1879. 1880.

OTTAWA

Field-Naturalists' Club.

TRANSACTIONS No. 1.

Ottawa, Canada:
Citizen Printing and Publishing Company, Sparks Street.
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Patron:

HIS EXCELLENCY THE GOVERNOR-GENERAL.

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Vice-Presidents:

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W. R. BILLINGS. | J. MARTIN.
H. BEAUMONT SMALL, M.D.

Secretary-Treasurer:

R. B. WHYTE.

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Anderson, W. P., *C.E.*
Anderson, Mrs. W. P.
Arnaud, E. D.

Bauset, E.
Bell, James
Bell, J. H., *M.A.*
Bell, W. D. M.
Billings, B.
Billings, W. R.
Bucke, E. F.
Butterworth, C. A.

Campbell, Wm.
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Chisholm, A.
Chrysler, F. H., *B.A.*
Clark, T. M.

Davy, R. A., *C.E.*
Dixon, F. A.
Duffy, A. J.

Ewart, D.

Ferguson, H. A.
Fleming, Sandford, *C.E.*,*C.M.G.*
Fletcher, J.
Fletcher, Mrs. J.
Fortescue, L.
Fortescue, Mrs. L.
Fraser, A.

Garrett, A.
Gordon, J. McD.
Grant, J. A., *M.D.*, *F.R.C.S.*, *Edin.*
Grant, Geo. W.
Gray, H. H. O.
Greata, J. M.
Griffin, Mrs. E.

Haliburton, R. G., *Q.C.*
Hamel, F. M., *C.E.*
Hamilton, L. A.
Harrington, W. H.
Harrington, Mrs. W. H.
Hawke, J. T.
Hector, Thos.
Heron, G. C.
Hine, E.

Jones, E. A. D.
Johnson, E. V., *C.E.*

Kemp, Rev. A. F., *M.A.*, *LL.D.*
Kilgannon, A. P.
Kingsford, Wm., *C.E.*

Leggo, W.
Le Sueur, W. D., *B.A.*
Lindsay, A.

McLaughlin, S.
Mara, E. A.
Martin, J.
Matheson, D.
Monk, J. B.

Newby, Frank
Nicholson, Vernon

Patton, Rev. H. B.
Pettegrew, W. S.
Plunkett, Jas.
Porter, H. C.

LIST OF MEMBERS.—*(Continued.)*

Riddell, W.R., *B.A., B.Sc., F.B.S.E.*
Rinfret, A. P. A.
Ripley, C. J.
Robertson, P.
Rogers, C. C.

Scott, W. L.
Seymour, Miss
Small, H. Beaumont
Small, H. B., *M.D.*
Stewart, J. Cunningham
Symes, P. B.

Thorburn, John, *M.A., LL D.*
Todd, A. H.
Tomlinson, J., *C.E.*

Watts, J. W. H., *A.C.A.*
Watters, H.
White, Geo. R.
White, *Lt.-Col.* Wm.
Whyte, E.
Whyte, G. C.
Whyte, J. G.
Whyte, R. B.
Wicksteed, R. J., *LL.D.*
Wiggins, E. Stone, *M.D.*
Wood, H. O., *P.L.S.*
Wright, A. P., *M. Inst. C.E.*
Wright, Miss F. M.
Wright, Miss K. L.
Wright, W. R.

CORRESPONDING MEMBERS.

Macoun, Prof. Jno., *F.L.S.*, Belleville.

Saunders, Wm., *Presdt. Ont. Ent. Soc.*, London.

Ottawa Field-Naturalists' Club.

RULES.

I.—*Name and Object.*—This Club shall be called the Ottawa Field-Naturalists' Club, and its object shall be the study of the Natural History of this locality.

II.—*Management.*—The Club shall be under the management of a Council, annually elected, consisting of a President, two Vice-Presidents, a Secretary-Treasurer, and a Committee of five other members, all of whom shall be eligible for re-election; three to form a quorum, Minutes of the meetings and proceedings of the Council to be duly kept.

III.—*Annual Meeting.*—The Annual Meeting of the Club shall be held on the third Tuesday in March; at which, in addition to other business, the Annual Report of the Council shall be read, and the officers for the ensuing year elected by ballot, after nomination.

IV.—*Special Meetings.*—A Special General Meeting of the Club may be called by the Council; and shall be called on requisition of not less than ten members, specifying the business they wish brought before the meeting. The Council shall call the meeting within fourteen days from the receipt of the requisition, giving one week's notice. No other business shall be transacted than that mentioned in the notice.

The Council may, however, summon a meeting for the transaction of general business at any time.

V.—*Proceedings.*—Excursions in Summer and Evening Meetings in the Winter shall be held; all arrangements for which shall be made by the Council.

VI.—*Members.*—Ladies and gentlemen desiring to join the Club shall send a written application, signed by the applicant and two members, to the Secretary, who shall bring the same before the next meeting of the Council for approval.

VII.—*Corresponding Members.*—The Council shall have the power of electing Corresponding Members, who shall be persons not residing in Ottawa or its immediate vicinity, but who may be desirous of promoting the objects of the Club. Corresponding Members shall not be required to pay membership fees.

VIII.—*Annual Fee.*—The annual membership fee shall be fifty cents, payable in advance, due on the third Tuesday in March; and no member in arrears shall be entitled to any of the privileges of the Club. New members to pay the fee for the current year upon signing the roll.

IX.—*Special Tickets.*—Special tickets for non-members who may wish to join an excursion may be granted by the Secretary, on the application of a member, and under such limitations as the Council may prescribe.

X.—*Amendments.*—No Rule shall be enacted or amended except at a special meeting of the Club, called for that purpose, and by a two-thirds vote of the members present.

ANNUAL REPORT.

To the Members of the Ottawa Field-Naturalists' Club :

The Council to whose care, twelve months ago, you entrusted the management of the Club, in laying before you a report of the year's transactions, have great pleasure in being able to congratulate you upon the satisfactory conclusion of the first year of the Club's existence.

As many of you were not members of the Club in the early part of the year, it will not be out of place here to give a brief sketch of the principal events connected with its early history. For two or three years back, several young men interested in Natural History discussed the possibility of starting a society in this city devoted to the investigation of the natural history of the vicinity. Nothing was done, however, till last winter, when it was resolved that an effort should be made. Circulars were sent to the members of the Ottawa Literary and Scientific Society, calling a meeting of all those favorable to the formation of such a society. To the great gratification of those interested, fully forty gentlemen attended the meeting held on the 19th March, 1879. After a lengthy discussion as to the form the organization should take, the Ottawa Field-Naturalists' Club was born and started in life with the following list of officers :—President, Lt.-Col. White ; 1st Vice-President, James Fletcher ; 2nd Vice-President, Prof. W. R. Riddell ; Secretary, R. B. Whyte ; Committee, W. P. Anderson, J. Martin, J. A. Guignard, B. Small, W. H. Harrington. Prof. Riddell and Mr. Guignard having since then resigned their positions, Mr. W. D. LeSueur and Mr. W. R. Billings were elected to fill their places. The Council-elect met and drew up a code of rules for the guidance of the club, which was subsequently ratified by a general meeting called for that purpose.

During the year there were two general meetings of the Club, the one just mentioned, and another to consider the resignation of Prof. Riddell as second Vice-President. The Council met twenty times during the year for the transaction of business, at irregular intervals, as occasion required. When it is stated that the average attendance at these meetings was nearly seven out of nine councillors, you will see that the Council have not neglected the duties entrusted to their care.

The principal business that occupied their attention during the summer, was in connection with the excursions, of which there were five. It is not within the limits of this report to give a detailed account of these excursions, nor is it necessary, as the first Vice-President, in his inaugural address to the winter course of evening meetings, so well and fully described all the points of interest connected with them. It will suffice here merely to mention the localities visited, the dates on which the excursions were held, and the number that attended. The first was to Kingsmere, in the Chelsea Mountains, on May 22nd, attended by 42 members and friends. The second was a joint excursion with the Montreal Natural History Society to Calumet, on June 12th, 28 persons leaving Ottawa. No. 3 was to Dominion Springs and the Mer Bleu, on July 19th, at which there were present 28. No. 4 was a Saturday afternoon excursion to Britannia, the least attractive of the season, as it only brought out 25, including visitors. The fifth and last was to Meech's Lake, four miles beyond Chelsea, on October 9th, at which there were present 29, including non-members.

The Council feel compelled to express their regret that, although these excursions were to the most interesting places in the neighborhood, and the price of tickets put so low, that three of them did not pay expenses, so few of the members thought them worth attending. It does not say much for the interest the members take in the Club's work, that, with a membership of over eighty the average attendance at the excursions should be only thirty, fully one-third of whom were visitors ; and they hope that during the coming season the excursions will be better supported by the members of the Club.

Besides the regular Club excursions mentioned above, some seventeen members were enabled, through the kindness of Dr. Wicksteed, to

make a Saturday afternoon visit, on August 2nd, to Duck Island, seven miles below the city.

The only other event of interest concerning the Club during the summer was the very creditable exhibit made at the Dominion Exhibition, when the following prizes were taken by its members: In the botanical section, the 1st by the 1st Vice-President and the 2nd by the Secretary. Mr. W. H. Harrington took 2nd prize for his collection of insects, and Mr. Gilbert Heron an extra prize for his collection of shells, while Dr. J. A. Grant's exhibit of fossils and Mr. W. L. Scott's of native birds' eggs were highly commended by the judges—a record of which a young Club like ours may well feel proud.

Our winter course of Soirées, of which the last was held last night, has been very successful in every respect. At each of these, with one exception, two papers were read, many of them the result of personal observation, and illustrated by original diagrams and specimens. The papers read covered a wide range of subjects, as will be seen from the following list, and were listened to by fair audiences, the average attendance being about 55.

The following are the titles of the papers read: Monday, November 24—Inaugural Address, Mr. J. Fletcher; Graphite of the Ottawa Valley, Mr. W. H. Harrington. Monday, December 15—On the forms and structures of some Spongillæ found in the Ottawa, Dr. A. F. Kemp; The connection of Botany with Mythology, Mr. R. G. Haliburton. Friday, January 16—Cystidian Life, Dr. J. A. Grant; Museum Education, Mr. H. B. Small. Friday, February 6th—On the Contractility of the Spores of Palmella Hyalina, Dr. A. F. Kemp; Asbestos, Mr. W. P. Anderson. Friday, February 20th—A Practical Demonstration of the Human Brain, Dr. J. A. Grant. Friday, March 5th—Design in Nature, Mr. W. D. LeSueur; Land and Fresh Water Shells of the Ottawa Valley, Mr. G. C. Heron. Monday, March 15th—On some Insects captured at our excursions, Mr. W. H. Harrington; On some Plants collected during our excursions, Mr. J. Fletcher.

At most of these Soirées there were on exhibition botanical and other specimens collected during the summer by members of the Club.

In addition to our regular course of Soirées, the Council, as a token of the good feeling which existed between the Ottawa Literary and Scientific Society and the Club, offered to take charge of one of the Conversaziones in the Society's winter course of meetings. Their offer was accepted, and the entertainment took place on January 9th. The programme consisted of an address by the Chairman, Mr. LeSueur; a series of chemical experiments illustrative of the phenomena of combustion by Mr. Henry Watters; an essay on coal by Mr. W. H. Harrington; recitations by Mr. J. Martin and Mr. W. Campbell, and an exhibition of natural history specimens in the Museum by members of the Club.

The membership of the Club has steadily increased, and now consists of ninety ordinary and two corresponding members—Prof. J. Macoun, of Belleville, and W. Saunders, Esq., of London, President of the Entomological Society of Ontario—who were elected by the Council according to Rule 7.

The following donations have been received during the year: 5 copies of the "Canadian Entomologist," No. 5 containing a notice of the organization of the Club, from the editor; Reports for three years of the Manchester Field-Naturalists' Club and of the Scientific Students' Association, of the same place, from Mr. W. R. Billings; 2 volumes of the proceedings of the Nova Scotian Institute of Natural Science from Dr. Honeyman, per Mr. W. P. Anderson; report of the Fruit-Growers' Association for 1879, containing the report of the Entomological Society of Ontario for the same year, from Mr. J. Fletcher. We have also received from the Curator of the Literary and Scientific Society a long list of donations made by the members of the Club to the Museum of that Society during the year.

The Council have on several occasions discussed the feasibility of printing the papers read before the Club during the winter, with an account of the excursions and the annual report as the transactions of the Club for 1879-80. The following extract from the minutes of last Council meeting expresses the view of the Council in the matter, which they commend to the favorable consideration of their successors.

"Moved by Mr. Billings, seconded by Mr. Harrington, That, in the opinion of this Council, it is desirable that the papers read before the Club during the past season, including the Inaugural address and Secretary's report, which dealt with the original researches of members, or with the Natural History of the Ottawa district, should be printed as the Transactions of the Club for the year 1879-80. Carried."

The following is the Financial Statement for the year, showing a balance on hand of $28.54 :—

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

To	Members' Subscriptions.	$38 50	By	Stationery and Postage..	$ 7 93
	Excursion Receipts.....	83 05		Printing.....	19 00
	Soirée Receipts	23 70		Excursion Expenses....	89 28
				Soirée Expenses.....	5 50
				Balance, Cash on hand..	28 54
		$150 25			$150 25

R. B. WHYTE,

Secretary-Treasurer.

OTTAWA, March 16th, 1880.

FIRST SOIRÉE.

INAUGURAL ADDRESS

DELIVERED ON MONDAY, 24TH NOVEMBER, 1879, BY JAMES FLETCHER,
FIRST VICE-PRESIDENT O.F.N.C.

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

The unexpected absence of our President during the past week has thrown upon my unworthy shoulders the responsibility of addressing you this evening. I shall merely remind you of what we have done during the past year, and draw your attention to what we propose to do during the coming winter season.

Our Club was formed in the commencement of the summer, with the express object of working up the Natural History of this locality. We started under the most favourable auspices. His Excellency the Governor-General graciously consented to be our Patron, and the first circular, addressed to the members of the Ottawa Literary and Scientific Society, was answered by about forty gentlemen. At the first general meeting, the gentlemen whose names are printed on the first sheet of the programme were elected as the Council. This meeting, and all subsequently, were held, as is this one to-night, in the Museum of the Ottawa Literary and Scientific Society, to whom, for their courtesy, we are under a debt of the deepest gratitude. The only return given for this kindness was a promise of duplicate specimens to be collected by the Club, and I am happy to say that, at the end of the season, I shall be able to add many valuable specimens, and even collections, to their Museum from this source. During the summer, we have held five Excursions into the country, choosing a different destination each time. The first of these was to Kingsmere, in the Chelsea Mountains, and was of the most pleasant kind, and many valuable additions were made to the collections of the members. Perhaps the gem of the expedition was the lovely *Clematis verticillaris*, or "Purple-flowered Virgin's Bower." The lucky discoverer of the first specimen was Master Ernest LeSueur, whose quick eyes detected it as it lay half concealed among the leaves and loose stones. The members of the Club experienced much kindness at the hands of Col. and Mrs. Dennis, who, nothing daunted at the formidable array of 42 members, insisted upon the whole party coming into their lovely garden by the lakeside, and making tea for them. Besides plants, there were also a few insects collected by Mr. Harrington, and some shells by Mr. Heron. The second expedition of the Club was not one of the regular meetings, but was in answer to an invitation, very kindly sent by the members of the Montreal Natural History Society, to join them in a field day at Calumet. Our members were most successful at this excursion, carrying off all the three-

prizes offered by the Natural History Society for botanical specimens, the first being taken by Mr. R. B. Whyte, the second by Mr. B. Small, and the third by Mr. H. M. Ami. This trip was much enjoyed by all who participated in it, and it is to be hoped that it is only the first of a long series of joint annual excursions.

The third excursion, and, perhaps, the most interesting of all, was to the Dominion Springs and the Mer Bleue. This remarkable locality presents a field of unusual interest to the naturalist, and many rare specimens were collected; of the plants the most interesting were *Microstylis ophioglossoides*, *Dalibarda repens* and *Triglochin maritimum* var *elatum*. On the 2nd of August, Dr. Wicksteed invited the members of the Club to take a trip in his steam yacht. About twenty availed themselves of the opportunity and paid a visit to Duck Island, a few miles below the city. The fourth excursion was to Brittania, where a pleasant afternoon was spent; the locality, however, was too near to Ottawa to offer many new specimens.

The next important item to mention in the history of the Club is the exceptionally fine exhibit which they sent to the Dominion Exhibition, when the following prizes were taken:—In the Botanical Section, all the prizes offered: the first, a silver medal and $8, being taken by the First Vice-President; the second, $4, by the Secretary. In the Entomological Section, Mr. Harrington took the second prize of $10; the first, a gold medal, being awarded to the Entomological Society of Ontario, a well-established institution of many years' standing. Besides the above, a bronze medal, an extra prize, was awarded to Mr. Gilbert Heron for a beautiful collection of land and fresh-water shells. The finest collection exhibited in the name of the Club, however, was Dr. J. A. Grant's case of twelve unique fossils, every one of which was of unusual interest; these were not entered for a prize, but were highly commended by the judges. Another beautiful collection was one of native birds' eggs, exhibited by Mr. W. L. Scott. This also obtained a special mention by the judges.

During the Exhibition week, the members of the Club received an invitation from the President of the Entomological Society of Ontario to attend the annual meeting of that Society, of which many availed themselves.

The last excursion was to Meech's Lake, in the Chelsea Mountains, in the beginning of October. The day was a charming one, but the collections were small, the only find of importance being a new shell called *Physa Lordi* by our indefatigable conchologist, Mr. Gilbert Heron.

This is, I think, a brief summary of what we have done towards effecting the work we laid out for ourselves in the beginning of the season. The programme, which has been sent to all the members, shews what the Council

propose to offer you during the winter, by the way of amusement, and to keep up an interest in the Club, which has already given us so much pleasant intercourse. One of the chief benefits bestowed by an organization, such as ours, is that it enables one always to know where to find a sympathetic companion. Of all recreations, there is none, to my mind, more enjoyable than a walk in the country with a congenial friend. No kind of intercourse brings you into closer contact with a companion than taking a walk. You cannot take ten steps, even with a stranger, without feeling a necessity of saying something, and, if there is anything in a man, you can soon bring it out of him in a country walk. Now, it is very clear that a judicious choice with regard to your companion is a most important matter; but it is not always easy to find one who has the same tastes or takes an interest in the same subjects as yourself. John Burroughs, in "Winter Sunshine," writes as follows: "Professional walkers are very fastidious in choosing or admitting a companion, and hence the truth of a remark of Emerson that 'you will generally fare better to take your dog than to invite your neighbor.' Your cur dog is a true pedestrian; he enters into the spirit of the enterprise; he is not indifferent or preoccupied; he is constantly sniffing adventure; laps at every spring; looks upon every field or wood as a new world to be explored; is ever on some new trail; knows something important will happen a little further on; whatever the spot, or whatever the road, he is always satisfied with it. In short, is just that happy excursive vagabond that touches one at so many points, and whose human prototype in a companion, when such can be found, robs miles and leagues of half their power and fatigue."

The most interesting companion in anything is undoubtedly the one who can tell you most about it. Therefore, the best companion in the country must be a naturalist, who can point out objects of interest and explain their beauties and wonders. No one looks upon the world so kindly as he does; no one else gives so much attention to, or takes so much enjoyment from, the country as he does, and he holds a more vital relation to nature, because he is freer, and his mind is more at leisure. Moreover, when a naturalist gets a friend, who is not one, out in the country, he feels a sort of moral responsibility resting upon him to find something particularly interesting to point out, so as to arouse his curiosity, and, if possible, to convert him to the study of "La Belle Science." I say particularly interesting, because everything in nature is interesting and beautiful; and I defy anyone to bring me a single object, picked up by a country roadside, which is not beautiful, and even exquisitely so—a stick, a piece of straw, a leaf, or a stone, it matters not what, if properly examined and understood, they are all wonderful and lovely. Let us briefly consider these common objects one at a time, taking them in the order I have mentioned them. We will suppose, for the sake of demonstration, that the stick is part of the stem of a young Canadian Sugar Maple (*Acer saccharinum*). This tree belongs to that division of the vegetable kingdom known as Exogens, or plants which increase by the deposition of a layer of new wood on their outer surface, beneath the bark, at regular periods. A plant stem, in its simplest state, consists merely of parenchymatous

cells, with, occasionally, a central vertical cord of fibre cells, as, for instance, in the mosses. Such a stem, however, would be unsuited to plants in which great strength is required, and we, accordingly, find that, in all plants above the mosses, the stem is made up partly of parenchymatous cells and partly of woody tissue and vessels of different kinds, by which the requisite toughness and strength are produced. In these stems, then, we notice two systems—the *parenchymatous*, or common cellular system, and the *fibro vascular*. Vegetable cells are divided into two groups. When they are of such form that, combined together, their ends merely come in contact without perceptibly overlapping, they are called *parenchymatous;* but when elongated and pointed at their ends, so that, in combination, they overlap each other, they are termed *prosenchymatous*. But these extreme forms are connected by all sorts of transitional ones. Formerly, all elongated organs found in plants were supposed to have an entirely different origin from the cells, and were described under the names of woody fibres and vessels or ducts. It is now, however, known that they are all derived originally from ordinary cells. The parenchymatous system grows in any direction, according to circumstances, either longitudinally, by which the stem is lengthened, or horizontally, by which it is increased in diameter. The fibro-vascular system only grows longitudinally, and thus forms cords and bundles, which are distributed vertically in the midst of the parenchymatous to strengthen the stem. The parenchymatous is, therefore, termed the horizontal system of the stem, and the fibro-vascular the longitudinal, or vertical system.

In the embryo state, the stem of an exogen is entirely composed of parenchyma; that is, a tissue composed of simple cells with thin walls, whose length does not exceed their breadth, or in which the proportion of the two diameters does not vary to any great extent. As soon as growth commences, some of the cells become developed into spiral vessels and wood cells, forming, at the end of the first year, a zone, consisting of two parts, the first composed chiefly of spiral vessels, and known as the *medullary sheath*, and outside this, and closely connected with it, another part, composed of wood cells; this zone is formed round the central mass of parenchyma, which, from this time, we will call the *pith;* it is not, however, a perfect circle, for it is interrupted at certain points by projections of the pith in radiating lines, which pass through it and connect with an external layer of parenchymatous tissue, which is called the *bark*. We have, then, as the result of one year's growth:—1. A central mass of parenchyma, which is called the *medulla*, or pith; 2. An interrupted zone of wood cells, and vessels forming the *wood*; 3. The radiating lines connecting the pith with the bark, called the *medullary rays;* and 4. An external zone of parenchymatous cells or the *bark*. Such is the structure of all exogenous stems which die yearly.

But our stick does not belong to an annual exogen; the stems, however, of plants which live more than one year, at first resemble those that die yearly, except that the wood formed is generally firmer and in larger proportion. During the second year, another zone of wood is formed on the outside of the one of

the previous year, while, at the same time, a new fibrous layer is added to the inside of the bark. These layers are developed out of the vitally active cells of the *Cambium layer*, which is situated outside of the indefinite vascular bundles which form the wood. The medullary rays, at the same time, increase by addition to their exterior ends, and thus continue to keep up their connection between the pith and the bark. In succeeding years we have, in like manner, new layers of wood and fibrous bark, one of each every year; and the medullary rays also continue to grow from within outwards; there are also other medullary rays, which connect each annual zone with the bark; these are called *secondary medullary rays*. Each succeeding yearly growth is, therefore, a repetition of the first, except as regards the pith; this never increases in size after the first year.

The second object is the piece of straw. Not a few of you, I imagine, will be surprised to hear me call a stalk of wheat a tall, symmetrical, tower of stone surrounded by a casing of wood; such, however, with all propriety, it may be called. It will be at once seen that, to keep the grain from the moisture of the ground, in order that it may ripen properly, a tall stem must be developed; and also in the case of most of the economic grain-bearing grasses, which produce such enormous crops in comparison to the size of the plants, that it must be of exceptional strength to bear the weight of the copious ear. Nature has effected this by a most beautiful and unexpected process. The cuticle in some plants, but especially in these which we are considering, has its cell walls impregnated with *silex*, or flint; so much so, that when all the organic matter has been removed by heat or prolonged maceration in diluted nitric acid, the forms of the cuticle cells, hairs and stomata are distinctly marked out in silex, and can be beautifully displayed under the microscope, with the aid of polarized light. Such silicious cuticles are also found in the husks of the grains yielded by these plants, and the hairs, with which the *paleæ* or chaff scales of most grasses are furnished, are strengthened by a like deposit. Moreover, the vegetable cells produced in straw are prosenchymatous and form fibrous-tissue, which, added to the silicious skeleton, and the shape of the stem, a hollow cylinder, give the great strength and flexibility necessary. A stem of wheat straw is, perhaps, one of the strongest structures, for the amount of substance in it, which can be found in nature. An ordinary thick stem would, of course, support the weight of the ear as well, but, as the seeds of these plants were to form the large portion of the food of the human race, which they do, it was necessary to provide them with stems which would take up as small an amount of space as possible. I have no doubt that, did the members of the grass tribes cover as much area, in comparison to the amount of fruit they produce, as other plants, the whole world would not suffice as a field to grow the amount annually required to sustain man.

Our next object is the leaf. There is no part of a plant, not even the flower, with its wealth of beauty and delicious scent, which deserves more careful consideration, nor which performs more important functions than the foliage, the source of that great charm in the landscape, which all feel so keenly in the spring, when nature has spread, with lavish hand, her mantle of refreshing green

over the trees of our forests, which have been gaunt and bare for so long during the dreary months of winter. For the better understanding of the special functions of the leaves, let us, for a moment, glance at the life history of a plant. The seed, containing the germ, is placed in the ground; under the influence of the warmth of the sun and a certain amount of moisture, the embryo which it contains begins to develop, and sends down a radicle into the soil, and a stem bearing the plumule, or little bud of undeveloped leaves, upwards to the light; at the same time the cotyledons or seed-leaves are formed. We have, then, a central axis developing in two opposite directions, the lower part is called the *descending axis* or root, and the upper the *ascending axis* or stem. Upon this axis or its divisions all the future organs of the plant are arranged; those which immediately succeed the cotyledons are the true leaves, and all which succeed the leaves in the way of development, such as the flower and its parts, are merely modifications of the leaves, designed for special purposes; therefore, the three organs which existed in the embryo in a rudimentary state are called the *fundimental organs* of the plant, or *organs of nutrition*, because they have for their object its nutrition and development. As a general rule, the plantlet exists ready formed in the seed. This can be easily seen by soaking a bean in water for a day or two and then opening it with a penknife, when there will be found a miniature stem and a pair of leaves, which need only be brought to the light to attain their green color. It has now only to form a root to fix it in the ground, when it becomes a perfect, though diminutive, vegetable. This root, though, can only be formed from proper material; neither water nor anything else which the plant is imbibing from the earth will answer. The proper material is prepared food, more or less of which is always provided by the parent plant and stored up in the seed, in the form of starch or similar nourishment, and generally deposited in the cotyledons or seed-leaves.

For a short time, this small stock suffices to support the young plant, and, by the time that is exhausted, it has formed roots and true leaves, and is, by their means, able to take care of itself.

The articles which form the diet of plants are exceedingly simple: they are water, carbonic acid, and ammonia. As soon as the young plant has expanded its green leaves, it absorbs these substances, from the soil by its roots and from the air by its leaves. It will not be difficult to understand what the organic constituents of plants are, and how the plant obtains them. A leaf consists of two parts: a woody and a cellular; the former is the framework of ribs and veins which serve to strengthen it, and also to act as canals to bring in the ascending sap, and to distribute it by the veinlets throughout every part. The cellular portion is the green pulp, and is nearly the same as the green layer of the bark; so that the leaf may properly enough be considered as an expansion of the fibrous and green layers of the bark; the whole is covered by a transparent skin called the epidermis. The green pulp consists of cells of various forms, usually loosely arranged so as to leave many irregular spaces or air passages, communicating with each other throughout the whole interior of the leaf. The

green color of vegetation is due to a peculiar green matter, lying loose in the cells, in the form of minute grains, named *chlorophyl*, which is merely the Greek for *the green of leaves*. The use of the leaves is to convert the crude watery matter sucked up by the roots into proper vegetable substance. They have been compared, because of this, to the digestive organs of animals, and, as their functions are respiratory as well, they have been compared also to the lungs.

A large portion of the moisture which the roots of a growing plant are constantly absorbing, after being carried up by the stem, is evaporated by the leaves. To prevent a too copious evaporation of this moisture, they have been provided with the delicate tissue of cells termed the epidermis.

The greater part of the moisture exhaled escapes from the leaf through the *stomata* or breathing pores; these are small openings through the epidermis into the air chambers, establishing a direct communication between the air chambers and the external air; through these, the vapour of water and the gaseous constituents of the atmosphere can freely enter or escape, as the case may be. The openings of these breathing pores are guarded by a pair of thin walled cells, which open when the weather is damp, so as to allow exhalation to go on; but promptly close when it is dry, so as to arrest it before the interior of the leaf is injured by the dryness. These stomata or mouths, too, are the entrances through which the plant receives its food. I have already mentioned that the chief materials which compose the food of a plant are carbonic acid, water—that is hydrogen and oxygen—and a little ammonia. The substance of which vegetable tissue, namely the walls of the cells, is made, is, by chemists, called *cellulose*, and is just the same in composition in the hardest wood of a full grown tree as in the soft cellular tissue of a succulent plant; it is composed of carbon, hydrogen and oxogen. These, then, are necessary materials for the vegetable growth, and must be received by all growing plants, and it only remains to be shewn whence the plant obtains them. Of all substances consumed by a plant, water is taken in to a far greater extent than any other, chiefly through the roots, but also, to a small degree, through the leaves. Now, water is composed of oxygen and hydrogen, two of the three elements of cellulose, and, strangely enough, these two gases exist in water in exactly the same proportion as they do in cellulose. It is perfectly apparent, then, that the plant obtains two of the three elements of cellulose from water, the other, carbon—by far the most important—is the only one now to be found.

Among the components of the atmosphere, there is one which is exceedingly injurious to animal life, which is called *Carbonic acid*, or more usually now Carbonic dioxide; this gas consists of carbon and oxygen and is the product of combustion. In breathing, which is one form of combustion, animals are constantly forming carbonic acid gas by uniting the carbon of their bodies with the oxygen which they inspire; it is then exhaled as carbonic acid gas. It generally exists in the atmosphere to the amount of $\frac{1}{2500}$ part of its bulk. This is not enough to prove injurious to animal life. But, with every breath, animals

are diminishing the oxygen in the air, so necessary for them, and increasing the amount of carbonic acid, so injurious to them; or, rather, which would be so injurious if it were allowed to accumulate; the reason why it does not, is because plants consume it as soon as formed. Chemical experiments have shewn that, when the leaves and green parts of plants are exposed to sunlight, they possess the wonderful power of decomposing the carbonic acid of the atmosphere. It is absorbed through the stomata, and the delicate cells are the chambers of the laboratory where it is decomposed, and the whole of its carbon is taken by the plant and assimilated with the water and other matters collected from the soil and air to form cellulose, which becomes wood, pulp, starch, sugar, etc., etc., according to circumstances, while the whole of the oxygen it contained is evolved back again into the air because useless to the plant, the full amount required by it to complete the composition of cellulose already existing there as one of the constituents of water. This is proved by the fact that there is a constant relation between the amount of carbonic acid gas absorbed and the oxygen exhaled. While the plant is a true apparatus of reduction, the animal is a true apparatus of combustion, in which the substances it derives from the vegetable are burnt and restored to the atmosphere in the form of carbonic acid, water and ammonia, ready to be again absorbed by the plant and to re-pass through the phases of organic life. The important influences exercised by vegetation on nature will be at once appreciated when it is remembered that this is the only known process by which oxygen gas, so essential to our existence, is restored to the atmosphere in a free condition. Thus we see that the two great organized kingdoms of nature are made to co-operate in the execution of the same design; each ministering to the other and preserving that one balance in the constitution of the atmosphere which adapts it to the welfare and activity of every order of being, and which would soon be destroyed were the operations of either of them to be suspended. It is impossible to contemplate so special an adjustment of opposite effects without admiring this beautiful dispensation of Providence, extending over so vast a scale of being, and demonstrating the unity of plan upon which the whole system of organized creation has been devised.

The last object of our collection is the stone. To anyone who has never examined a stone critically, it would appear to be a perfectly homogeneous mass, with no structure at all. This is seldom the case, however. Almost every solid, when slowly deposited from a liquid or aëriform condition, assumes a definite symmetrical shape, called a *crystal*. The perfect crystal represents the natural condition of a substance, and the form peculiar to each is one of its most important characteristics. The idea of symmetry is inherent in every human mind, it may be more or less cultivated by experience; but the germs of the idea are found in the most untutored. However rude his condition, man is pleased with a symmetrical arrangement of objects, and his mind is offended when his eye detects a violation of the laws of symmetry, although he may have no name for the idea. Corresponding with this idea, we find symmetry everywhere in nature. The parts of an animal are most symmetrically arranged round the body, as also

are the leaves round the stem of a plant; but nowhere is the idea of symmetry so fully developed as in the mineral kingdom, where everything is arranged in the most beautiful and perfect regularity.

The reason I have dwelt at such length this evening on these objects is to endeavor to point out that there is nothing, not even the commonest object in nature, that is not worthy of a careful examination. It is a great mistake, but a mistake which is often made, even by scientific men, to suppose that new knowledge can be gathered only from the unexplored fields of science, when, in the most familiar walks of life, there are countless riches of truth which the reapers, in the hurry of the harvest, have passed unnoticed, and which will abundantly reward the careful gleaner. The French aptly express this thought in the provrb "*La Science court les rues*"—Science runs the streets;" or, more freely translated, Knowledge is to be found everywhere, by those who will look for it, for it is so plentiful that it runs in the very gutters of the streets.

Now as to the effects or defects of a special study. There is much to be said on both sides of this question. There are many classes of students in the natural sciences. The largest of these are: *Firstly*, those who study merely for the pleasure it gives themselves and their friends, and the furtherance of knowledge generally; and *secondly*, those who study simply for the furtherance of knowledge in some special branch.

There is, besides, another class, who are hardly worthy of the name of scientific students, who do so simply for what they can make out of it, in the way of reputation, or even money; this last class, I am glad to believe, however, is very small.

To the first class most belong. This is that class which embraces all those who, appreciating the beauty and splendour of the objects revealed in a study of nature and the amount of true pleasure they can thus enjoy, acknowledge the responsibility which is upon them, and strive to induce others to study it too, and so participate in the pleasure which they know is so real. These men make utilitarianism their chief object, first, to make themselves useful to others, and then to induce these, in their turn, to do the same. To gain this end they strive particularly to be as interesting as possible to everyone, always ready to give a helping hand, or explain anything they themselves understand to those who do not. The work of these students is to popularise science, and to remove, as much as possible, that veil which the very word seems to have drawn over itself. I do wish that word "science" had never been invented. I am convinced that there are more turned aside from the study of natural science by it than by anything else. People seem to think that, when anything is spoken of as a science or an "ology," that it is something requiring special adaptations and much study to

at ain, and, consequently, from preoccupation, or other reasons, consider it is beyond them. Science simply means knowledge; but it has now gained a significance in the eyes of many of something abstruse and not to be had by all. This impression I consider it the duty of all of us to endeavor to clear away.

To the second class belong those who take up a special branch of natural history, and, paying little attention to others, push their investigations to the furthest possible limit, giving their whole time to it. They may have the intention of taking up other branches when they have thoroughly studied the first, but here the impossibility of doing everything, and the sh ortness of man's life, interfere, and they find that, unless their labors were undertaken with the express object of establishing some fact, or throwing a light upon some connected study, that they have wasted their whole lives and furthered the general work of science very little. Now, the former class is composed of the generous students of nature, who use their time in popularizing and making pleasant the by-ways of science; the latter, of the unselfish, (if a distinction can be drawn between the two words generous and unselfish) who give their whole time to the dry and difficult task of solving knotty points, the clearing up of which may or may not, eventually, be of value. Now, one of these is not more important than the other, for they are both essentially necessary in order that the work of science may go on and prosper. Specialists are particularly useful, and, in fact, everyone must be a specialist to a certain extent, for the different branches of natural science are so intimately connected that, to understand one thoroughly, you must know a little of all. The proper system is to choose very deliberately which branch you intend to take up. Look into all, and find which you have the greatest taste for, then set to work and work it up from its commencement beginning at its very elements, and work on slowly; you will soon find that you require, frequently, to know something of the other branches. Now comes the critical point. Do not drop it altogether; you do not want to make a study of all. Let the first compose the backbone of your studies, and work the others round it; but remember you only want the rudiments of the other branches, not to know all about them, but enough to help you to understand your own. This is the great secret of progress: keep on steadily at your one branch, and, at the same time never allow anything which affects it to pass unexamined, even though in another branch, until you quite understand the connection. Take as instances: Where would the Entomologist be without a knowledge of Botany, to know where to look for insects which he knew to feed on a certain plant, or a slight knowledge of Mineralogy to know in what description of places to find the plant; or, again, the Conchologist: how would he know where to spend a day looking for specimens, could he not discriminate whether there were or were not lime in the soil, in some form, from which the shells could be formed; or the Geologist, how could he identify his specimens if he knew nothing of

Botany, Conchology and Entomology? These are a few of many instances that might be quoted, but they shew how one branch depends upon the others for support. Let us, then, cast our lot in with the first class, and strive, while working up the natural history of our neighborhood thoroughly, to do so in a popular manner, intelligible to all. I believe we have it in our power to give much happiness to many, by inducing them, by our example and persuasions, to study with us Nature. Its wonders are open to everyone, from the young child to the aged man; it offers charms and fascinations to all—for all is wonderful and beautiful; and, as nothing makes men so happy as contemplating the beautiful, I consider nothing is so well calculated to make men good and happy as a study of nature.

Through the kindness of the Rev. Dr. Dawson, Principal of McGill University, Montreal, I am enabled to exhibit some beautiful microscopical slides, in illustration of some of the points I have brought before your notice this evening.

"Graphite of the Ottawa Valley.—Mr. W. Hague Harrington."

[The first half of this paper, treating in a general manner with the composition, mining, manufacture, etc., of graphite in other countries, has necessarily been omitted.]

Turning now to the more special consideration of the deposits of graphite found in this section of the Dominion, which is known as the Ottawa Valley, it will not be going beyond the limits of the subject if, at the outset, we give a momentary glance at the formation and character of the rocks in which they occur.

The Archæan era in geology includes the oldest rocks known to that science—rocks which are supposed to have been formed from the original rocky crust produced by the cooling of the earth. They are easily seen to be the result of the disintegration of an older series, and frequently contain pebbles unlike any rocks now known.

In Canada, where these rocks are very fully represented, they are divided into two periods—the Laurentian and the Huronian—the former being considered the oldest. The long chain of mountains, of which a portion is visible across the Ottawa, is composed of the Laurentian rocks, the estimated thickness of which is 30,000 feet, consisting, with few exceptions, of metamorphic or crystalline rocks.

These rugged, broken hills, which lift their stony crests above the pines that clothe their sides, contain immense masses of nearly every species of mineral. The three at present most worked and valuable are iron, apatite and graphite, the latter being most frequent in the limestone. In this series of

rocks there are three great limestone layers, separated by gneissoid rocks, aggregating not less than 3,500 feet in thickness. The limestone of each of these layers is often mixed with, or passes into, rocks which consist largely of pyroxene, or hornblende, and these portions abound frequently with valuable minerals, the most common being mica and graphite.

As to the probable origin of the graphite in these rocks, Dr. Dawson remarks that "It may fairly be assumed that in the present world and in those geological periods with whose organic remains we are more familiar than with those of the Laurentian, there is no other source of unoxidized carbon in rocks than that furnished by organic matter, and that this has obtained its carbon in all cases, in the first instance, from the deoxidation of carbonic acid by living plants. No other source of carbon can, I believe, be imagined in the Laurentian period."

When we come to consider the enormous deposits of carbon held by the Laurentian rocks, it will easily be seen that immense periods, even of a most prolific vegetation, must have been necessary for their formation. The atmosphere of that period must have contained a great amount of carbonic acid, and the seas have been charged with abundance of carbonate of lime, and have contained, in common with the land surface, enormous expanses of vegetable life. The amount of carbon, in the form of graphite, in the Laurentian system, is considered by Dawson to equal that (in the form of coal) of equal areas in the carboniferous.

In the Township of Buckingham a band of limestone, with some thin interstratified bands of gneiss, about six hundred feet in thickness, occurs, and is filled to such an extent with veins, or disseminated crystals and scales of graphite, that the mineral is estimated to constitute one-fourth of the whole in places, and, allowing for the poverty of some portions, the total vertical thickness of pure graphite can not be less than from 20 to 30 feet. It occurs in equal abundance at several other horizons in beds of limestone, estimated by Logan to have an aggregate thickness of 3,500 feet; and the total quantity thus contained can readily be seen to be enormous.

Unlike beds of coal, which occupy the place where the forests which produced them formerly flourished, graphite has been disseminated through the rocks by changes therein. In some places, to be sure, beds are found so regular and pure that they may be fairly compared to deposits of anthracite; but these are the exceptions: the great bulk of the mineral is scattered in scales, lumps or thin veins. Many of these veins are mere shrinkage cracks, traversing in countless numbers the containing rocks, and so irregular in size as often to resemble strings of nodular masses.

The graphite contained in these is supposed to have flowed into them in the form of a hydro-carbon; or it may have been in a state of aqueous solution at an enormous heat. It is evidently derived from the rocks traversed by the veins, and has deposited with it sediment from these beds. Hence there is no occurrence of fossils as in coal, and the vegetable origin of graphite can only be inferred from analogy, and from the fact of a few scanty organic remains, as those of eozoon, having been found in the containing rocks. * * * *

The graphite of the Buckingham district occurs in three distinct forms, always in or in close proximity to bands of crystalline limestone. First, in foliated scales or plates in limestone, gneiss, pyroxene or quartzite, and sometimes even in iron ores, as is the case at Hull: secondly, in distinct embedded masses, or pockets in the limestones; thirdly, in veins traversing in every direction the containing rock.

The first form is most common, and occurs in greatest abundance in the limestones, often forming such large deposits as to possess great economic value, as at Buckingham.

The second form is of common occurrence, and has been worked in Buckingham and Lochaber, where the deposits are considerable. In the latter town-

ship the bed which has been mined is over ten feet in thickness, and yields about 20 per cent. of pure material.

The last, or fissure graphite, is not so common, and, though of much greater purity and brightness, cannot, in general, be worked to such profit.

The series of rocks in which graphite and its companion minerals occur in this district has been described by Vennor, in a letter to Dana, as follows: "The order, then, thus given to the economic minerals just mentioned is, in ascending order, as follows: first, hematite iron ore; secondly, magnetite and apatite (unimportant); thirdly, magnetite and hematite (important); fourthly, plumbago (very extensive); fifthly, phosphate of lime, with iron ore (an extensively worked belt); and then, sixthly, eozoon Canadensis in abundance, with serpentine, chrysotile, and veins of baryta and galena. You will thus observe that iron ore runs through the series, though most important in one horizon; that plumbago, with a great deal of pyrites, is toward the upper portion, while the great body of apatite-bearing rocks is at the very summit."

It is said that plumbago was mined to a small extent in the vicinity of Grenville as long ago as thirty years, and that the farmers around Buckingham were accustomed to use the purer specimens, which they picked up, for polishing their stoves with. No mining worth speaking of, however, was done until a New York company opened a mine in the Township of Lochaber, where they purchased a number of plumbago deposits and erected factories, at an expenditure of about $50,000. After working for four years they were compelled to cease.

The Montreal Company commenced operations about the same time. They invested about $150,000, and made some large shipments to England and New York. They manufactured immense quantities of "Dome" stove polish, but about eight years ago they closed work, and soon afterwards their buildings were all burnt down. Difficulty of transportation was one main cause of the failure of these companies, and this, although somewhat remedied of late, is still a great source of expense and trouble.

The principal mines recently in operation were those of the Dominion of Canada Company, discovered about ten or twelve years ago by Messrs. Pennock and Devine. This company (which claimed to have started with a capital of £100,000, subscribed largely by English capitalists) owned about two thousand acres of land, containing very rich deposits. Among these are about fifteen lodes or rich veins, one of which (in lot No. 21 in the 7th con.) is stated by Vennor to vary in thickness from one to two feet; it runs in a W.S.W. direction, and contains very pure graphite.

The deposits of disseminated mineral were, however, found to be more easily and profitably operated. The quarry worked was about one-eighth of a mile in length and about seventy feet in depth, and yielded from ten to sixty per cent. of plumbago. The machinery in use was capable of turning out about fifteen tons per week.

The graphite, when received at the mill, was broken into lumps weighing about three pounds and then crushed. It was afterwards separated into different grades by passing through large tubs about fifteen feet in diameter, known as "muddlers," in which the heavier particles are deposited in the centre and the lighter ones toward the outside edge. After being dried in an oven, it was ground and separated, as in a grist mill; the coarse grades being packed in barrels for crucibles, and the finer in tin boxes for pencils, electrotyping, etc.

About five years ago the foundation of the factory was laid by Hon. R. W. Scott, and the little settlement which has since grown up around it rejoices in the appropriate, if somewhat high-flown, name of Graphite City. It contains, beside the factory, a post-office, blacksmith shop, saw mill and boarding-houses.

The Buckingham Mining Company owns about one thousand acres of land, and had commenced active operations three or four years ago, but did not erect factories, and is now doing little or nothing.

In 1877 three hundred tons of disseminated mineral were taken out by Mr. Miller in the ninth range of Buckingham, but for want of a market he was compelled to suspend work.

In the same year, a mine, said to be very rich, was also discovered and slightly opened by Thomas Lynch, about three miles from the Dominion of Canada mine.

The graphite obtained from these mines is, from its purity and other qualities, eminently adapted for all the uses to which plumbago has been applied. Granular graphite, such as was formerly obtained in Cumberland, and is now mined in other European countries, is suited chiefly to the manufacture of pencils, and for stock where strength is not needed, but it is almost useless for crucibles; while the foliated graphite of Ceylon is used entirely for the latter purpose.

The plumbago of this country, consisting, as it does, of both varieties, can be used for each and all of the numerous forms in which this valuable substance is employed. The Dominion of Canada Company were manufacturing all kinds and grades of crucibles, pencils, stove polish, etc. They claimed that their purest graphite contained ninety-seven per cent. of carbon, and that the pencils, crucibles and other stock made from it were equal to any produced elsewhere. Owing to great commercial depression, this company was compelled to suspend operations, and became bankrupt. The diminished production of iron caused a great decrease in the demand for plumbago crucibles for steel smelting, and prices in consequence, dropped from $250 per ton to $75 or less. At present, appearances point to a decided revival of the iron industries, and, when we learn that 8,000 tons of plumbago were used yearly by one English firm alone for manufacturing crucibles, we may hope yet to see a good demand and profitable prices for our graphite. * * * * *

SECOND SOIREE

On Monday, 15th December, 1879, Rev. A. F. Kemp, M.A.; LL.D., delivered a very interesting address (oral) "On the Forms and Structures of some Spongillæ found in the Ottawa." Three species of these fresh-water sponges were stated to be found in the river viz: *S. Ottawaensis, S. Dawsonii and S. Asperima.* Two at least of these species can be gathered in McKay's Bay, below the city. The structure and distinguishing characteristics of the different forms were clearly explained, as also the methods of their growth and reproduction.

"The connection of Botany with Mythology" was the title of a paper read before the Club on the same evening by Mr. R. G. Haliburton, *Q.C.* It dealt with the origin and influences of the belief, common to ancient nations and to the uncivilized tribes of the present day, in a "Tree of Life." Versions of such traditions still existing among the North American Indians, Australians, Polynesians and other races were given in illustration. The paper clearly showed evidence of much research into the Mythology of the past and present.

THIRD SOIRÉE.

FRIDAY, 16TH JANUARY, "CYSTIDEAN LIFE" J. A. GRANT, M.D., F.R.C.S., EDIN. F.G.S., LONDON, ETC.

Mr. President, Ladies and Gentlemen:

In compliance with the request of the President and Council of the Ottawa Field-Naturalists' Club, I have very great pleasure indeed in being here to-night, as an old citizen of the capital of the Dominion of Canada, to throw my mite into the scale and assist in the development of the work of natural history. To the young, I know of no subject of greater importance than that of the cultivation of the observation which is necessary in the study of Nature and Nature's laws. I should like very much, in our educational institutions, to have impressed upon the minds of the rising generation the necessity for ocular demonstration and careful observation as regards the various objects that are constantly being presented to our youth on every side throughout the paths of life. There is no part of the whole Dominion of Canada, with reference to the subject of natural history, that takes a more important place as an evidence of creative power than the city of Ottawa. In our rocks, on every point, we find entombed the records of animal and vegetable life; there is not a stone wall, a stone hedge or a macadamized road throughout the length and breadth of the city that is not made up of organic remains. And let me tell you, ladies and gentlemen, that we have reason, from more than one point of view, to feel proud of this section of the country, from the amount of scientific information that has been contributed, not only to the people of Ottawa, but to the whole civilized world, as regards the work of palæontological investigation. Some of the old workers, who have now gone to their long homes, have done much towards building up the subject of palæontology, and certainly I can speak of no name with a greater degree of pride and gratification than that of the late Mr. Billings, who was one of the very first workers in the subject of natural history investigation in Canada. His writings are well known everywhere. His name is a household word; you cannot pick up any volume without finding the name of the late Mr. Billings largely quoted. It ought to be to us, as Ottawa people, a source of pride and gratification to think that this very institution has been in itself a germ and nucleus for the development of that department of natural science which the youth of this section of the country have reason to look forward to with no ordinary degree of gratification. The time was—25 years ago, when I first became interested in the subject of geology—that really it was somewhat dangerous for an individual to take hold of a stone, no matter who he might be, for fear of being called a lunatic—in fact, not to be trusted in society, because he undertook the pleasure of observing what was in Nature's book. This volume here in the valley of the Ottawa is an important one; you cannot examine even the cover without finding, as it were, photographed views of flora and fauna, such as are not only to be observed by the naked eye, but to be closely tested by the microscope. I will, to-night, bring before you only one of the species of cystideæ, and offer to you a few observations upon it, but, before doing so, permit me to say that I am pleased to know that the Government of Canada have decided to remove the Geological Department of Canada from Montreal to Ottawa. And why? Because then the public men of the Dominion will have an opportunity of closely observing what is being done towards the development of the economic resources of our country. In every section of the Dominion there are mineral resources, and the Senators and the Members in their leisure hours will have an opportunity of comparing the products within their own immediate neighborhood with the products accumulated in geographical survey, and thus contribute to the development of the

natural resources of this Dominion. Again, I have seen it mentioned, a few days ago, that we were to have a national museum, something after the style of the British Museum, or the Smithsonian Institution in Washington. Concerning this I do not know, but I am aware of the fact that the Government contemplates making a collection of the curiosities, if we might so term them, peculiar to the Indian tribes in North America. There is a very large collection now in British Columbia, and at Fort Pelly, under the control of the Department of the Interior, and I think it is the intention of the present Premier to have these articles brought here to form a nucleus for such a collection, and the day is not far distant when the Government of Canada may undertake the construction and formation of an institution such as the United States has in the Smithsonian Institution, and Great Britain in the British Museum. Before entering upon the description of this animal, I wish to draw your attention to the section in which we are now living. * * * * * * *

Of the strata which form the rock structure in the neighborhood of Ottawa City, the Trenton beds possess the greatest degree of interest, as far as the remains of animal and vegetable life are concerned. For convenience of description, the silurian rocks of Canada are divided into three—upper, middle and lower silurian. The latter are designated as Trenton by Dr. Hall, of the New York Geological Survey, and the term has been adopted by the Geological Survey of Canada. From this rockbed the late Mr. Billings made his world-wide reputation. Prior to his labors little was known of Canadian Cystideæ, and the decades of the Canadian Geological Survey form a record alike creditable to Canada and the name of one so closely identified with field-naturalists' work in this particular section of country. Cystideæ are known as a family of *Silurian echinoderms*, so called from their spherical or bladder-like form. In the primeval seas, they constituted the representatives of the sea-urchins of the secondary, tertiary and current epochs, and appear to have been furnished with a short foot-stock, and not to have been free moving, like the Cidaris or Echinus. According to the late Mr. Forbes, they are supposed to have affinities with the Crinoids on the one hand, and the sea-urchins on the other, and covered, like the Lily Enchrinites, with a coat of mail, richly ornamented, in many instances, with radiating ridges, or striæ. In 1843, Mr. Channing drew the attention of British geologists to these rare forms of life, many fragments of which were collected by the British Geologic l Survey of that date, and particularly in the explorations in South Wales. At this date comparatively little was known either as to the organization or zoological affinities of Cystideæ. In 1845, Von Buch, of Berlin, investigated carefully the peculiarities of cystideæ, the result of which has been much valuable information on these forms of life so rich in the neighborhood of Ottawa.

Anatomy of Cystideæ.—Their structure is that of a more or less spherical body, with a *column* and *arms*. The body is covered with polygonal plates, closely fitting together, so as to invest the animal with a coat of mail, except at four points—superiorly at the mouth, inferiorly at the attachment of the stem to the body, centrally at the opening of the reproductive organs, which are generally covered by valves, and at an opening near the mouth, considered the termination of the alimentary canal. The body of the British species is usually small compared with the Canadian species, which vary in length and breadth from an inch and a half to two inches, and vary considerably as to shape, viz: globular, oval, pyriform, conical or subcylindrical. The plates are divided into three classes:—1st. Those which are definite in arrangement, and remain constant throughout the life of the animal, the shell enlarging, as muscular fibre enlarges, by the growth of the original plates, with the addition of new ones; 2nd. Those not definite in arrangement, or constant throughout the life of the animal, growth being effected by the enlargement of the old plates, as well as by the introduc-

tion of new ones; 3rd. Those in which there is a combination of the definite and indefinite, the former on the dorsal side of the animal, the latter on the ventral. The plates which compose the outside or exoskeleton of cystideæ, are so arranged as not to close the orifices essential to the animal economy; at all other points they join completely, forming an exact covering for the protection of the body, and the maintenance of those parts performing the various functions of these peculiar animals. The surfaces of the plates are usually ornamented with grooves, striæ and rugosities, and occasionally exhibit pores, scattered singly or in pairs, which are supposed to serve as media for communication between the interior and exterior of the animal. The precise nature and function of these pores has not yet been perfectly ascertained. According to Forbes, there are only three pectinated rhombs found on the body of each cystidean, and their homologues have not been discovered in any section of the entire class of echinoderms. It is considered that the pectinated rhombs have situated on them ciliary organs, such as those found on the epaulettes of the larvæ of echini. The pores are usually disposed in rhomboidal figures, one-half in each contiguous plate, and every two pores of these rhombs are invariably united by small canals or grooves. These rhombs are considered so important that Professor Muller, of Berlin, has adopted them as a basis for classification. *The mouth* of this animal is an opening of moderate size placed on one side of the body, about its centre, but usually inclines towards either extremity. In some species it opened and shut by a sort of valvular apparatus, whereas, in others this peculiar arrangement is wanting. In cystideans provided with arms, the mouth is usually circular, and on its sides these appendages arise. In those species wanting arms, it is supposed that the mouth possessed a peculiar compensating power, by which it could protrude and retract its lips, and thus seize the material requisite for its digestive functions from the surrounding media.

The ambulacral orifice.—This constitutes one of the most important openings in the structure of this species. It is placed near the centre of the upper part of the body, and usually between the bases of the arms, when present. These peculiar openings were a subject of considerable discussion amongst naturalists, and now there is little doubt that those vessels which constitute the *ambulacral system* communicate from the exterior to the interior, and *vice versa*, through these openings, as in the madreporic canals and tubercles of asterids and echinids, such as defined by Huxley. Although no specimen containing the soft parts has ever been discovered, by which we might be enabled to demonstrate the communication more pointedly, still, the natural inference is, that an animal such as a cystidean, stationary in its character, and possessing as its chief part a large body, to be sustained and nourished, would have ample circulating media throughout, to receive from the thoracic centre that degree of nourishment requisite to sustain the various functions of this strange organism in perfect activity. The third small opening (anus), is very minute, and frequently not observed in certain genera in which the wear and tear of the system is supposed to escape through the mouth, as in some of the star-fishes.

The Arms and Pinnulæ.—For some time the arms of cystideæ formed the subject of a sharp controversy between Von Buch and Volbroth; the former denying the existence of these parts, while the latter adhered to the contrary idea. At present no one doubts the presence of arms in some shape or other. The Cystidean arms are considered to be like those of crinoids in many respects, although not remarkable for extensive development. For simplicity of description they are divided into three classes: 1st, Cystideæ, in which the body of the arm was not developed, but only the grooves and pinnulæ. 2nd. Cystideæ, in which the arms were developed, but bent backwards and attached to the body. 3rd. Cystideæ with free arms. This arrangement of arms must not be considered as an attempt at classification, for, on a closer examination of the genera, we find

varied combinations of arms and pinnulæ, sufficient to point out any such division as of minor consequence.

Stem. The stems of cystideans are constructed much as the stems of crinoids, being, in fact, cylinders composed or made up of successive ring-shaped joints, which, as far as observed, become broader and thinner as they near the body of the animal, and frequently alternate in size, presenting a necklace-like appearance. British cystideans differ from Canadian ones in the respect that they present no traces of a stem except the point of attachment on the base of the bodies. The lower part of the stem is usually attached to the rock with which it is in contact, thus rendering the animal more or less a fixture, a peculiar fact in connection with its manner of life.

Having briefly adverted to the leading anatomical peculiarities of cystideæ I may here state that the particular specimen under consideration—"Comarocystites Punctatus"—(Billings) has free arms and the pinnulæ of a true crinoid, and,consequently, comes under the third class, as previously defined. The term Comarocystites is from comeron, a straw-berry, according to Billings, who first discovered, in this district, that portion of the animal remains which enabled him to determine the genus. According to the description (in Decade III, of the Canadian Geological Survey, 1858); "the body of this species is of an oval or pyriform shape, and in large specimens about an inch and a half in length. It is protected by plates, which have a deep concavity, occupying nearly the whole of the area of each, the effect of which is to cover the surface of the fossil with large rounded pits, an aspect that serves to distinguish it at the first glance from any other known in the Lower Silurian rocks of Canada. In certain states of preservation the sutures are marked by minute, thickly set, square or oblong rough punctations, which do not, however, appear to penetrate through to the interior. In some specimens there is only one, and in others two or three rows of these punctures upon each suture. The greater portion of the area of the plate is marked with deep fissure-like striæ, at right angles to the suture, and with their erect lamellæ or partitions between them. These are sometimes crossed by other lamellæ, parallel with the edges of the plates, the effect of which is to produce a peculiarly rough surface. Sometimes none of these are visible, and the surfaces of the plates are then uniformly smooth and solid. The mouth is large near the apex, and closed by a pyramid of five triangular valves. The arms are four in number, and consist of an anterior pair situated directly over the mouth, and a posterior pair placed opposite on the posterior side of the summit; a deep narrow grooves crosses the apex, in a direction from the anterior to the posterior side; from one end it sends up two branches into the anterior pair of arms, and from the other end, two into the posterior pair. The arms consist of a single series of joints, each about one line and a half in length; the pinnulæ are nearly cylindrical, and divided by joints, at lengths of one-half a line. There is but one pinnula to each joint, and only on one side. The column is rounded and smooth, formed of very thin joints, and does not, in a specimen with *three inches* preserved, *exhibit any signs of tapering*." Until 1864, when the first entire specimen came under my notice, nothing definite was known of the column. Its entire length is about 4½ inches, and at its lower part or terminal extremity, it presents a decidedly tapering appearance, and is more or less concave at its point of attachment and fully half an inch in breadth. Its length is about equal to that of the body and one of the arms combined.

From an examination of the column, the idea of cystideæ being fixtures is considerably strengthened. For a time naturalists inclined to the belief that the arms and pinnulæ of cystideæ alone acted as prehensile organs, but the most generally accepted opinion at present is that of Dr. W. B Carpenter, who considers that the large ciliæ within the alimentary canal are capable of producing a powerful indraught ot water, sufficient to supply the requirements of the

animal with nourishment quite independent of either arms or pinnulæ: Cystideæ, being attached firmly to the sea bottom by their columns, are supposed to remain motionless during the digestive process; accomplished while streams of water are received and ejected through the mouth as in the common starfish. Ciliary motion is likened to that of a cornfield when agitated by frequent gusts of wind. It is quite independent of the will of the animal and also of the life of the rest of the body. Such is the accepted opinion in man's organization.

The digestive process is one of the most important in every organism, and the material required is supplied in accordance with the necessities of the system. Under such circumstances, it does appear peculiar that the special duty of supplying the system of even a cystidean should be assigned to parts over which, by analogy, there is little or no control whatever. "Cystideæ being a race of small marine animals, which flourished vigorously during the Silurian period, and disappeared before the commencement of the Carboniferous era," I shall only briefly refer to some of the chief characteristics of their time. With few exceptions indeed, the fossil remains of cystideæ consist of mere fragments, notwithstanding the fact that, while the upper half of the Lower Silurian rocks of Canada, in which these organic remains flourished, were in process of formation, cystideæ swarmed in the bottom of the ocean, and, according to Barrande, formed entire beds, from one to two yards in thickness, in Bohemia. In 1852 only one specimen was known in the Lower Silurian rocks of Canada. At present there are at least 21 distinct species in the collection of the Canadian Geological Survey. From all the facts known, the belief is that cystideæ made their appearance amongst the first creations on the earth's surface, obtained the greatest degree of growth in the Lower Silurian formation, and died out at or about the dawn of the Devonian period. To the student of nature and nature's laws, the period of cystidean life is one of more than ordinary interest. To interpret fully nature's works we require to observe closely nature's operations at the present time. We can better form an idea of the past by comparing it with the present. Time obscures the upheaving action of central power when gradually brought about. In the case of the sudden earthquake, or unexpected volcano, matters are quite different, and the rapid change of physical points of interest gives quite a lively impression of passing events. The geological aspect of the immediate Ottawa section is quite an interesting chapter in the history of the pre-adamite world. The flora and fauna of the present do not in any sense surpass in interest those of the past, of which we have evidence in the upturned strata daily brought to view. In the Silurian period, and, in fact, long anterior, order, regularity and perfection as to form, in lower types, both in the animal and vegetable world, are well established facts. Life was then, as at present, governed by recognised laws, and the chemical and physiological principles involved were in many respects analogous to those we now enjoy. The vast chain of being is spoken of as a scale of "animal life," in which species succeed species in a regular series, both as to development and organization, from life's lowest forms to the very highest, where the genus homo is recognised as the chief order of creative power. The difficulties in the way of such a form of succession are not easily overcome. It may answer to treat of creatures in a linear form; however, the complex structure of even a cystidean on such an hypothesis would doubtless give considerable trouble in tracing its history. The great leading ideas which constitute the types of animal life (which I shall now briefly touch upon for the interest of some of the juniors in natural history) are four in number. The *Radiata* or star-like type of life, embodied in form, radiating from a centre, like the "starfish." The *Articulata*, composed of articulations, movable on each other, as the Trilobite or true crustacean. The *Mollusca*, of which we have a good example in the order Brachiopoda and the genus lingula. In this class there is a distinct quality of corresponding parts on the side

of a central axis. This same class is represented by the ordinary clam, as well as the cuttle fish, of the present. Lastly, the *Vertebrata*, having a back bone, and, the skeleton being internal, constitutes the frame work, upon which the muscles act. Fishes, batrachians, reptiles, birds and mammals belong to this last and most important division of the Animal Kingdom, inasmuch as it includes man, the highest representative of vertebrate power. Thus we have the four leading types as indices in tracing the various sub-divisions which frequently perplex the student of natural history. In conclusion, I may here state that the nearest type to cystideæ, is the Silurian crinoid, which usually differs from the former, in being elaborately ornamented and supported by a much longer stem, fixed in its character, like the cystidean, and having functions in many respects alike. Thus these interesting forms of life played their part in this world's history, and lead us to coincide with the sentiment of the poet who has so beautifully expressed * * *

> "'Tis hard to tell of work begun,
> Of work completed, work undone,
> And all the wonders that are wrought
> By tiny agents of God's thought."

Museum Education: Mr. H. Beaumont Small.—The subject was chosen in connection with the removal here of the Geological Museum, and a graceful compliment was paid to Dr. Grant, for his unremitting exertions to accomplish this object. The origin and usefulness of museums was treated of, and the formation of local museums strongly urged, with a wish strongly expressed for the establishment of a national museum, which, as an adjunct to Government, may be eventually anticipated. The neglect hitherto shewn in all young countries with regard to such institutions may be traced to the intense worship of wealth compared with that paid to intellect, whilst the struggle of parties and factions contribute to this neglect. In order to be a naturalist, a man need not necessarily be highly educated. We may gather ideas from books, but we get them from nature direct; books and nature are a reflex of each other; the museum is their co-worker, and the information to be gained there from collected material is the index to what we have to acquire by patient and personal observation of nature. Public opinion has greatly changed with regard to science, and science and infidelity are no longer counted synonymous. Science is, in the present century, the magician's wand, and he who follows it is the magician of to-day.

FOURTH SOIRÉE.

Friday, 6th February, 1880.—"The Contractility of the Spores of Palmella Hyalina:" Rev. A. F. Kemp, *M.A., L.L.D.*

A paper describing observations made by the writer during the autumn on this plant, which is a species of *Algae* found in the quiet

waters of lakes and rivers throughout Canada. It was intended to publish this valuable contribution to the labors of the Club, but Dr. Kemp prefers to withhold it until, with an instrument of greater power, he has made more extended observations of the phenomena witnessed by him.

"Asbestos:" W. P. Anderson, *C.E.*

The paper was prefaced by an expression of regret that, in a district so rich in minerals and fossils as Ottawa, more serious attention was not bestowed upon the geological branch of Natural History, and a hope that the defect would be remedied to some extent during the coming season.

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Asbestos is a term used to denote a peculiar form assumed by several minerals, rather than to designate any particular species. Tremolite, actinolite, and other forms of hornblende containing little alumina, augite and serpentine, pass into fibrous varieties, all of which are popularly known as asbestos, though, technically, that name is restricted to the hornblende variety, while fibrous serpentine should be called chrysotile.

All these varieties are similar in appearance, the fibres, which run transversely of the veins and parallel to each other, looking, when compact, like mica. The color varies from pure white to gray, or greenish, and the texture of the separated fibres from that of coarse cotton to the finest silk. The longest fibre of which mention has been found came from Italy, and measured 44 inches. In Canada it is never found of any great length, the average being probably not over 1½ inches. The fibre has a soft, greasy feel. Specific gravity varies from 2 9 to 3·4. Before the blowpipe a single fibre fuses into a white glass globule, specimens containing most iron being most readily fusible. In masses it is infusible at ordinary temperatures. This property, together with its insolubility in acids, its being a bad conductor of heat, and the remarkable strength of its fibre, are qualities that make it valuable in several branches of manufacture.

To understand its chemical character it will be necessary to give some account of the rocks in which it exists.

In the lower members of the oldest groups of rocks, three minerals, hornblende, augite, and serpentine, are more or less widely distributed.

Hornblende consists of silica and magnesia, with a greater or less quantity of lime, protoxide of iron, and other oxides, and is usually found in a scaly form.

Augite differs from hornblende mainly in the shape of its crystals, and in containing, usually, a greater portion of lime and less magnesia.

Serpentine contains little or no lime, but has about 12 per cent. of water in its composition, in addition to the ingredients of hornblende.

All these substances are classed under the same head mineralogically—being non-aluminous silicates—and are, indeed, so closely connected that it is sometimes difficult for even the mineralogist to tell to which species a specimen should be referred.

Another fact that shews the close relation hornblende, augite and serpentine bear to one another is that, amongst themselves, they are frequently subject to pseudomorphism, a process by which the chemical character of a mineral is changed while it retains its original form of crystalization. There is no doubt

that this process is sometime undergone in veins of asbestos, so that what may have been originally true asbestos is now chrysotile. Prof. Dana states that all crystalized serpentines are pseudomorphs. In the report of Dr. Harrington on some of the minerals of Ottawa County, in the Geological Report for 1877-78, instances are given of asbestos being an alteration product or pseudomorph of pyroxene.

The following table shows the results of analyses of the several varieties of Asbestos, with the localities from which the specimens came :

	Hornblende Asbestos, from Tarentaise.	Hornblende Asbestos, from Zillerthal.	Augite Asbestos, from Schwartzenstein, in Tyrol.	Chrysotile, from Reichenstein.	Chrysotile, from New Haven, Connecticut.	Chrysotile, from Montarville, New Jersey.
Silica	58.20	55.87	58.19	43.50	44.05	42.62
Lime	15.55	17.76	....	....	....	....
Magnesia	22.10	20.33	30.79	40.00	39.24	42.67
Protoxide of Iron	3.08	4.31	7.93	2.08	2.53	.27
Protoxide of Manganese	.21	1.12	....	....	....	....
Oxide of Alumina	.14	....	.18	.40	....	.38
Hydrofluoric Acid	.60	....	1.86	....	....	....
Water	.14	....	....	13.80	13.49	14.25
	100.02	99.89	98.95	99.78	99.31	100.19

The origin of the fibrous forms does not appear to be fully explained, but it seems probable that they were formed later than, and out of, the chemically similar rocks surrounding them. Dr. Hare explained, in a lecture delivered before the Literary and Scientific Society, that mineral veins were formed by water, or other chemical fluid, penetrating the rocks in which the minerals were disseminated, combining with them into new chemical compounds, and finally depositing them in fissures, where they had an opportunity of crystallizing. This would seem a natural way of accounting for the presence of the fibrous silicates now under consideration.

Or they may have been crystallized and deposited in the fissures which contain them, in some way by the action of the same heat that crystallized the surrounding rocks.

In Europe, asbestos occurs very abundantly, being found in Piedmont, Saxony, Switzerland, Salzburg, the Tyrol, Dauphiné, Hungary, Silesia; also in Corsica so abundantly as to have been used for packing other minerals; at St. Kevern in Cornwall, in Aberdeenshire, and in some of the islands north of Scotland.

On this continent it occurs in Greenland, and in nearly all of the United States, particularly in North Carolina, on Staten Island, at Baltimore, and at Montarville, N.J., the quality differing in different localities. There is said to be a gradual increase in the tenacity of the fibre in proceeding from Georgia northwards, this improvement appearing to culminate in northern Vermont,

where the mineral closely resembles the finest European varieties, although it cannot approach them in length of fibre.

That occurring in Canada will be referred to hereafter.

There are some other very curious allied fibrous substances that deserve passing notice. *Mountain Leather*, a kind in thin flexible sheets made of interlaced fibres, and *Mountain Cork*, the same in thicker pieces; both so light as to float in water, and both often hydrous, or containing water in their composition. Another substance, known as *Mountain Wood*, is compact fibrous, varying in color from gray to brown, looking a little like dry or petrified wood. These are found generally in the same districts as the common varieties of asbestos. An interesting specimen of mountain leather has been found on the Grant lot, in Buckingham.

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An account of the history of asbestos, and its various uses in arts and manufactures was here given.

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As explained earlier, asbestos is an altered form of either hornblende, augite or serpentine, and wherever we find formations containing these substances, we may reasonably look for asbestos. These minerals are found abundantly throughout the older formations, the Laurentian and Lower Silurian. The country bounded on the south by the St. Lawrence and Ottawa Rivers is almost entirely Laurentian, while the remainder of the Province of Quebec embraces principally Lower Silurian rocks

As yet, comparatively little asbestos has been found, and the few discoveries that have been made are without exception of the serpentine variety, more properly known as chrysotile. It has been asserted that chrysotile fibre is useless for making fire-proof fabrics. It contains about 12 per cent. of water, and chemists explain that when exposed to flame the heat drives off this water, and so destroys the composition of the mineral. But notwithstanding this theory, the fact remains that Canadian chrysotile commands a price in the United States market, varying from $40 per ton for inferior grades, up to $120 for long and silky fibre, with a demand exceeding the supply.

The source of the Canadian asbestos of commerce is a narrow band of serpentine in the Quebec group, a series of rocks at the bottom of the Lower Silurian formation, and which runs from the Vermont boundary to the River Chaudière, through the Eastern Townships of Potton, Bolton, Orford, Brompton, Melbourne, Shipton, Cleveland, Ham, Garthby, Coleraine, Thetford and Broughton.

There is a mine being worked in Shipton, near the village of Danville, on the Grand Trunk Railway, from which a considerable quantity has been got out and sold at $60 per ton. The output of this mine for the next ten years has been contracted for.

The most successful mine in Canada was discovered in the autumn of 1877, in the Township of Coleraine, by a Frenchman, and is now owned by the Boston Packing Company, who, during 1878 and 1879, sent about 200 tons to their factory in Boston. In the spring of 1878, Dr. James Reed, of Inverness, and L. H. Goff, of Vermont, purchased a large tract of land adjoining this mine, and opened up several more. The district in this neighborhood in which asbestos is found is about three miles in length, northerly and southerly, by one in width. The rock formation is serpentine, with chromic iron ore. These gentlemen have sent samples to manufacturers in Europe, who, it is said, pronounce it the finest and strongest fibre known, and have sent out orders for large deliveries this year. English and American capitalists are negociating for the purchase of some of these mines.

A good quality of asbestos has been found in Shefford, on the line of the Quebec Central Railway, which deposits Mr. Selwyn, the Director of the Canadian Geological Survey, pronounces the most promising he has seen.

On the Chaudière River good specimens of asbestos were got out as long ago as 15 or 16 years, and a small quantity has been exported from the Des Plantes River, a tributary of the Chaudière; but it has been impossible to obtain any definite information regarding this locality.

The whole quantity exported from all the district in the Quebec group of rocks cannot much exceed 300 tons, which realized an average price of $50 at the mines. There appears to be no question as to the profitable nature of asbestos mining operations in that belt of country.

In the Laurentian rocks the first worked was in a vein of serpentine, in Papineau Seigneury, near the village of St. André Avelin, from which, ten years ago, an American took out about five tons of 1-to 2-inch fibre, which was alleged to have been used in the manufacture of lamp wicks in Rhode Island. As no work has since been attempted at this opening, the inference is that it is exhausted. This locality is also celebrated as having yielded some of the finest specimens of Eozoon Canadense.

In Templeton I have heard of two workings—one upon the S. ½ of Lot 11, the other upon Lot 10, in the 8th Range, about 300 yards apart, and in the same band of serpentine. The seams of chrysotile—they are not sufficiently regular be called veins—in some places run nearly parallel to one another, following the direction of the serpentine, in others they are curved, and even more or less reticulated. The width of the seams, and consequently the length of the fibre, here varied from a fraction of an inch up to three inches. The form in which the asbestos occurs has been very well described by the owner of one of the workings. He says "The asbestos occurs in a narrow vein of serpentine rock, which lies in a hill of coarse white crystalline limestone. We found the serpentine dipping towards the east. In places there would occur a great many narrow seams of asbestos, separated from each other by narrow veins of serpentine. Again, in places, several of these seams would run together, and we would get the asbestos with a fibre from one to two inches long, to be again separated into narrow seams."

A single ton was shipped from one of these mines last autumn, and realized $100, delivered free on board in Ottawa.

Among miners opinions differ as to the future value of the Ottawa Valley deposits. Some think the quantity in any one place so small, and the cost of separating the asbestos from the gangue of serpentine that encloses it so great in proportion, that, except for some unusually good croppings, the working would never be found profitable. Others are of opinion that large finds will be made, and that the mining of asbestos is destined to become an industry second in importance only to the mining of iron and apatite. With these I am disposed to agree, though my judgment is based merely on the geological character of the rocks and the analogies that exist between them and those of other districts where workable deposits are found.

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FIFTH SOIRÉE.

Friday, 20th February, 1880: Dr. J. A. Grant, F.R.C.S., Edin., gave a practical demonstration of "The Brain" and many of

the members had, for the first time, an opportunity of seeing a human brain skilfully dissected, and its manifold parts beautifully and simply explained. The nerves, blood-vessels, ventricles, etc., were all shown, while, at the same time, their various functions and their connection with the bodily organs were made clear. The importance of carefully developing the brain, and maintaining it in health was strongly and eloquently urged.

SIXTH SOIRÉE

Friday, 5th March, 1880: Mr. W. D. LeSueur, B.A., read a very interesting paper on "Design in Nature," in which, after dwelling on the spirit in which scientific investigations should be pursued, he proceeded to show the embarrassments in which scientific investigators had involved themselves by a determination to find in nature a confirmation of preconceived theories. He quoted largely, in illustration of this point, from the Bridgewater Essay of the Rev. Wm. Kirby, on "The History, Habits and Instincts of Animals," and concluded by explaining the view of nature taken by modern evolutionists.

"On the Land and Fresh-water Shells of the Ottawa," Mr. Gilbert C. Heron.

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There is very little variety in the land and fresh water-shells of this distri t; and in this respect, it is very like the greater part of the Dominion of Canada. The reason for this want of number in species, as well as color, is the excessive heat and cold of our climate. While many of the shells are pleasing and the forms elegant, for the greater part they are but common, small in size, and want the fine coloring of those from the tropics. And those who have seen collections from uniformly warm countries, will, I fear, dispise the few specimens which occurred to me about Ottawa during the season of last year.

A shell found in all rivers and ponds about Ottawa, and yet not common, is *Paludina decisa*, Say. It will be found on clay and sandy clay shores, burrowing in the mud near the water's edge; a little dome of clay will generally indicate where to dig for this gasteropod. I found associated with it, a little below Gatineau village on the Ottawa, a very interesting little *Dymnaria-Pisidium adamsii (?)* It has never been found in Canada before, or at least it is not on the lists, and is very rare. *Valvata tricarinata*, Say, is very common, yet it is the most extraordinary of our shells, and cannot be mistaken with its three keels and delicate green color. The three-keel variety only is found here, so far as I know, but the species may be seen semi-fossil in the marl beds with one, two, and three keels, but as often plain. *Valvata humeralis*, Say, is found in vast numbers in the little pond, in Dow's swamp, near Billings' Bridge, but has not been met with elsewhere so far. This shell may be the same as *Valvata sincera*, Say, but I have not seen a specimen of the latter, which is said to exist in the north-west

of the United States. The animals of *Valvata tricarinata* and *humeralis* are the most beautiful that I know. Anyone who has examined them in a dish of water with a magnifier, and has seen their branched gills or lungs, of a delicate white color, thrust out over the head, and the whole body of elegant form arrayed in most delicate shades of green and gray, will agree with me in saying that they are to be placed among the most beautiful of living creatures.

The only *Melania* found here is *M.-livescens*, which is very plentiful and has great variety in color and form. In the Rideau River it is generally olive and more perfect towards the apex than those in the Ottawa, which are sometimes of a rich brown, occasionally banded with darker revolving zones. There is also a difference in the shape of the aperture.

Very fine *Limnæa stagnalis* are to be found in the Rideau Canal, but it is common elsewhere.

Limnæa gracilis, Say, a shell new to the Canadian list, was found by me in the rapids above Billings' Bridge. I obtained two specimens, one very fine but dead, and the other but a fragment. I am sure there will be other specimens found, in the future, in this favored spot.

It is to be noticed that the fresh-water shells are not so constant in their characteristics as the land shells. This great variety in form, etc., has led to many mistakes in naming, and it is now said that *Limnæa elodes*, *umbrosa*, *reflexa*, *caperata*, *decolata* and *catascopium* are all one and the same shell.

Physa elongata, Say, is found everywhere during summer in dried-up ponds with *Sphærium occidentale*, under leaves and rubbish, but still alive. Many of the shells are very large, even larger than Mr. Say's specimens got in the State of Illinois. A few of my specimens were as much as eight-tenths of an inch in length. This shell is the same, I think, as *Physa hypenorum* of Europe.

I am again fortunate in being able to add two more shells: *Physa lordi*, Baird, and *P.-brevispira* to our lists. The last was found by the late Mr. Billings and named by Dr. Isaac Lea, but it was not generally known and was never put into any list, being considered but a variety of *P.-ancillaria*. It is the *P.-brevispira* of Lea, found by Mr. Billings, or a new shell. I am inclined to regard it as new, and, therefore, claim a place for it in our list. It is common in the Rideau River, about the rapids, and will, I think, be found in the Ottawa.

Physa lordi I found in Meech's Lake, among the mountains, fourteen miles north of Ottawa, in the month of October, on the occasion of our last excursion. This shell, I am told, has been found only in the mountains of Oregon and British Columbia. It appears to be confined to the mountainous districts; while *Physa heterostrophia* and *ancillaria* are only found on the plains and in the valleys. Meech's Lake is about 400 (?) feet above the sea, and is surrounded by the Laurentian rocks. It contains but few gasteropods. I only got five or six *Limnæa stagnalis*, and but one *Planorbis bicarinatus*, but there are vast quantities of small *Unio complanatus*.

The different species of *Planorbis* are generally plentiful in all ponds and rivers; but St. Louis Dam, Rideau Canal and River, are favorite haunts. *Planorbulina armigera*, Say, appears to be rare; I only found a single specimen during the season, and that dead.

The *Helices*, or land snails, are found in secluded, damp and fertile places. They are found in greatest number in hard-wood forests, especially when the old trees are cut down and there is a second growth of timber, and are a sure indication of fertility of soil; but not unfrequently by old fences, and along the banks of rivers under pieces of board. The last is the peculiar haunt of *Helix nitida* of Muller, now for the first time added to the Canadian list. I found my first specimens near the Hog's Back Rapids, on the Rideau River, but afterwards I found many more near the Show Grounds, on the Rideau Canal, in company with *Helix labyrinthica*, and *Vertigo ovata*, Say. *Helix Sayii*, Binney, does not appear to be so rare as in other parts of Canada. *Helix* (*Bulimus*) *lubrica*, Muller, is very com-

mon. On the St. Lawrence and Ottawa Railway, six miles from Ottawa, I have collected hundreds from a single square foot of sod. Vast numbers are destroyed every spring, when the old dry grass is burnt by the track-men. In this section of country the frost leaves the ground about May 1st, and it is about ten days after this that the snails first venture into the open air for a short time at mid-day. If *Helix lubrica* is examined before the inhabitant ventures to stir, the aperture of the shell will be found closed by a thick yellowish substance. This is not an operculum, nor yet is it a part of the shell, but appears to have been built by the animal for winter use alone, since it is lost as soon as the weather gets warm. This must have been observed before, but I find no mention made of it in any work on shells.

Another very interesting shell is that of *Vetrina limpida*, Gould. It occurred to me in but two places: by the Rideau River, near Billings' Bridge, and in the Hull Mountains. It appears to require a still richer soil and more moisture than any of the other *Helicidæ*. It cannot be mistaken by any who have seen it, with its mantle thrown over the shell and up to the apex.

Many persons who have walked along paths and side roads in the country, after a warm shower of rain, are surprised to see a curious snail crawling in countless numbers. If the sun dries the ground quickly, many of them will be found to have cemented their houses to stones or hard gravel, waiting for more moisture. This shell is *Succinea obliqua*, Say. We have two other *Succineas*, but they are rare.

Pupas are found about Ottawa everywhere, and if their extremely small size is considered, the color being very often the same as the ground, it would not appear surprising to hear it said they are very rare. With one exception they are not rare, but only hard to find. *Carychium exiguum* is found in great numbers everywhere, and, although the smallest of our shells, it is not so difficult to discover, being always white. Our shell is the same as *C.-minimum*, of Europe.

Conchifera:—of the family *Unionidæ*, seven *Unios*, three *Margaritanas*, and three or four *Anodons*, occurred to me during last year. Generally the *Unionidæ* are not easy to get, and the best specimens are to be had only by dredging in deep water. All the specimens of *Margaritana* appear to be rare. The best places for collecting them are in the Ottawa at Duck Island, and in the Rideau at the Rapids, under the stones. At Britannia I got two varieties of *Anodon*, which may prove to be new shells.

There is another family of the *Conchifera*, which are very interesting. I refer to *Cycladidæ*. The shells of this family are very often taken to be young clams; in Scotland they are called "Buckies." They are very hard to classify, and it is only after much study that they can be identified. *Sphærium rhomboideum*, Say, is found in ponds by St. Louis Dam, also in Dow's Swamp; and, although found in considerable numbers in those two places, is not a common shell. Those found in the little lake, in Dow's Swamp, were almost white, while those got at St. Louis Dam were of the usual olive color, with yellow bands. This is the most beautiful shell of its class we have. The other species of this family are found almost everywhere—in still water, in rapids under stones, in mud, and clinging to roots of plants; while one variety, *S.-occidentale*, is able to live without any water for months during the summer, in dried-up ponds, under leaves and rubbish as dry as dust.

During the season just closed, I succeeded in collecting between ninety and one hundred species of mollusks, four or five of which are new to the district, and, so far as I can learn, to Canada.

Considering the discoveries made to the east and west, as well as to the south of us, having due regard to the influence of climate, I think there remain about thirty-five species of land and fresh-water shells yet to be accounted for in the vicinity of Ottawa. Of those undiscovered shells, one of the most interesting to me is *Helix nemoralis* or *hortensis*, which is known to have been seen a

few miles to the south of this city eight years ago. It is found in the Eastern States, and along the St. Lawrence River, and is supposed to have been imported from Europe. They retain the habits of the European species, climbing hedges, trees and stems of plants, not remaining concealed under decaying leaves, logs, etc., like other American *Helices*.

To many the study of conchology is but a trifling affair—something to pass the time away—which may be very true, so far as the mere collector of shells is concerned—but to the student of nature it is a very different thing. Sowerby says, in his manual, page 157 :—"Indeed all who would study geology with success, will find it very essential to obtain a thorough knowledge of conchology.

Among the reasons for the study of conchology, the following might be mentioned:—The great assistance it affords the students of geology ; second, the determination with all speed of the limits of species before they are influenced by civilization ; and last, though not least, is the vast amount of amusement and instruction to be obtained therefrom, or, in other words, the pleasure of having a hobby.

I hope the coming season will not pass without our Club being able to add three or four workers in this very interesting, but much neglected field of natural science.

List of Shells found about Ottawa City, 1879.

GASTEROPODA.

Pectinibranchiata.

Viviparidæ.

Paludina decisa, Say.
Valvata tricarinata, Say.
" humeralis, Say.
Amnicola porata, Say.
" granum, Say.
" lapidaria? Hald.

Melaniadæ.

Melania livescens.

Pulmonibranchiata.

Limnæidæ.

Limnæa stagnalis, Lin.
" columella, Say.
" elodes, Say.
" umbrosa, Say.
" catascopium, Say.
" caperata, Say.
" humilis, Say.
" desidiosa, Say.

Limnæidæ.—Continued.

Limnæ gracilis, Say.
" decolata, Mighells.
Physa heterostropha, Say.
Physa ancillaria, Say.
" Lordi, Baird.
" brevispira, Lea.
" hypenorum, Lin.
Planorbis trivolvis, Say.
" lentus, Say.
" campanulatus, Say.
" bicarinatus, Say.
" exacutus, Say.
" deflectus, Say.
" hirsutus, Say.
" parvus, Say.
" Billingsii ? Lea.
" macrostomus, Whiteaves.
Planorbulina armigera, Say.
Ancylus rivularis, Say.

Helicidæ.

Tebennophorus Carolinensis. Bose.
Limax campestris, Gould.
Vitrina Limpida, Gould.
Succinea obliqua, Say.
" ovalis, Say.
" avara, Say.

List of Shells found about Ottawa City, 1879.—*Continued.*

Helicidæ.—Continued.

Helix albolabris, Say.
" Sayii, Binney.
" monodon, Racket.
" alternata, Say.
" multidentata, Binney.
" lineata, Say.
" labyrinthica, Say.
" chersina, Say.
" striatella, Anthony.
" pulchella, Muller.
" concava, Say.
" electrina, Gould.
" arborea, Say.
" indentata, Say.
" inornata, Binney.
" exigua, Stimpon.
" minutissima, Lea.
" nitida, Muller.
Bulimus lubricus, Draparuand.
Pupa pentodon, Say.
Pupa contracta, Say.
" corticaria, Say.
Vertigo ovata, Say.
" Gouldii, Binney.
" simplex, Say.
Carychium exiguum, Say.

CONCHIFERA.

Dymnaria.

Unionidæ.

Unio radiatus, Lamarck.
" cardium, Lea.
" complanatus, Solander.
" dilatatus, Rafinesque.
" olivarious.
" rectus, Lamarck.
" alatus, Say.
Margaritana costata, Rafinesque.
" marginata, Say.
" undulata, Say.
Anodon cataracta, Say.
" undulata, Say.

Cycladidæ.

Sphærium sulcatum, Lamarck.
" striatinum, Lamarck.
" rhomboideum, Say.
" occidentale, Prime.
" securis? Prime.
" partumeum? Say.
Pisidium compressum, Prime.
" Adamsii? Prime.
" abditum? Hald.
" ventricosum, Prime.

List of shells (fossil) found in marl beds near Ottawa City during the year 1879:—

Valvata tricarinata, Say.
Amnicola porata, Say.
Planorbis campanulatus, Say.
" parvus, Say.
" exacutus, Say.
" bicarinatus, Say.
Physa heterostropha, Say.
" ancillaria, Say.
Ancylus ——?
" ——?
Limnæa disidiosa.
Sphærium rhomboideum, Say.
" sulcatum.
Pisidium ventricosum?
" ——?
Unio complanatus? Say.

Since the above was written I have learned that Physa Lordi (Baird) is found in the northern parts of the State of Michigan, but was at first described as Physa Parkeri; also, that Helix nitida, Muller, is common in the same State, and that it may prove common in Western Canada.

I have also found Helix milium, Morse (April, 1880); and I find Helix minutissima, Lea, to be very common in certain localities. Both of these shells are new to the Canadian list, so far as I have been able to learn.

SEVENTH SOIRÉE.

MONDAY, 15TH MARCH.—ON SOME INSECTS CAPTURED DURING OUR EXCURSIONS.—MR. W. HAGUE HARRINGTON.

It affords me much pleasure to have the opportunity this evening of bringing before you a few facts concerning some of the various insects taken during our delightful excursions last summer. If the first half of my paper seems somewhat wide of the text, it is because I feared that an address devoted entirely to descriptions of insects might be uninteresting to some, and because I wished to make a few general observations on Entomology, a subject which has as yet not received, from the members of this Club, the consideration it so richly deserves. Still, recollecting that Rome was not built in a day, we must make allowance for the youth of the Club, the work accomplished by which during the year just closing—the first year of its existence—has been a highly creditable one, surpassing the most sanguine anticipations of its promoters, who now can confidently look forward to increasing fruitful labours by its members. The attention of these has been, in the present year, too exclusively occupied by one subject, in itself a very worthy one, but one which should not absorb so much of the best talent of the Club. While botany has had its score or more of devotees, the sister branches have been attended but by two or three. Thus it has been with Entomology, which has claims equal with, if not greater than, those of Botany upon our members. Perhaps it is as well that Botany has first been investigated, because some knowledge of it is necessary to the student of insect life. If one would be a thorough entomologist—and to be thorough should be the aim of all—it is indispensable that he should be able to identify the plants upon which he may find certain insects. We need only look around us at the well-filled and carefully-arranged cases upon these walls to be aware that, at one time, an entomologist of no mean abilities pursued his pleasing and useful labours in this locality; and have we not the right to expect that some among the members of this Club may be able to accomplish like results and achieve like reputation in this wide field where he (Mr. Billings) worked so successfully?

At the present time there is not much occasion to vindicate the study of any branch of Natural History from the charge of being merely the frivolous amusement of unpractical minds. Some years ago it might have been necessary to do so, for naturalists, and particularly entomologists, were looked upon as harmless lunatics and idlers. No doubt, by many of our citizens, in common with those of other places, the insect-collector is still looked upon with mingled compassion and ridicule when they chance to meet him wandering in field and wood, but as these places have few charms for such practical and hard-headed personages, he is generally free from their observations. I am sure, however, that no such feeling lurks among my fellow-members, for, having enrolled themselves among the students of Nature, they have learned that all her productions are of much interest and worthy of careful investigation. Still, those who have not paid particular attention to the subject of insect life can have but a slight idea of the important part played by these minute but innumerable creatures in the economy of nature. Their size, in general, is so insignificant, and their individual performances are so limited, that it would seem almost absurd to accuse them of the destruction actually accomplished by their joint efforts. You are all familiar with the loss inflicted on our farmers by the Colorado potato beetle;—perhaps many of you have had some difficulty in keeping him off your premises—yet this beetle, despite the potatoes and paris-green he devours, is a much less obnoxious insect than some which infest even our own country. Our prairie province, Manitoba, has in the past suffered severely from the locusts, or grasshoppers, and these have also devastated, in some years, immense tracts in the Western States, devouring wheat, corn, barley and every green thing; the loss

caused by them in 1873 being estimated at $40,000,000. As a partial compensation it has been proposed to use the grasshoppers as food, as is the custom in the East, and, according to those who have tried them as an article of diet, there is at least no occasion for anyone to starve, even if every vestige of his crops were devoured. In the case of some equally destructive insects even this last recourse fails, for they are so small, and sometimes so unsavory, that they can serve neither for soup nor roast. Of such is the chinch bug, which, although no bigger than a grain of wheat, destroys millions of bushels of this and other grain every year. The damage wrought by them in 1864 has been estimated at $100,000,000, and a like sum was the cost of their ravages in 1874. As they are not equally abundant every season the average annual loss caused by them may be set down at $25,000,000, or considerably more than would alleviate the present distress in Ireland. In the Southern States the cotton worm—the larva of a moth called *Aletia argillacea*—causes a yearly loss of $50,000,000, representing an amount of raw material sufficient to furnish cotton to clothe our whole population for at least five years.

A still smaller insect, known as *Phyloxera*, a species of plant-louse, has, within the last few years, ruined over 700,000 acres of the fairest vineyards of France, and has almost destroyed one of the leading industries of the kingdom. You are all aware of the immense sum paid by that country as a war indemnity; well, it has been stated by a high authority that she would be cheaply rid of these American invaders at the same price paid to the Germans for vacating her territories. The failure of foreign vintages, however, to most of us, is of far less importance than the deficient yield of our grain fields. Wine is the luxury of the few; whiskey—I meant to say bread—the necessity of the many. In addition to the insects just mentioned, there are countless myriads belonging to different species which attack other plants. Our fruit and forest trees are attacked in root, trunk, branch, leaf, bud, flower and fruit. Seventy-five species infest, more or less, the apple tree, and a similar number our beautiful elm. About a hundred varieties are found upon the lofty pine and stately oak, while every kind of tree and shrub has its special enemies. In our fields, heavy tolls are levied on the various crops, and in our gardens they rob us of our green peas and asparagus, our young corn and salads, our cucumbers and tomatoes; vegetables and flowers alike suffer by their depredations. The yearly loss inflicted on agriculturists in the United States and Canada is estimated to exceed $250,000,000. When we further find these minute enemies riddling our garments, revelling in our larders, and not hesitating even to pierce and torment our bodies, we may be led to consider them unmitigated pests, present in this fair world only to plague and harm us. But we will find, on examination of the insect world, that there are numerous and extensive families of beneficial insects preying upon the obnoxious ones, and otherwise aiding man, and we will be led gradually to modify, and, finally, greatly to reverse our former opinions, as we find insects occupying a most important part in preserving the balance of nature, while man himself is chiefly responsible for many of the evils which he suffers from them. Linnæus has denominated insects "the diligent and faithful servants of nature—perpetually engaged in destroying all that is dead, and checking all that is living in the vegetable world." The evidences of this can be witnessed daily in our own magnificent forests, tenanted as they are by so many destructive and obnoxious insects; and in the tropics, where insects are vastly more numerous and of far greater size, the luxuriant vegetation teaches us that, under normal conditions, vegetable productions do not suffer to a hurtful degree by their myriad enemies. These, by removing all dead and decaying vegetation, but clear the ground more rapidly for new growths, while, by devouring seeds and young plants, and by assisting in the destruction of matured ones, they prevent the more rapidly-growing species from crowding out the slower. A certain equilibrium is thus maintained until disturbed by the agency of man.

As soon, however, as immense tracts of land are cleared of their natural growth and sown with those plants so widely cultivated for man's sustenance, the insects, deprived of their proper food plants, are in many cases found transferring themselves to the new quarters provided. The natural enemies also of a plant will, as that plant is more and more widely sown, be placed in a more favourable position to live and multiply, and often will increase so enormously in number as to be a source of much dread to the agriculturist. If the farmer, glancing proudly across his spreading fields of wheat, presently sees, hovering over them, clouds of minute insects, dancing in the sunlight, and finds these to be innumerable swarms of chinch bugs, hessian flies or similar foes, he must not consider it a special affliction of Providence, but the natural working of laws that have existed for untold periods. Man, as he has spread from continent to continent, clearing and cultivating and subduing the earth, has carried with him not only his various animals, grains, flowers, fruits and vegetables, but has continually borne along, or been steadily followed by, many of his natural insect foes. Long lists could be given of insects which have been introduced into this country from Europe. One instance may be noticed, because the insect was brought but recently into Canada, and is known to all of you—I refer to *Pieris rapæ*, the cabbage butterfly. This, the common white butterfly—of which numbers were seen at several of our excursions—is easily distinguished from our native white by the black spots on its wings and the yellowish tint of the under-surface. It is about twenty years since it was first brought to Quebec—probably in the egg state on cabbage leaves—and its descendants have since destroyed millions of cabbages. The first one was captured in Quebec in 1859; ten years later it had occupied a large portion of the Middle States; in 1875 it reached the western part of this province; two years ago I found it common in the most eastern portion of Nova Scotia, and its range is steadily widening west and south; last year it was reported common in Alabama and beyond Ohio, and wherever cabbages can grow this lover of them may be expected to find its way. It is impossible to estimate the extent of the loss inflicted by them, but, in one year, they destroyed, in the neighbourhood of Quebec, over 250,000 head of cabbage. Those of you who cultivate this vegetable in your gardens must have observed that, of late, these butterflies have not been so numerous as in former years, and you may have wondered why it should be so; well, it is to the efforts of a very small ichneumon fly, called *Pteromalus puparum*, that the diminution in their numbers is due. This little fly, the natural foe of the butterfly, has, in some unknown way, followed it here from Europe, and has since multiplied so greatly as to be a powerful check upon the increase of the butterflies. The female ichneumon deposits her eggs in the chrysalis, which, if opened some time afterward, will be found occupied by some fifty small grubs; and at least half the chrysalids examined will be found in this condition.

In contemplating the loss and annoyance caused by insects, people too readily overlook the benefits derived from them—benefits so numerous that I shall mention only the chief one. They are the scavengers of nature, removing quietly and quickly all decaying animal and vegetable matter, and thus purifying both the air and the water. I will not weary you by entering further this evening into the great and varied claims that Entomology, as a study, has upon us, whether we consider the beauty or the grotesqueness of colour or ornamentation of some species; the social instincts and surprising intelligence of such as bees and ants; the curious and often complex habitations of many; the metamorphoses undergone; the products with which they furnish us; the wonderful instruments, such as stings, which they possess; or a multitude of equally important points, we find scope for the exercise of the highest powers of the intellect, and material can be gathered near at hand to give employment throughout a lifetime, and I trust that some among my hearers may be tempted to look more carefully and fully into the strange and admirable phases of insect life, by

which they are surrounded, than they have in the past, and favour us next winter with the results of their observations. A recent writer in one of our periodicals asserts that "the happiness of life depends far more on the choice that young people make of a recreation than it does on their profession or employment—choose your pastime out of doors; make yourself Nature's playmate." This may seem at first the somewhat strong expression of an enthusiastic lover of out-door life, but on consideration it appears not unworthy of cordial acceptance. Work must be interspersed by recreation to make life really enjoyable, and to those whose work keeps them much shut up, the advice to choose an out-door pastime is indeed good. The very existence of this Club testifies that its members at least are followers of such advice.

The first and most notable insects taken on the 22nd May, the day of the excursion to King's Mere, were a pair of fine luna moths, *Attacus luna*. This species is one of a group in which our largest and handsomest moths are contained, and is, in the estimation of many, the most beautiful of all our lepidoptera. The body of the moth, as you will observe on inspection, is snowy white, while the wings are of a delicate pale green, with a transparent eye-spot in each. The hinder wings are prolonged so as to form tails an inch and a half in length. The caterpillars feed upon walnut and hickory, and may be found full grown about the end of July on the butternut trees in this vicinity. They are then from two to three inches long, and are pale green with a yellow stripe on each side, in addition to other slight markings. Their strong, oval, white cocoons are spun in the leaves, with which they fall to the ground in autumn. The moths emerge in early spring, and fly, as do the majority of such insects, at night; hence they are rarely seen except in collections. At the time of the first excursion it was too early in the season for most of the butterflies, and many other insects, to be abroad, but a good many varieties of beetles were to be had. Among these were several species of weevils, including *Balininus nasicus*, the nut-weevil, which destroys so many hazel-nuts, and which was unusually abundant last summer. This beetle derives its name from its very long and slender rostrum or snout, which is longer than its body, although no thicker than a stout bristle. Its oval or somewhat pear-shaped body is clothed with short yellowish hair. Three or four other species were taken upon pines, which they greatly damage by destroying the terminal shoots, and thus checking the growth of the tree and stunting it. One of these, *Pissodes affinis*, is shown on the upper left corner of this chart upon the wall, with its larva, which is a stout, footless grub. The family of the Curculionidæ, or weevils, is very extensive, numbering several thousand named species. Its members are readily distinguished by the long snout and elbowed antennæ; the majority are small, and many are very minute insects. The life history of the greater number remains to be investigated, but their young live generally in seeds, fruits, etc., and are of course destructive to vegetation. The plum, pea and grain weevils are known to all farmers by their ravages. A very pretty species taken at King's Mere was *Polydrosus elegans*. This beetle is usually of a greyish buff, but the color varies considerably, and some of the males found by me are of a beautiful green. *Corymbites triundulatus* and *hieroglyphicus* with a few other elaters, were taken on pines and on some trees, such as cherry, which were in blossom. The upper figure on the right represents a member of this family, which are commonly known as spring-beetles, because they have the power when placed upon their backs of throwing themselves some distance into the air, in which they turn so as to alight upon their feet again. The larvæ of some species live under bark, or in old trees or decaying wood, and are harmless, but those of other species burrow in the soil, and destroy much vegetation by cutting off young plants at the surface, and by gnawing roots, etc. The species intended to be shown is a somewhat common one, *Agriotes mancus*, the larva of which does much injury to young wheat. In early spring, immense numbers of small cylindrical beetles are often observed, which, from their shape, appear as if

they had been made by the inch and then cut into ten, fifteen or more pieces. They live under the bark of various trees, and *Hylastes pinifex* and others were taken at King's Mountain. On the occasion of our trip to meet the Montreal Natural History Society at Calumet, the season was more favourable to an abundance of insect life, and many species were observed, including some of our largest butterflies. Unfortunately, the only member who collected butterflies on this excursion (Mr. Greata) has since left the city, so that I do not know exactly what ones were taken. Among them, however, was *Danais archippus*, which is a very large butterfly with tawny orange wings, margined and veined with black, and bordered with a double row of white spots. The caterpillar, when full grown, is about two inches long, and is banded with alternate transverse stripes of yellow, black and white. It has also a pair of thread-like black horns at each end, and may be found feeding in June and July upon the common milk-weed. Another large and handsome butterfly seen was *Papilio turnus*, the yellow swallow-tail, the caterpillar of which feeds upon apple, wild cherry, etc., and is of a light green color, with rows of blue spots along the back, and a curious eye-spot, yellow with a black centre, on each side of the third segment. The caterpillars of this and of *Papilio asterias*—the black swallow-tail—when touched, thrust out through a slit just behind the head, a curious forked scent-organ, which emits a disagreable smell, apparently with the object of driving away insect foes. *Colias philodice*, the bright yellow butterfly, was abundant. Its larva feeds upon clover, which valuable plant, by the way, is known to be relished by over fifty species of insects. A fine species of tiger-beetle, *Cicindela longalabris*, which I have never observed elsewhere, was taken, apparently searching for ants, in the open spot in which we all lunched. Tiger-beetles have received their name from their swiftness and fierceness in seizing the insects upon which they live. The larvæ live in sandy or light soils, in perpendicular holes, at the top of which they lie in wait for passing insects. Three species of these beetles are common, viz.: *Vulgaris*, the common, *Hirticollis*, the hairy-necked, and *Sex-guttata*, the six-spotted. The two first are to be found upon roads, or sandy places; they fly swiftly a short distance when alarmed, and also run quickly about. *Cicindela sex-guttata* is more frequently found sunning itself on fences and stones. It is of a lustrous green, with six, or frequently eight yellow spots on the wing-covers. Another fine tiger-beetle, *C. purpurea*, is found in fields among the grass, and is more difficult to capture. A beetle taken at Calumet in some numbers was *Saperda vestita*, the clothed or coated saperda, so named from its covering of short, yellowish hair. Its length is about three-fourths of an inch, and the larva, figured with the beetle, in centre of upper row, does much damage sometimes to lindens. An allied species, *Saperda tridentata*, the "three-toothed Saperda," was also taken; its larva is an elm-tree borer. A third species *Saperda candida*, a brownish beetle with two longitudinal white stripes, is also found around here, and is known as the apple-tree borer, on account of its damages to that tree. Two more long-horned timber beetles were taken on young basswood trees, viz.: *Clytus ruricola*, a black beetle with yellow markings, and *Clytus erythrocephalus*, a delicate and rare beetle, of a brownish colour, with three yellow bands. The five beetles just named are among the fifty species of Cerambycidæ which I have painted, and are as nearly as possible correct in size, markings and coloring. All these fifty were taken in this immediate vicinity, and, in addition, I have some twenty others. Owing to the extent and diversity of the surrounding woods, Ottawa is very favourably situated for the collection and study of wood-eating insects, of which there are many belonging to different orders. Two species of Buprestians were also taken at Calumet, viz.: *Dicerca divaricata* and *Brachys terminans*. The larva of the first bores in beech and cherry, etc.; that of the second mines in the leaves of the basswood; that is, it lives between the upper and lower surfaces of the leaf, and devours the soft tissues. The white blotches so frequently seen in different kinds of leaves are thus formed by mining larvæ. The Buprestians are remarkable for the solidity

hardness and metallic brilliancy of their bodies and legs. The great majority of the species found in Canada can be obtained in this vicinity. About thirty were taken by Mr. Fletcher and myself during the past season, including one at least new to the Canadian list, viz.: *Chrysobothris Harrisii*, a beetle of a brilliant green, found on pine saplings. It is slightly smaller than the species figured in the lower left corner, which is *C. femorata*. This beetle formerly inhabited oak trees, but has now transferred itself to apple trees, which it greatly damages. The larva is very similar in form to those of the other Buprestians, and it is easy to distinguish the holes bored by them, as they are oval instead of round.

Our excursion to the Mer Bleu was, I regret to say, productive of few insects. For my own part, I was feeling quite unwell, and far from able to make any search for them. Our botanists added largely to their lists, and where new plants are found, new insects may be expected. We know, for instance, that there are some peculiar to the pitcher-plant. The pools and ditches filled by water from the mineral springs would appear favourable to the production of rare aquatic forms. Fluttering over the surface of the barren were great numbers of small butterflies, but as no specimens were captured, I cannot state confidently to what species they belonged, or if there was more than one variety. Other butterflies were seen along the route and at the Springs, including *Limenitis arthemis*, or the White Admiral. This is a very handsome butterfly, easily recognized by the broad, white band across its rich dark wings. Its flight, as it sails about through the trees along the border of an open space in the woods, is most graceful, and as it alights but for very brief intervals, its capture is often attended with some difficulty. Some years it is comparatively abundant, but last season, in common with many other butterflies, it was quite rare.

On our Saturday afternoon trip to Britannia, I observed few specimens new or worthy of description. *Epicauta cinerea*, the ash-grey blister beetle, often occurs in great numbers on wild plants, also on potatoes, and quickly strips them of their leaves. This beetle belongs to the *Cantharides*, or blister-beetles, so named from the effect produced by applying their powdered bodies to the skin. Several species occur in Canada; the one shown, lower centre figure, is *Meloe Augusticollis*, a dark-bluish insect known as the Oil Beetle. The larva of this beetle is worthy of much attention, both on account of the number of its metamorphoses, and of its peculiar and varied life. It emerges from the egg as a sprightly little six-footed creature, resembling certain forms known as spring-tails. Able to go without food for several days, it climbs upon some plant near by and lays in wait until a bee alights alongside it. When this happens, it transfers itself to the body of the bee, and holding on to the hairs with its little claws, is thus safely transported to the nest, where it fastens upon the nearest bee-grub, feeding upon it, and gradually changing to the footless form shown below. Other changes are undergone before it becomes a beetle, and even then it appears but little like one. I have not found it here, but my friend, Mr. Heron, has given me specimens taken up the Gatineau.

Owing to the late date on which the last excursion—the one to Meech's Lake—was held, few insects were met with. The spring and early summer months are those in which insects are most abundant and in which the collector makes his richest haul. After that they are, of course, always to be found, but it is more necessary to know where to look for them, and more careful and systematic searching is required to find them, so that at an excursion where much ground has to be traversed, and where sight-seeing, etc., occupy much of one's time, it cannot be expected that very many captures will be made. Concealed by a large toad-stool, and feasting upon its substance, I found a number of the curious little beetles called *Onthophagus hecate*. It is not an uncommon beetle, for it abounds wherever there is decaying animal matter, but owes its interest to the odd appearance of the male, which is easily distinguished by the upper part of the thorax projecting like a horn over the head, the front of which is also

ornamented by an upright horn. Several species of small beetles were also taken in or under fungus upon decaying wood, where many varieties can always be obtained. One *Phellidius cornutus* has the thorax of the male produced in two long flat horns. Another, *Cratoparis lunatus* is a weevil. Among these fungi-eaters, and, probably, preying upon them, was a black beetle, a species of *carabidæ*, the members of which family live chiefly—both as larvæ and in the perfect state—upon other insects. The large diagram shows one found under stones during the daytime. It is enlarged about twenty diameters in order to show the mouth-parts, etc., common to nearly all beetles.

Spring, with its revivifying influences, is again near at hand, and with the first warm days, insects will make their appearance in rapidly-increasing numbers. Now, then, is the time to prepare the few simple articles constituting the collector's outfit, so as to be ready to take advantage of the first opportunity to go out into the fields and woods, and, note-book in hand, observe and record the doings of their lesser inhabitants.

On the same evening an instructive paper on "Some plants collected during our Excursions" was read by Mr. Fletcher, who also handed in the annexed list of plants collected by the Ottawa Field-Naturalists' Club during the season, to be held as a record by the Club. This list is arranged after the plan of Professor Macoun's catalogue, but does not include the *Musci* and *Hepaticæ*; these will be published next year.

The structure and growth of a few of the most interesting were explained, the first considered being *Clematis verticillaris*, or the large mauve-flowered woodbine. The chief part of the paper, however, was devoted to Insectivorous plants, in connection with which subject detailed descriptions were given of "the Pitcher Plant," *Sarracenia purpurea*, and the two Sundews, *Drosera rotundifolia* and *Drosera longifolia*. It was pointed out that, although these two species take their names from the shape of their leaves, they often approach each other so closely that the only sure mode of identifying them is by a microscopical examination of the seeds. A curious method of reproduction in *Nasturtium lacustre* was explained; this plant is aquatic in its habits, and, as is frequently the case with such plants, has the submerged leaves very much laciniated or cut up. These leaves become detached from the plant very early in the summer, before it has done flowering, leaving the stem naked and bare. Why these leaves should drop so early is a matter of surprise, until it is explained that when each one drops into the water it does not decay, but floats about on the surface, while at its base is gradually developed a young plantlet, which takes root and remains stationary as soon as a suitable spot is reached. Mention was also made of certain marine plants found about Ottawa, such as *Rumex maritimus*, *Triglochin maritimum*, var. *elatum*, etc., etc., pointing to the fact, which is sustained by geological investigation, that the ocean once extended to this now far inland spot.

At the conclusion of this paper, Mr. Fletcher introduced to the meeting Professor Macoun, of Belleville, a corresponding member of the Club. This gentleman made a vigorous speech, setting forth the claims of Natural Science as a means of training both mind and body to greater and more prolonged activity than can be attained by any other course of study. The Professor opposed the idea that any plants were insectivorous, in which he was supported by Dr. Kemp. There was a prolonged discussion on the subject. Mr. Fletcher defended his previously expressed belief in the insectivorous proclivities of those plants named by him, and gave an account of his own experiments and cited some of those of Professor Darwin in England.

FLORA OTTAWAENSIS.

BY

JAMES FLETCHER.

RANUNCULACEÆ.

Clematis
verticillaris, DC.
Virginiana, L.

Anemone
cylindrica, Gray.
multifida, DC.
Pennsylvanica, L.
Virginiana, L.

Hepatica
acutiloba, DC.
triloba, Chaix.

Thalictrum
Cornuti, L.
dioicum, L.

Ranunculus
abortivus, L.
acris, L.
aquatilis, L. *v.* trichophyllus, Chaix.
Flammula, L. *v.* reptans, Meyer.
multifidus, Pursh.
Pennsylvanicus L.
recurvatus, Poir.
repens, L.

Caltha
palustris, L.

Coptis
trifolia, Salisb.

Aquilegia
Canadensis, L.

Actæa
alba, Bigel.
spicata, L. *v.* rubra, Mx.
——————(white berried form)

MENISPERMACEÆ.

Menispermum
Canadense, L.

BERBERIDACEÆ.

Berberis
vulgaris, L.

Caulophyllum
thalictroides, Michx.

NYMPHÆACEÆ.

Brasenia
peltata, Pursh.

Nymphæa
odorata, Ait.

Nuphar
advena, Ait.
pumilum, Smith.

SARRACENIACEÆ.

Sarracenia
purpurea, L.

FUMARIACEÆ.

Corydalis
aurea, Willd.
glauca, Pursh.

Adlumia
cirrhosa, Raf.

Dicentra
Canadensis, DC.
Cucullaria, DC.

PAPAVERACEÆ.

Sanguinaria
Canadensis, L.

Papaver
Rhœas, L.
somniferum, L.

Chelidonium
majus, L.

CRUCIFERÆ.

Nasturtium
Armoracia, Fries.
lacustre, Gray.
officinale, R. Br.
palustre, DC.
———*v.* hispidum, Fisch. and Meyer.

Cardamine
hirsuta, L.
———*v.* sylvatica, Gray.
rhomboidea, D.C.
pratensis, L.

Dentaria
diphylla, L.
laciniata, Muhl.

Arabis
Drummondii, Gray.
hirsuta, Scop.
lævigata DC.
perfoliata, Lam.

Barbaræa
vulgaris, R. Br.

Erysimum
cheiranthoides, L.

Sisymbrium
officinale, Scop.

Brassica
alba, Gray.
campestris, L.
nigra, Gray.
Sinapistrum, Boiss.

Camelina
sativa, Crantz.

Capsella
Bursa-pastoris, Mœnch.

Thlaspi
arvense, L.

Lepidium
Virginicum, L.

VIOLACEÆ.

Viola
blanda, Willd.
Canadensis, L.
canina, L. *v.* sylvestris Reg.
cucullata, Ait.
pubescens, Ait.
renifolia, Gray.
rostrata, Pursh.

DROSERACEÆ.

Drosera
longifolia, Mx.
rotundifolia, L.

HYPERICACEÆ.

Hypericum
Canadense, L.
corymbosum, Muhl.
ellipticum, Hooker.
mutilum, L.
perforatum, L.

Elodes
Virginica, Nutt.

CARYOPHYLLACEÆ.

Silene
antirrhina, L.
Armeria, L.
inflata, Smith.
noctiflora, L.

Saponaria
officinalis, L.
vaccaria, L.

Lychnis
Githago, Lam.

Arenaria
lateriflora, L.
Michauxii, Hook.
serpyllifolia, L.

Stellaria
borealis, Bigel.
longifolia, Muhl.
media, Smith.

Cerastium
nutans, Raf.
viscosum, L.

PORTULACACEÆ.

Portulaca
oleracea, L.

Claytonia
Caroliniana, Michx.

MALVACEÆ.

Malva
crispa, Gray.
moschata, L.
rotundifolia, L.
sylvestris, L.

Abutilon
Avicennæ, Gærtn.
Hibiscus
Trionum, L.

TILIACEÆ.

Tilia
Americana, L.

LINACEÆ.

Linum
usitatissimum, L.

GERANIACEÆ.

Geranium
Carolinianum, L.
Robertianum, L.
Erodium
cicutarium, L'Her.
Impatiens
fulva, Nutt.
Oxalis
Acetosella, L.
corniculata, L. *v.* stricta, Hook.

RUTACEÆ.

Zanthoxylum
Americanum, Mill.

ANACARDIACEÆ.

Rhus
Toxicodendron, L.
typhina, L.

VITACEÆ.

Vitis
cordifolia, Mx.
Ampelopsis
quinquefolia, Mx.

RHAMNACEÆ.

Rhamnus
alnifolia, L'Her.
Ceanothus
Americanus, L.

CELASTRACEÆ.

Celastrus
scandens, L.

SAPINDACEÆ.

Acer.
dasycarpum, Ehrh.
Pennsylvanicum, L.
rubrum, L.
saccharinum, L.
————*v.* nigrum, T. and G.
spicatum, Lam.
Negundo
aceroides, Mœnch.
Staphylea
trifolia, L.

POLYGALACEÆ.

Polygala
Senega, L.

LEGUMINOSÆ.

Trifolium.
agrarium, L.
arvense, L.
hybridum, L.
pratense, L.
procumbens, L.
repens, L.
Meliotus
alba, Lam.
officinalis, Willd.
Medicago
lupulina, L.
Astragalus
Canadensis, L.
Desmodium
acuminatum, DC.
Canadense, DC.
cuspidatum, T. and Gr.
Vicia
Cracca, L.
hirsuta, Koch.
sativa, L.
tetrasperma, Mœnch.
Lathyrus
ochroleucus, Hook.
palustris, L.
————*v.* myrtifolius, G.
Apios
tuberosa, Mœnch.
Amphicarpæa
monoica, Nutt.

ROSACEÆ.

Prunus
Americana, Marsh.
Pennsylvanica, L.
serotina, Ehrh.
Virginiana, L.

Spiræa
opulifolia, L.
salicifolia, L.
tomentosa, L.

Agrimonia
Eupatoria. L.

Geum
album, Gmelin.
strictum, Ait.

Waldsteinia
fragarioides, Tratt.

Fragraria
vesca, L.
Virginiana, Ehrh.

Potentilla
Anserina, L.
argentea, L.
arguta, Pursh.
Norvegica, L.
palustris, Scop.

Rubus
Canadensis, L.
Dalibarda. L.
hispidus, L.
occidentalis, L.
odoratus, L.
strigosus, Mx.
triflorus, Rich.
villosus, Ait.
———*v.* frondosus, Tor.
———*v.* humifusus, T. and G.

Rosa
blanda, Ait.
lucida, Ehrh.

Cratægus
coccinea, L
tomentosa, L.

Pyrus
Americana, DC.
arbutifolia, L. *v.* erythrocarpa, Gray.
———*v* melanocarpa, Hook.
sambucifolia, Ch. and Sc.

Amelanchier
alnifolia, Watson.
Canadensis, T. and G.
———*v.* (?) oblongifolia, T. & G.

SAXIFRAGACEÆ.

Ribes
Cynosbati, L.
floridum, L'Her.
lacustre, Poir.
oxacanthoides, L.
prostratum, L'Her.
rubrum, L.

Saxifraga
Virginiensis, Mx.

Mitella
diphylla, L.
nuda, L.

Tiarella
cordifolia, L.

Chrysosplenium
Americanum, Schw.

CRASSULACEÆ.

Sedum.
acre, L.

Penthorum
sedoides, L.

HALORAGEÆ.

Hippuris
vulgaris, L.

Myriophyllum
spicatum, L.

ONAGRACEÆ.

Circæa
alpina, L.
Lutetiana, L.

Epilobium
angustifolium, L.
coloratum, Muhl.
molle, Torr.
palustre, L. *v.* lineare, Gray.

Œnothera
biennis, L.
———*v.* grandiflora, Lindl.
———*v.* muricata, Lindl.
pumila, L.

Ludwigia
palustris, Ell.

LYTHRACEÆ.

Nesæa
verticillata, H. B. K.

CUCURBITACEÆ.

Echinocystis
lobata, T. and G.

UMBELLIFERÆ.

Sanicula
Canadensis, L.
Marilandica, L.

Hydrocotyle
Americana, L.

Daucus
Carota, L.

Pastinaca
sativa, L.

Cicuta
bulbifera, L.
maculata, L.

Sium
cicutæfolium, Gmelin.

Cryptotænia
Canadensis, DC.

Osmorrhiza
brevistylis, DC.
longistylis, DC.

Conium
maculatum, L.

Carum
Carui, L.

ARALIACEÆ.

Aralia
hispida, Mx.
nudicaulis, L.
quinquefolia, Gray.
racemosa, L.
trifolia, Gray.

CORNACEÆ.

Cornus
alternifolia, L.
Canadensis, L.
circinata, L'Her.
sericea, L.
stolonifera, Michx.

CAPRIFOLIACEÆ.

Linnæa
borealis, Gronov.

Symphoricarpus
racemosus, Mx. *v.* pauciflorus, Robbins.

Lonicera
ciliata, Muhl.
hirsuta, Eaton.
parviflora, Lam.

Diervilla
trifida, Mœnch.

Sambucus
Canadensis, L.
pubens, Mx.

Viburnum
acerifolium, L.
lantanoides, Michx.
Lentago, L.
nudum, L. *v.* cassinoides, G.
Opulus, L.
pubescens, Pursh.

Triosteum
perfoliatum, L.

RUBIACEÆ.

Galium
Aparine, L.
asprellum, Michx.
circæzans, Michx.
lanceolatum, Michx.
trifidum, L.
triflorum, Mx.
verum, L.

Cephalanthus
occidentalis, L.

Mitchella
repens, L.

COMPOSITÆ.

Eupatorium
ageratoides, L.
perfoliatum, L.
purpureum, L.

Aster
acuminatus, Michx.
cordifolius, L.
corymbosus, Ait.
longifolius, Lam.
Novæ-Angliæ, L.
macrophyllus, L.

miser, L.
puniceus, L.
simplex, Willd.
tenuifolius, L.

Erigeron
annuum, pers.
Canadense, L.
Philadelphicum, L.
strigosum, L.

Diplopappus
umbellatus, T. and G.

Solidago
arguta, Ait.
———*v.* scabrella, Gray.
bicolor, L.
———*v.* concolor, G.
cæsia, L.
Canadensis, L.
gigantea, Ait.
latifolia, L.
lanceolata, Ait.
nemoralis, Ait.
squarrosa, Muhl.

Inula
Helenium, L.

Ambrosia
artemisiæfolia, L.

Xanthium
strumarium, L.

Rudbeckia
hirta, L.

Bidens
Beckii, Torr.
cernua, L.
chrysanthemoides, Mx.
connata, Muhl.
frondosa, L.

Maruta
Cotula, DC.

Achillæa
Millefolium, L.

Leucanthemum
vulgare, Lam.

Tanacetum
vulgare, L.

Artemisia
Absinthium, L.
biennis, Willd.
vulgaris, L.

Gnaphalium
decurrens, Ives.
uliginosum, L.
polycephalum, Mx.

Antennaria
margaritacea, R. Br.
plantaginifolia, R. Br.

Senecio
aureus, L.

Erechthites
hieracifolia, Raf.

Circium
arvense, Scop.
lanceolatum, Scop.

Lappa
officinalis, All.

Lampsana
communis, L.

Cichorium
Intybus, L.

Hieracium
Canadense, Mx.
scabrum, Michx.

Nabalus
albus, Hook.
altissimus, Hook.

Tragopogon
pratensis, L.
porrifolius, L.

Taraxacum
Dens-leonis, Desf.

Sonchus
arvensis, L.
asper, Vill.
oleraceus, L.

Lactuca
Canadensis, L.
———*v.* sanguinea, Gray.

LOBELIACEÆ.

Lobelia
cardinalis, L.
inflata, L.

CAMPANULACEÆ.

Campanula
aparinoides, Pursh.
rotundifolia, L.

ERICACEÆ.

Gaylussacia
resinosa, T. and G.

Vaccinium
Canadense, Kalm.
corymbosum, L.
macrocarpon, Ait.

Oxycoccus, L.
Pennsylvanicum, L.
vacillans, Solander.

Chiogenes
hispidula, T. and G.

Arctostaphylos
Uva-ursi, Spreng.

Epigæa
repens, L.

Gaultheria
procumbens, L.

Cassandra
calyculata, Don.

Andromeda
polifolia, L.

Kalmia
angustifolia, L.
glauca, Ait.

Ledum
latifolium, Ait.

Pyrola
chlorantha, Swartz.
elliptica, Nutt.
rotundifolia, L.
———— *v.* asarifolia, G.
———— *v.* incarnata, G.
secunda, L.

Pterospora
Andromedea, Nutt.

Moneses
uniflora, Gray.

Chimaphila
umbellata, Nutt.

Monotropa
uniflora, L.

AQUIFOLIACEÆ.

Ilex
verticillata, Gray.

Nemopanthes
Canadensis, DC.

PLANTAGINACEÆ.

Plantago
lanceolata, L.
major, L.

PRIMULACEÆ.

Trientalis
Americana, Pursh.

Lysimachia
ciliata, L.
stricta, Ait.
thyrsiflora, L.

Anagallis
arvensis, L.

Samolus
Valerandi, L. *v.* Americanus, Gr.

LENTIBULACEÆ.

Utricularia
cornuta, Michx.
intermedia, Hayne.
vulgaris, L. *v.* Americana, Gray.

OROBANCHACEÆ.

Epiphegus
Virginiana, Bart.

SCROPHULARIACEÆ.

Verbascum
Blattaria, L.
Thapsus, L.

Scrophularia
nodosa, L.

Chelone
glabra, L.

Pentstemon
pubescens, Solander.

Mimulus
ringens, L.

Gratiola
aurea, Muhl.
Virginiana, L.

Ilysanthes
gratioloides, Benth.

Veronica
agrestis, L.
Anagallis, L.
Americana, Schw.
arvensis, L.
officinalis, L.
peregrina, L.
scutellata, L.
serpyllifolia, L.

Gerardia
purpurea, L. *v.* paupercula, G.

Pedicularis
Canadensis, L.

VERBENACEÆ.

Verbena
hastata, L.
urticifolia, L.

Phryma
Leptostachya, L.

LABIATÆ.

Teucrium.
Canadense, L.

Mentha
Canadensis, L.
piperita, L.

Lycopus
sinuatus, Gray.
Virginicus, L.

Hyssopus
officinalis, L.
———(white flowered variety)

Calamintha
Clinopodium, Benth.
Nepeta, Link.

Hedeoma
pulegioides, Pers.

Nepeta
Cataria, L.
Glechoma, Benth.

Dracocephalum
parviflorum, Nutt.

Brunella
vulgaris, L.

Scutellaria
galericulata, L.
lateriflora, L.
parvula, Mx.

Galeopsis
Tetrahit, L.

Leonurus
Cardiaca, L.

Stachys
palustris, L.
———*v.* aspera, Gray.
———*v.* cordata, Gray.

Lamium
amplexicaule, L.

BORRAGINACEÆ.

Echium
vulgare, L.

Symphytum
officinale, L.

Lithospermum
arvense, L.
officinale, L.

Asperugo
procumbens, L.

Echinospermum
Lappula, Lehm.

Cynoglossum
Morisoni, DC.
officinale, L.
Virginicum, L.

Lycopsis
arvensis, L.

CONVOLVULACEÆ.

Calystegia
sepium, R. Br.
spithamæa, Pursh.

Cuscuta
Gronovii, Willd.

Convolvulus
arvensis, L.

SOLANACEÆ.

Solanum
Dulcamara, L.
nigrum, L.
rostratum, Dunal.

Physalis
grandiflora, Hook.
Peruviana.

Hyoscyamus
niger, L.

Datura
Stramonium, L.

Nicotiana
rustica, L.

GENTIANACEÆ.

Gentiana
Andrewsii, Griesb

Menyanthes
trifoliata, L.

APOCYNACEÆ.

Apocynum
androsæmifolium, L
cannabinum, L.

ASCLEPIADACEÆ.

Asclepias
Cornuti, Decaisne.
incarnata, L.

OLEACEÆ.

Fraxinus
Americana, L
pubescens, Lam.
sambucifolia, Lam.

ARISTOLOCHIACEÆ.

Asarum
Canadense, L.

CHENOPODIACEÆ.

Chenopodium
album, L.
Botrys, L.
glaucum, L.
hybridum, L.
urbicum, L.

Blitum
Bonus-Henricus, Reich.
capitatum, L.

Atriplex
patula, L.

AMARANTACEÆ.

Amarantus
albus, L.
retroflexus, L.

POLYGONACEÆ.

Polygonum
acre, H. B. K.
amphibium, L. *v.* aquaticum.
————*v.* terrestre.
arifolium, L.
aviculare, L.
————*v.* erectum, Roth.
cilinode, Mx.
Convolvulus, L.
dumetorum, L'Her.
————*v.* scandens, Gray.
Hydropiper, L.
hydropiperoides, Mx.
orientale, L.
Pennsylvanicum, L.
Persicaria, L.
sagittatum, L.

Rumex
Acetosella, L.
crispus, L.
maritimus, L.
obtusifolius, L.
orbiculatus, Gray.
verticillatus, L.

Fagopyrum
esculentum, Mœnch.

THYMELEACEÆ.

Dirca
palustris, L.

ELÆAGNACEÆ.

Shepherdia
Canadensis, Nutt.

SANTALACEÆ.

Comandra
umbellata Nutt.

CERATOPHYLLACEÆ.

Ceratophyllum
demersum, L.

CALLITRICHACEÆ.

Callitriche
verna, L.

EUPHORBIACEÆ.

Euphorbia
Cyparissias, L.
Helioscopia, L.
maculata, L.

Acalypha
Virginica, L.

URTICACEÆ.

Ulmus
Americana, L.
fulva, Michx.
racemosa, Thomas.

Urtica
gracilis, Ait.

Laportea
Canadensis, Gaud.

Humulus
Lupulus, L.

Pilea
pumila, Gray.

Bœhmeria
cylindrica, Willd.

Cannabis
sativa, L.

JUGLANDACEÆ.

Juglans
cinerea, L.
Carya
amara, Nutt.

CUPULIFERÆ.

Quercus
alba, L.
macrocarpa, Michx.
rubra, L.
Fagus
ferruginea, Ait.
Corylus
rostratra, Ait.
Ostrya
Virginica, Willd.
Carpinus
Americana, Michx.

MYRICACEÆ.

Myrica
Gale, L.
Comptonia
asplenifolia, Ait.

BETULACEÆ.

Betula
papyracea, Ait.
lutea, Michx. f.
Alnus
incana, Willd.

SALICACEÆ.

Salix
candida, Willd.
cordata, Muhl.
———*v.* angustata, Pursh.
discolor, Muhl.
fragilis, L.
humilis, Marshall.
livida, Wahl. *v.* occidentalis, Gray.
lucida, Muhl.
nigra, Marshall.
petiolaris, Smith.
Populus
alba, L.
balsamifera, L.
dilatata, Ait.
grandidentata, Michx.
tremuloides, Michx.

CONIFERÆ.

Pinus
Banksiana, Lamb.
resinosa, Ait.
Strobus, L.
Abies
alba, Mx.
balsamea, Marsh.
Canadensis, Michx.
nigra, Poir.
Larix
Americana, Mx.
Thuja
occidentalis, L.
Taxus
baccata, L. *v.* Canadensis, Gray.
Juniperus
communis, L.
Virginiana, L.

ARACEÆ.

Acorus
Calamus, L.
Calla
palustris, L.
Arisæma
triphyllum, Torr.

LEMNACEÆ.

Lemna
minor, L.
polyrrhiza, L.
trisulca, L.

TYPHACEÆ.

Sparganium
eurycarpum, Engelm.
simplex, Huds.
Typha
angustifolia, L.
latifolia, L.

NAIADACEÆ.

Naias
flexilis, Rostk.
Zanichellia
palustris, L.
Potamogeton
Claytonii, Tuck.
compressus, L.
gramineus, L. *v.* heterophyllus, Fries
natans, L.
pectinatus, L.

perfoliatus, L.
pusillus, L.
Spirillus, Tuck.

ALISMACEÆ.

Alisma
Plantago, L. *v.* Americanum. Gr.

Triglochin
maritimum, L. *v.* elatum, G.

Sagittaria
variabilis, Engelm.
heterophylla, Pursh.

HYDROCHARIDACEÆ.

Anacharis
Canadensis, Planch.

Vallisneria
spiralis, L.

ORCHIDACEÆ.

Orchis
spectabilis, L.

Habenaria
blephariglottis, Hook.
dilatata, Gray.
Hookeri, Torr.
———*v.* oblongifolia, G.
hyperborea, Lindl.
orbiculata, Torr.
psychodes, Gray.
rotundifolia, Rich.
tridentata, Hook.
viridis, R. Br. *v.* bracteata, Reich.

Goodyera
repens, R. Br.

Spiranthes
cernua, Richard.

Calopogon
pulchellus, R. Br.

Calypso
borealis, Salisb

Pogonia
ophioglossoides, Nutt.

Microstylis
monophyllus, Lindl.
ophioglossoides, Nutt.

Liparis
Loeselii, Rich.
———? (large form with 24 flowers and leaves 9 inches long)

Corallorhiza
innata, R. Br.
multiflora, Nutt.

Cypripedium
acaule, Ait.
parviflorum, Salisb.
pubescens, Willd.
spectabile, Swartz.

IRIDACEÆ.

Iris
versicolor, L.

Sisyrinchium
Bermudiana, L.

SMILACEÆ.

Smilax
herbacea, L.

LILIACEÆ.

Trillium
cernuum, L.
erectum, L.
———*v.* album, Pursh.
erythrocarpum, Mx.
grandiflorum, Salisb.

Medeola
Virginica, L.

Streptopus
roseus, Mx.

Uvularia
grandiflora, Smith.
perfoliata, L.
sessilifolia, L.

Clintonia
borealis, Raf.

Smilacina
bifolia, Ker.
racemosa, Desf.
stellata, Desf.
trifolia, Desf.

Polygonatum
biflorum, Ell.

Asparagus
officinalis, L.

Lilium
Philadelphicum, L.

Erythronium
Americanum, Smith.

Allium
tricoccum, Ait.

JUNCACEÆ.

Luzula
campestris, DC.
pilosa, Willd.

Juncus
bufonius, L.
Canadensis, J. Gay. *v* coarctatus, Gray.
effusus, L.
filiformis, L.
nodosus, L.
tenuis, Willd.

PONTEDERIACEÆ.

Pontederia
cordata, L.

Schollera
graminea, Willd.

CYPERACEÆ.

Cyperus
diandrus, Torr.
inflexus, Muhl.
strigosus, L.

Dulichium
spathaceum, Rich.

Eleocharis
acicularis, Torr.
obtusa, Schultes.
palustris, R. Br.

Scirpus
atrovirens, Muhl.
Eriophorum, Mx.
fluviatilis, Gray.
pungens, Vahl.
validus, Vahl.

Eriophorum
gracile, Rith.
polystachyon, L.
Virginicum, L.

Rhyneosphora
alba, Vahl.

Carex
aquatilis, Wahl.
aurea, Nutt.
bromoides, Schk.
Buxbaumii, Wahl.
canescens, L.
————*v.* vitilis, Gray.
crinita, Lam.
cristata, Schw.
Deweyana, Schw.
eburnea, Boot.
Emmonsii, Dew.
gracillima, Schw.
granularis, Muhl.
gynocrates, Wormsk.
Hitchcockiana, Dew.
Howtonii, Torr.
hystricina, Willd.
intumescens, Rudge.
lagopodioides, Schk.
lanuginosa, Michx.
laxiflora, Lam.
————*v.* blanda, G.
————*v.* intermedia, Boot.
limosa, L.
lupulina, Muhl.
monile, Tuck.
Œderi, Ehrh.
oligocarpa, Schk.
oligosperma, Michx.
pauciflora, Lightf.
pedunculata, Muhl.
Pennsylvanica, Lam.
plantaginea, Lam.
platyphylla, Carey.
polytrichoides, Muhl.
Pseudo-Cyperus, L.
retrorsa, Schw.
riparia, Curtis.
rosea, Schk.
scirpoidea, Michx.
scoparia, Schk.
siccata, Dew.
sparganioides, Muhl.
stellulata, L.
————*v.* scirpoides, Boot.
stipata, Muhl.
straminea, Schk.
stricta, Lam.
squarrosa, L.
tenella, Schk.
teretiuscula, Good.
trisperma, Dew.
Tuckermani, Boot.
umbellata, Schk.
utriculata, Schk.
varia, Muhl.
vulpinoidea, Michx.

GRAMINEÆ.

Leersia
oryzoides, Schw.
Virginica, Willd.

Zizania
aquatica, L.

Alopecurus
aristulatus, Mx.

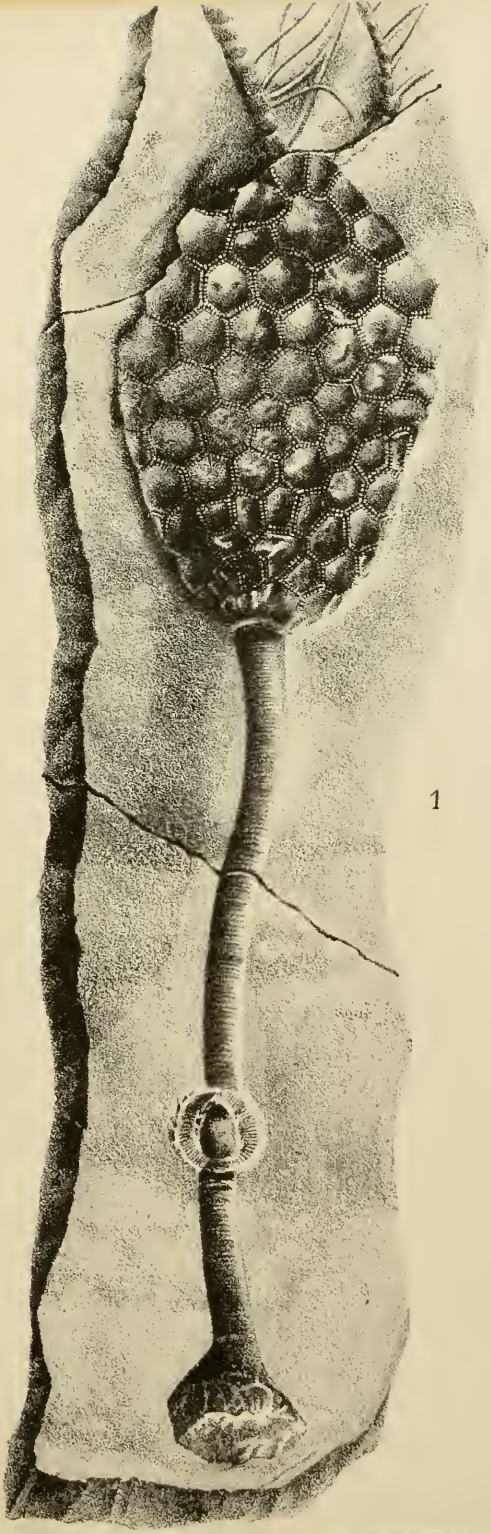
Phleum
pratense, L.
Sporobolus
heterolepis, Gray.
Agrostis
alba, L.
scabra, Willd.
vulgaris, With.
Cinna
arundinacea, L. *v.* pendula, G.
Muhlenbergia
glomerata, Trin.
Brachyelytrum
aristatum, Beauv.
Calamagrostis
Canadensis, Beauv.
Oryzopsis
asperifolia, Mx.
melanocarpa, Muhl.
Spartina
cynosuroides, Willd.
Dactylis
glomerata, L.
Glyceria
aquatica, Smith.
Canadensis, Trin.
fluitans, R. Br.
nervata, Trin.
pallida, Trin.
Poa
annua, L.
compressa, L.
pratensis, L.
Festuca
ovina, L.
——— *v.* rubra, G.
rubra, L.
Bromus
ciliatus, L.
Kalmii, Gray.
racemosus, L.
secalinus, L.
Lolium
perenne, L.
Triticum
repens, L.
Hordeum
jubatum, L.
Elymus
Canadensis, L.
——— *v.* glaucifolius, Muhl.
Virginicus, L.
Danthonia
spicata, Beauv.
Aira
cæspitosa, L.
Phalaris
arundinacea, L.
Canariensis, L.
Panicum
Crus-Galli, L.
depauperatum, Muhl.
dichotomum, L.
glabrum, Gaudin.
sanguinale, L.
xanthophysum, Gray.
Setaria
glauca, Beauv.
Italica, Kunth.
viridis, Beauv.
Sorghum
nutans, Gray.

EQUISETACEÆ.

Equisetum
arvense, L.
hyemale, L.
limosum, L.
scirpoides, Mx.
sylvaticum, L.

FILICES.

Polypodium
vulgare, L.
Pteris
aquilina, L.
Adiantum
pedatum, L.
Asplenium
angustifolium, Mx.
Filix-fœmina, Bernh.
thelypteroides, Mx.
Trichomanes, L.
Camptosorus
rhizophyllus, Link.
Phegopteris
Dryopteris, Feé.
polypodioides, Feé.
Aspidium
acrostichoides, Swz.
cristatum, Swz.
Goldianum, Hook.
marginale, Swz.
Noveboracense, Swz.
spinulosum, Swz. *v.* intermedium.
Thelypteris, Swz.



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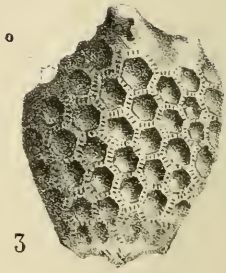

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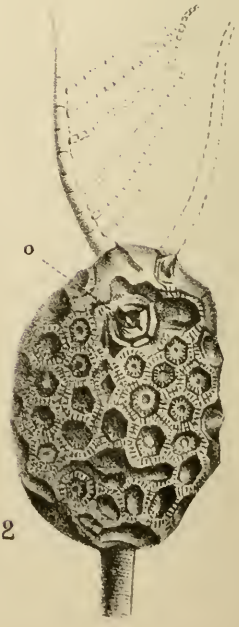

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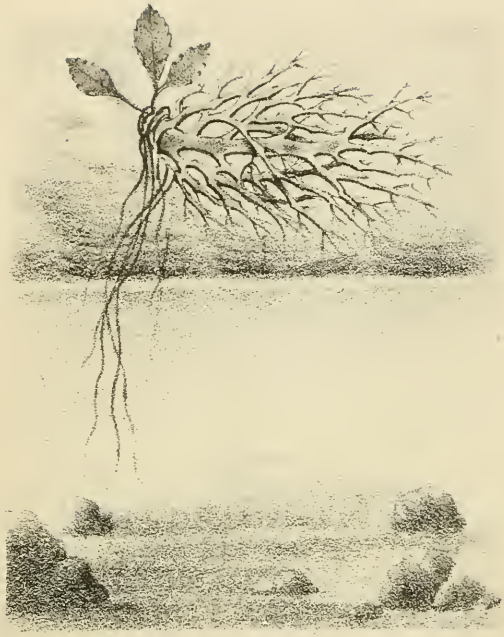

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A. Grignard, del.

G Cox. Lith. Ottawa

Woodwardia
Virginica, Smith.

Struthiopteris
Germanica, Willd.

Onoclea
sensibilis, L.
———*v.* obtusilobata, Tr.

Cystoperis
bulbifera, Bernh.
fragilis, Bernh.

Woodsia
Ilvensis, R. Br.

Dicksonia
punctilobula, Kunze.

Osmunda
cinnamomea, L.
Claytoniana, L.
regalis, L.

Botrychium
ternatum, Swartz. *v.* lunarioides, Mc
Virginicum, Swz.

LYCOPODIACEÆ.

Lycopodium
annotinum, L.
clavatum, L.
complanatum, L.
———————*v.* sabinæfolium, Sp.
dendroideum, Mx.
lucidulum, Mx.

Selaginella
apus, Spring.
rupestris, Spring.

Description of Plate I.

Fig. 1. *Comarocystites punctatus*, Billings:—Dorsal view of a specimen in possession of Dr. J. A. Grant, probably the largest and most perfect yet discovered.

Fig. 1*a*. Arms and pinnulæ of the same, figured separately to enable the fossil to be depicted natural size.

*Fig. 2. Ventral side of a specimen; *o* the mouth.

*Fig. 3. Left side of a specimen; *o* the mouth.

*Fig. 4. Lateral opening (enlarged).

*Fig. 5. View of summit (enlarged), showing opening and position of arms.

Description of Plate II.

Fig. 1. Leaf of *Nasturtium lacustre*, showing mode of reproduction from the leaves.

Fig. 2. *Pityobius Billingsii*, Bland:—A beautiful and rare Elater, of which this locality appears to be the peculiar habitat. The first specimen was found by the late Mr. B. Billings, and presented to the Entomological Society of Philadelphia, in whose Proceedings for 1864 its description is given. No other specimen is recorded, except the one from which this drawing is made. This (a male) was captured by Mr. W. H. Harrington, at Billings' Bridge, on the 26th June, 1878.

*Figs 2, 3, 4 and 5 are taken from Decade III, Geological Survey of Canada.

†Fig. 3. *Physa Lordi*, Baird:—Two of the largest specimens found in Meech's Lake, showing the greatest variations.

†Fig. 4. *Limnœa gracilis*, Say:—From a dead but very perfect specimen.

†Fig. 5. *Physa Billingsii*, Heron:—From the largest specimen found, the usual size being much less. This shell was formerly (with doubt) considered by Mr. Heron to be identical with *Physa brevispira*, of Dr. Lea,—for the description of which see Philadelphia Academy of Science, 1864, page 116—but, having collected many more of the shells during the publication of these Transactions, he feels sure that it is a new species, and has given it the above name. Description: shell, ovate, semi-translucid, thick and strong; smooth when not covered with a very slight drab incrustation of dirt; colour, pale greenish drab; whorls, rather more than four, the last very large; suture, distinct, but not very much impressed; spire, prominent, acuminated; aperture, one-half the size of shell; lips, sharp, strongly thickened within with white enamel, which is a continuation of the columellar fold; in many shells there are three or four of these lip thickenings, marking former stages of growth; these thickenings are apt to become yellow with age. Animal, tentacular, with a distinct heavy black line running full length, except at the base, where there is a transparent zone, often broken or disturbed; body covered with minute black spots, which are assembled into what are apparently two lines, diverging from tip of tail, which is sharp. Shell, with animal alive, dark olive; divergence, generally 62 degrees, but, in a few shells, it reaches even 89 degrees; dimensions, one shell (62 degrees), length, half an inch, width, five-sixteenths of an inch; another (89 degrees), length, seven-sixteenths of an inch, width, a little over a quarter of an inch; habitat, Billings' Bridge, near Ottawa, Canada.

†Fig. 6. *Helix nitida*, Muller (enlarged).

†Fig. 7. *Helix minutissima*, Lea (enlarged).

†Fig. 8. *Helix milium*, Morse (enlarged).

These two beautiful plates have been kindly executed for these Transactions by Mr. A. Grignard, who has joined the Club during the present year.

†The above six species of shells are recorded from Canada for the first time.

CONTENTS.

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