two on each side of the opening, one above and one below, the upper single organ is the upper lip or *labrum*, the lower the *labrum* or lower lip, this lower lip has a basal joint (*mentum*) supporting a more flexible part (*ligula*); the upper or inner integuments of the *ligula* is usually developed into a kind of tongue, which is a distinct part (*lingua*) in the locusts and dragon flies; the superior pair of the lateral organs are the upper jaws or mandibles, which are generally hard and serve to tear the food, the inferior pair are the lower jaws or maxillæ, which are generally soft and serve to carry the food to the gullet, to be swallowed. To the lower jaws and under lip are attached short jointed processes, called *palpi* or feelers. These oral organs are the same in all insects, although the structure is vastly different among those which obtain their food by mastication and those which obtain it by suction; by dissection and comparative anatomy, however, it can be shown that they are identical, only greatly modified in form, in both of these classes. In biting insects, as beetles, the side pieces are short, far apart, and have a horizontal motion, and the upper lip is a flat plate closing the mouth above; with sucking insects as mosquitoes, the same parts are elongated into lancet-like organs, are close together, and have a longitudinal motion, and the lower lip at the same time is developed into a tube, which encloses them. In Lepidoptera the three upper organs are very feebly developed, while the maxillæ are elongated into a delicate proboscis, the identification of which with the maxillæ is shown by the occasional presence at its base of a pair of minute palpi; the lower lip is soldered to the head, but is furnished with a pair of palpi, well developed and

clothed with scales, which act as a protection to the proboscis. In the flea the middle lancet seems to represent the upper lip.

In bees the lower lip and maxillæ form together a sucking apparatus, but they are also provided with well developed upper jaws or mandibles.

In the front part of the face of an insect are two appendages, which vary very much in form, in the different sub-orders and genera, and even in the sexes of one species; they are called antennæ. What the exact functions are of these important organs, is not known, but it is probable they have more uses than one. Experiments have been made with moths in which it was observed that if the antennæ were removed the insect seemed unable to direct its flight. It is probable too that the olfactory nerve is situated in the antennæ. The different forms which the antennæ take have been made use of by entomologists in classifying insects.

The next division of the body of an insect is the *thorax*. This is the solid portion which bears the organs of locomotion, and comprises the three segments which follow the head. The first one is called the pro-thorax and bears the first pair of legs, the next or middle segment is called the meso-thorax and supports the second pair of legs and the anterior pair of wings, the third segment is called the meta-thorax, and to it are attached the third pair of legs and the hind wings. The wings are objects of great beauty and strength, and consist, as a rule, of a double membranous plate, traversed more or less, by bony veins.

The last division of an insect's body is the *abdomen*, which consists of a series of segments attached by membranes. Each of these segments is formed of two arcs or semi-segments, one above and the other below. The abdomen is the seat of the organs of reproduction and alimentation. The senses of insects are dependent upon the nervous systen, which consists of a series of nervous masses or ganglia, joined together by two nervous threads, the whole constituting a nervous chain, from which nerves ramify to the different organs, enduing them with the various senses they possess; from the first ganglion the nerves of the eyes and antennæ are fed, and from the second the mouth. Hearing and smell are certainly possessed by insects; but their appropriate organs are not ascertained. They also possess taste, sight, and touch, the latter being seated probably in the antennæ, the palpi and in the tarsi of the feet.

The circulatory system is well represented in insects. The blood is generally colorless, but occasionally of a greenish or reddish hue. The heart, which comprises a series of large reservoirs in the form of a long tube plainly discernible through the transparent skins of caterpillars, lies above the alimentary canal on the upper surface of the body.

Insects do not breathe, like large animals, through their mouths; but by means of breathing-holes in their sides, which connect with two great air canals

(tracheæ) which run along the sides of the body, and from which smaller tubes convey the air in very small volumes to different parts of the body, and so oxygenate the vital fluid in its passage. In the *Arachnida* this tracheal system is considerably modified, respiration being effected among some spiders by ordinary ramified tube-tracheæ, and among others in certain sacs or cavities in the abdomen which have been called pulmo-branchiæ from an idea that they partook both of the nature of the lungs of the higher animals and the branchiæ or gills of fishes; as, however, the blood does not penetrate these sacs, but is merely oxygenated in its passage by and round them, while it is being re-collected after use and previous to being sent back to the dorsal vessel or heart, these cavities are now believed to be tracheæ localized within a peculiarly furnished sac. Tube-tracheæ when examined with the microscope are wonderfully beautiful. Traversing as they do the whole bodies of insects, they must necessarily be very flexible, and it might be supposed that the rapid movements of the insect might sometimes cause them to collapse, in which case the circulation of the air would be stopped. Upon examination we find that there is a beautiful and simple contrivance which renders this impossible. The tubes consist of a double integument between which runs a hair-like spirally-twisted fibre, just like the coil of wire which is sometimes put inside indian-rubber speaking tubes; this adds considerably to the elasticity of the air vessels, and when these collapse through the movements of the insects, it prevents the opposite sides from adhering, and causes them to resume their tubular form as soon as the pressure is removed. There are generally nine pairs of breathing pores or openings through which the air is admitted into the tracheæ. These openings are so constructed that it is impossible for the dust to enter the tracheæ. At the outside orifice is a corneous plate, and inside that is a hollow chamber, and then at the other side of that is another valve. In perfect insects nearly all the air enters through the thoracic spiracles.

"When an insect is preparing itself for flight, the act of respiration resembles that of birds under similar circumstances. At the moment of elevating its elytra and expanding its wings, which are indeed acts of respiration, the anterior pairs of spiracles are opened, and the air rushing into them is extended over the whole body, which by the expansion of the air-bags is enlarged in bulk, and rendered of less specific gravity; so that when the spiracles are closed, at the instant the insect endeavors to make the first stroke with, and raise itself upon its wings, it is enabled to rise in the air, and sustain a long and powerful flight with but little muscular exertion." In the pupal and larval state respiration is performed almost equally by all the spiracles; but in the imago almost all the air enters by those in and near the thorax, so that, generally, a pinch under the thorax will kill most soft-bodied insects by suffocating them.

Perhaps no sub-order of insects presents more examples of wonderful instinct and exquisite adaptation of their forms and habits to required ends than

are to be found among the Hymenoptera or membrane-winged insects. It is on account of the highly developed instincts, exhibited in the care they take in providing for their young and in laying up stores for winter use, added to the important part they play in the fertilization of many plants, that they have been placed first in Dr. Packard's system of classification. I shall speak later on of the relations between insects and plants, and will now direct your attention to a few points in the life history of insects which have seemed to me to be of more interest than usual.

By far the larger proportion of these insects are beneficial, and feed either in the larval or perfect state upon other insects. Of beneficial insects mention must first of all be made of the honey bee, concerning which alone whole volumes have been written; and afterwards of the various wasps and allied genera which feed upon and store up for the sustenance of their grubs, enormous numbers of caterpillars, and other insects, as well as acting as scavengers. Among the social bees, wasps and ants, there are found not only males and females, but also other kinds of individuals which are necessary for the successful propagation of the species; these are called neuters, and sometimes laborers or nurses; they are, however, essentially females, having the female organs, but in an imperfectly developed and passive state, their sting being only an accessory part, which is changed into a special weapon of defence, and is the homologue of the ovipositor in fertile female insects. The worker bee, besides collecting the honey and pollen which is to serve as food for the offspring of the queen, has to carry the eggs from the queen to their proper cells and feed the larvæ when they are hatched; they are therefore indispensable for the propagation of the race.

I class wasps among beneficial insects, because the sting for which they are dreaded is never used against man, except as an instrument of defence, while its proper use is the destruction of his enemies, the caterpillars of numerous noxious species of insects.

Although some members of the wasp family do fill their cells at certain periods with honey, the food of the greater part, undoubtedly, consists of animal matter, chiefly other insects, which they either seize with their mandibles, or, when it is to be stored away for the use of the larvæ, sting to death. The poison introduced by the sting owes its virulence to the presence of a peculiar acid known as formic acid. This acid is said to be chemically very similar to chloroform, and its action upon insects stung to death is very peculiar. It does not kill them at once, but paralyzes them, so that they live for many days, and, in some cases, larvæ have been known to turn into pupæ after having been stung, but have not had sufficient strength to complete their final change into *imagines*. The use of this antiseptic property of the poison is easily seen. The mother wasp, having prepared the nest for her young, fills it with insects which she has stung; she then lays an egg and closes up the nest. Upon the grub hatching it has a larder well supplied with provisions which will keep fresh as long as required for it to complete its transformations.

The Ants do not demand much of our attention in this country as either injurious or beneficial insects, although there are a few species which are occasionally troublesome, and destructive to posts and fences. The almost human aspects of ant-life, however, as exhibited by different species, provide a favorite study for the entomologist, and an investigation of them could not fail to fill even the least curious with wonder and amazement. Their dwellings are constructed on the most scientific architectural patterns; some species have their cows (*aphides*), which they tend with the utmost care. There are some again which make expeditions against less powerful ants, and carry them off to serve them as domestic servants, they themselves becoming entirely dependent upon the assistance they thus secure, so as to be almost helpless without it. Others, notably the celebrated Agricultural ants of Texas, cultivate the ground, reap the harvest, and store up the grain.

Of all insects beneficial to man, none, perhaps, surpass the ichneumon flies which are parasitic upon the larvæ of various insects. This is an enormous class embracing insects of all sizes, according to the size of the insects they infest. *Rhyssa lunator*, the largest found in this country, has a body nearly an inch and a half long, and an ovipositor of upwards of four inches, while there are some which are so small that they can only be distinguished by the aid of a strong magnifying glass. No class of insects seems to be exempt from the attacks of these freebooters; and with them there does not even seem to be honor among thieves, for nearly every species has a parasite of its own class. As a rule, the parent fly has at the end of the abdomen a long pointed instrument with which she pricks a hole through the skin of a larva, and down which she passes an egg which, in time, hatches into a white, footless, eyeless grub, inside the skin of the caterpillar. Now, I have said that most insects breathe through breathing-pores in their sides. These, however, are an exception, and have their spiracles in the tail. The first care of the newly-hatched grub is to find one of the caterpillar's breathing-pores and fix its tail to it, so that it may breathe the air. It then sets to work and feeds upon the body of its host until fully developed, when it eats a hole through the skin and escapes.

Before closing this, I fear, already too long address, I feel constrained to direct your notice to some of the contrivances by which Nature provides that the flowers of plants may be visited by such insects as may assist in fertilizing the ovary, and may keep away such as are useless.

In order that the ovules contained in the ovary, which is part of the pistil of a flower, may be fertilized, it is necessary that the pollen from the anthers of the same, or a different flower of the same species, should reach the stigma or top part of the pistil. Some flowers are capable of self-fertilization ; but it has been proved by experiment that it is more advantageous to the future plants that they should be fertilized by pollen from other specimens ; and it will be found on examination that there are several very beautiful contrivances by which self-fertilization is prevented. These are either in the structure of the flower or in a difference in the time that the pistils and anthers reach maturity. In some plants, too, the staminate flowers are all borne on one individual plant, while the pistillate are on another ; but it is necessary that the pistils should be fertilized by pollen from the anthers, and this is generally effected by insects carrying pollen on their bodies from one flower to another when visiting them in search of honey. To ensure these visits just at the time when the flowers are in full vigor, this nectar is secreted to attract them. Of course, flowers can only be fertilized by pollen from flowers of the same species, and it is a remarkable fact that a bee only visits the flowers of one certain species of plant during any one journey, and further, that honey only developes in flowers just when the essential organs are mature. There is a most remarkable and interesting book just published called "Flowers and their unbidden guests." It is by Dr. Kerner, Professor of Botany in the University of Innsbruck, and translated from the German by W. Ogle, M.D. It is, perhaps, the most valuable contribution yet written towards demonstrating the principle which, I believe, should actuate every student of Natural History, viz. : finding a use for everything that nature has made. The author holds the opinion that the position, direction, and shape of the leaf is of just as great significance for the preservation of a species as the form, colour and smell of a flower ; and that not even a hair is meaningless whether found on the cotyledon, the leaf, the stem, or the blossom. In fact, he proves that these contrivances are formed, among other things (for they have probably more uses than one) for the prevention of those small flying insects, which are too small to touch both the anthers and stigma of a flower, and also those creeping ones which, from not having wings, are unlikely to go immediately from one plant to another, from obtaining the nectar. These contrivances, as I have said, are of many kinds. In some plants there is a viscid ring in the middle of each joint of the stem, as in our own *Silene antirrhina ;* in others, as *Polygonum Pennsylvanicum*, the short stalks which support the flowers are embellished with viscid glands. This is also the case in *Linnæa borealis*, the lovely little flower known by the name of Twin Flower. In some the leaves meet in a ring round the stem, and thus form a cup which collects dew and rain, and entirely isolates the stem, and so prevents creeping insects from mounting. In some plants we find thorns, which are most effectual barriers to all soft-bodied animals as snails and slugs. As a rule, too, the closer to the flower the greater is the accumulation ; everyone must have noticed that in the common thistle the lower leaves are much less prickly than the upper. The form of the flower, in many instances, acts as a barrier to useless insects. In the common garden antirrhinum, or snap-dragon, the mouth of the corolla is firmly closed, and can only be opened by strong insects like humble bees; such small insects as ants are unable to enter. When, however, an insect as large as a bee has entered and covered the stigma with pollen, the tension of the corolla gradually diminishes, and smaller insects can freely enter. Perhaps one of the most remarkable proofs that the hairs often found on the stems of plants are meant as a protection against creeping insects is presented in the variation which takes place in our common water polygonum. When this plant grows in water it is evident that nothing is required to keep off useless *creeping* insects, for it is so isolated that they cannot get at it; but there is a very common form found upon the shore, the whole stem of which is densely covered with rigid hairs; and I have no doubt at all that this is to protect the flowers against creeping insects. One more curious method occasionally found in plants to protect their flowers from creeping insects is the presence of nectariferous glands at the base of the leaves, generally on the petioles; these act as allurements to draw them off. There are sometimes other appliances designed to protect the flower during the time the seeds, the means of reproduction, are maturing; these lie in the actual flower itself. Some flowers have thorns on the calyx and on no other part of the plant; and, again, many plants are preserved from destruction by the presence of certain alkaloids and other chemical compounds, as in *Datura*, *Asarum*, *Solanum* and *Conium* Anyone who has bred butterflies will have noticed that caterpillars will feed upon the leaves of a certain plant, but will not touch the flower; and this is also the case with many ruminant animals—they will eat the leaves, but not touch the flower.

There are many other subjects of vital importance and immense interest to which I should like to direct your attention, but time forbids. The magazines and literature of the day teem with articles setting forth the claims of natural science, and anyone that wishes to keep up with the age must work hard, but I venture to say that his work will have so much interest attached to it that he will find a reward for his labors in a life of unalloyed pleasure.

SECOND SOIREE.

TUESDAY, December 21st, 1880: The first paper of the evening, "The Relation between Science and Literature," was read by Mr. W. D. LeSueur, B.A., who pointed out that the differences between literature and science, as regards the faculties they called into play and the methods by which they worked, were by no means so great as often supposed. To see aright in any branch of study required considerable preparation of mind; and to generalize with success either in the region of science or that of literature, required considerable imaginative power. Literature had, under the influence of science, become more definite in its methods and aims, and science, under the influence of literature, had become more popular in its character. Some of the most eminent men of science of recent times were possessed of a high degree of literary power. Both literature and science had suffered somewhat through the vanity of some of their professed students; and there was a tendency on the part of both to degenerate into mere individualism. Both were, however, essentially social in their character, and should therefore be pursued in subordination to social ends. If we were to keep in view the vast debt we owe to the civilization into which we have been born, we should not, as students either of science or literature, seek merely to please ourselves, but should consecrate our best efforts to the cause of humanity.

The second essay, by Mr. J. G. Whyte, on "Herbert Spencer's Biology," gave a most excellent condensation and exposition of the theory so ably advocated by that illustrious philosopher. He pointed out the gradual and widespread change which has taken place in conceptions of the formation and progress of the earth and its inhabitants, so that the once universally accepted theory of special creations and frequent catastrophes has in great part yielded to that of evolution, first brought into prominence by the writings of Darwin. While it is not claimed that this theory will furnish the immediate solution of every problem which greets the student of natural history, it undoubtedly enables him to grasp the meaning of many things formerly unintelligible, to arrange them in proper sequence, and to render them of service in his further studies of the animal and vegetable worlds. As the studies of palæontology, embryology, etc., receive increased material and workers, more of the "missing links" are from time to time unshrouded, and the forms at present inhabiting the earth are more readily traced back to those which existed in far earlier ages.

THIRD SOIREE.

TUESDAY, January 11th, 1881: Rev. A. F. Kemp, M.A., LL.D., delivered an address on "Some Fungi found at Ottawa," first explaining the difficulties encountered by a student in this branch of botany through the absence of works of reference or other means of determining the numerous species, many of which require careful microscopic study on account of their minuteness. He then gave an outline of the classification of fungi and a description, illustrated by admirable figures on the black board, of the structure and fructification of several species, selecting such as might be easily found in the neighborhood.

Dr. R. J. Wicksteed, B.C.L., L.L.D., then read an interesting paper on "The Chaudiere Gold Fields," in the Province of Quebec, in which the geological formation of the district was fully discussed, and illustrated by the aid of maps. The various methods of working and extracting the gold were then considered, and models of several of the machines used were shown, as also nuggets of gold from the mines, and packets of unsifted dust, in which could be seen specks of the precious metal.

FOURTH SOIREE.

TUESDAY, January 18th, 1881.—"METEORS AND METEORITES."—MR. H. B. SMALL.

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The phenomenon of shooting or falling stars, or meteors as they are more generally styled, is now acknowledged to have existed since the formation of the solar system, long anterior to the existence of man. On any clear evening it is estimated a watchful observer may see on an average two shooting stars every five minutes, and at certain periods of the year in such abundance as to have obtained the name of meteoric showers. These apparently emanate from some constellation or from a point of space known as a *radiant*, represented by a certain constellation, whilst single meteors appear to come from no particular point, but move in all directions and from every part of the sky. These are styled *sporadic*. In their normal condition these wandering bodies before they reach our vision are known as *meteoroids*, and in their own proper orbit are never visible from the earth. They are then regular circumsolar bodies obeying the laws of motion and gravitation as rigidly as the planets. Striking or rather entering our atmosphere at a speed of forty-eight miles per second, they at once become self-luminous from the heat engendered by friction with the atmospheric medium, and the arrested motion producing a sudden compression of the air. To illustrate this I may mention that there is a little instrument called an air match, consisting of a piston and a cylinder, somewhat like a syringe, in which a light can be struck by suddenly forcing down the piston upon the air below in the cylinder. As the air cannot escape it is suddenly compressed and gives out a spark sufficient to ignite a piece of tinder at the bottom of the cylinder. Some idea from this may be formed of the heat evolved by the motion of a large body in the atmosphere with the velocity of a meteor. A combustible body under such circumstances would be speedily ignited, but could not burn freely till reaching air of greater density; thus on entering the lower portion of the atmosphere it would burn with great rapidity and according to its distance be more or less entirely consumed before reaching the earth. It has been estimated that by the time they have traversed a space of fifty miles, the meteoroid, or meteor as it has then become, is heated, melted, evaporated, and extinguished in a period of not less than a second of time. The height from us at which they become heated to visibility is sometimes as much as 200 miles, but the average has been put down at seventy-five miles, and extinction about fifty miles above the earth.

The length of the arc or course they describe in their visible path varies greatly, owing to the position of the observer. One may flash up, increase in size and brilliancy and disappear without seemingly describing any arc. The course of such a one is directly towards the observer, but to another person thirty or more miles distant it would exhibit an arc of several degrees in length.

Different and varied views are held by philosophers as to the origin of meteoroids. One theory is that they are fragments of an exploded or shattered planet filling interplanetary space, most of which through holding orbits round the sun will ultimately fall into that body and serve as fuel for that central orb. To illustrate this, supposing our earth through some gigantic convulsion became disintegrated and burst into numerous portions, these would continue to move on becoming more or less erratic in their movements; the smaller portions would first feel the influence of disturbing agencies larger than the earth, and moving inward would become entangled as it were in the resisting medium in space which is now acknowleged to exist. This resistance would change their orbits, and the lighter particles would form a more erratic orbit than the heavier or denser ones. They would gravitate towards Venus, which lies inside our orbit, and be the first to fall on it, whilst the denser fragments metalloids, and metals would be the last.

Dr. Brewster favors the theory of Meteoroids being fragments of a large planet similarly as the asteroids, the previous existence of which was long ago suggested by the vast chasm between Mars and Jupiter, where only asteroids have as yet been observed Dr. Olbers, the discoverer of three of the known asteroids, held the same idea, and that the lesser fragments coming within the attractive power of a planet would fall towards it, and when entering its atmosphere would go through all the conditions referred to, fusion, luminosity, etc. Sir John Herschell, however, differs from this theory. The diameter of Jupiter, the largest known body in our planetary system, is 80,000 miles, whilst that of Clio, one of the smallest, is only sixteen miles. Chladin, a philosopher at the end of the last century, thought that bodies might exist as much smaller in comparison as Clio to Jupiter, having only sixteen feet diameter, and in the same ratio we come down to one-twenty-fifth of an inch, mere cosmic dust. Myriads of these may revolve in space without our having any knowledge of their existence.

To this comet dust is now attributed by scientists that peculiar fleecy brightness known as the zodiacal light. Any observer of the western sky at this season of the year for about one hour after sunset may see a soft faint cone shaped glow of light extending about forty degrees, following nearly the Sun's path in the heavens. Near the equator when the ecliptic rises high above the horizon it can be seen nearly all the year round, and in a very clear atmosphere in the tropics has been traced all the way across the heavens from east to west forming a complete ring. The theory that now prevails is that the light from the sun when below our horizon reflects on the cosmical atoms of floating star dust and meteoroids is the cause of the soft celestial glow that now lingers evening after evening in our western sky. An illustration of this is afforded by a ray of light which finds its way into a darkened room through a small orifice, revealing as motes dancing in a sunbeam the particles of dust floating in the air of the room, but only visible where the entering ray of light falls athwart them.

In this connection the recent deep sea soundings of the *Challenger* have brought to light a curious fact. Sir Wyville Thomson found that beds of sediment were being slowly formed on the deepest ocean floors, but so slowly was the rate of deposition made that it has been compared to the fall of dust in an unoccupied room. No better proof of this can be given than that an examination of the abyssal mud disclosed the presence of an appreciable proportion of meteoric iron the product of those falling stars which dissipate themselves on entering our atmosphere. Professor Geikie says in a recent geographical lecture in Scotland "to learn that mud gathers there so slowly that the very star dust forms an appreciable part of it, brings home to us as hardly anything else could do, the idea of undisturbed and slow accumulation."

An interesting memoir by M. Tschermak, of the University of Wissenchaften was published in 1875 on the source of meteoroids, and a paper on his memoir was last year read before the Royal Irish Academy by Mr. Robert Ball. Techermak claims a volcanic source in some celestial body. Mr. Ball follows the theory further, and by able reasoning shows that if ejected from the planets or asteroids there would only be a chance of one in 50,000 of them falling on the earth. If in the early stage of our own earth's history, long anterior to life, when mighty convulsions were rending it, colossal volcanoes may have existed with explosive energy enough to drive missiles upwards with a velocity which would carry them far enough from the earth to a point where they would continue to move in orbits round the sun, crossing at each revolution the point of the earth's track from which they were originally discharged— if this were the case there are now doubtless myriads of these projectiles moving through the solar system, the only common feature of whose orbit is that they all intersect the track of the earth, and it and they now and then meeting, the point of intersection would be marked by the desent of a meteorite. This theory was hinted at by Dr. Phipson in a work published by him in 1866, and Mr. Lawrence Smith, another later writer on this subject inclines to the same view. No volcano now exists with explosive energy enough to eject fragments that could constitute future meteoroids and if such ever did exist, it could only be in the early stages of the earth's history.

Another and an ingenious theory advanced by Professor Newton of Yale College, and one meeting with general acceptance, is that meteoroids are fragments of or attendants on a comet, and in a lecture of his in 1879 he scientifically endeavors to prove this. Speaking of the recurring November meteoric showers which manifest themselves at their maximum every thirty-three years, he says vast masses of these small bodies move in a long thin stream around the sun, and the earth at stated times plunges through them taking with its atmosphere each time scores of millions of them. Their orbit is described in thirty-three and a quarter years. They go out a little farther than the planet Uranus or about twenty times as far as the earth is from the sun. While they all describe the same orbit they are not collected in one compact group, but taking four or five years to pass a given point in the orbit, they may be likened to a train several hundred million of miles long, but only a few thousand in thickness. Along with this train travels a comet. Every August, about the tenth of the month, there is another star sprinkle or slighter display of meteors (known amongst the common people as St. Lawrences' tears) and a comet whose period is 125 years, moves in the plane with these meteors and in a like orbit. Again early in December there are star showers, the meteoroids composing them travelling in the orbit of Biela's comet. In April slight showers again occur, connected with another comet's orbit. The sporadic meteors of nightly occurrence are but outlying stragglers of a number of meteoroid streams, and the leading problem of meteor science to-day is to find these streams and their attendant comets. Professor Newton says the known comets have been apparently growing smaller with their successive returns. Halley's comet was much brighter in its earlier than its later recurrences. Biela's comet has divided into two, if not more, parts, and has perhaps gone altogether to pieces, as it could not be found in 1872 where it should have appeared. The question naturally arises what causes a comet to break up. This is as yet only a matter of speculation, but this much is known that comets surely come from stellar space in whose unimaginable degree of cold a condensing mass furnished heat for the making of a meteoroid. In cooling, or by some internal convulsion the mass may break and enter the solar system either as a mass of pebbles or as one huge body. Nearing the sun new and strong forces act on it. The same heat and repulsion that develop and drive off from a comet in one direction a tail 100,000,000 miles long may have worked off and scattered in another direction solid fragments to wander in their own orbit around the sun, an infinitesimal comet for millions of years—till entering the earth's atmosphere one by one they crash through it either to fall on the ground or to be annihilated by friction before reaching it.

Professor Schiaparelli an Italian authority on these questions regards meteoroids as original inmates or portions of one of what he styles star drifts, and of whose existence decided proofs are given by Proctor, and composing with other stars of the same vast eddy attendant bodies accompanying in its journey through space the general drift or star family of which the sun forms part. On this assumption they are bodies from some more distant space than the star family of the sun, wanderers from more distant star drifts.

The conflagration of a star through contact with meteoroid bodies is not an unknown occurrence. The first on record took place 2000 years ago, and is described by Hipparchus. It was seen blazing in full daylight. Similar events are recorded in 945, in 1264, and in 1572 In 1596 Fabricius observed a similar occurrence, followed by another in 1604. In 1673 another made its appearance, remaining visible for two years, whilst as recently as 1848 a similar event was noticed, and a few years ago, the latest on record, another appeared which was ably written upon by Proctor in an article of his in *Belgravia*. In 1869 two meteoric masses are recorded as having fallen into our sun, affecting the whole frame of the earth. Vivid auroras were seen where they had never before been seen, accompanied by electro-magnetic disturbances all over the world. In many parts the telegraph lines refused to work, signal men received many shocks and at Boston and elsewhere a flame of fire followed the pen of Bain's telegraph. This was the effect of two comparatively small meteors. What would be the effect of a comet, bearing in its flight many millions of these falling into the sun can be understood. It would be only temporary, but no student of science would be left to record it. Proctor reassures us by saying that all but one of the known star conflagrations have occurred in the zone of the milky way, and that one in a region connected with the milky way by a stream of stars, and if among the comets in attendance on our sun there is one whose orbit intersects the sun's globe, it must already have struck it before the era of man.

An interesting question has quite recently been put forward by the *Lancet* the well known English medical publication, respecting the possible influence of meteoric matter on the animal life of the earth. Professor Herschell has succeeded in examining and analysing by means of the spectroscope, the light of seventeen of these bodies, and he has succeeded in detecting the well known yellow bands produced by sodium in combustion. "It is strange," says the *Lancet*, "to consider what becomes of all the sodium thus dispersed throughout the upper regions of the air, as there can be no doubt that in some form or other it reaches the earth. The very air we breathe must at all times contain, in however minute a proportion, the cosmical dust thus brought to us from the interplanetary spaces, and as the different meteoric systems are differently constituted, the air we breathe is constantly being impregnated with various forms of metalic dust. It is not certain that deleterious results do not occasionally flow from an excess of some of the elements contained in meteors. Professor Roscoe goes so far as to conjecture that the soda which all accustomed to work with the spectroscope find present everywhere may by its antiseptic properties, exert a considerable influence in maintaining the public health. Speculations and hypotheses of this kind are no doubt interesting, but, it seems to me, barren of utility till proved. And I merely quote from the *Lancet* to show that the study of meteors is attracting other attention than that of astronomers.

Atmospheric electricity is now also being attributed to meteoric influence, and Professor Govi in 1878 leans to the idea that a certain amount of heat is introduced into our atmosphere by the meteors that enter it, and Professor Everett attributes the sudden variations of the needle of the electrometer from no apparent assignable external cause, to the same influence. He adds our great want at present is balloon observation, and he says that he "feels convinced that friction of the air or of the solid particles contained in it is one cause of the generation of electricity in the air."

Scientific theories necessarily lack finality. Sufficient to-day to explain all the known facts, to-morrow's discoveries may show their inadequacy, and lead to their modification or abandonment.

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A description of the most celebrated meteorites here followed, which it is found necessary to omit.

The above was the only paper read at this soiree, as Mr. H. M. Ami, whose name appeared upon the programme for a paper upon the "Iron Deposits of the Ottawa District," was unable through ill-health to prepare it.

FIFTH SOIREE

TUESDAY, 1st February, 1881: Prof. Geo. Baptie, M. A., delivered an address upon "Some Diatoms found in the Ottawa," explaining the nature of these minute organisms and their importance as showing the co-relation and interdependence of the natural sciences. He stated that the Ottawa River was particularly rich in diatomaceæ, and showed the construction of several species, with their delicate silicious skeletons, varying in shape and marking. The lecture was illustrated by figures on the blackboard as well as by a fine set of microscopic slides.

"ON SOME COLEOPTERA INJURIOUS TO OUR PINES."—W. HAGUE HARRINGTON.

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With the exception of a few species, which, (unless they occur in most unusual abundance), can do little or no harm, all our beetles injurious to the pine are comprised in four families, named respectively:—*Buprestidæ*, *Cerambycidæ*, *Curculionidæ*, and *Scolytidæ*.

The family Cerambycidæ contains our largest and commonest pine-borers, such as *M. Confusor*, that large grey beetle with very long antennæ, which is so abundant here in summer and autumn. Its members also destroy much timber, but their depredations are confined chiefly to dying or dead trees, whereas many of the species included in the other families attack living ones. I will therefore leave untouched to-night these very interesting "long-horned" beetles and briefly consider some species from the other families which are found to infest the pines in the vicinity. The first, Buprestidæ, contains some of our handsomest beetles, and all its members have strong, shapely bodies, clad in horny armour so tough that transfixing them with the entomologist's slender lance (a pin) is often quite a difficult matter. Their shape is oblong, the head being sunken as far as the eyes in the somewhat square thorax, which is joined closely to the abdomen. The color varies much in different species, but is usually very striking, and of a metallic-like lustre; golden, coppery, green, and other brilliant tints prevailing.

The largest species is *Chalcophora fortis*, a remarkably fine beetle varying from one to one and two-tenth inches in length and being about three-tenths of an inch wide. Their color is a coppery brown, but newly emerged specimens have often a golden-greenish burnish, or a powdery appearance caused by very minute particles of wood, scattered in the indentations of the elytra and thorax. The brilliancy of their appearance is increased by raised lines and patches on the thorax and elytra which are polished and show off against the remaining surface, as work of burnished metal does against a grained or frosted ground. This beetle is comparatively rare, but perhaps as common in this locality as in most parts of the country.

Chalcophora liberta very closely resembles the last species in its markings, and might readily be mistaken therefor by those not familiar with both. It is smaller, however, being only from three-quarters of an inch to one inch long and is somewhat different in color. It is generally of a bright coppery red, but varies greatly in this respect, specimens being found of all shades from brassy-black or purple to orange-bronze. This beetle, like the preceeding one, is frequently found (especially upon saplings) in the centre of a cluster of leaves, head inwards and in this position would, by the inexperienced observer, be probably taken for a young cone. It appears to feed upon young cones and leaves at such times, and these are probably the food of all the pine-investing Buprestians after reaching the perfect state, as I have found nearly all the species thus situated in the leaf clusters. This beetle, *C. liberta*, is quite abundant, as will be seen when I mention that M. Fletcher and Mr. Greata (a former member of this club) collected with me in one afternoon (21st Sept., 1878), in a small grove of saplings and young trees, over one hundred specimens, and that a couple of days afterwards we collected in the same place over half as many. On the 23rd Sept., 1880, I captured in about an hour 28 (13 males and 15 females) and could easily have obtained more. The larvæ of these beetles had probably bred in trees, or stumps and logs in the neighborhood and had resorted to these saplings to feed and pair.

Chalcophora virginiensis is stated by Fitch to be *always* an inch or more in length, but I have measured a great many specimens and find that few exceed an inch in length, the rest varying from seven eights of an inch up to the maximum of slightly over an inch. This species is duller in color than the preceding species, and the raised lines on the elytra are less sharply defined. It can be further distinguished by two impressed spots on each elytron interrupting the the second line. This species have been found by me almost invariably crawling, or at rest, upon the sunny side of the trunk or limbs, instead of among the leaf clusters. Its color tones so well with the bark of young trees that it is not easily seen, until this habit of frequenting the sunny side of the tree is known, when it can be more readily found. We have already noticed that *liberta* closely resembles the young cones and thus have in these beetle two very good instances of protective coloring and habits. *C. virginiensis* is not so abundant as *C. liberta* but is by no means rare and is not unfrequently found about the city on the sidewalks or crawling on houses or fences.

There is great difficulty in determining the complete life-history of the Buprestidæ, as the greater part of their existence is spent within the tree, and the effects of their depredations are seldom apparent until they have quitted their dark winding passages to emerge clad in bright armour for a brief existence in the sunlight. Observations by different naturalists have, however, established pretty conclusively the chief points in the life of the larvæ, many species of which do not confine their ravages to old and dead trees but are found destroying those still living and thriving. The larvæ of these beetles may be readily recognized by the broad flattened segments immediately behind the head; the rest of the body being narrow, thus giving them some resemblance to a tadpole. Commencing life as minute, footless grubs they bore crooked passages between the bark and wood; gradually, as they acquire strength and size, they sink sloping and winding tunnels through the sapwood to some depth below the surface, and when nearing maturity again work upward to the bark and undergo their metamorphoses in the end of the burrow, finally eating through the bark and emerging as brilliant beetles.

I have found in pine stumps a large larva evidently belonging to one of the three species already described, between the larvæ of which there can be but little difference either in size or shape. Last summer I made drawings and measurements of one, which I unsuccessfully attempted to rear. It was two and four-tenth inches long and four tenths of an inch across the widest segment, narrowing afterwards to half this width. These larvæ, in common with those of the other beetles to be mentioned this evening are footless, and move forward in their burrows by muscular expansion and contraction of the segments of their bodies.

Entomologists are at variance as to the time passed by these beetles in the larval state; some thinking that they only spend one year as grubs, and others allowing twice as long. It is only certainly known in the case of a few species, and varies greatly for different genera. My observations made during several seasons seem to establish the fact that the members of the genus Chalcophora make their appearance in two broods, the first in Spring and the second in the Autumn.

Early in May they appear abundantly for a short time, and are found in gradually diminishing numbers until the end of June. During the next two months none are to be seen, but about the middle of September they are numerous and continue so until the end of that month. The appearance of the specimens both in May and September indicates that they have just emerged, for the depressed portions of the elytra are whitened by some powdery substance, apparently like fine saw-dust, which soon rubs off.

During both these periods the sexes may be seen paired and it is my opinion that the beetles from eggs laid in May and June come forth in the September of the following year, while from eggs laid in September the beetles emerge in the Spring of the second year after. This gives to the larvæ of the first batch an existence of fifteen months, including one winter, and to those of the second a period of nineteen or twenty months, including two winters, during which season of the year the grubs must be more or less inactive, probably entirely so.

Dicerca tenebrosa is a beetle one-half to five-eighths of an inch in length, of robust form and having the wing-covers tapering and prolonged at the tips, and rough looking from the presence of several rows of raised, black spots, separated by spaces densely punctured.

Buprestis maculiventris is a brassy-brown species, from five-eighths to six-eighths of an inch long, common upon both old and young trees in June and July. I am inclined to think that it feeds also upon spruce, as while in Cape Breton last August I noticed a couple of these beetles, in a section wooded almost entirely with spruce, pines being rarely met with. It is easily distinguished by the yellowish-red spots on each side of the segments of the abdomen beneath, and by smaller spots of the same color upon the shoulders of the thorax and upon the face. Its wing-covers are thinner and softer than those of preceding species and often have a rumpled appearance, as if bent in two or three places. It is inferior in beauty to our other Buprestidæ. I have found several of the beetles emerging from the pine timbers of the Maria Street Bridge, about the end of June.

A species closely allied to it, but slightly larger and marked by four yellowish bands across the elytra, is named *A. consularis*. I have never found it upon pine trees but feel confident that, from its similarity to the last species and from having found specimens near lumber yards and on pine structures, it infests the pine. It is somewhat rare in this locality.

Buprestis striata is a handsome beetle five-eighths to six-eighths of an inch long. Each wing-cover is marked by four raised lines and, in the greater number of specimens, by a bright green stripe down the middle. The thorax is covered with coarse punctures, becoming denser and confluent at the sides, and has also a slight glimmer of green. The lower surface of the beetle has the appearance of brightly polished copper. This very beautiful and strikingly marked insect is occasionally taken feeding on the pine leaves in May and June. A couple were taken at the *Chats Falls* on the occasion of our excursion on 24th June last.

Melanophila fulvoguttata is a small brassy-black beetle five-sixteenths to seven-sixteenths of an inch long, the wing-covers bearing each three yellow dots arranged almost in the form of a circle upon the back of the beetle. The surface is very finely granulated and punctured. The beetle is found during June both on spruce and pine.

The last of the Buprestians which I have to describe is in my opinion the gem of them all, so brilliant is it, especially in the sunlight. It is also the smallest, the males only averaging four-sixteenths of an inch in length and the females five-sixteenths. The larvæ inhabit young saplings and the small limbs of larger trees. The beetles are found on the trees during June and July ; seeming to delight in the hottest and brightest days of these months, and displaying in such weather great activity, whereas on a cool, cloudy day they are much less alert. When among the leaves they are, from their color, very difficult to see, and if shaken off upon a beating net they take wing with such swiftness as very frequently to escape capture. The instant they drop upon the net they are off like a flash of emerald light. The color of the female is a uniform vivid green or blue-green, with the exception of the antennæ and feet which are black, but the male has the thighs and sides of the thorax coppery or bronzed, and is thus easily distinguished, as well as by his smaller size.

The members of the family Curculionidæ are very easily recognized by the manner in which the head is elongated; many species having it prolonged into a very slender proboscis or beak, whence they have received the distinctive name of "snout beetles." They are all vegetable feeders and the larvæ invariably live concealed within the substances upon which they feed. Several species do considerable harm to pines, of which the commonest here is *Hylobius pales*, the dark weevil dotted with scanty grey heirs, so abundant about our lumber yards and streets during the greater part of the summer. Its length is about three-eighths of an inch. In May and June the beetle may be observed perforating the bark with its long snout, the end of which bears minute but strong jaws, and depositing its eggs in the holes thus made. The larvæ when hatched burrow between the wood and the bark, loosening the latter and inducing decay in the tree. *H. Stupidus* is a larger beetle, distinguished by having the scutel and the scanty hair clothing the body yellow. Its habits are the same as those of the preceding species but it is far less abundant.

Pissodes strobi, the "white pine weevil" is slightly smaller than the foregoing species but attacks the young trees in a more vital part, and often effects serious damages upon rising forests. It is a chestnut or reddish-brown beetle, having two little dots on the thorax, the scutel and an interrupted band across the back white, and patches of yellow hair upon the elytra. The leading or topmost shoot of thrifty young pines is the object of its attack, and often in a grove of young trees every one will have the top shoot destroyed. The female bores holes in the bark, in which it places eggs, at irregular intervals the whole length of the shoot, and as soon as the larvæ are hatched they eat downward towards the centre of the twig and burrow in the pith. In the cells thus formed they undergo the necessary changes and emerge the following spring in the perfect state. For a month or two after the eggs are laid the growth of the twig is unaffected, but as the larvæ increase in size it begins to wither and dies very shortly. One of the lateral or side shoots curves upward to take place of the one destroyed, but a crook is thus caused which lessens in a great degree the value of the tree and renders it totally unfit for a spar or mast, which is one of the most important and noble uses to which a pine tree can be devoted. Thus was probably caused the fork in the famous old pine on Bank Street near Patterson's Creek. When the weevils are numerous they also attack and destroy the lateral or side shoots. The only way to prevent their ravages is but cutting off all the dead shoots, in autumn, while the larvæ are in them, and burning them.

The Scolytidæ are closely related to the snout beetles and are often called bark weevils although they have not the elongated heads of the true weevils. They are small beetles, our largest species but little exceeding one-quarter of an inch in length. Their cylindrical shape, abruptly truncated at each end, has led to the remark that they appear as if they had been made by the inch and then cut into small pieces. By perforating the bark and loosening it they injure and destroy many of our forest-trees, their immense numbers counterbalancing their minuteness.

A number of years ago, a train of passenger cars crashed through a high bridge, built of timber and comparatively new, and many lives were lost. The accident was caused by the rapid decay of the timbers and a celebrated entomologist on examining them found that the exterior had been bored by myriads of these little beetles, and water filtering into their tunnels had rotted the wood.

Pityophthorus sparsus is the first on the list, as well as the smallest of those I have found, and it is also very abundant. It is barely one-sixteenth of an inch long; the thorax being dark and the wing covers yellowish. About the middle of May pine saplings may often be seen with drops of balsam oozing out of the bark and standing like beads of amber all over the trunk and limbs. Each of these drops show where one of these minute beetles has perforated the bark. On examination many will be found still in their tiny burrows beneath the bark, usually in groups of three of four, and others will be found boring their way through the bark to deposit eggs.

Xyleborus Xylographus is a considerably larger species, measuring between two-sixteenths and three-sixteenths of an inch in length and about one-sixteenth of an inch in diameter. The thorax is nearly as long as the body, and is bluntly rounded in front, the head being deeply sunken in it and almost hidden. The end of the body appears as if a piece had been gouged out, and the sloping tips of the elytra bear several small teeth and are bearded with hairs. The beetle varies in color from yellow to yellowish brown, and, from its habits, has very appropriately been named the "wood-engraving" bark-beetle. It is said by Fitch to be "the most common and probably the most pernicious of all the insects infesting the forests in the State of New York" because "it is liable to attack trees that are in full health and vigor, those that are young as well as old." The beetle bores through the bark, and then tunnels for some distance between the bark and the wood, lengthwise of the trunk or limb. Along the sides of this gallery the eggs (about fifty) are laid in notches, and, as soon as hatched, the young larvæ proceed to mine slender passages for themselves, working outward from the original one, and enlarging them as they proceed. Each larva avoids, if possible eating into its neighbour's burrow, and the tracks of some species of bark-beetles make very regular patterns indeed. The bark is thus so loosened from the wood that it dies and comes away in large pieces, enfeebling the tree and subjecting it to the attacks of large borers.

Tomicus calligraphus, the "elegant writing" bark-beetle, is slightly larger, but is very similar in appearance to the last species. It is of a chestnut brown color, and is sparsely clothed with yellowish hairs; the elytra being lined with coarse punctures. The burrow formed by the female in which to deposit her eggs is from six to twelve inches long, but more irregular than is that of the last species. The tracks of the larvæ are more tortuous and larger, and the perforations in the bark are also bigger.

Tomicus pini, the pine bark-beetle, is smaller, being barely one-eighth of an inch long. It is probably the most abundant of all our pine bark-beetles, but as its ravages are said to be confined to old trees, it is not so serious a foe as the preceding varieties. The tracks made by the larvæ differ from those of other species, and look as if several eggs had been placed at the bottom of a hole bored in the bark, and the young had eaten outward in diverging directions. The burrows are about two inches long, and are eaten partly in the outer surface of the wood and partly in the bark. The beetle is dark brown, the tips of the elytra bearing each four teeth.

Dendroctonus terebrans is the largest of our bark-beetles, measuring four-sixteenths to five-sixteenths of an inch in length and found in some abundance. The head is much larger, proportionately, than in the other species, and is plainly visible; the thorax is shorter, and the elytra bluntly rounded at the tips, not excavated, nor toothed. Its color is dark reddish or foxy. It perforates larger holes in the bark, and mines curving galleries in all directions, confined chiefly to the inner bark-layers, and only slightly grooving the surface of the wood.

Hylurgops pinifex is a smaller and darker beetle, about three-sixteenths of an inch, or slightly more, in length, and of a dark reddish brown color; very abundant about lumber yards and pine groves.

The last species which I shall mention resembles the foregoing, but is slightly slenderer and varies much in size; being from two-sixteenths to four-sixteenths of an inch long. Its color is black, and in this and other respects it appears to correspond with the beetle given as *Hylastes carbonarius* by Dr. Fitch, and for the present I have named it so, not knowing the synonym which it now bears. The specimens of it exhibited were taken, on the 24th May last, at Wright's Island, in the Gatineau.

The two cases upon the table contain specimens of the beetles described, as well as others, in all, forty species of Ottawa coleoptera injurious to the pine, viz.:—

SCARABÆIDÆ.

3426 Dichelonycha albicollis, *Burm.*

BUPRESTIDÆ.

3683 Chalcophora virginiensis, *Drury.*
3684 " liberta, *Germ.*
3686 " fortis, *Lec.*
3696 Dicerca tenebrosa, *Kirby.*
3715 Buprestis maculiventris, *Say.*
3718 " consularis, *Gory.*
3721 " striata, *Fabr.*
3735 Melanophila fulvoguttata, *Harris.*
3768 Chrysobothris Harrisii, *Hentz.*

CERAMBYCIDÆ.

4915 Orthosoma cylindricus, *Fabr.*
4924 Tragosoma Harrisii, *Lec.*
4927 Asemum mœstum, *Hald.*
4928 " atrum, *Mann.*
4932 Criocephalus agrestis, *Kirby.*
4960 Callidum antennatum, *Newm.*
4961 " janthinum, *Lec.*
5153 Atimia confusa, *Say.*
5165 Rhagium lineatum, *Oliv.*
5323 Monohammus scutellatus, *Say.*
5325 " confusor, *Kirby.*
5326 Monohammus marmoratus, *Rand.*
" dentator, *Fabr.*

CHRYSOMELIDÆ.

5609 Cryptocephalus notatus, *Fabr.*
5676 Glyptoscelis hirtus, *Oliv.*
5740 Chrysomela philadelphica, *Linn.*

CURCULIONIDÆ.

8853 Scythropus elegans, *Couper.*
8928 Hylobius pales, *Herbst.*
8931 " stupidus, *Sch.*
8934 Pissodes strobi, *Peck.*
8937 " affinis, *Rand.*
8990 Dorytomus mucidus, *Say.*

SCOLYTIDÆ.

9501 Pityophthorus materiarius, *Fitch.*
9528 " sparsus, *Lec.*
9546 Xyleborus xylographus, *Say.*
9562 Tomicus calligraphus, *Germ.*
9568 " pini, *Say.*
—— " semicastaneus, *Mann.*
9619 Dendroctonus terebrans, *Lec.*
9642 Hylurgops pinifex, *Fitch.*
—— Hylastes carbonarius, *Fitch.*

NOTE.—The numbers in the above list are from Crotch's (revised) Check-List of North American Coleoptera.

SIXTH SOIREE.

FRIDAY, 11th February, 1881: J. A. Grant, Esq., M.D., F.R.C.S., F.G.S. delivered a lecture upon "The Brain, the Gymnasium of the Mind," which might be considered a continuation of his lecture upon "The Brain" in last year's course, and was in like manner illustrated by the dissection of a human brain, as well as by charts and a series of skulls. He contended that the human countenance, which derives its expression from the influence of the brain, was a much more scientific index of a man's mental qualifications than the shape of his skull, and detailed the physical composition of the brain. He condemned in unsparing language the cramming process so prevalent in our public system of education, and earnestly advocated the bestowal of more attention upon the physical health of the young, in order that their brains might first be properly developed. The lecturer instanced several men of commanding intellect who had in their youth been more noted for athletic skill than for mental attainments.

"Notes on Two Species and One Genus of Fossils from the Trenton Limestone, Ottawa." Mr. W. R. Billings.

1. *Lichenocrinus crateriformis*, Hall.—I have to record the discovery of this species in the Trenton Limestone at Rochesterville. Previous to this no species of *Lichenocrinus* has been observed in the Trenton Limestone, being confined to the Utica Slate and lower part of the Hudson River Group. There are four recorded species of this genus, and *L. crateriformis* is the lowest in time, it alone having been found so low as the Utica Slate, while the others belong to the Hudson River Group. My specimens are imperfect, are two in number, and were discovered associated with *Lixcrophycus Ottawaensis*, *Paleophycus obscurus*, *Pasceolus globosus*, *Chætitis petropolitanus*, *C. discoideus*, *Ptylodictya acuta*, *Murchisonia bellicincta*, *M. gracilis*, *Orthis testudinaria*, *O. subquadrata*, *Leptena sericea* and *Heterocrinus Canadensis*.

2. *Pleurocystites filitextus*, Bill.—This species was founded upon an imperfect specimen which had lost a part of the base containing the greater portion of the basal rhomb. The condition of the specimen rendered it doubtful whether another specimen, figured on the same plate* belonged to the species under consideration or to *P. Elegans*. During the past summer I was fortunate enough to obtain a suite of specimens of *P. filitextus*, ranging in size from 0·5 inch to 1·5 inches in length of body (head of most authors); and a careful examination has caused me to form the opinion that the figure originally taken as doubtful belongs to this species. The specimens in my possession appear to show that the peculiarities of the upper rhombs, the size of the irregular plates on the ventral side, and the general form of the body, afford excellent specific means of distinction, but the basal rhomb in some specimens is hardly distinguishable from *P. Elegans*, while in others it presents the rounded corners of the typical specimen.

3. *Genus Carabocrinus*, Bill.—I give a note on this genus principally to point out how the freshest beginner in the study of a scientific subject may be of use in collecting facts to aid a scientific authority in generalization. The genus I am considering was founded in 1856, and three species described. A specimen of one of these species alone exhibited the azygos plates, the peculiarities of which separated the genus from *Cyathocrinus*. No other species have since been described; nor has the discovery of new specimens been recorded. In the "Proceedings of the Academy of Natural Sciences, Philadelphia," Nov. 4, 1879, Mr. Charles Wachsmuth, the highest American authority on the Palæozoic Crinoids, stated the opinion† that "*Carabocrinus* is founded upon a malformed or recuperated *Cyathocrinus*." The anomalous form of the azygos plates was dwelt on

* Fig. 2, Decade 3, G. S. C.

† Revision of the Palæocrinodea, page 144.

in detail, and the distinguished author stated the view that they were portions of a single plate "which was accidentally broken during the life of the animal, and afterwards recuperated, leaving marks of fracture which Billings took to be sutures between the plates." During last Spring I collected a small specimen of a species of this genus, and shortly after was favored with a view of another specimen (likely of a new species), which Dr. Grant had sent him from Belleville, in company with specimens of a new species of *Porocrinus*, for description. Both the specimens had the identical arrangement of azygos plates shown in the generic diagram.* I communicated the result of my examination to Mr. Wachsmuth, and he at once stated that he would abandon his view.

SEVENTH SOIREE.

FRIDAY, 25TH FEBRUARY, 1881.—"LILIACEÆ," BY LIEUT.-COL. WM. WHITE.

* * * * * * * * * *

I propose to devote our time this evening to the genus *Lilium*, from which the order *Liliaceæ* derives its name. This genus includes plants with scaly bulbs, from which arise leafy stems, bearing at the top from one to many large showy flowers. The stem leaves are alternate or whorled, short and usually sessile, except the two eastern forms, which have heart-shaped leaves and long petioles. The great characteristic of the Tiger Group, and one by which they are easily propagated, is the constant presence in the axils of each leaf of one to three bulblets, shiny and black, about the size of peas, which, in the Autumn, fall, or are gathered, and in three years' time will, if cultivated, produce flowering bulbs.

The flower of the lily consists of six petal-like divisions or sepals, either distinct or partly united below, and spreading or recurved above, forming a funnel-shaped or bell-shaped perianth. Each of the divisions has a honey-bearing furrow at the base.

The genus *Lilium* has been sub-divided by Professor Baker, of Kew, into five sub-genera; each being perfectly distinct from the others, so that any person who will take the trouble to master the characters of these five sub-genera will have no difficulty in referring to its proper position any specimen which may be under consideration.

According to Professor Baker's classification, the first sub-genus is—

Cardiocrinum.—The perianth is funnel-shaped, with oblanceolate segments, falcate only at the apex. Leaves large, rotundate-cordate, very different to the lanceolate or linear leaves of all the others, with true petioles sometimes as long as the leaves. The only two lilies at present known belonging to this sub-genus are the heart-shaped leaved (*L. cordifolium*) lily from Japan, and the Giant Lily (*L. giganteum*) from the Himalayas. This sub-genus is at the same time the finest and most distinct of all true lilies, being completely different from all the rest in possessing long petioles, and in the shape and veining of its leaves.

The second sub-genus has been named—

Eulirion.—Perianth funnel-shaped, with oblanceolate segments, falcate only at the apex, stamens slightly curved parallel with the style, lines linear or lance-shaped, sessile or nearly so, flowers fragrant, often white, never red. Of this sub-genus there are twelve species known to the Old World, of which the one best

* Decade 4, G. S. C.

known is the White Lily of our gardens (*L. Candidum*). The white Japan Lily (*L. longiflorum*), which also belongs to this sub-genus, is now frequently met with in cultivation, but is rather tender in our severe climate.

The third sub-genus is—

Archelirion.—Perianth open, funnel-shaped, with deeply spreading segments, which are broadest below the middle; stamens diverging from the curved style. Leaves sessile, as in the Tiger Lily, and with short stalks, as in *Auratum* and *Speciosum*. There are only four species in this sub-genus, but three of the four, the Tiger Lily (*L. Tigrinum*), the Golden Lily (*L. auratum*), and the red-spotted Japan Lily (*L. speciosum*), originally introduced as *L. lancifolium*, are now to be met with in most large collections.

The next, the fourth sub-genus, is—

Isolirion, erect-flowered lilies.—Perianth broadly funnel-shaped, standing erect for a considerable time, usually brilliant red or yellow, segments oblong, lance-shaped, or spathulate, stamens diverging on every side from the erect style. Leaves in whorls, as in *L. Philadelphicum*, or scattered, as in *L. Catesbæi*. *Lilium Philadelphicum* is common in open copses throughout Western Canada and the Northern United States, stretching westward to the Rocky Mountains, and southward along the Alleghanies to North Carolina. It was introduced to England in 1754. *Lilium Catesbæi* is also an American lily. It is found from Carolina to Georgia, taking, in the South, the place occupied by *L. Philadelphicum* in the North. This lily does not usually succeed well under cultivation, and is therefore rarely met with in gardens.

The fifth and last sub-genus is the

Martagon, or Turks-cap Lilies.—Flowers in racemes, nodding, dotted usually of a brilliant red or orange colour; perianth broadly campanulate; segments lance-shaped, deeply falcate, grooves deep; stamens diverging on all sides from the curved style. In this sub-genus we have twenty-three species, including many superb forms:—*Excelsum*, with its tall, peculiarly graceful, nankeen-coloured flowers, so exquisitely scented; *Canadense*, with its beautiful nodding, bells, one of the first introduced to European gardens from this continent, figured in Parkinson's Paradisus in 1629; the purple *Martagon*, which puts forth its flowers in the early summer months; and several others not less handsome, but not so generally known.

The genus *Lilium* (the name lily is said to be derived from a Celtic word "li," signifying whiteness, the lily having been long considered an emblem of purity), as you will already have observed, embraces several of the most remarkable species in the whole vegetable kingdom, distinguished by elegance, size and variety of colour; ranging in size from the dwarf forms of *Umbellatum*, with flowers only six or eight inches from the ground, to the magnificent Giant Lily of the Himalayas, bearing its crown of blossoms eight or nine feet high. Lilies are among the oldest and best known flowers of our gardens; they are also among the most recent introductions of plant collectors.

The White Lily (*L. Canodidum*) is said to be a native of the eastern islands of the Mediterranean. It has been cultivated in England since the days of John Gerarde, a surgeon and botanist, who was born in Cheshire in 1547, and died in 1607. Yet, with this exception, lilies may be said to be of recent introduction.

In 1774 Linnæus found only nine species to describe, of which five belonged to the Old World exclusively; three, *Superbum*, *Canadense* and *Philadelphicum*, to North America; and one, *Kamschatkense*, said to be common to both continents. This latter, however, appears to have been re-named, as I am unable to identify it in more recent classifications. Shortly after the time of Linnæus, the Pyrenean (*L. Pyrenaicum*), the Orange (*L. Croceum*), and Catesby's Lily (*L. Catesbæi*), were added to the list.

Towards the close of the last century, Thunberg published a work on the flora of Japan, and introduced to the world some of the wonderful species from that country. About 1823 Dr. Van Siebold, of Wurzberg, visited Japan in the capacity of physician to the Dutch Embassy, and up to his death, in 1866, never ceased to collect and to encourage the collection of these plants for introduction into Europe.

In 1804, the now well-known Tiger Lily (*L. Tigrinum*) was bronght fro m Japan by Captain Kirkpatrick. The attractiveness of its brilliant red flowers, joined to the hardiness of the plant, which enables it to withstand the extreme cold of Canada, and to flourish in the moist climate of Britain equally well, has rendered it for many years past one of the best known and most generally cultivated of all lilies.

It is only quite recently, however, that the most magnificent lilies of Japan have become generally known, the splendid Golden Lily (*L. auratum*) having only come into general cultivation within the last ten or twelve years. Lilies are supposed to have been cultivated in Japan for centuries with as much care and attention as have been given to the production of tulips and hyacinths in Holland.

It is somewhat singular, considering how much attention has been given of late years to the introduction and cultivation of lilies, that the origin of two of the most beautiful species in cultivation is unknown.

The Nankeen Lily (*L. Excelsum*), a beautiful sweet-scented lily of the *Martagon* sub-genus, closely resembling in form and general appearance the well-known White Lily (*L. Candidum*), is one of them ; and Brown's Lily (*L. Brownii*), a lily of the *longiforum* type, having the outside of the petals a deep chocolate colour, is the other. *L. Excelsum* (or *Testaceum*, as it is frequently called,) is unknown in a wild state, and is supposed to be a hybrid between the common White Lily (*L. Candidum*) and scarlet Turk's-cap (*L. Chalcedonicum*. *L. Brownii* is believed to have been introduced from China or Japan, but nothing certain seems to be known either as to the place from whence it came or the person who first brought it into notice.

* * * * * * *

On the same evening an instructive paper was read by Mr. J. Martin "On the study of Botany." He described the different parts of plants, their functions in the economy of nature, and the simplicity of the method of classification that had been adopted by botanists ; and urged the claims of the science of botany on the younger members of the Club in an able and interesting manner.

EIGHTH SOIREE.

FRIDAY, 11th March, 1881 : On this evening a lecture was delivered by Prof. J. Macoun, F.L.S., Botanist to the Canadian Government, on "The Capabilities of the Prairie Lands of the Great North-West, as shown by their Fauna and Flora." The lecturer first explained the laws of geographical distribution, by which, for example, the geologist can state the horizon to which certain fossils must belong, and the botanist determine, by the inspection of plants from a certain locality, the character of the soil and of the climate, and the consequent adaptability of the district for the growth of certain varieties of cultivated plants. He asserted that this botanical test was the only true criterion by which the agricultural status of any district should be judged. In the North-West every species of plant was found to have its particular *habitat* as regards soil and moisture. This fact had been realized by the members of the Geological Survey, for in the last report Prof. Bell had stated that "the information derived from a study of the distribution of trees and shrubs, and of the flora generally in any district, affords one of the most certain means of judging the climate for agricultural purposes." Such a test had been applied by him in his explorations of the Peace River country during 1872 and 1875. Many excursions off the direct line of travel were made in descending the river, and all the species of plants noted, with the exception of three, were similar to those of Ontario, whence he deduced that the summer climate of the Peace River region was similar to that of Ontario, and that the same cereals which came to perfection in the latter place would do so in the former. Actual cultivation had since fully proved the truth of that deduction. The previous season he had visited the Cypress Hills region, and received unfavourable impressions of it on account of the number of Rocky Mountain species of plants growing there. He at once concluded that the district would not ripen cereals, and further observation justified that conclusion. With reference to the large tracts of alkaline lands, so generally denounced as sterile and incapable of cultivation, he explained that their apparent aridity and want of vegetation was nearly always due to causes which cultivation of the soil would remove. Holland, principally an old sea-bottom, was noted for its fertility, and salt marshes when reclaimed from the sea, as in the Basin of Minas, were known to form the best pastures in the world, although salt lands were said to be regions of sterility. Yet he knew that on the alkaline soil, even where the cactus and sage-bush grew, the grass was always cropped short by the cattle, and from his observations he believed them to be some of the best pasture lands in the world. On these soils also seaside plants, such as the cabbage, grew in great luxuriance. Passing on, the lecturer alluded to the warm and cold soils of the vast interior, and stated that nearly all the prairie uplands were covered with a warm soil, and, from the nature of the flora, he was positive that frosts would never do serious injury in these localities. The river silts and clays produced plants that were boreal in their tendency, as contrasted with the southern plants found growing on the uplands; and in the river valley crops invariably suffered from frost. The farmers were rapidly learning this fact, and, avoiding the loamy lands of the valleys, preferred the dry exposed prairies formerly neglected, but now found to be incomparably superior, for the growth of cereals, to the lower but cooler lands. It was found that on the warmer soil of the prairies the crops ripened three weeks earlier than in the river valleys and the colder lands of Manitoba. Hence, the second prairie steppe, beginning one hundred miles west of Winnipeg and extending to the Saskatchewan, would be found far superior to Manitoba for the growth of cereals, because there a certainty of at all times ripening the crops was assured. Although summer frosts might occassionally make their appearance in the valleys, there were none, or scarcely any, on the level plateaux. Last year crops put in after the 15th June had been injured by frost, but only severely in the valleys. With regard to rain, little fell before the crops were planted, but after that there was an ample fall to secure their full growth. The lecturer then enunciated an important botanical law, as accounting for the well-known heavy crops of grain secured so far north. This was the law of wonderfully increased reproduction as plants approached their outer, or northern, limit. Hence, the cereals grown in the districts alluded to, so near the extreme northern limit, were found to be more prolific than those grown anywhere else. Ordinarily, on an ear of wheat grown in Ontario each fascicle contained but two grains. In Winnipeg they averaged two and a-half, at Prince Albert four, and at Edmonton nearly five. When it was taken into account that the heads also increased in length, it was not difficult to understand that the same number of stalks that would produce fifteen to twenty bushels to the acre in Ontario would yield twenty-five bushels at Winnipeg, and from thirty to forty bushels farther north. As regarded the grasses found in various parts of the country, the same species grew under the eastern base of the Rocky Mountains as were found farther east, and commonly supposed to be inferior in quality. The only difference was, that on the dry plains of the south hardly any grasses produced large crops of seeds, so that the fodder afforded by the natural drying up of the grasses was richer in nutriment, nearly equalling first-class hay. The "buffalo grass," incorrectly named "wild oats," did not, as often stated, harm either sheep, horses or cattle. Referring to Capt. Palliser's assertion, that the country near the Red Deer Lakes was barren, he explained that this was due to buffalo and deer having eaten the district bare. In 1879 the same tract of land was covered with waving grass, but not a quadruped was to be seen there. The land which had supported millions of buffaloes could assuredly not be called barren, but could feed cattle for the English market, and also supply the wheat, flax and hemp so largely imported from

Russia by the Mother Country, for its climate was similar to that of Southern Russia, which supplied all these commodities. While considering the stock-raising capabilities of the country, he referred to the popular belief that cattle fatten on the grazing lands of Texas and warm districts of the South, characterizing it as a fallacy, as shown by the custom amongst graziers of driving their herds northward to fatten. This was also in obedience to a well-known law which provided that the farther north animals were found the greater was their capacity for putting on fat. On this ground he was convinced of the great advantages possessed by the North-West as a cattle-raising country. A few years ago Major Butler had styled this country the Great Lone Land, but it was being rapidly settled, and was destined, in the near future, to be a great grain-producing and stock-raising country, sustaining a large population and exporting an immense surplus of grain and meat.

Errata—Flora Ottawaensis, page 41.

For "Nuphar luteum, Smith" *read* "Nuphar luteum, Smith. *var.* ——— ?"

For "Sarracenia purpurea, L.
———*v.* hiterophylla" } *read* "S. purpurea, L. *var.* heterophylla, Torr."

Omit "ROSACEÆ. Amelanchier Canadensis, T. & G.
———*v.* Botryapium, Gray."

For "Sedum Telephium, L" *read* "*Sedum Telephium*, L."

For "Senecia vulgaris, L." *read* "*Senecio vulgaris*, L."

For "Pyrola rotundifolia, L.
———*v.* Uliginosa, G." } *read* "P. rotundifolia, L., *v.* uliginosa, G."

For "LABIATEÆ" *read* "LABIATÆ."

For "Lycopus Europæus, L.
———*v.* integrifolia, G." } *read* "L. Europæus, L., *var.* integrifolius, G."

For "*Nicaudra*" *read* "*Nicandra*."

For "Urtica Dioica, L." *read* "*Urtica dioica*, L."

For "Schenchzeria" *read* "Scheuchzeria."

For "Carex irrigna" *read* "C. irrigua."

For "Poa Scrotina" *read* "Poa serotina."

For "Asplenium Filix-Fœmina.
———*v.* Michauxii, Mettenius." } *read* "A. Filix-fœmina, Bernh., *v.* Michauxii, Mettenius."

FLORA OTTAWAENSIS.

ADDITIONS TO LIST OF 1879-1880.

NYMPHÆACEÆ.

Nuphar luteum, Smith.

SARRACENIACEÆ.

Sarracenia purpurea, L.
———v. hiterophylla.

ROSACEÆ.

Amelanchier Canadensis, T. and G.
———v. Botryapium, Gray.

CRASSULACEÆ.

Sedum Telephium, L.

HAMAMELACEÆ.

Hamamelis Virginica, L.

CUCURBITACEÆ.

Sicyos angulatus, L.

COMPOSITÆ.

Aster æstivus, Ait.
Senecia vulgaris, L.
Cirsium muticum, Michx.
Onopordon Acanthium, L.

ERICACEÆ.

Pyrola rotundifolia, L.
———v. Uliginosa, G.

SCROPHULARIACEÆ.

Linaria vulgaris, Mill.

LABIATEÆ.

Lycopus Europæus, L.
———v. integrifolia, G.

SOLANACEÆ.

Nicaudra Physaloides. Gærtn.

CHENOPODIACEÆ.

Chenopodium Ambrosioides, L.

URTICACEÆ.

Urtica Dioica, L.

BETULACEÆ.

Betula lenta, L.
Alnus viridis, D. C.

SALICACEÆ.

Salix myrtilloides, L.

NAIADACEÆ.

Zannichellia palustris, Micheli.
Potamogeton Vaseyi, Robbins.

ALISMACEÆ.

Schenchzeria palustris, L.
Sagittaria graminea, Michx.

ORCHIDACEÆ.

Habenaria fimbriata, R. Br.
———virescens, Spreng.

CYPERACEÆ.

Carex Backii, Boott.
———limosa, L.
———irrigna, Smith.
———arctata, Boott.
———filiformis, L.
———longirostris, Torr.

GRAMINEÆ.

Vilfa vaginæflora, Torr.
Agrostis perennans, Tuckerm.
Muhlenbergia sylvatica, T. and G.
Poa cæsia, Smith.
———Scrotina, Ehrhart.
Festuca nutans, Willd.
Triticum caninum, L.
Gymnostichum Hystrix, Schreb.
Avena striata, Michx.
Millium effusum, L.
Panicum capillare, L.

FILICES.

Asplenium Filix-Fœmina.
———v. Michauxii, Mettenius.

DESCRIPTION OF A NEW SPECIES OF POROCRINUS,

FROM THE TRENTON LIMESTONE.

With remarks on the Genus, by JAMES GRANT, M.D.; F.R.C.S.; F.G.S., etc.

GENUS POROCRINUS, BILLINGS.

Porocrinus, Billings, Report Geological Survey of Canada, 1856.
Porocrinus, Billings, Decade 3, Geological Survey of Canada, 1859.
Porocrinus, Meek and Worthen, Proc. Acad. Nat. Sci. Phila., 1865.

This genus was founded on one species from the Trenton Limestone at Ottawa :—*P. Conicus*, the type of the genus. In the Proceedings of the Academy of Natural Sciences, Philadelphia, 1865, Meek and Worthen described *P. Pentagonus*, from the Trenton Limestone, and *P. Crassus* from the Hudson River Group, both from Illinois.

We have now a new species from the Trenton Limestone at Belleville, discovered by Mr. W. R. Smith, of that city.

The specimens examined exhibit some new features, which do not, however, in any way invalidate the original description of the genus.

In the original description of *P. Conicus* the pores are spoken of as "fine elongated parallel slits which appear to penetrate through the plates." In the descriptions of *P. Pentagonus* and *P. Crassus* the divisions between the pores are mentioned as "plates." A careful examination of the new specimens, about to be described, show that the pores do not open on the outside surface, each pair of plates being externally arched, making the hydrospires appear like one side of a collection of flat black tubes placed side by side, while one specimen (Fig. 2) has on several of the hydrospires a thin investing membrane, as in *Paleocystitis* and *Comarocystitis*. E. Billings states that in these last named genera it is probable that the pores are not visible externally unless the surface is worn. I fancy that all the species of *Porocrinus* already founded were described from worn specimens. The membrane mentioned covers each hydrospire completely and obliterates the sutures of the plates where it covers them.

I cannot find that the vault plates or the structure of the arms have been before observed. Meek and Worthen, in describing *P. Crassus*, state that the vault seems to consist of three or four comparatively large plates." The vault and arms described hereinafter are much the same as in *Cyathocrinus* (as revised by Wachsmuth.)

POROCRINUS, SMITHI, Sp. Nov.

Basals.—Five, pentagonal, wider than high, of nearly equal size.

Subradials.—Five ; three hexagonal and two heptagonal.

Radials.—One by five, as long as the sub-radials, while four of them are wider, hexagonal, excepting that their apices are notched about one-fifth the length of the plates to form a part of the passages of the arms, and in two of them the angle adjacent to the proboscis is wanting. Articulating facets about one-quarter the width of the radials, and extending downwards nearly to their centres.

Brachials.—One by five, as wide as arm joints, but at their points of greatest length nearly three times as long as an arm joint.

Azygos plates two, the lower one quadrangular, resting on the two heptagonal plates ; and the other, pentagonal, supported on one heptagonal and the lower azygos plate.

Cup, obconical of a sub-pentagonal outline viewed from below; at the junction with the column the diameter is a little less than one-half the greatest diameter. Surface of cup ornamented with radiating costæ, two lines of which, one each at the centre of the radials and sub-radials, form zones around the cup; between these two lines others pass at right angles across the sutures of the plates, forming a series of triangles; below the lower zone, from the centre of each sub-radial, a single costa passes downward to the basals, where it is continued, one-half on each plate (without bifurcation), and expands into a slightly elevated ring, encircling the base of the cup.

Each rhomb, or hydrospire, occupies an angle of three separate plates; they are trilobate, and in shape bear some resemblance to a very stout letter Y, with pointed terminations, having three re-entering and nine salient angles.

The angles of the inter-costal triangles to the edges of the hydrospires are striated in lines parallel to the lines of the spiracles. These striations are not even grooves, but appear to be formed of elongated, shallow pits or punctures placed with their ends in contact.

Arms simple, apparently long, one specimen having a portion of an arm, once and a half the length of the cup, but slightly reduced in diameter, and without branching (Fig. 3). The same specimen shows that the grooves of the arms were bordered by erect rows of plates about two-thirds the width and somewhat less than one-half the depth of the arm joints.

Vault composed of five large plates separated by broad grooves continuous with the upper grooves of the arms and radiating from the centre of the apex; four of these fit in between the re-entering angles of the radial plates, and the fifth (situated immediately over the proboscis) is excavated in the same manner as the radials on either side of the upper azygos plate. The radiating grooves appear to be covered with double rows of small plates interlocking and alternating with one another. Only one specimen has been examined showing the summit structure, and in it the arrangement of plates at apex could not be satisfactorily made out. A small tube or circular opening was observed at the lower end of one of the grooves, immediately above the arm notches (Figs. 1 and 6).

The proboscis appears to have been short and made up of lancet-shaped imbricating plates, but as the area immediately around it has none of the plates preserved in the only specimen possessing this organ, it cannot be spoken of with certainty.

Column round, with a small pentagonal canal. In the specimens examined only small portions of the columns are preserved, and these taper to such a degree that the diameter is reduced from one-quarter inch to one-fourteenth inch in a proximal fragment of column three-eighths of an inch long; and in a similar portion five-sixteenths of an inch long from one-quarter inch to one-ninth inch. The separated disks of column appear flat and smooth, and show five indistinct petaloid depressions on the under side which correspond with similar elevations on the upper side, and which terminate outward on the line of sutures of basals; these disks do not reach the external surface of the column, there being an investing sheath or covering encircled by wavy lines at distances from each other equal to the thicknesses of the disks.

This species differs from *P. Conicus* in having prominent costæ instead of a smooth surface; in having wide short basals; in having the external shape of the hydrospires trilobate instead of being spherical triangles; as also in its greater size. From *P. Crassus* the chief points of difference are that the sutures are not prominent, nor does the base overhang the column, while the hydrospires are trilobate throughout. *P. Pentagonus* is the species most nearly related to the one now under consideration. It differs in the shape of the body which (in *P. pentagonus)* is obovoid and broadest on a line drawn through the centre of the sub-radials; it also has only a portion of the hydrospires trilobate: otherwise it appears to agree very closely with our new species.

DESCRIPTION OF PLATE.

Fig. 1. Side view of a specimen of *Porocrinus Smithi*, without arms or column.

Fig. 2. An imperfect specimen, having a membrane covering two of the hydrospires.

Fig. 3. Flattened specimen, with portions of arms and column.

Figs. 4 and 5. Sections of column showing size of central canal, &c.

Fig. 6. Summit structure of specimen shown in Fig. 1.

Fig. 7. One of the sub-radial plates enlarged.

Fig. 8. Diagram.

Fig. 9. Specimen of *Agelacrinites Dicksoni* from the Cabinet of Dr. Grant.

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