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TREASURER'S REPORT—1891.

GENTLEMEN,—I have much pleasure in reporting that the finances of the Club are in a very satisfactory condition. A far larger amount has been collected during the past year for subscriptions than has ever before been the case. An amount of \$25.00 not yet paid out, has been put aside by the Council to finish the publication of the *Flora Ottawensis*. I beg again to draw the attention of the members to the names of the firms which assist the Club by advertising in the OTTAWA NATURALIST. It is not too much to say that these firms are equal to, or the best, in their several lines, and I trust that the members will endeavour to show them that it is a paying investment to assist the Club. In conclusion I would draw attention to the fact that nearly \$6.00 has been unnecessarily expended in postage by the Treasurer in writing for subscriptions. The fees are payable in advance on the third Tuesday in March. If this were attended to by all the members, not only would it save much trouble and expense; but they would get much better value for their money. During the past year owing to the fact that subscriptions were paid in more promptly, no less than 38 pages were added to the OTTAWA NATURALIST. Had everyone paid up this number might have been doubled and the *Flora Ottawensis* would have been finished. As it is impossible for me, owing to my official duties, to again accept the post of Treasurer I lay this matter before the meeting and beg that you will assist my successor to this extent.

TREASURER'S BALANCE SHEET—1890-91.

RECEIPTS.		EXPENDITURE.	
1890.		1891.	
March 18, Balance.....	\$ 30 52	March 17, Ottawa Naturalist,	
1891.		Vol. iv..	\$254 49
March 17, Subscriptions		Postage ...	11 26
1890-91..	\$212 00		————— \$265 75
Arrears	48 00	Extras. Flora	
	260 00	Ottawaensis	26 00
Advertisements.....	37 00	" Authors'	16 12
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Transaction sold.....	18 39	General printing....	2 95
Excursion receipts...	159 55	General postage....	8 77
		Stationery.....	1 11
		Gratuities.....	6 00
		Library—	
		Shelves....	6 00
		Binding....	10 00
			16 00
		Excursion expenses .	157 39
		Balance	15 12
			—————
	\$515 21		\$515 21

JAMES FLETCHER,
Treasurer.

Ottawa, March 17, 1891.

DRINKING WATER.

WITH SPECIAL REFERENCE TO THE OTTAWA CITY SUPPLY.

A Lecture by A. McGill, B.A., B.Sc., Assistant Analyst to the
Inland Revenue Department.

A very little thought given to the subject will convince us of the hopelessness of seeking for absolutely pure water as a natural product. The great solvent power of water, together with the universal presence of substances, gaseous liquid or solid, which it can take into solution, are conditions which amply suffice to explain the contamination of all natural sources of supply. The whole of the fresh water on the face of the earth has fallen as rain on field, forest, city, street, swamp, or other more or less similar gathering-ground, except such insignificant fraction as falls directly into river or lake. The soluble impurities present in such gathering grounds are conveyed to the storage centres in river, lake or well, and it is fortunate for us that nature has provided, in the course of natural filtration to which such supplies are necessarily subjected, a means of reducing in a great degree the pollution due to organic matter, as will be hereafter explained more fully. The mineral content remains to give so-called "hardness," or other specific character to the supply of each locality. Even before the rain has reached the surface of the earth, however, it is far from pure, since there are always present in the atmosphere particles of organic and inorganic dust, ill-smelling and often poisonous gases, the products of decay, microscopic germs, and other impurities which are washed out of the air by the rain, and make it,—especially the first portion of each shower,—decidedly polluted and unfit, without filtration, to be used as a food supply. The conditions which influence the solubility of solids in water are essentially three, namely, the specific nature of the substance, the temperature of the water, and the presence of other bodies in solution. Even among quite soluble substances very marked and interesting specific differences may be observed. In the six flasks before you I have suspended, in muslin bags, equal quantities (1 ounce) of six different salts, themselves having important relations in the subsequent treatment of this subject, all of them decidedly soluble, and powdered to an approxi-

mately equal degree of fineness. I will now add to each flask one pint of pure water at the ordinary temperature and set them aside for about half an hour. The salts I have selected are 1st, Nitrate of Ammonia, a proximate form taken by much of the decaying animal matter on the earth's surface. This salt will be found to dissolve with extreme readiness,—2nd, Common Salt, or Chloride of Sodium, which exists in vast stratified deposits on every continent and is brought to the surface by natural agencies, such as mineral springs, or artificially by pumped wells (as in the St. Clair Flats, at Goderich, Seaforth, etc.), or by mining as at Cracow and elsewhere. This salt forms the most universal condiment and anti-putrescent agent in the preservation of human food, and as a consequence is present in all sewage, forming a most important clue to the identification of sewage and the tracing of its course where it enters rivers or lakes. Although quite soluble, this salt dissolves only to about one-sixth the amount of the last named. 3rd. Epsom Salts, or Sulphate of Magnesia, and 4th. Glauber's Salt, or Sulphate of Soda, two substances which are very extensively found in mineral waters, and, in fact, give their cathartic properties to most medicinal springs and wells. Epsom Salts dissolves to about the same extent as common salt, while Glauber's Salt has only half this degree of solubility. 5th. Washing Soda, or Carbonate of Soda, and 6th. Bi-carbonate of soda, or Baking Soda, which occur—especially the latter—in many effervescing mineral waters, as in the Vichy and Apollinaris waters, although they are of very much greater importance as manufactured salts. Washing Soda is practically of equal solubility with Glauber's Salt, while bi-carbonate of soda is much less soluble. The solubility of these six salts is seen to be inversely in the order in which I have named them.

As illustrations of naturally occurring salts which are difficult of solution, and yet dissolve to an appreciable extent in natural waters, I can select no better examples than gypsum and chalk, the sulphate and carbonate of lime. Five hundred parts of water are required to dissolve one part of gypsum at the ordinary temperature, so that if a gallon of water fully saturated with gypsum were evaporated to dryness the residual gypsum would weigh only 140 grains, or less than one-third of an ounce. Yet this salt occurring in natural hard waters in very much less amount than is needed to saturate them, is a most

troublesome and harmful impurity when steam boilers are supplied with it. Chalk is as nearly insoluble in pure water as most substances with which we are acquainted, one million parts of water dissolving only eighteen parts of chalk. That is, were a gallon of water fully saturated with chalk to be evaporated to dryness the residue would weigh only about $1\frac{1}{4}$ grains. We shall see, however, that under conditions quite commonly found in nature the solubility of chalk may be increased to 880 parts per million, *i. e.*, a residue of 62 grains would be obtained from a gallon of water saturated under these circumstances. The condition referred to is the presence of free carbonic acid in the water. Before illustrating this, let me indicate the laws which govern the solution of gases in water. These are, briefly, (1st), the specific nature of the gas; (2nd), the temperature; (3rd), the pressure. The two gases, of which our atmosphere is essentially composed, are soluble in water only to a very slight extent. At the ordinary temperature and pressure of the air 100 gallons of water dissolve about 3 gallons of oxygen, and nitrogen is only about half as soluble as oxygen. A fourth law of gaseous solubility applies when a mixture of gases is exposed to a solvent, as in the case of air and water. Each gas is dissolved just in such proportion as it would be were the other gas not present (the pressure, of course, being correspondingly reduced). A consequence of this is that while oxygen and nitrogen are present in air in the ratio of 1 to 4 they are dissolved in water in the ratio of 1 to 2. Thus the atmospheric gases present in water form a mixture very much richer in oxygen than is the air, and the important consequences that follow from this are not far to seek. It is from this dissolved oxygen that fish and all water-breathers obtain the supply to arterialize their blood, and, what bears more directly upon our subject to-night, it is by means of this dissolved oxygen that the various processes by which the harmful and even poisonous organic impurities of natural water are changed to innocent substances, are carried on. So emphatically is the presence of oxygen in solution an essential condition of purity in a surface water, that many chemists always estimate the dissolved oxygen in water analysis. In illustration of this point I may quote the following figures from a report upon the river Seine, above, at, and below Paris :—

Corbeil (20 miles above Paris).....	Dissolved Oxygen =	9.32	CC	per litre.
Epinay (below all the sewers).....	“ “ =	1.05	“ “	
Pont de Poissy (49 miles below Paris)..	“ “ =	6.12	“ “	
Pont de Meulau (58 miles below Paris).	“ “ =	8.17	“ “	
Mantes (68 miles below Paris).....	“ “ =	8.96	“ “	
Vernon (94 miles below Paris).....	“ “ =	10.40	“ “	

These numbers are very easy to explain when we consider that the decaying organic matter brought into the river by the sewage of Paris consumes the dissolved oxygen, and is by this consumption of oxygen, converted into other and comparatively harmless compounds, so that, at a point 90 miles below the city and 70 miles below the sewer mouths, the river regains its normal condition as far as this factor is concerned.

Carbon di-oxide, or carbonic acid gas is much more soluble than oxygen. Roughly we may say that water dissolves its own volume of this gas. The only other gas which I shall mention is ammonia, and the extreme solubility of this gas in water is well illustrated in the experiment before you, in which the first portions of water entering the large flask filled with ammonia gas dissolve the whole of the gas thereby creating a vacuum into which a fountain plays -the red liquid (a slightly acid solution of litmus in water) being constantly changed into blue in the fountain jet, and thus bearing witness to the alkaline character of the ammonia.

The solubility of gases in water becomes less as the temperature rises. It is for this reason that water that has been boiled and allowed to cool makes so flat and insipid a beverage. The atmospheric gases, and particularly carbonic acid gas, have been expelled at the boiling temperature, and the water requires artificial aëration before it can become again a sparkling and palatable drink. Under increased pressure a very much larger amount of gas can be held in solution. Effervescing drinks like soda-water, ale and champagne are kept in strong bottles with corks wired down. When the bottle is opened, and ordinary atmospheric pressure applied to the surface of the liquid, the excess of gas which could only be kept in solution by abnormal pressure escapes, and gives the sparkling effervescence characteristic of these beverages.

Unlike gases, a rise in temperature is usually attended with a

marked increase in solubility in the case of solid bodies. The following diagram (see Roscoe and Schorlemmer's *Treatise on Chemistry*, vol. ii., p. 45) will serve to illustrate graphically this point. You will observe that while the rate of increase in solubility for increased temperature varies with the specific nature of the salt, it is pretty generally true that the solubility increases as the temperature rises. In the case of sulphate of soda we have a peculiarity in that the maximum of solubility is found at about 90° Fah. In common salt we find another interesting peculiarity in that for temperatures between the freezing point and boiling point of water the solubility is practically constant at about four pounds of salt per gallon of water. In the case of sulphate of lime we find the very slight solubility of this salt in cold water is even lowered as the temperature reaches the boiling point, although the decrease in solubility is too small to be well marked. However, did this diagram indicate temperatures as high as those found in steam boilers, where water boils under artificial pressure, we should find that at 270° Fah., a temperature which corresponds to the boiling point of water under a pressure of two and a half atmospheres, or about 40 pounds per square inch—a very ordinary boiler pressure—the solubility of gypsum is reduced to one-twentieth part of its solubility at 212° Fah.; and as a consequence of this nineteen-twentieths of the sulphate of lime in solution in a feed-water is deposited as a coherent and very hard crust on the inner surface of the boiler.

The remaining condition which affects the solubility of solids in water is the presence of other substances in solution. There is probably no exception to the statement that the solubility of a solid is influenced more or less by the presence of other dissolved bodies. All the phenomena of precipitation depend upon this principle. I shall have occasion to illustrate this in the course of the evening, but I may now ask you to observe how promptly chlorides are thrown out of solution by salts of silver, salts of iron by ammonia or other alkali, lead salts by carbonates or sulphates, all of which reactions are of great value to water consumers, whether the water be used for household or manufacturing purposes. I can only make detailed reference to two cases of great importance in this connection. The first is the solubility of lead in water, and is of great importance from the extensive use of lead

pipes for conveying water in dwellings. The conditions under which lead is dissolved by water are very complicated, and by no means perfectly understood, but the following broad generalizations are justified by facts. Where water contains nitrates in any considerable amount, and in general where water is essentially soft in character—such as rain-water—the danger of lead being dissolved from the pipe is very great, and poisoning has frequently occurred from this source, as little as one-tenth of a grain per gallon being a poisonous quantity when the water is continually used, since lead is a cumulative poison. Water containing less than one-fourth of this amount has been known to cause serious and dangerous illness. In presence of carbonates, sulphates or phosphates, a thin coating of the carbonate, sulphate or phosphate of lead is formed on, and adheres to, the inner surface of the pipe. Since these salts are practically insoluble they protect the lead pipe from contact with the water and render its use quite safe. Fortunately most natural waters contain a sufficient amount of dissolved carbonic acid or carbonates to prevent danger from the use of lead pipes in their conveyance. It is, however, advisable always to allow water to run freely for a short time where it has been stored in lead service pipes over night, or for any considerable time, especially at a temperature such as is usual in dwellings.

The second illustration of increased solubility due to the presence of a substance in solution is the case of chalk in water containing free carbonic acid. The large glass vessel before you contains water partially saturated with slaked lime. On passing carbonic acid gas from the generator into this water the first effect is the conversion of some of this lime into carbonate of lime or chalk; and the great insolubility of this compound causes its separation with formation of a dense white precipitate which gradually settles down to the bottom of the vessel if allowed to stand at rest. On continuing, now, to pass the carbonic acid gas, after all the lime has been converted into carbonate, we observe this curious effect. The liquid gradually loses its turbidity, and in a few minutes is as clear and transparent as at the first. The excess of carbonic acid gas has caused the precipitated chalk to pass into solution. We have now what is known as *hard* water, and its effect with soap will be apparent from the following

experiment. In the first of these two cylinders I put a pint of ordinary soft water; in the second cylinder I put the same quantity of the hard water which we have now prepared. To each cylinder I now add the same volume of a solution of soap and shake vigorously half a minute. A bulky and persistent lather, nearly filling the cylinder, is formed by the soft water, while the hard water shews merely a thin pellicle of scum, the product of the destruction of the soap added. You will observe that it is necessary to add nine or ten times as much soap to the hard water in order to get a lather comparable with that obtained in the first cylinder. It is evident that hard water causes a waste of soap, and the amount of waste is strictly proportional to the amount of lime in the water, since a perfectly definite decomposition takes place between the soap and the lime salt present. Were the lime present as sulphate the destruction of soap would still occur, with this difference, that in that case no simple and inexpensive mode of softening the water could be applied, and the water would be what is usually called *permanently* hard. The only practicable remedy in such a case is the use of washing soda, for although such remedies as soluble barium salts are very effective in throwing the sulphates out of solution, yet the poisonous character of barium salts, to say nothing of their cost, makes them unavailable in ordinary circumstances. In the case of water which possesses only temporary hardness, *i.e.*, hardness due to carbonate of lime, not only may we use washing soda to cure the evil, but two other processes deserve mention. By boiling the water we drive out of solution the carbonic acid gas, in virtue of which the carbonate of lime is held in solution. On now allowing it to settle, the almost insoluble chalk is deposited, and the soft water may be drawn off. The second and very ingenious plan of softening such water is due to the late Prof. Clarke of Aberdeen, and is usually known as Clarke's process. It consists in adding slaked lime to the water in proper amount to form chalk with the free carbonic acid, which is therefore withdrawn from solution and precipitated along with the now insoluble lime salt originally present in the water. Many large towns and cities in England and elsewhere now soften their whole supply in this way. The water of the Ottawa River is remarkably soft since the gathering ground is essentially free from limestone rocks. The Upper Ottawa region is

characterized by its granites and allied siliceous rocks, with a soil which has resulted from their weathering and destruction by glacial and other agencies. The peaty character of large areas of this gathering ground is evidenced in the brownish colour of the water of the river ; a colour which is due not to the presence of dissolved salts, but to the products of decay of vegetable matter. The results of many analyses of the Ottawa River shew it to contain less than *one* part of solid matter for *ten thousand* parts of water, or less than seven grains per gallon in solution. At certain periods of the year it, however, contains solid matter suspended in the water, causing a turbidity which you must often have remarked. This is particularly characteristic of the river in spring, when the swelling of the smaller streams which feed it and the fine particles of clay and sand washed down from fields and roads, sufficiently account for its muddy appearance, while its current is rapid enough to prevent the settling of this mud to the bottom. In respect to suspended solid matter, however, the Ottawa River compares very favourably with many others—I might say with any other river of its size. The sources of the Ottawa are situated for the most part in a rocky region where there is comparatively little soil to be washed into its waters by spring freshets. It is quite otherwise with such rivers as the Red River at Winnipeg, which gets its name from the highly coloured ferruginous clay, which it carries in suspension ; or with the Missouri and Mississippi, whose waters, joining at St. Louis, sometimes contain the enormous amount of 1,225 grains of solid matter (or nearly three ounces) per gallon. Yet it is from this water that St. Louis takes its supply ; and it will not surprise you to learn that four settling basins of large size have to be provided, so that while one is being drawn from another is being filled, and the other two are settling for use in their turn. Either by subsidence, as at St. Louis, or by simply constructed filter beds, such suspended matter may be got rid of. Of the principles involved in the construction of filter beds, I shall speak later.

From what has been said it will appear that absolutely pure water is not to be sought for in nature. In order to prepare it we must resort to the process of distillation ; and one method of carrying out this process is illustrated by the apparatus before you. The water

which is boiling in the flask upon the left contains sand and clay in suspension, sulphate and carbonate of lime in solution, as well as salts of ammonia and common salt. We shall look in vain in this distillate (the condensed steam) for any traces of these, and although we may find traces of carbonic acid and ammonia, since these readily volatile substances may come over with the first portions of the water vapour, yet if we reject the first portion of distilled water, we shall find the remainder to be absolutely pure, since the salts mentioned above are not converted into vapour at the temperature at which water boils, and they therefore remain behind in the flask. Even the ammonia might have been prevented from coming over had we taken proper precautions in treating the water before applying heat. It will, however, be evident that distillation is too expensive a method to be practically available on the large scale for water purification; and it is only in such cases as on shipboard that water for drinking purposes is obtained in this way. A process quite analogous to this is, nevertheless, carried on by natural agencies on the large scale. The formation of clouds, and the precipitation of their watery burden, as rain, snow, etc., is but a vast distilling of the surface waters of the earth; and were it not for the impurities washed out of the air by it, rain water would be quite as pure as the distilled water flowing from this condenser. Indeed, were proper pains taken to reject from cisterns the first portions of each shower, as containing the bulk of the impurities of the air, and the dust and dirt from the roofs on which it falls, rain water might be collected and stored so as to form a perfectly wholesome and even palatable drinking water, since it is well aerated, and the insipidity due to absence of dissolved solids is less and less noticed as people become habituated to its use. I have figured in this diagram two original devices, by means of either of which a definite portion of each rain-fall may be automatically prevented from entering the cistern, and only the later portions of the shower allowed to flow into it; and I think that every cistern should be provided with a contrivance fitted to effect this separation of the earlier from the later portion of each rain-fall.

For purposes of brevity I shall omit any mention of sea water, or lake water; and devote the remainder of the evening to some remarks upon river and well waters; and in order to make it possible to define

the character of a sample from the results of its analysis, I propose to indicate here the essential features of the operations collectively known as *Water Analysis*.—

Naturally the first tests made are those which require only the direct use of the senses : taste, smell and sight.

1. *Taste*.—It is only in rare instances that this character is sufficiently definite to be of any value. When the taste of a sample is so markedly unusual as to attract attention, as, for instance, to its saltiness or its sulphur flavour, or its sharpness or pungency, as is the case of some mineral springs, it may be safely asserted that such a water, however useful medicinally, is unsuited to ordinary household purposes.

2. *Smell*.—It is rare that a natural water exhibits any smell at the ordinary temperature. Certain spring waters contain sulphurous gases in solution and these have a more or less nauseating smell, at times intense enough to remind one of rotten eggs. Many samples, however, which are quite odourless when cold, become distinctively *bad smelling* when heated. A pint or so of the water may be placed in a glass stoppered bottle and the whole heated to about 100° F., when, if the stopper be withdrawn and the bottle immediately applied to the nose, peaty waters will often betray themselves by a characteristic smell, and water from surface wells to which sewage has access will frequently be found to have quite a stinking odour.

3. *Colour*.—It is perfectly wonderful how many different tints of colour are exhibited by natural water from different sources; indeed it would scarcely be overstating the case to say that no two water samples have the same tint. True it may not always be possible, even with the refinements of science, to distinguish with absolute exactitude the nice differences that occur, yet, when we employ a colour comparer of the model exhibited, and look through a column of water 24 inches deep, it becomes possible to distinguish very slight differences indeed. The first of these tubes contains distilled water, and seems quite colourless; the second contains ordinary Ottawa river water and looks quite brown by comparison. In the third tube I have a sample of Ottawa water which has been treated with 10 grains of common alum to the gallon, and you will note that although not as colourless as distilled water, it

has been very greatly improved in this respect. The brownish tint of the Ottawa river water, in common with many other Canadian rivers, as the Richelieu, the Yamaska, etc., is due chiefly to dissolved vegetable matter of peaty origin. Alumina has the property of precipitating such colouring matter, hence the improvement on adding alum. In reference to this feature, namely, colour in water, I may say that while it is desirable on æsthetic grounds that a drinking water should be as colourless as possible, we know of no positive reason for condemning a highly coloured water as unwholesome. I shall show later that the presence of much organic matter, even though only of vegetable origin, and innocent enough in its character, is cause for anxiety and possible danger, and of course so far as colour helps us to ascertain the presence of such matter it becomes a valuable factor in the analysis; still we must remember that it is only as potentially, not as actually dangerous, that we object to the use of peaty waters, and we cannot therefore condemn them on the ground of high colour alone. The observation and recording of colour in water is of greatest consequence when the *same water* supply is studied from day to day. Then indeed, a change in tint corresponds always to a change in character; and the cause of this change must be looked for, if necessary, by a complete analysis of the water. For purposes of registering the observed depth of colour nothing better is known to me than the scale devised by Lovibond, in which a set of glass slips of fixed and comparable colour values is employed. I am able to shew you the standard glasses, but a full illustration of the mode of using them would require more time than we have to spare. The depth of colour is expressed in terms of this scale in Bulletins 15 and 18 of the Inland Revenue Department.

4. *Turbidity and Clearness* are due to matter in suspension or its absence, and vary according to conditions which have already been explained.

5. *Oxygen in Solution* becomes a valuable factor in the analysis of the water of the same stream at different points of its course, as I have already illustrated in the case of the Seine at and below Paris. The estimation is, however, of no value when a single sample is concerned, since the amount which may be present in a perfectly pure water varies

with so many conditions. Water from deep artesian wells is sometimes nearly free from dissolved oxygen, and is yet of the purest possible description.

6. *The Dissolved Solids* are estimated by evaporating a known volume of the water to dryness in a platinum dish and weighing the residue. The drying of the residue is effected at 100° C. ($=212^{\circ}$ F.), a temperature high enough to drive off all except chemically combined water. This residue is then ignited in the dish, and the resulting ash is weighed; the loss of weight is usually stated in a separate column in reporting the analysis, although a much less value is attached to this number than was the case some years ago. The loss was then supposed to be essentially due to organic matter which had been burnt away, and was hence thought to be a measure of the impurity of the water analyzed. Now, we know that far more importance must be attached to the kind of organic matter present than to the total amount of it, and since the loss on ignition gives no information on this point its indications are of correspondingly small moment. Besides this, the loss is partly due to escape of carbonic acid gas from carbonates, and to loss of water which has been combined in such a way that it was not driven off by heating to 100° C.

I may here mention that it is possible to burn away the organic matter from the residue in such a way as to collect the products of combustion, and from them to calculate the amounts of carbon and nitrogen which the residue contained. Since nitrogen is, as a rule, present to a larger amount in organic matter having an animal origin than in that having a vegetable origin, it is possible from the relative amounts of nitrogen and carbon to get an idea of the proportion of animal impurities existing in the sample analyzed. This process is a very tedious and troublesome one, and requires the utmost care in its execution that results of any value may be obtained. It was employed by Dr. Frankland in the analysis of the waters of Great Britain (1868—1876), and he concludes that surface water or river water containing 2 parts of organic carbon, or 0.3 parts of organic nitrogen per million, should be rejected where possible. I have not employed the process in the analyses of Canadian river and well waters which I have made within

recent years, nor am I aware that it is in use by any Canadian analyst at present. Prof. Marsan, in December, 1888, found 9 parts organic carbon and 0.47 parts nitrogen per million in the Ottawa city supply, and did not consider these numbers to condemn the water for domestic use.

The ignited residue contains the inorganic salts, sand, etc., which were present in the water. Unless these are in excessive amount their discrimination is not necessary, since in ordinary water samples they consist of lime, magnesium, or soda salts, quite harmless in character, unless, as I have already explained, the water is wanted for boiler supply. Many analyses of the Ottawa river water shew the ignited residue to vary from 20 to about 80 parts per million, according to the season of the year, and the part of the river from which the sample is collected. Other rivers show a much higher inorganic content, as, for instance, the Grand River, at Brantford (Nov., 1889), 348 parts per million, and the Assiniboine, near Winnipeg (May, 1888), which gave 1088 parts per million.

In this residue, however, we always look for phosphoric acid, since phosphates are highly characteristic of sewage, and their presence in the minutest traces is a very suspicious indication.

7. *Nitrogen* existing as ammonia in water is present in consequence of the fact that whenever organic matter containing nitrogen undergoes decay a considerable proportion of this nitrogen takes the form of ammonia, and the exceeding solubility of this gas in water causes it to be at once dissolved. You are, many of you at least, acquainted with the fact that the atmosphere of a stable, unless kept very thoroughly cleaned, has a decided smell of spirits of hartshorn. This odour is due to the decomposing nitrogenous matters present, and the formation of ammonia as one of the products of decay. The universal occurrence of organic decay makes it practically impossible that a natural water should be absolutely free from ammonia. When, as in some tables of analysis, you find nitrogen as ammonia stated to be absent, you must understand this to mean that the amount present is too small to make its quantitative estimation possible. Yet it is wonderful with what certainty we can measure minute traces of ammonia. When you find tables in which the nitrogen existing as ammonia is stated to three places of decimals,

the results being given in parts per million, this means that we aim at estimating one part of nitrogen in one billion parts of water, or less than one-tenthousandth of a grain per gallon. In order to give you some idea of how this is done I place in one of these tubes a column of 24 inches of water quite free from ammonia, and in another I place an equal quantity of water to which I have added ammonia in the proportion of one part nitrogen to one million parts of water. The two samples as reflected to you from the mirrors are of course quite indistinguishable from each other. To each I now add a small quantity of a prepared test liquid called Nessler's solution, and you will observe in the course of a minute or two that while the contents of the first tube are unchanged in colour, a faint brownish yellow colour gradually develops itself in the second tube. Of course it is possible in the laboratory to apply this test in such a way as to obtain still greater sensitiveness, but the illustration will serve to give you confidence in numerical statements of the results of analysis even when fractional parts of a million are expressed.

8. While the simpler organic bodies containing nitrogen yield this nitrogen as ammonia during decomposition, many of the more complex substances which enter into the composition of animal structure, such as albumen, fibrin, etc., form other proximate products of decay, these possessing the common property of being converted into ammonia when boiled with a strongly alkaline solution of permanganate of potash. The ammonia obtained by treating a sample in this way, after the ammonia already present in it has been taken off, is called "Albuminoid" ammonia, as suggested by Wanklyn, the author of the process, and is properly considered as a most important factor in the analysis. Indeed, if it were ever allowable to adjudge a sample of water for drinking purposes upon the indications of a single factor in the analysis I would select this estimation as the critical one. The author of the process, who in conjunction with other analysts, worked upon a very large number of samples of all degrees of badness, concludes from his experience that "0.10 per million begins to be a very suspicious sign, and 0.15 per million ought to condemn a water absolutely." This standard would go hard with Ottawa river water, which in 1888 gave from 0.12 to 0.27 in different samples; in March and April of last year gave 0.15

and 0.16; and in August last gave 0.125 albuminoid nitrogen per million. We must not forget that these are English standards and on that account are questionably applicable to American rivers, which flow for very great distances over forest and marshy regions where contamination by sewage—in the ordinary acceptance of this term—cannot occur. We must, I think, concur in the wisdom of Prof. Mallet's decision that "local standards of purity should be adopted, based on sufficiently thorough examination of the water-supply in its usual condition. Unfortunately no systematic and continuous examination of our city supply has yet been undertaken, and it is impossible for me to state, except in a very imperfect way, what the normal composition of the Ottawa water is. It must, of course, be expected to vary for different months; but we should have a series of analyses made at weekly intervals for a number of years: and from the averages so obtained it would be a simple matter to determine the mean character of the water for any period. When we consider that water is a universal food substance that it enters into the preparation of every article of food; that from the nature of its production and storage, it is peculiarly liable to contamination in various ways, and that the most fatal diseases have been fully proven to have become epidemic, through its agency, we shall, I think, agree that a constant and careful examination of the supply of a city like ours is but a reasonable and necessary precaution.

9. When organic matter containing nitrogen has been exposed for a sufficiently long time to the ameliorating influences that are always at work in nature, the nitrogen takes the form of nitric acid, and when this is once formed and enters into combination with bases as nitrates, the condition of the nitrogen is fairly stable, and the nitrates so formed may exist as such for an indefinite length of time. Complex organic substances like albumen are thus changed into simple inorganic substances, perfectly harmless, and only interesting to the analyst as serving to measure the previous sewage contamination of the supply. For where much sewage has found entrance to a well-water, for example, although little or none may be now present as sewage, the tell-tale nitrates serve to prove past contamination. I need scarcely say that such wells as those quoted below are undoubtedly infected by sewage:—

	NITROGEN PER MILLION PARTS, AS		
	Ammonia, Free, &c.	Albuminoid Ammonia.	Nitrates and Nitrites.
Inland Revenue Department, bulletin 5, page 8, No. 16.....	0.033	0.305	11.967
Inland Revenue Department, bulletin 5, page 8, No. 17.....	0.090	0.165	15.909
Inland Revenue Department, bulletin 13, page 6, No. 6761.....	0.000	0.148	27.357
Inland Revenue Department, bulletin 13, page 15, No. 43.....	trace.	0.050	39.000

In order to guard against miscomprehension I must mention here that nitrates although fairly stable compounds, are not absolutely such ; but may, under certain conditions, be again resolved into ammonia or nitrogen.

10. I have already referred to the universal employment of common salt as a condiment and preservative ; a fact which accounts for its presence in sewage, and makes a search for it in water analysis a very important step in the examination. The readiness with which minute traces of kitchen salt can be recognized will be evident to you from this experiment. When nitrate of silver solution is added to this solution of chromate of potash, a few drops of this weak solution is sufficient to produce a decidedly reddish tint, due to the bright red chromate of silver formed in the re-action, the particles being suspended through the water in the tube. I will now repeat the experiment, taking the precaution to add a very small amount of common salt to the chromate solution, before adding the silver, drop by drop, for a very long time without producing any red colour in the liquid ; in fact, no chromate of silver will be permanently formed until enough silver has been added to decompose the common salt present. On this principle is based a method by which we can detect less than 1 part of salt in 1 million parts of water. Wherever sewage is present chlorides will be found. In the four wells whose nitrates indicated past sewage contamination, the chlorine in chlorides was found to be 148, 134, 65 and 143 parts per million respectively. A large number of good wells whose analyses

are to be found in the bulletins of the Inland Revenue Department will be seen to contain chlorine in varying amounts from 1 to 10, or more parts per million. We must not, however, forget that in many parts of Canada salt is found in the soil, and in various deep-seated springs, and it is therefore absolutely essential that the location and surroundings of the well should be known to the analyst before he pronounces an opinion on the results of chlorine estimation. Many wells in Winnipeg and other parts of Manitoba contain from 200 to 300 parts of chlorine per million, and are yet free from sewage pollution.

11. The only other feature in water analysis to which I need refer is the estimation of dissolved organic matter essentially non-nitrogenous in character, in other words, of vegetable origin. Such organic matter is with difficulty destroyed by oxidation and requires the employment of the most powerful oxidizing agencies we know to effect its decomposition. For the purpose we always use permanganic acid, a sample of which I show you in solution. Observe its beautiful deep purple colour and see how the addition of a very small quantity of water, impure from decomposing organic matter in solution, serves at once, or at least in a very short interval of time to cause the purple to become less and less intense, and shortly to disappear altogether. Now, by using a solution containing a known amount of permanganic acid, and adding it in excess to a measured quantity of the water to be examined, we can easily, at the end of, say four hours, estimate the excess of permanganic acid by chemical means, which need not be here explained, and thus obtain by difference the quantity used up in oxidizing the organic matter present in the sample of water. Since permanganic acid gives up a definite amount of its oxygen to this purpose, it is convenient to state the results of the examination as so many parts by weight of oxygen to the million parts by volume of water. The observation is usually made for two periods, viz., intervals of 15 minutes and 4 hours; the more easily oxidized organic matter being attacked in the shorter interval, and this part always includes any animal or more objectionable matter present. The following numbers quoted from Bull. v of the Inland Revenue Department will serve to give an idea of the indications afforded by this test:—

	OXYGEN CONSUMED PER 1,000,000 PARTS WATER.	
	15 Minutes.	4 Hours.
Lake Ontario, at Hamilton.....	0.120	0.440
River St. Lawrence, at Brockville.....	0.276	0.612
River Richelieu, at St. John's, Que.	0.740	1.668
Bay of Quinte, at Belleville.....	1.420	3.040
River St. Maurice, at Three Rivers, Que.	2.612	4.456
Ottawa River, February, 1888.....	2.808	5.760
Moncton Supply, New Brunswick.....	5.436	10.444

The place occupied by Ottawa river water in this list is certainly one of *bad eminence*. As this water has been examined at irregular intervals since 1888, I may add the following results:—

Ottawa River, April, 1890.....	3.060	4.886
“ “ August, 1890.....	3.747	6.387

It will be seen from these numbers that while the amount of oxidizable organic matter in the river varies from month to month as might be expected, and according to a law which we have not the necessary data to discover, the amount is at all times very large, and it behoves us to examine the conditions under which a water containing so large a quantity of dissolved organic matter is safe as an article of food. That the organic matter is not *per se* of an injurious nature is sufficiently evident from the fact that we and our fathers do use it and have used it with impunity. Let me ask your attention for a few moments to another matter. There is a large class of diseases generally spoken of as *zymotic* which have this property in common. Whenever a single case of such a disease occurs in a locality we may be pretty sure that immediately in its vicinity, and gradually further and further from that point as a centre, we shall find the disease spreading until it

becomes an epidemic. That is to say, such is the normal tendency of this class of diseases, and I may instance cholera, typhoid fever, diphtheria, influenza and la grippe as examples. There can be little doubt that the plagues and pestilences, such as the Black Death which visited England in the 14th century after having spread all over Europe and caused the death of twenty five millions of people, were other instances of zymotic diseases; and the fact that such plagues and pestilences are of so much less frequent occurrence now-a-days, and so much less malignant when they occur in the more civilized parts of the world than elsewhere, gives us the first important clue to their comprehension, and we may hope to their extermination. For it has been and is just in proportion to the cleanly habits of a people that these diseases lose their fatal character. This suggests a close connection between *filth and disease*, and the more carefully that we look into the matter, following this clue, the more fully are we convinced that such is the case; that cleanliness of person and surroundings is the first law of health. Still, this does not fully explain the phenomenon of zymotic disease, since the advent of a specific case of disease is necessary that the evil effects of uncleanly habits may be fully emphasized. This would seem to imply the existence of a specific disease virus or poison for each of these epidemics, the spread of which poison was favoured by the prevalence of uncleanly habits. Reasoning on this line led Pasteur, Koch, Cohn and others to the discovery of what will hereafter be regarded as the most important generalization of medical science in our century, namely, that which points to the existence of a special microbe, bacillus or living germ for each of the so-called zymotic diseases. The next step was to attempt the isolation of this germ, and with certain diseases this has been done. In the case of *Anthrax*, Koch has cultivated the bacillus and studied it throughout its complete development. The chart before you will serve to give an idea of the appearance of this enemy of mankind, as magnified about 15,000 times linear. In the next diagram I shew you both *in situ*, and isolated the *bacillus tuberculosis* from photographs by Koch. It is the study of this bacillus which has made Koch's name so widely known within the last year; but my purpose in emphasizing the matter is to draw your attention to the explanation which this theory of zymotic diseases offers of their sudden spread. The specific

bacilli are found in the waste matter from the bodies of patients, and may, and must, if the greatest care be not taken to make the thing impossible, find their way into the atmosphere, and into open water courses, into wells by surface or sewer drainage if such drainage finds access to them. And while the taking of these disease germs into the lungs in respiration is unquestionably the most effective way of spreading the disease yet experience has proved beyond a doubt that taking them into the system in our drinking water or our food is only second in danger. I might quote many historical instances in proof of this if time permitted, You will find such in the Sixth Report of the Royal Commissioners (1868) on preventing the pollution of rivers. The importance of immediate attention to the destruction of the dejecta of patients suffering from any of these zymotic diseases will be evident; but how are we to protect ourselves when by chance such infection pollutes our streams and wells? There is but one safe rule, and it is this: — Use no water for domestic purposes which at any time contains sewage; because although normal sewage may not contain actually poisonous substances, and may, when sufficiently diluted, be drunk with impunity, as proved by Dr. Emmerlich and others: yet we can never know when diseased sewage containing morbid germs may enter such a water course, and the only safe way is to have nothing to do with it. As I have said this is really the only safe rule, but what shall we do when we cannot help ourselves. To take our own case; there is apparently no other source from which we can obtain a supply than the Ottawa river, and this receives the sewage of places like Aylmer, Quyon and others; together with the drainage of fertilized fields all along its course, and the fertilisers used are, as we know, not unlikely to contain disease germs. Fortunately nature furnishes, in dissolved oxygen and through other conditions, the means of self purification for such contaminated waters. Only give time enough and the most dangerous sewage contamination will be converted into harmless matter by natural agencies. Still, it is reasonable to suppose that water containing much organic matter in solution is more likely to furnish a suitable and congenial *nidus*, or nourishing ground for bacteria than water that is more nearly free from organic matter. This is the disadvantage at which we are placed; and I have no hesitation in saying that not only on æsthetic, but

also on hygienic grounds some method should be provided for precipitating, or otherwise separating from our river water the large amount of organic matter it contains before supplying it to the citizens for household use.

Returning now to the consideration of well water, it will appear that the chief differences in character to be expected between deep well waters on the one hand, and shallow well, or surface waters on the other hand are such as may result from the influence of filtration through deep layers of soil. The most effective way of presenting these differences will be by asking your attention to the following table in which a few shallow wells, and a few deep wells are contrasted as regards the results of their chemical analysis :—

	No.	Total Solids.			Nitrogen.			Chlorine in chlorides.	Phosphates.	Oxygen Consumed.	
		Dry at 100° C.	Ignited.	Loss.	Alb.	Free.	Nitrates			15 min.	4 hours.
Shallow Wells .	1	128	84	44	0.066	0.016	0.133	3.0	none	0.168	0.440
	2	424	312	112	0.016	0.090	0.109	66.0	"	0.194	0.232
	3	148	99	49	0.250	0.020	0.450	9.6	tr.	1.830	3.645
	4	424	320	104	0.181	0.946	1.154	4.0	none	2.412	5.042
Deep Wells....	5	1312	1136	176	0.080	0.140	0.260	330.0	"	0.076	0.244
	6	552	404	148	0.060	0.090	0.010	10.0	"	0.160	1.600
	7	993	692	301	0.640	0.200	37.000	108.0	heavy traces	3.390	8.670
	8	1112	640	472	0.218	11.190	5.910	260.0	traces	0.552	1.55

No. 1—A well in the suburbs of Hamilton, Ont.

No. 2—A well at Ashburnham, Ont.

No. 3—A well in a bog at Joe's Point, St. Andrews, N.B.

No. 4—A well at Brandon, N.W.T.

No. 5—A public well in Winnipeg, Man.

No. 6—An artesian well at Goderich, Ont.

No. 7—A well at Three Rivers, Que.

No. 8—A well in a large tenement house, Sherbrooke, Que.

Numbers 1 and 2 in the above table give a very fair idea when contrasted with numbers 5 and 6, of the differences which exist between shallow and deep wells. The solids in the latter are much higher, and although chlorides are present even in large amount, they need not indicate sewage contamination, since their presence may be due to chlorides in the soil or in rock strata through which the water has passed. Albuminoid nitrogen should be low in these deep waters; that it happens to be still lower in amount in the shallow wells quoted indicates their freedom from sewage. Number 3 shews sewage contamination not only in its albuminoid nitrogen but in its traces of phosphates, and this is corroborated by its chlorine, for while 66 parts chlorine does not indicate anything wrong in No. 2, one-seventh part as much chlorine is a bad indication in No. 3, since its sewage origin is borne out by other features of the analysis. The free ammonia in No. 4 serves to indicate sewage, and the nitrates here shew past sewage contamination. Numbers 7 and 8, although deep wells, shew in many items of the analysis that sewage has found entrance to them, and they cannot be safe or desirable sources of domestic supply.

I had intended interpreting for you the results of analysis of Ottawa river water for some years past, so far as I have been able to collect statistics; but this would require at least another half hour, and it is now past ten o'clock. I must therefore defer this portion of the subject until some future opportunity. There remains also the important question of how, by artificial means, the quality of a natural water supply may be improved. This is in itself a subject large enough to occupy a whole evening in its treatment, and must therefore be left to be dealt with in the future.

THE BIRDS OF OTTAWA.

The appended list of birds found in the neighbourhood of Ottawa has been compiled by the leaders of the Ornithological Branch of the Ottawa Field-Naturalists' Club, from the records of the Club, and embodies the work of the Branch from its establishment in the beginning of the year 1881 to the end of the year 1890.

A list was published in 1882 (TRANSACTIONS O. F. N. C., Vol. I., No. 3, p. 29), enumerating one hundred and sixty-nine species. Of these the following were afterwards struck off the list, having been inserted by mistake:—12, *Harporhynchus cinereus*; 329, *Glaucidium passerinum*, var. *Californicum*; 398, *Egialitis Wilsonius*; 609, *Podiceps cristatus*. The following substitutions were also made:—33, *Parus Hudsonicus* for 34, *P. rufescens*; 125, *Vireo gilvus* for 132, *V. pusillus*; 467, *Rallus Virginianus* for 470, *Porzana Jamaicensis*; 556, *Larus Philadelphia* for 555, *L. Franklinii*. Of those remaining, or since added to the list, it is now thought advisable to drop the following, either because of mistakes in identification, or because sufficient evidence cannot now be adduced to support the records:—*Coturniculus passerinus*, TRANSACTIONS O. F. N. C., Vol. I., No. 3, p. 30; Ibid., No. 4, p. 85; *Steganopus Wilsonii*, Ibid., No. 3, p. 32; *Larus atricilla*, Ibid., p. 44; *Cistothorus stellaris*, Ibid., Vol. II., p. 141. See also OTTAWA NATURALIST, Vol. IV., pp. 93, 162. *Buteo Swainsoni*, OTTAWA NATURALIST, Vol. II., p. 49; *Acanthis linaria rostrata*, Ibid., p. 150; *Geothlypis agilis*, Ibid., p. 150; *Turdus alicia*, Ibid., p. 150. With these changes, the additions made to the old list since its publication bring the number recorded to two hundred and twenty-four. This number includes two species now recorded for the first time by the Club, viz.: No. 11, *Urinator lumme*, and No. 301, *Lagopus lagopus*, besides those mentioned in the Report for the year 1890, which has not yet been published.

The district covered by this list is embraced within a circle of thirty miles radius, with the City of Ottawa as its centre. It includes, roughly speaking, the Counties of Carleton and Russell, in Ontario, and the Southern portion of the County of Ottawa, in Quebec, and lies between 45° and 46° N. lat. The Northern portion of this district is covered by what may be termed the first range of the Laurentian Hills,

one of which, known as King's Mountain, has an elevation of 1,125 feet above sea level, and rises about 900 feet above the large alluvial plain lying between it and the Ottawa River. These hills are covered with a great variety of deciduous and evergreen trees, and among them are numerous mountain lakes, varying in size from mere ponds to lakes of five miles and upwards in length. Flowing from the North through this range of hills, the rapid river Gatineau empties, opposite the city, into the Ottawa, which flows from the West across the centre of the district, widening above the City, with a Southward sweep into a broad and beautiful sheet of water known as Lake Des Chenes, and again narrowing at the City where, falling over a limestone ridge, it forms the well-known Chaudiere Falls. Below these its course is straighter and narrower, and about twenty miles down it receives from the North the waters of another rapid stream, the Du Lievre. South of the Ottawa is a somewhat undulating tract of country, drained principally by the Rideau, which joins the Ottawa at the City. It is rather a sluggish stream in its upper reaches, through being dammed back at various points for canal purposes, and thus affords several excellent resorts for marsh birds. Much good farming land, with occasional hardwood ridges, is to be found in this part of the district, as well as swamps overgrown with tamarac, cedar, and other cone-bearing trees. The largest of these swamps is a peat-bog in Gloucester Township, known as the Mer Bleue, which covers several thousand acres of land, carpeted to a great depth with *sphagnum* moss, and produces immense quantities of berries of many kinds, notably cranberries and blueberries. Thus it will be seen that the district in its various parts offers attractive breeding and feeding grounds for many diverse forms of bird life, and as there are parts of it as yet little explored by the ornithologist, it may still be looked to to yield new records, as well as much valuable information, of the breeding and other habits of many species of which too little is now known.

It is too much to expect that the list has escaped the errors to which a compilation of the kind is so liable, but the compilers trust that when it shall have passed through the purifying fires of criticism, to which it is hoped it will be subjected, it will form a useful basis for future work and study, at least for our local workers.

LIST OF BIRDS OF THE OTTAWA DISTRICT.

The following abbreviations are used :—"S.," summer resident or visitant ; "W.," winter resident or visitant ; "R.," resident ; "M.," migrant ; "B.," known to breed ; "a.," abundant ; "c.," common ; "m. c.," moderately common ; "r.," rare. The numbers prefixed and the nomenclature are those of the A. O. U. Check-list.

ORDER, PYGOPODES—DIVING BIRDS.

PODICIPIDÆ—GREBES.

1. *Aechmophorus occidentalis*, Western Grebe. Casual. A pair were shot at the mouth of the North Nation river previous to 1881. The skins spoiled before they could be attended to. (G. R. White.)
2. *Colymbus holboëllii*, Holboëll's Grebe. M. r. A young male was shot by Mr. W. F. Whitcher in October, 1881, out of a flock of eight, in Campbell's Bay, about 28 miles down the Ottawa. It was also reported in 1885 and 1889.
3. *Colymbus auritus*, Horned Grebe. S. m. c. B.
6. *Podilymbus podiceps*, Pied-billed Grebe. S. c. B.

URINATORIDÆ—LOONS.

7. *Urinator imber*, Loon. S. c. B.
11. " *lumme*, Red-throated Loon. M. r. A young female was shot on the Ottawa 12th November, 1885, by Mr. T. R. Coursolles and presented to the Museum of the Geological and Natural History Survey.

ALCIDÆ—AUKS, MURRES, PUFFINS, ETC.

13. *Fratercula arctica*, Puffin. Casual. A young bird of this species was shot on the Ottawa towards the end of October, 1881. It was probably blown inland by a severe storm which took place some days before.

ORDER, LONGIPENNES—LONG-WINGED SWIMMERS.

LARIDÆ—GULLS AND TERNS.

47. *Larus marinus*, Great Black-backed Gull. Casual. One was seen May 2nd, 1885, near Kettle Island on the Ottawa, in com-

- pany with ten or twelve American Herring Gulls. (G. R. White.)
- 51a. *Larus argentatus smithsonianus*, American Herring Gull. S. m.c. B. Most common in spring and fall. Found breeding in the lakes north of Ottawa.
60. *Larus philadelphia*, Bonaparte's Gull. S. m.c. May be found to breed, as it has been seen as late as June 9th (1885.)
70. *Sterna hirundo*, Common Tern. Casual. A male shot near St. Louis dam, on the Rideau Canal, June 29th, 1885, and another on the Ottawa, August 27th, 1887.
77. *Hydrochelidon nigra surinamensis*, Black Tern. Casual. Six, including both males and females, were shot 28th May, 1888, on the Ottawa, by Mr. E. White.

ORDER, STEGANOPODES—TOTIPALMATE BIRDS.

PHALACROCORACIDÆ—CORMORANTS.

120. *Phalacrocorax dilophus*, Double-crested Cormorant. Casual. A young bird of this species was shot about 1st October, 1890, at Shirley's Bay, near Britannia, on the Ottawa, by Mr. C. G. Rogers.

ORDER, ANSERES—LAMELLIROSTRAL SWIMMERS.

ANATIDÆ—DUCKS, GEESE AND SWANS.

129. *Merganser americanus*, American Merganser. M. c.
130. " *serrator*, Red-breasted Merganser. M. r.
131. *Lophodytes cucullatus*, Hooded Merganser. S. a. B.
132. *Anas boschas*, Mallard. M. r.
133. " *obscura*, Black Duck. S. c. B.

NOTE.—Two ducks, a male and female, apparently hybrids between the two last named species, were shot by Mr. G. R. White on the Ottawa in 1882.

135. *Anas strepera*, Gadwall. Casual. A female was shot on the Ottawa, from a small flock, October 29th, 1885, by Mr. W. F. Whitcher.
137. *Anas americana*, Baldpate. M. r.
139. " *carolinensis*, Green-winged Teal, M. m.c.

140. *Anas discors*, Blue-winged Teal. M. m.c. A few may breed.
142. *Spatula clypeata*. Shoveller. Casual. A few were shot on the Rideau in the Fall of 1882; two were seen on the Ottawa in October, 1883, (both females), and two were shot by Mr. W. P. Lett in 1886, one at Richmond and the other at Brigham's Creek.
143. *Dafila acuta*, Pintail. M. r.
144. *Aix sponsa*, Wood Duck. S. c. B.
146. *Aythya americana*, Redhead. M. a.
147. " *vallisneria*, Canvas-back. M. r.
148. " *marila nearctica*, American Scaup Duck. M. m.c.
149. " *affinis*, Lesser Scaup Duck. M. c.
150. " *collaris*, Ring-necked Duck. M. c.
151. *Glaucionetta clangula americana*, American Golden-eye. W. r. Common in migration.
153. *Charitonetta albeola*, Buffle-head. M. c.
154. *Clangula hyemalis*, Old Squaw. M. c. A pair in full breeding plumage were obtained by Mr. E. White in the Spring of 1887 from a person who had just shot them on the Rideau.
160. *Somateria dresseri*, American Eider. Casual. A young male in the plumage of the female was shot by Mr. G. R. White on the Ottawa, below the City, 9th November, 1889. A male in mature plumage, said to have been shot on the Gatineau, was seen on the By Ward market about the same time.
163. *Oidemia americana*, American Scoter. M. c.
165. " *deglandi*, White-winged Scoter. M. c.
166. " *perspicillata*, Surf Scoter. M. r.
167. *Erismatura rubida*. Ruddy Duck. M. m.c. This species appeared in large numbers in the fall of 1882, arriving early and staying late.
- 169a. *Chen hyperborea nivalis*, Greater Snow Goose. M. r. On November 1st, 1884, Mr. S. Herring, the Taxidermist of the Geological and Natural History Survey, "put up" a bird of this species from a stubble field on the Ontario side of the Ottawa, and, although he did not secure it, is quite positive as to its identity. The late Dr. Van Cortlandt shot one just above the

Chaudiere Falls about 1867, the head and wings of which were in the possession of the Ottawa Literary and Scientific Society until destroyed by moths.

- 169.1. *Chen caerulescens*, Blue Goose. Casual. Two geese and a gander of this species were shot 11th October, 1886, within a few miles of the City. (G. R. White.) The bills and feet were black instead of being lake-red as in Dr. Coues's description, but the birds corresponded with it in every other particular.
172. *Branta canadensis*, Canada Goose. M. c.
173. *Branta bernicla*, Brant. Casual. One was shot by Mr. P. Thompson on a sand-bar some thirty miles down the Ottawa in the fall of 1887, and identified by comparison with Audubon's colored plate of the species.

ORDER, HERODIONES—HERONS, STORKS, IBISES, &c.

ARDEIDÆ—HERONS, BITTERNS, &c.

190. *Botaurus lentiginosus*, American Bittern. S. c. B.
191. " *exilis*, Least Bittern. S. r. B.
194. *Ardea herodias*, Great Blue Heron. S. c. B. For accounts of visits to the heronry of this species, near Thurso, see TRANSACTIONS O. F. N. C., Vol. I., No. 4, p. 81, and Vol. II., p. 141.
202. *Nycticorax nycticorax nevius*, Black-crowned Night Heron. S. m.c. B. Young of this species have been taken here in July. (G. R. White.)

ORDER, PALUDICOLÆ—CRANES, RAILS, &c.

RALLIDÆ—RAILS.

212. *Rallus virginianus*, Virginia Rail. S. m.c. B.
214. *Porzana carolina*, Sora. S. c. B. One found dead in Mr. R. B. Whyte's garden in the City, 13th July, 1889, apparently having flown against some object in the night.
219. *Gallinula galeata*, Florida Gallinule. S. c. B. A nest of this species, with seven eggs partly incubated, was taken near Kars, on the Rideau, 9th July, 1890, by Messrs. W. E. and F. A. Saunders.
221. *Fulica americana*, American Coot. S. c. B.

ORDER, LIMICOLÆ—SHORE BIRDS.

PHALAROPODIDÆ—PHALAROPES.

222. *Crymophilus fulicarius*, Red Phalarope. Casual. One shot 21st October, 1886, at Cummings's Island, in the Rideau, by Mr. E. White, and another, a young one, on the Ottawa, 1st September, 1888, by Mr. G. R. White.
223. *Phalaropus lobatus*, Northern Phalarope. Casual. One was obtained by Mr. A. G. Kingston, on 10th September, 1890, which had just been shot near Burritt's Rapids on the Rideau.

SCOLOPACIDÆ—SNIPES, SANDPIPERS, &C.

228. *Philohela minor*, American Woodcock. S. m.c. B.
230. *Gallinago delicata*, Wilson's Snipe. S. m.c. B.
231. *Macrorhamphus griseus*, Dowitcher. Casual. A pair were shot May 22nd, 1890, by Mr. E. White.
234. *Tringa canutus*, Knot. M. r. A male in full breeding plumage was shot by Mr. E. White 4th June, 1890.
235. *Tringa maritima*, Purple Sandpiper. Casual. One shot on the Rideau 29th October, 1885, by Mr. W. Forbes.
239. *Tringa maculata*, Pectoral Sandpiper. M. c.
240. " *fuscollis*, White-rumped Sandpiper. M. r. One shot in 1883, and five in 1884. Of the latter Mr. E. White got two on 8th October and one on 18th, and Mr. S. Herring two on 27th.
242. *Tringa minutilla*, Least Sandpiper. M. m.c.
- 243a. " *alpina pacifica*, Red-backed Sandpiper. M. r. One shot 2nd October, 1885.
246. *Ereunetes pusillus*, Semipalmated Sandpiper. M. m.c.
248. *Calidris arenaria*, Sanderling. M. m.c.
251. *Limosa hæmastica*, Hudsonian Godwit. M. r.
154. *Totanus melanoleucus*, Greater Yellow-legs. M. c.
255. " *flavipes*, Yellow-legs. M. c.
256. " *solitarius*, Solitary Sandpiper. S. c. B.
262. *Tryngites subruficollis*, Buff-breasted Sandpiper. M. r. One shot on an island in the Ottawa, near Templeton, by Mr. E. White, 24th August, 1886.
263. *Actitis macularia*, Spotted Sandpiper. S. a. B.

CHARADRIIDÆ—PLOVERS.

270. *Charadrius squatarola*, Black-bellied Plover, M. c.
 272. " *dominicus*, American Golden Plover. M. c.
 273. *Ægialitis vocifera*, Killdeer. M. r. A few breed (G. R. White.)
 274. " *semipalmata*, Semipalmated Plover. M. r.

APHRIZIDÆ—SURF BIRDS AND TURNSTONES.

283. *Arenaria interpres*, Turnstone. M. r.

ORDER, GALLINÆ—GALLINACEOUS BIRDS.

TETRAONIDÆ—GROUSE, PARTRIDGES, &C.

298. *Dendragapus canadensis*, Canada Grouse. R. m.c. B.
 300a. *Bonasa umbellus togata*, Canadian Ruffed Grouse. R. a. B.
 301. *Lagopus lagopus*, Willow Ptarmigan. Casual. One shot on the Gatineau in the winter of 1885-6 is now in the collection of Mr. G. R. White.

ORDER, COLUMBÆ—PIGEONS.

COLUMBIDÆ—PIGEONS.

315. *Ectopistes migratorius*, Passenger Pigeon. S. r. B.

ORDER, RAPTORES—BIRDS OF PREY.

FALCONIDÆ—HAWKS, FALCONS, EAGLES, &C.

327. *Elanoides forficatus*, Swallow-tailed Kite. Casual. One was seen by Lt.-Col. White and Mr. G. R. White, perched on a flagstaff at the Rideau Rifle Range. Though not secured it was closely examined through a glass, and no doubt exists as to its identity. The date was not noted, but it was previous to 1881.
 331. *Circus hudsonius*, Marsh Hawk. S. c. B.
 332. *Accipiter velox*, Sharp-shinned Hawk. R. c. B.
 333. " *cooperi*, Cooper's Hawk. S. r.
 334. " *atricapillus*, American Goshawk. W. r.
 337. *Buteo borealis*, Red-tailed Hawk. S. r. B.
 339. " *lineatus*, Red-shouldered Hawk. S. r. This species was not recorded here till 24th September, 1888, when Mr. G. R. White shot one near the quarries on the Montreal Road.
 343. *Buteo latissimus*, Broad-winged Hawk. S. c. B.

- 347a. *Archibuteo lagopus sancti-johannis*, American Rough-legged Hawk. M. r.
349. *Aquila chrysaetos*, Golden Eagle. R. r. B. A female was shot 30th October, 1883, near Casselman, by Mr. J. S. Castleman, and another was seen near the same place shortly afterwards. There are other records of its occurrence in the district. It breeds in the Laurentian Hills (G. R. White.)
352. *Haliaeetus leucocephalus*, Bald Eagle. R. r. B. On 21st March, 1888, one was seen flying low over the Rideau Rifle Range. Several have been shot or taken alive in the Gatineau district, and its nest has been seen at Lake Wilson, near Wakefield.
- 354a. *Falco rusticolus gyrfalco*, Gyrfalcon. Casual. One was shot by Mr. E. White on the bank of the Rideau, below Cummings's Bridge, on 23rd December, 1890. One was shot here before, but not recorded as the skin was lost (G. R. White.)
356. *Falco peregrinus anatum*, Duck Hawk. M. r. One was seen flying low over the Rifle Range 28th April, 1889, by Mr. G. R. White and others, and another was seen at King's Mountain 11th July, 1890, by Messrs. W. E. and F. A. Saunders. A third was shot and wounded, but not secured, by Mr. F. A. Saunders, 22nd September, 1890.
357. *Falco columbarius*, Pigeon Hawk. M. r. One was seen in the City 19th December, 1890, eating an "English" Sparrow (W. A. D. Lees.)
360. *Falco sparverius*, American Sparrow-Hawk. S. c. B. A winter record for this species is 26th January, 1890.
364. *Pandion haliaetus carolinensis*, American Osprey. S. m.c. B.
- BUBONIDÆ—HORNED OWLS.
366. *Asio wilsonianus*, American Long-eared Owl. S. r. One shot by Mr. F. A. Saunders near the Experimental Farm 7th July, 1890. This is the only record.
367. *Asio accipitrinus*, Short-eared Owl. R. r. A pair were shot 6th October, 1883, by Mr. G. R. White, and one was seen on 28th of same month by Mr. W. L. Scott. It has not been reported since.
368. *Syrnium nebulosum*, Barred Owl. R. m.c.

371. *Nyctala tengmalmi richardsoni*, Richardson's Owl. W. r. Shot by Mr. G. R. White January 1st and November 29th, 1884, and seen by Mr. W. A. D. Lees and others February 21st, 1889.
372. *Nyctala acadica*, Saw-whet Owl. R. m.c.
375. *Bubo virginianus*, Great Horned Owl. R. r.
376. *Nyctea nyctea*, Snowy Owl. W. r.
- 377a. *Surnia ulula caparoch*, American Hawk Owl. W. r.

ORDER, COCCYGES—CUCKOOS.

CUCULIDÆ—CUCKOOS, ANIS, &c.

387. *Coccyzus americanus*, Yellow-billed Cuckoo. S. r. B. A pair nested in Lt.-Col. White's garden in this City in 1890. The female was shot June 27th, but the male and young escaped.
388. *Coccyzus erythrophthalmus*, Black-billed Cuckoo. S. c. B.

ALCEDINIDÆ—KINGFISHERS.

390. *Ceryle alcyon*, Belted Kingfisher. S. a. B.

ORDER, PICI—WOODPECKERS.

PICIDÆ—WOODPECKERS.

- 393a. *Dryobates villosus leucomelas*, Northern Hairy Woodpecker. R. c. B.
394. *Dryobates pubescens*, Downy Woodpecker. R. a. B. Most abundant in the spring migration.
400. *Picoides arcticus*, Arctic Three-toed Woodpecker. R. m.c. Probably resident in the Laurentian Hills, as it is seen here in September and October.
401. *Picoides americanus*, American Three-toed Woodpecker. R. r. One shot 5th November, 1883 (G. R. White.) Probably also resident within the district. Seen 28th and 29th September and 12th and 13th October, 1890, in company with the last, (F. A. Saunders.)
402. *Sphyrapicus varius*, Yellow-bellied Sapsucker. S. c. B. Commoner in migration than at other times.
405. *Ceophloeus pileatus*, Pileated Woodpecker. R. r. B. It is not uncommon in the hills north of us, where it known as "Wood-

cock," and is occasionally sent to our game dealers braced with
 "Pa'tridge" (Ruffed Grouse).

406. *Melanerpes erythrocephalus*, Red-headed Woodpecker. S. c. B.

412. *Colaptes auratus*, Flicker. S. a. B.

ORDER, MACROCHIRES—GOATSUCKERS, SWIFTS, &c.

CAPRIMULGIDÆ—GOATSUCKERS, &c.

417. *Antrostomus vociferus*, Whippoorwill. S. c. B.

420. *Chordeiles virginianus*, Night Hawk. S. a. B.

MICROPODIDÆ—SWIFTS.

423. *Chaetura pelagica*, Chimney Swift. S. a. B. In the first week of February, 1883, a Chimney Swift came down a chimney in the house of Mr. J. F. Whiteaves, Assistant Director of the Geological and Natural History Survey. It was caught and examined by him, and remained alive for several days. A similar instance is known to have occurred in Toronto.

TROCHILIDÆ—HUMMINGBIRDS.

428. *Trochilus colubris*, Ruby-throated Hummingbird. S. c. B. A nest with two fresh eggs was taken 12th July, 1890, by Messrs. W. E. and F. A. Saunders.

ORDER, PASSERES—PERCHING BIRDS.

TYRANNIDÆ—TYRANT FLYCATCHERS.

444. *Tyrannus tyrannus*, Kingbird. S. a. B.

452. *Myiarchus crinitus*, Crested Flycatcher. S. m.c. B.

456. *Sayornis phæbe*, Phæbe. S. c. B.

459. *Contopus borealis*, Olive-sided Flycatcher. S. r. A pair were shot near the City 24th May, 1883, and it has been occasionally seen since.

461. *Contopus virens*, Wood Pewee. S. c. B.

463. *Empidonax flaviventris*, Yellow-bellied Flycatcher. S. r. B. The taking of the nest of this species is recorded in the Report of the Branch for the year 1881, but the bird is not mentioned in the old list, appended to that report. It is added as a species new

to the list by the report for 1884, one having been shot by Mr. E. White on May 26th of that year.

- 466a. *Empidonax pusillus traillii*, Traill's Flycatcher. S. m.c. This species seems to have become rather common here in the last two years. It was considered rare before.
467. *Empidonax minimus*, Least Flycatcher. S. c. B.

ALAUDIDÆ—LARKS.

474. *Otocoris alpestris*, Horned Lark. M. a. The Horned Larks of this district were, for the first time, satisfactorily determined and distinguished in the spring of 1890. This species arrived 19th April, and remained together in flocks till May 25th, when it departed. It was again present in the fall, from September 26th to October 28th.
- 474b. *Otocoris alpestris praticola*, Prairie Horned Lark. S. c. B. This sub-species arrives in the end of February or beginning of March, remains all summer to breed, and leaves about the beginning of November.

CORVIDÆ—CROWS, JAYS, MAGPIES, &C.

477. *Cyanocitta cristata*. Blue Jay. R. c. B.
484. *Perisoreus canadensis*, Canada Jay. R. c. B. This species rarely visits the immediate neighborhood of the City, though common in the hills to the north of it.
- 486a. *Corvus corax principalis*, Northern Raven. R. m.c. B.
488. " *americanus*. R. B. Abundant in summer but scarce in winter.

ICTERIDÆ—BLACKBIRDS, ORIOLES, &C.

494. *Dolichonyx oryzivorus*, Bobolink. S. c. B.
495. *Molothrus ater*, Cowbird. S. a. B. On 11th July, 1882, two eggs of this bird almost hatched were found in the nest of a Vireo (presumably *V. olivaceus*), no eggs of the latter being present. A similar case, with three eggs instead of two, is recorded in *The Canadian Sportsman and Naturalist* for June, 1883.
498. *Agelaius phoeniceus*, Red-winged Blackbird. S. c. B.
501. *Sturnella magna*, Meadowlark. S. m.c. B.

507. *Icterus galbula*, Baltimore Oriole. S. c. B.
509. *Scolecophagus carolinus*, Rusty Blackbird. M. a. It probably breeds sparingly.
- 511b. *Quiscalus quiscula cneus*, Bronzed Grackle. S. a. B.
- FRINGILLIDÆ—FINCHES, SPARROWS, &c.
515. *Pinicola enucleator*, Pine Grosbeak. W. Irregularly abundant. It appeared in immense numbers in the winter of 1882-3, and again in 1888-9, as did many other of our winter birds.
517. *Carpodacus purpureus*, Purple Finch. S. c. B. Abundant in migration. There are a few winter records of this species, one of which is 29th December, 1885.
521. *Loxia curvirostra minor*, American Crossbill. W. c. Summer records are as follows:—10th May, 1882; 4th August, 1887; 19th June, 1889; 3rd July, 1890.
522. *Loxia leucoptera*, White-winged Crossbill. W. c. A large flock was seen near Beechwood Cemetery in June, 1882.
- 527a. *Acanthis hornemanni exilipes*, Hoary Redpoll. W. r. Specimens of this bird, taken by Mr. W. L. Scott in the spring of 1883 were identified by Dr. Coues. It is also included in the list of arrivals for 1887 on March 19th.
528. *Acanthis linaria*, Redpoll. W. a. Summer records are 6th June, 1882; 3rd June, 1888; 22nd May, 1890.
529. *Spinus tristis*, American Goldfinch. S. a. B. It occasionally winters here in large flocks. It did so in 1888-9.
533. *Spinus pinus*, Pine Siskin. W. c. Somewhat irregular in its visits like most of our winter birds. Summer records are as follows:—10th May, 1882; 15th May and 15th August, 1884; 2nd May, 1888; 16th May, 1890.
- *Passer domesticus*, European House Sparrow. R. a. B. Introduced. An intolerable nuisance.
534. *Plectrophenax nivalis*, Snowflake. W. a.
536. *Calcarius lapponicus*, Lapland Longspur. M. c. This species was first recorded here in the spring of 1890, when, in company with Horned Larks, (*O. alpestris*), and Snowflakes, it remained in flocks till May 25th. It was again present in the fall from October 3rd to November 18th.

540. *Pooecetes gramineus*, Vesper Sparrow. S. a. B.
 542a. *Ammodramus sandwichensis savanna*, Savanna Sparrow. S. c. B.
 549. *Ammodramus caudacutus*, Sharp-tailed Sparrow. Casual. One shot in 1882 and identified by Dr. Coues. It would probably now be referred to 549b, *A. c. subvirgatus*, Dwight.
 554. *Zonotrichia leucophrys*, White-crowned Sparrow. M. c.
 558. " *albicollis*, White-throated Sparrow. S. c. B.
 559. *Spizella monticola*, Tree Sparrow. M. c.
 560. " *socialis*, Chipping Sparrow. S. c. B.
 563. " *pusilla*, Field Sparrow. S. r. In each of the years 1888, 1889 and 1890, at least one of this species has been observed several times through the summer.
 567. *Junco hyemalis*, Slate-colored Junco. S. m.c. B. Abundant in spring and fall.
 581. *Melospiza fasciata*, Song Sparrow. S. a. B.
 583. " *lincolni*, Lincoln's Sparrow. Casual. A male of this species was shot 16th May, 1884, near the East end of the City, by Mr. G. R. White.
 584. *Melospiza georgiana*, Swamp Sparrow. S. m.c. B.
 585. *Passerella iliaca*, Fox Sparrow. M. m.c.
 595. *Habia ludoviciana*, Rose-breasted Grosbeak. S. m.c. B.
 598. *Passerina cyanea*, Indigo Bunting. S. m.c. B.

TANAGRIDÆ—TANAGERS.

608. *Piranga erythromelas*, Scarlet Tanager. S. m.c. B.

HIRUNDINIDÆ—SWALLOWS.

611. *Progne subis*, Purple Martin. S. c. B.
 612. *Petrochelidon lunifrons*, Cliff Swallow. S. c. B.
 613. *Chelidon erythrogaster*, Barn Swallow. S. a. B.
 614. *Tachycineta bicolor*, Tree Swallow. S. a. B.
 616. *Clivicola riparia*, Bank Swallow. S. a. B. A set of *spotted* eggs of this species was taken here in 1881.

AMPELIDÆ—WAXWINGS.

618. *Ampelis garrulus*, Bohemian Waxwing. W. It is now many years since this bird has visited us in large numbers.
 619. *Ampelis cedrorum*, Cedar Waxwing. S. c. B.

LANIIDÆ—SHRIKES.

621. *Lanius borealis*, Northern Shrike. W. m.c.
 622a. “ *ludovicianus excubitorides*, White-rumped Shrike. S. r. B.
 On 22nd July, 1890, Mr. A. G. Kingston received from Capt. Veith a shrike which seemed about midway between this variety and the typical *ludovicianus*.

VIREONIDÆ—VIREOS.

624. *Vireo olivaceus*, Red-eyed Vireo. S. a. B.
 626. “ *philadelphicus*, Philadelphia Vireo. S. r. As this species is not easily distinguished from the next it may be commoner than is generally supposed.
 627. *Vireo gilvus*, Warbling Vireo. S. a. B.
 628. “ *flavifrons*, Yellow-throated Vireo. S. r.
 629. “ *solitarius*, Blue-headed Vireo. S. m.c.

MNIOTILTIDÆ—WOOD WARBLERS.

636. *Mniotilta varia*, Black and White Warbler. S. c. B. Commoner in migration than in summer.
 645. *Helminthophila ruficapilla*, Nashville Warbler. S. r. B. A nest of this species with four eggs was taken in Dow's Swamp 13th July, 1881. In 1882 the bird was noted as “quite common.”
 646. *Helminthophila celata*, Orange-crowned Warbler. Casual. A male was shot by Mr. E. White 27th September, 1885, near the Eastern end of the City.
 647. *Helminthophila peregrina*, Tennessee Warbler. M. r. One was shot on the bank of the Rideau 9th April, 1882, by Mr. G. R. White. Another was shot May 16th, 1888.
 648. *Compsothlypis americana*, Parula Warbler. M. m.c.
 650. *Dendroica tigrina*, Cape May Warbler. M. r. A pair were shot by Mr. E. White near the Rideau 24th May, 1883. Further records are 7th June, 1885; 11th May, 1887; 16th May, 1888.
 652. *Dendroica æstiva*, Yellow Warbler. S. a. B.
 654. “ *cærulescens*, Black-throated Blue Warbler. M. m.c.
 655. “ *coronata*, Myrtle Warbler. M. a. Has been seen all through the summer and probably breeds in the Mer Bleue.

657. *Dendroica maculosa*, Magnolia Warbler. M. m.c. Found at the Mer Bleue 3rd July, 1890 (W. E. Saunders).
659. *Dendroica pensylvanica*, Chestnut-sided Warbler. S. c. B.
660. " *castanea*, Bay-breasted Warbler. M. m.c.
661. " *striata*, Black-poll Warbler. M. m.c.
662. " *blackburniae*, Blackburnian Warbler. M. c. A male in full plumage was seen in Dow's Swamp June 24th, 1890 (F. A. Saunders).
667. *Dendroica virens*, Black-throated Green Warbler. S. m.c.
671. " *vigorsii*, Pine Warbler. S. r.
672. " *palmarum*, Palm Warbler. S. c. B. This species was found common and breeding in the Mer Bleue 3rd July, 1890, by Messrs. W. E. and F. A. Saunders, and several of the young were shot. It was again seen there August 9th.
- 672a. *Dendroica palmarum hypochrysea*, Yellow Palm Warbler. M. r. Latest record May 6th and 8th, 1888.
674. *Seiurus aurocapillus*, Ovenbird. S. c. B.
675. " *noveboracensis*, Water Thrush. S. m.c. B.
679. *Geothlypis philadelphia*, Mourning Warbler. S. m.c. B.
681. " *trichas*, Maryland Yellow-throat. S. c. B.
685. *Sylvania pusilla*, Wilson's Warbler. S. m.c. B. Found breeding in the Mer Bleue 3rd July, 1890, by Messrs. W. E. and F. A. Saunders.
686. *Sylvania canadensis*, Canadian Warbler. S. m.c. B.
687. *Setophaga ruticilla*, American Redstart. S. c. B.

MOTACILLIDÆ—WAGTAILS.

697. *Anthus pensilvanicus*, American Pipit. M. a.

TROGLODYTIDÆ—WRENS, THRASHERS, &C.

704. *Galeoscoptes carolinensis*, Catbird. S. c. B.
705. *Harporhynchus rufus*, Brown Thrasher. S. m.c. B.
721. *Troglodytes ædon*, House Wren, S. a. B.
722. " *hiemalis*, Winter Wren. S. m.c. B.
725. *Cistothorus palustris*, Long-billed Marsh Wren. S. c. B.

CERTHIIDÆ—CREEPERS.

726. *Certhia familiaris americana*, Brown Creeper. M. c. Winter

records are 8th December, 1883, and 18th February and 5th December, 1885.

PARIDÆ—NUTHATCHES AND TITS.

727. *Sitta carolinensis*, White-breasted Nuthatch. R. c. B.
 728. “ *canadensis*, Red-breasted Nuthatch. R. c. B.
 735. *Parus atricapillus*, Chickadee. R. c. B.
 744. “ *hudsonicus*, Hudsonian Chickadee. W. m.c. Early fall records for this species are 31st October, 1883, and 20th October, 1889.

SYLVIIDÆ—KINGLETS, GNATCATCHERS, &C.

748. *Regulus satrapa*, Golden-crowned Kinglet. M. c.
 749. “ *calendula*, Ruby-crowned Kinglet. M. c.
 751. *Polioptila cærulea*, Blue-gray Gnatcatcher. Casual. One was shot by Mr. G. R. White previous to 1881. The skin has since been lost, but was seen at the time by Mr. W. L. Scott, who is satisfied of its identity.

TURDIDÆ—THRUSHES, BLUEBIRDS, &C.

755. *Turdus mustelinus*, Wood Thrush. S. r. B.
 756. “ *fuscescens*, Wilson's Thrush. S. c. B.
 758a. “ *ustulatus swainsonii*, Olive-backed Thrush. S. r.
 759b. “ *aonalaschkæ pallasii*, Hermit Thrush. S. c. B.
 761. *Merula migratoria*, American Robin. S. a. B. Winter records are : 20th December, 1881, 8th March, 1882, and 15th November, 1883. Mr. G. R. White has in his collection a peculiarly colored robin, a description of which is to be found in TRANSACTIONS O. F. N. C., Vol. II., p. 356.
 766. *Sialia sialis*, Bluebird. S. c. B.

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EXCURSION NO. 1—To KINGSMERE, Saturday, May 16. Members' tickets 50c, Non-members 60c, Children 30c.

ANNUAL REPORT OF THE COUNCIL.

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

LADIES AND GENTLEMEN,—It has been the pleasing duty of the Council—since the formation of the Club—to report its affairs in a more prosperous state each succeeding year, but at no previous period has the condition of the Club been so satisfactory, or the success achieved during any year, been equal to that which has attended it during the one just ending.

At the close of last year the membership was 232, and now—after revising the list and deducting the lapses through death, removal and resignation—it stands at 296. There were 66 new members elected during the year.

There were five general excursions held during the summer ; the first was on the 31st of May, to Butternut Grove, near Old Chelsea ; the second on the 21st of June, to Casselman ; the third on the 19th of July, to Montebello ; the fourth on the 9th of August, to Eastman's Springs, and the fifth on the 6th of September, to Kirk's Ferry, on the Gatineau River. Besides these excursions a number of the members availed themselves of the invitation given by the Montreal Natural History Society, and met the members of that body at Lachute, P.Q., on the 7th of June.

Sub-excursions were also carried on throughout the season, as usual, to different points of interest within easy reach of the City.

The winter course of meetings was arranged as formerly, and consisted of Soirées and Afternoon Lectures. The Soirées were held on alternate Thursday evenings, in the Lecture room of the Normal School building, and the papers read at them were as follows :—

1890.

Dec. 11.—Science as an Aid to Education, by Dr. McCabe.

The President's Inaugural Address, by Dr. Ells.

1891.

Jan. 15.—Report of the Zoological Branch.

Asbestos, by Dr. Ells.

" 29.—Report of the Ornithological Branch.

The Chimney Swift, by Mr. Kingston.

Feb. 12.—Report of the Botanical Branch.

The Development of Cultivated Fruits from Wild Varieties,
by Mr. John Craig.

“ 26.—Canadian Gems, by Mr. Willimott.

March 3.—Report of the Geological Branch.

Additional Notes on Geology and Palæontology of Ottawa
by Mr. Ami.

“ 12.—Report of the Entomological Branch.

Mineral Phosphates, by Mr. Lainson Wills.

The Monday afternoon elementary lectures were commenced on 12th January, and continued every Monday afternoon at 4.15 up to the 9th of March, and were nine in number, as follows :—

The Study of Natural History, by Miss M. A. Mills.

The Geographical Distribution of Plants, by Prof. Macoun.

The Educational Value of Botanic Gardens, by Mr. Fletcher.

The Physiology of Plants, by Mr. W. Scott.

The Migration of Birds, by Mr. Lees.

The True Bugs, by Mr. Harrington.

Two Lectures on the Chemistry of Food, by Mr. Shutt.

Beneficial Birds, by Mr. Kingston.

The large attendance at these lectures of teachers and students of the Normal and Model Schools, especially at the afternoon lectures was very gratifying.

In addition to the courses of lectures, a series of sub-excursions to the Geological Survey Museum took place on the 2nd and 4th Saturday afternoons of each month, from November to March, at which interesting addresses were kindly given by the following officers of the Survey on the Geological and Natural History exhibits in that building: Mr. Whiteaves, Prof. Macoun, Dr. Dawson, Mr. Ami and Mr. Ferrier.

From the Treasurer's report, which will now be submitted, it will be seen that the collection of membership and other dues has been one of the features of the year's success. Many members who were in arrears have paid up, which has considerably swollen the receipts, and, after settling all claims against the Club, there will remain a comparatively large balance to be carried to the incoming year's account.

The Librarian's report shows that this important department is also in a very satisfactory condition, and that the small appropriation which was made through the judicious management of the Club's finances, for binding, has been expended in that way to the very best advantage.

The authority given to the Council at the last annual meeting, to use its own discretion as to the manner of publishing the OTTAWA NATURALIST, was promptly acted upon at the beginning of the year; the monthly number was adopted, and the Editor and his assistants deserve much credit for the satisfactory manner in which the journal has been conducted, and for its prompt issue throughout the year.

As the members have been kept well posted through the pages of the NATURALIST, on all matters of interest in connection with the work of the Club, it is not considered necessary to further enlarge this report.

In conclusion, your Council cannot too strongly emphasize the importance of, and the advantages which have accrued to the Club, by the acquisition—through the kindness of Dr. MacCabe—of the use of rooms for lecturing and library purposes in the Normal School building. When this and the other important changes and features of the year's success are taken into consideration—such as the enlarged range of the Club's operations, the addition of lady members on the Council, the successful publication of the NATURALIST in monthly parts, the great addition to the membership, the large attendance at lectures, and the increased activity in the working ranks—the twelfth year may well be considered as marking an epoch in the Club's existence.

It is considered well to state here—in order that it may be discussed at this meeting if necessary—that the International Congress of Geologists has invited the members of this Club to take part in, or send delegates to, the meeting of the Congress which is to take place on the 26th of August next, at Washington, D.C.

Respectfully submitted on behalf of the Council.

T. J. MACLAUGHLIN,
Secretary.

ON THE NICKEL AND COPPER DEPOSITS OF SUDBURY, ONT.

By Alfred E. Barlow, M.A., Geological Survey Department,

(Read before the Logan Club, Ottawa, March 6th, 1891.)

Published by permission of Dr. Selwyn, Director Geological Survey.

The presence of large deposits of nickel and copper in the District of Algoma, Ontario, has of late years attracted world-wide attention, in the first place on account of their immense and apparently inexhaustible character, but latterly because of the proposed application of nickel in alloy with steel to improve the quality of the latter. The existence of workable deposits of copper in this region was a fact that had long been known, and as far back as 1770 a company had been formed and attempts made to mine this metal, but the difficulty of procuring and maintaining miners at so great a distance from any centre of civilization, the remoteness of any market for the ore, as well as the absence of facilities for transportation, rendered these first attempts abortive. However, in 1846, owing to the activity in prospecting and locating mineral lands on the southern shore of Lake Superior, and a favourable report by Mr. W. E. Logan, then newly appointed Provincial Geologist, some enterprising Canadians banded themselves together into two associations called "The Montreal Mining Co'y," and the "Upper Canada Mining Co'y." The former company having purchased, amongst others, what was then known as "The Bruce Mines" location, and on account of the richness of the deposit decided to commence active work at this locality, while the Upper Canada Co'y proceeded to develop and work what was known as the "Wallace Mine," at the mouth of the Whitefish River. The Montreal Mining Co'y continued their operations from 1846 to 1865, when, from a variety of causes, the work proving unremunerative, they sold out the whole of their claim to the "West Canada Mining Co'y," who had previously leased and worked the western half of the location under the name of the Wellington Mine. This company continued working till 1876 when, owing to unsatisfactory results, work was suspended and has not been resumed since. The Wallace Mine was chosen on account of its promising character and proximity to civilization, and is chiefly remarkable as having been the first place in Canada in which the presence of nickel had been detected.

According to Mr. Alex. Murray, of the Geological Survey of Canada, who made an examination of the location in 1848, "No true vein can be discovered, but the ore occurs at the contact of quartzose and chloritic slates with diorite, as bunches and strings of pyritous matter, interlaminated irregularly with the slates, and distributed in specks and patches in the diorite. Abundant evidence of disturbance is displayed in irregularities of dip and intrusion of the diorite. The material collected for assay was chosen as free as possible from copper pyrites, but nearly two-fifths of the specimen consisted of earthy materials which might readily be separated by dressing," (See Report Geological Survey of Canada, 1848-49, p. 42—45.) Dr. T. Sterry Hunt, in his report on this ore, says that "the specimen is a steel grey arseniuret, the species not determined, with white iron pyrites and probably some arsenical sulphuret of iron. The mass, weighing 45 oz., was reduced to powder and submitted to analysis, with the following results:—

Iron.....	24.78
Nickel, with trace of cobalt.....	8.26
Arsenic.....	3.57
Sulphur.....	22.63
Copper.....	.06
Earthy materials.....	40.01
	<hr/>
	99.31

In the process of washing the ore, the earthy parts being removed by washing, the composition of the ore in 100 parts, as deduced by calculation from the above, would be—

Iron.....	41.79
Nickel and cobalt.....	13.93
Arsenic.....	6.02
Sulphur.....	38.16
Copper.....	.10

From the small proportion of arsenic the nickel must, in part at least, be present in a state of sulphuret, a fact which is, indeed, made evident by the spontaneous oxidation of the ore. The nickel from this

source contained about three parts in a thousand of cobalt. In conclusion, he remarks that in the same bands of rocks we may detect the presence of nickel and cobalt, a prophecy which has since been amply verified.

A mass of copper pyrites from the same mine weighing $9\frac{1}{2}$ lbs. was also assayed, which yielded 11.6 per cent. of metallic copper. Acting on these and other favourable reports, the company began to sink shafts to test the extent and the quality of the ore, and one of these shafts at least attained a depth of 10 or 15 fathoms. Work was carried on energetically for some years, but the enterprise was finally abandoned, as the quantity of ore did not seem sufficient to justify further expenditure.

In his report for 1856, Mr. Alex. Murray (see Report Geological Survey of Canada, 1853-56, p. 180,) mentions the occurrence of a "dingy green magnetic trap" associated with red syenite in the north-west corner of the Township of Waters on Salter's meridian line. Specimens of this trap were given to Dr. Hunt for analysis, and the result of his investigation showed that it contained magnetic iron ore and magnetic iron pyrites, generally distributed through the rock, the former in very small grains; titaniferous iron was found associated with the magnetic ore and a small quantity of nickel and copper. The variation of the magnetic needle near this mass was from ten to fifteen degrees west of the true meridian. It can thus be seen that even at this early period of its history the officers of the Geological Survey were aware of the existence of nickel in this region, and had pointed out the probability that workable deposits would be found. Years passed by and the inaccessible nature of the country deterred prospectors from making very detailed exploration or examination, so that it was not till 1883, when the Canadian Pacific Railway was in course of construction, that the first discoveries of any consequence were made, since which time the whole belt of the Huronian district has been overrun with eager prospectors and miners. A not infrequent accident in newly settled districts led to the first important discovery. Judge McNaughton, stipendiary magistrate at Sudbury, had been lost in the woods to the west of that village, and diligent search was at once instituted for him. A party consisting of Dr. Howey and two others found the judge

seated on the small eminence which then marked the site of what is now known as the "Murray Mine." Early in 1884 the Canadian Pacific Railway made a cutting for their main line through this small hill, about $3\frac{1}{2}$ miles northwest of Sudbury, and on July 12th of the same year Dr. Selwyn made a careful examination of the location and pronounced the lode to be one of the most promising he had yet seen in Canada. Other discoveries soon followed, and the McConnell, Lady Macdonald, Stobie, Blezard, Copper Cliff and Evans Mines were all located. At first the wildest notions were entertained as to the extent of these deposits, and the most exaggerated reports circulated as to their value. It was even confidently asserted that these were immensely important discoveries, and would revolutionize the whole copper trade and render other mines then in operation quite unremunerative. Rounded hills of gossan, indicating the presence of the more solid and unaltered ore beneath, occur at intervals for miles in a southwesterly direction, conforming rudely to the strike of the rocks in the vicinity. This circumstance is all that seems to have justified the early discoverers in describing the deposits as veritable mountains of solid ore, many miles in extent and hundreds of feet thick. Closer investigation revealed the fact that these surface gossans everywhere indicate the presence of the ore beneath, and that the ore itself occurs in lenticular masses, entirely separated from one another, whose longer axes correspond with the strike of the enclosing rock. This gossan has resulted, as is usual, from the formation of peroxide and hydrated peroxide of iron, due to the decomposition of the pyrrhotite and chalcopyrite which gives a prevailing red or reddish brown colour to the upper portion of the deposit. This covering of iron oxide is sometimes as much as six feet in depth, although usually it is only two or three feet, gradually merging itself into the unaltered ore beneath. During the last few years prospectors have not been idle, and at the present time about twenty very promising deposits of these ores have been "located" and "taken up." The McAllister Mine, now called the Lady Macdonald Mine, was the first property on which any work was done in the summer of 1885, although later in the fall the Evans Mine was opened up and some preliminary tests made. On January 6th, 1886, the Canadian Copper Company was formed with a subscribed and paid up capital of \$2,000,000, which

was afterward increased to \$2,500,000, to operate the Copper Cliff, Stobie and Evans Mines.

On May 1st, 1886, work was started in earnest at the Copper Cliff mine, and later on in the same year both the Stobie and Evans mines were opened up, and with the exception of a few months last summer, when, on account of some difference with the Canadian Pacific Railway, the Stobie was shut down, these three mines have been in active operation ever since. The chief business of the Canadian Copper Company is done at Copper Cliff, for here they have prepared a well equipped roast yard, two smelting furnaces, laboratory and offices, and other things requisite for carrying on this mining on an extensive scale. The Stobie and Evans mines are provided with excellent rock houses, but all their ore is brought by branch railways to Copper Cliff to be roasted and smelted. In 1889 the Dominion Mineral Company was formed to operate the Blezard mine, and later on they purchased the Worthington mine from the original owners. During the past summer this company have had their smelter in operation, and both their mines are being energetically developed. During the summer of 1889 the Murray mine was prospected under bond by Messrs. Henry H. Vivian & Co., Swansea, England, and in October of the same year they purchased it. About the end of last September, everything being ready, the smelter "was blown in" and set to work on some ore which had been previously roasted. All three companies are now prosecuting the work vigorously, and the output of these mines has already reached very large proportions. The whole district has been prospected, and I think that a very conservative estimate would now place the number of promising deposits at twenty.

The Huronian system in which these ore deposits occur may be regarded as the oldest series of sedimentary strata of which we have at present any certain knowledge. Amongst the more important of these rocks may be mentioned quartzites, greywackés, conglomerates, slates, evenly laminated gneisses, felsites, hydromica, chloritic, epidotic, hornblendic and micaceous schists and narrow bands of cherty limestone. Most of these clastic rocks have been derived from the waste of older felspathic material, and hitherto it has been most generally supposed and stated that the Laurentian gneiss was the source from which the

sediments had been derived. The Huronian conglomerates, however, hold no pebbles that are undeniably referable to the Laurentian, and the origin of the syenitic, quartzose and jaspery pebbles is still a matter of doubt. The microscope can throw no certain light on the original character of some of these rocks, for very often metamorphism and recrystallization has gone on to such an extent that the former structure has been either partially or completely obliterated. A close study of these uncertain rocks in the field, aided by the use of the microscope in the laboratory will eventually enable us to assign them their proper place. We have thus numerous sedimentary rocks showing the various stages of this metamorphism, from the typical sandstone or greywacké, composed of well rounded grains of quartz and felspar, to the compact felsite, which contains no trace of its original clastic structure. Associated with these sedimentary strata are certain undoubted eruptive and irruptive rocks, among which may be mentioned many varieties of diabase, diorite and gabbro. Besides these igneous rocks, there are some granites and gneisses concerning whose origin many are in doubt. After a close and careful study of these rocks, which have usually been classified as Laurentian, and their relations with the true Huronian stratified deposits, I have been fully convinced of their irruptive nature. These granites and gneisses probably represent the original crust of the earth which has undergone refusion, and was in a molten or plastic condition at a period subsequent to the hardening of the Huronian sediments. The earth gradually cooling from a state of original incandescence, had reached that stage in the process when it admitted of being surrounded by an ocean nearly, if not quite, universal. Then began that tearing down and building up which has since gone on in forming the sediments which subsequently hardened into rocks. The first formed crust was necessarily thin and weak, and it is therefore not surprising that there were frequent irruptions, accompanied by the fusion of the lower portion at least of the first formed deposits.

It is unnecessary here to go into all the facts of the case, as my views have already been stated at some length in a paper read before this club on February 27th of last year. Suffice it to say that the fuller examinations of last summer have served to further strengthen these views. Both clastic and irruptive rocks have been subjected to in-

tense pressure, as evidenced by the extensive cataclastic structure which has been developed in both series of rocks. Frequently the rocks show a pyroclastic origin, and volcanic tuffs and breccias are very commonly met with. The relations of the diabase or basic irruptive rocks with the surrounding sedimentary strata was closely examined in a large number of instances, and revealed the fact that the diabase is apparently of later age, as it breaks through and alters the bedded Huronian. The occurrence of these masses of diabase with a surrounding breccia or agglomerate in many cases would seem to point to the fact that they are the bases of Huronian volcanoes, which continued in action after the latest sediments had been deposited. Some of these diabolic masses send out dykes which ramify through and alter the surrounding strata, these dykes frequently containing fragments of highly metamorphosed Huronian quartzite. These irruptive masses are usually lenticular, although occasionally rudely circular or oval in outline, and their longer axes correspond in general with the strike of the enclosing rock. They vary in breadth from a few chains to half a mile, or even more, and frequently extend for miles in length. The origin of the nickel and copper is closely connected with this diabase or gabbro, and the formation of the fissures containing these ores was no doubt due to the disruptive forces of the intrusion, and the contraction caused by the subsequent cooling of the igneous rock matter. These fissures were necessarily most frequently formed along the line of contact with the cooler sedimentary strata although in certain cases they were formed in the midst of the igneous mass itself. In nearly every case, therefore, the deposits of nickel and copper occur close to the contact of the diabase with the stratified rocks, although in a few cases they are found in the diabase near its junction with granite or micropegmatite. Another proof of the common genesis of these ores and the enclosing diabase is that the diabase itself commonly contains these sulphides disseminated through its mass, these impregnations occasionally forming such considerable and rich deposits as to be workable.

All geologists who have examined these deposits agree that they are not true fissure veins, and although at times a certain sloping surface is obtained which seems to have a uniform inclination, yet it seems certain that there are no regular walls in the miner's sense of the

term, and at both sides of the deposits the enclosing rock is impregnated more or less with the pyritous matter. Though mining is thus rendered somewhat difficult and uncertain on account of the absence of the walls and irregularity in the distribution of the ore, so that there is no means of knowing in what direction to drive the levels, this uncertainty is more than compensated by the extent and massiveness of the deposit when found. The ore bodies like the masses of diabase with which they are so intimately associated are lens or pod-shaped and "pinch out" in both directions. This structure is also characteristic of their downward extension, and the deposits have been very truly likened to a string of sausages, so that when one lenticular body of ore gives out another commences close at hand, which in its turn gives place to another, and though at the Copper Cliff they are down about 600 feet on a slope of 45° , the quantity and quality of the ore shows no diminution. I have occasionally found true veins of quartz holding this pyrrhotite, but such evidences of secondary action are extremely rare and proves nothing in regard to the origin of the more massive deposits. The ores and the associated diabase were therefore in all probability simultaneously introduced in a molten condition, the particles of pyritous matter aggregating themselves together in obedience to the law of mutual attraction. The ore bodies were, therefore, not contemporaneous with the stratified Huronian, although there is nothing to prove that they do not belong to the close of the Huronian period. Mr. Ferrier of the Geological Survey has noticed the occurrence of this nickeliferous pyrrhotite in a specimen of chloritic schist and gneissic granite, which had been taken to show the contact between the two rocks. The pyrrhotite is disseminated through both rocks, and its occurrence here in the Township of Dill at the junction of what has been called Laurentian would seem to be another proof of the irruptive origin of this gneiss.

The ore itself is a mixture of pyrrhotite, a monosulphide of iron (Fe_7S_8) and chalcopyrite, a sulphide of copper and iron (Cu Fe S_2). The two minerals are not so intimately commingled as to form a perfect homogeneous mass, but one may be described as occurring in pockets, spots, bunches or threads in the other. The chalcopyrite is not so closely intermixed with the pyrrhotite, but isolates itself rather in spots

and patches enclosed by massive pyrrhotite, so that it is not hard to separate considerable masses of chalcopyrite that will assay over 30 per cent. of copper, or pyrrhotite that will only show traces of that metal. In practice, however, careful examination and trial have proved that the two minerals are too intimately associated to make sorting by hand at all practicable, and the pyrrhotite is very often so feebly magnetic as to preclude the possibility of separation by magnetism. Although the chalcopyrite seldom occurs free from the pyrrhotite, large and massive deposits of the latter occur comparatively free from copper. In this connection Dr. Peters mentions a slope which, having furnished about 2,000 tons of pyrrhotite, gave place, just before the end boundaries were reached, to a deposit which afforded nearly 20 tons of almost pure chalcopyrite. In some instances these ore bodies show a brecciated character, large angular or partially rounded boulders or "horses" of almost barren rock being mingled with the ore, which seem to evidence the disruptive force of the intrusive mass, while in others, as at the Worthington mine, the diabase in which the ore occurs has developed a concretionary structure while cooling, and large irregularly rounded concretions, which, on weathering, peel off in concentric layers, are cemented together, so to speak, by a very pure chalcopyrite and highly nickeliferous pyrrhotite. The concretions themselves usually contain more or less pyritous matter disseminated through them, but are usually cast aside as too barren for the roast heap. The pyrrhotite varies in colour from steel-grey to bronze yellow, and the chalcopyrite is the usual brass or deep yellow colour. Both tarnish readily, and very beautiful iridescent specimens can be easily obtained from the ore heap or scattered around the works. These sulphides, therefore, may be said to occur in three distinct ways—

1st. As contact deposits of pyrrhotite and chalcopyrite situated between the clastic rocks, such as felsites, quartzites, etc., and irruptive diabase or gabbro, or between these latter and granite or micropegmatite. Good examples of the former are furnished by the Evans, Stobie and Copper Cliff, while the Murray mine may be cited as illustrating the latter.

2nd. As impregnations of these minerals through the diabase or gabbro, which are sometimes so rich and considerable as to form

workable deposits. These sulphides are in no case present as disseminations through the clastic rocks very distant from the diabase or gabbro, which seems clear evidence that they have been brought up by the latter.

3rd. As segregated veins which may have been filled subsequently to the irruption which brought up the more massive deposits. These veins are not very common, although certain portions of the more massive deposits may have been dissolved out and re-deposited along certain faults and fissures.

The composition of the ore varies according to the preponderance of either the pyrrhotite or chalcopyrite in the specimen examined. The pyrrhotite may be said roughly to be composed of 40% sulphur and 60% iron, with a varying proportion of the iron replaced by nickel, while the chalcopyrite contains 35% sulphur, 35% copper and 30% iron. The mines of the Canadian Copper Co'y, as the name of the company indicates, were first opened for their copper contents, and it was not until considerable work had been done that nickel was discovered to be present in the ore. A large shipment of ore had been made to New York, and a chemist there who was making a volumetric determination of the copper contents by the Potassium Cyanide process, was struck by the great variation in his results, which led him to make a more minute examination of the ore, when he found that nickel was present. The ore has now become of more value on account of its nickel than its copper contents, and Dr. Peters himself greatly doubted if the mines would pay to work for copper alone. The percentage of nickel and copper varies greatly, as might be expected, but assays of nine samples from the different mines of the Canadian Copper Co'y, made in November 1888, will show the usual percentage of these metals. These assays were made by Mr. Francis L. Sperry, and show a range in the percentage of nickel from 1.12% to 4.21%, with an average of 2.38%, while the copper varied from 4.03% to 9.98%, with an average of 6.44%. A minute proportion of cobalt also occurs in the pyrrhotite, usually about $\frac{1}{50}$ th as much as the nickel present. Mr. G. C. Hoffman assayed four samples from this district which I collected last summer, and these showed the nickel contents to vary from 1.95% to 3.10%, with an average of 2.25%. Three of these samples contained traces of cobalt,

which are included in the above percentage of nickel. The nickel is usually spoken of as replacing an equal quantity of iron in the pyrrhotite, but the discovery of undoubted crystals of niillerite or sulphide of nickel 150 feet below the surface at Copper Cliff Mine, as well as the more recent recognition of polydymite, a ferriferous sulphide of nickel, at the Vermilion Mine, in the Township of Denison, seems to justify the assumption that in the more highly nickeliferous deposits of the region at least, the nickel is also present as a sulphide, disseminated through the ore mass like the iron and copper.

This view is also borne out by Dr. Hunt's analysis of the ore of the old Wallace mine which seems precisely analogous to some of the richer deposits nearer the Canadian Pacific Railway. Traces of gold and silver, as also platinum are also usually found in these ores, and in this connection it was thought advisable to call your attention to the detection of what Messrs. Clarke & Catlett call a "platiniferous nickel ore from Canada." They say (see article xxxix, page 372, *American Journal of Science*, 1889.) During the autumn of 1888 we received, through two different channels, samples of nickel ores taken from the mines of the Canadian Copper Company at Sudbury, Ont. From one source we obtained two masses of sulphides to be examined for nickel and copper, from the other came similar sulphides together with a series of soil and gravel-like material (gossan), 7 samples in all. In the latter case an examination for platinum was requested, and in 5 of the samples above mentioned it was found the gravel yielded 74.85 ozs. of metals of the platinum group to the ton of 2,000 lbs. The sulphide ores submitted to us from Sudbury were all of a similar character. They consisted of mixed masses in which a grey readily tarnishing substance was predominant with some chalcopyrite, possibly some pyrite and a very little quartz. Two samples were examined in mass: one gave 31.41 % nickel with a little copper, and the other gave 35.39 % nickel and 5.2 % copper. The nickel mineral itself proved to be a sulphide of nickel and iron, and as ores of that composition are not common, it was thought advisable to examine the substance further. It is steel-grey, massive and exceedingly alterable in the air with a Sp. Gr. of 4.5. An analysis of carefully selected material gave:—

Nickel.....	41.96
Iron.....	15.57
Silica.....	1.02
Copper.....	.62
Sulphur.....	40.89

These figures give approximately the formula $\text{Ni}_3 \text{Fe S}_5$. Neither cobalt nor arsenic could be detected. If we deduct silica together with the copper reckoned as admixed chalcopyrite and re-calculate the remainder of the analysis to 100% we get the following figures:—

Nickel.....	43.18
Iron.....	15.47
Sulphur.....	41.35

In short the mineral has the composition of $\text{Ni}_4 \text{S}_5$ with about $\frac{1}{4}$ th of the nickel replaced by iron, which seems to agree with Laspeyres polydymite of which it is doubtless a ferriferous variety. Probably in most cases the niccoliferous constituent of pyrrhotite is millerite, but other sulphides like polydymite may occur too. The polydymite which was selected for the above analysis came from the mass in which the average of 35.39 % nickel and 5.20 % copper had previously been found.

The mass weighed several kilograms and was remarkably free from quartz. The same mass, with two smaller pieces resembling it, were also examined for platinum. The results were as follows, "A" representing the large mass in which the polydymite was determined:—

A....	2.55 oz.	platinum per ton, or	.0087 %
B....	1.8 oz.	" " "	.0060 %
C....	7 oz.	" " "	.024 %

Probably the platinum exists in the ore as sperrylite, although this point was not proved. The amount of platinum in the mass most thoroughly examined would require to form sperrylite only about .007 % of arsenic, which is too small a quantity for detection by ordinary analysis. That platinum should exist in appreciable quantities in an ore of such a character is something quite extraordinary, but whether it could be profitably extracted is an open question. Sperry-

lite was first found at the Vermilion mine in the gossan or loose material, and was named after Mr. Francis L. Sperry of the C. C. C. by Messrs. Horace L. Wells and S. L. Penfield, of the Sheffield Scientific School, who examined and described this new species. It is isometric; simple cubes are common, octahedrons are exceptional, while the majority of the crystals are combinations of the cube and octahedron. H.—Between six and seven, as it scratches felspar but not quartz. The crystals have no distinct cleavage, but are very brittle and break with an irregular, probably conchoidal fracture. The chemical composition, according to the mean of two analyses was as follows:—

Arsenic.....	40.98
Antimony .....	.50
Platinum.....	52.57
Rhodium.....	.72
Palladium	trace.
Cassiterite or oxide of tin.....	4.62

The composition is therefore represented by the formula Pt As_2 , a small portion of the platinum being replaced respectively by rhodium and antimony. The color of the mineral was nearly tin white or about the same as metallic platinum. The fine powder is black. Nearly all the grains showed extremely brilliant crystal faces, though most of the crystals were fragmentary in size they were usually $\frac{1}{50}$ — $\frac{1}{500}$ th of an inch in diameter. Sp. Gr. 10.602.

ROASTING.

The metallurgical treatment of this ore commences at the roast yard whither it is conveyed, and, being piled in convenient heaps on previously laid cordwood, is exposed at high temperatures without fusion, or, at most, incipient fusion, to the action of a current of air. The objects of this roasting are, 1st, an oxidation of the iron, and, incidentally, of the sulphur, as complete as is possible without involving an undue loss of copper in the slags of the following smelting, and 2nd, the expulsion of arsenic if there is any present. If the oxidation be very imperfect the resulting matte will contain so much iron that its bringing forward will be unduly costly, while, if the oxidation be too thorough, an undue loss of metal will occur on smelting the roasted ore.

At Copper Cliff the Canadian Copper Company have spared neither trouble nor expense in the construction and equipment of their roast yard. The natural rough and uneven surface has been cleared and levelled, and the whole given a gentle slope, which, with carefully made drains, serve to remove at once any rain or surface water. These precautions have to be taken to prevent loss of copper as soluble sulphate of copper, which is liable to be washed out by the rain.

At the Murray mine a large shed has been erected to roast ore during the winter months, with openings in the roof to allow of the escape of sulphurous fumes, but during last summer they had no regular roast yard, and the few heaps burnt could only be placed where the surface of the ground would permit. This was also the case at the Blezard and Worthington mines, and the mechanical loss alone from this carelessness must have been of considerable moment. The shaft of the Copper Cliff mine, on an incline of 45° , has reached already a depth of nearly 600 feet. It is provided with a double skip road, the skips dumping automatically at the mouth of the breaker in the top of the rock house. Here the ore is sledged to a proper size for the 15×9 in. Blake crusher set to about $1\frac{3}{4}$ inches, which has a capacity of nearly 20 tons an hour. It is then passed through a revolving screen where it is sized into three classes for the succeeding operation of roasting. The coarse size passes a 4-inch ring, the medium or ragging, a $1\frac{3}{4}$ -inch ring, while the fines pass through one $\frac{3}{4}$ of an inch in diameter. Each of these sizes falls into a separate bin under which a car runs. Thus the ore is loaded automatically into cars holding $1\frac{1}{2}$ tons, whence it is transported to the upper story of the ore shed. There it falls into a series of bins from which it is loaded by means of inclined steel shutles into the cars and taken up a rather steep grade to a high trestle which extends the whole length of the roast yard. The only wood that can be obtained is dead pine, a good deal of the surrounding district having been burnt over about 20 years ago. This can be procured very cheaply, and although it does not roast the ores as thoroughly as hard wood, it makes very fair and economical fuel, and serves on account of its short fierce heat to ignite the pile, and this once started continues burning on account of its sulphur contents. These piles are built as follows :—The place selected

is first covered with about six inches of fine ore distributed as evenly as possible over the clay soil. Sticks of cordwood of nearly uniform size should be placed side by side across both sides and ends of the rectangular area. The whole interior of this can be filled in with old stumps roots, ties or cordwood, but in such a way as to form a level and solid bed for the ore to rest on. Over all this is placed small wood and chips to fill up all interstices, care being taken to provide small canals filled with kindlings at intervals of 8 or 10 feet leading from the outer air to the chimneys along the centre of the heap. These chimneys which assist in rapidly and certainly kindling the whole heap are usually built of four sticks or old boards, so fixed together as to leave an opening and communicating below with the draught passages. Five or six of these chimneys suffice for each pile, and they should project 2 feet above the upper surface of the heap, so that no pieces of ore could fall into the flue opening. The coarsest class of ore is first thrown on, then the ragging or medium, on top of which is scattered a layer of rotten wood or chips, and lastly the whole heap is covered over with fines till it reaches a height of about 6 feet. The whole structure should then form a shapely rectangular pile with sharp corners and as steeply sloping sides as the ore will naturally lie on without rolling (about 45°). Only a portion of the fine ore is put on at first, the rest being shovelled on after the fire is fairly started. The best way to light the pile is to place a quantity of ignited cotton waste saturated with coal oil down each of the chimneys. About 12 hours after firing the whole heap should be pouring forth dense yellow fumes of sulphurous acid. Great attention is at first paid to the pile to prevent undue local heating which frequently causes partial fusion of the ore, and this can at once be prevented by covering the place with more fines. This heap should then burn from 50 to 70 days when the outer covering of raw or partially roasted ore is removed, and the remainder of the heap conveyed a few yards in wheelbarrows to a sunken railroad which runs alongside of the roast-yard. When filled, the cars are pushed up another steep grade along a track running over the bins back of the smelter. The sloping sides and corners of a pile are frequently covered with almost raw ore, this evil being often remedied by placing ignited sticks of cordwood around the whole structure, or by building a new pile in

the passageway between two others which have been almost burnt out, the latter plan adding very materially to the capacity of the roast yard. After this operation the ore is invariably so thoroughly roasted that it is necessary to add from 10 to 25% of raw fine ore during the smelting to prevent the matte from being too rich. Each pile usually contains about 600 tons of ore, and requires 30 cords of wood to roast it. The roast yard at Copper Cliff is nearly half a mile long by 100 feet wide, while each pile occupies a space of 40 x 80 feet, room being left to get round them, and for drains. The present capacity is about 60,000 tons, which, with a little extra work, could be increased to 90,000 tons. Working full power each roast bed can be used four times a year, counting the time in making, roasting and clearing the beds. The yearly capacity would therefore be 240,000 tons, and by increasing the space, 360,000 tons. The unroasted ore contains from 35 to 40% sulphur, and assays of a large number of samples of the roast heaps have varied from 2½ to 8% of sulphur. One analysis taken at random which may be taken as a fair sample of all the rest, gave 5.40% copper, 2.43% nickel, 7.92% sulphur and 25% iron, lime, magnesia, etc., and the residue chiefly hornblende. Up to October 1st, 1890, 56,534 tons had been taken to the roast yard.

SMELTING OF THE ORE.

There are two smelting furnaces at Copper Cliff, and the building which contains these is 65 feet long by 40 feet wide. Thirty-five feet of this length is on a level with the ground, while the rest of the floor is 8½ feet higher, and it is on this upper flat that the ore and fuel bins are situated. The daily capacity of each of these furnaces is 125 tons, although one of the furnaces has reduced 187 tons of ore in one day, and the furnace manager says that 135 tons could be reduced without much forcing. The furnace itself is a steel plate water jacket of the Herreshof patent, made in Sherbrooke, P. Q., by the Jenckes Manufacturing Co'y. It is nearly oval in form, the longer diameter at the tuyères being 6 ft. 6 in., while the shorter one is 3 ft. 3 in. There are 11 2½ in. tuyères through which the blast enters from a Baker's rotary blower under a pressure of about 9 oz. per square inch. It is 9 feet high from these tuyères to the charging door, and is an unbroken water jacket from the cast iron bottom up. It is made of rolled steel with

ly a 2 inch water space, and not a single brick of any description. The well is a circular, cast iron water jacketed vessel, mounted on four strong wheels for convenience of moving it when repairs are necessary, and so made that the hole in one side connects with the outlet hole of the furnace, which is also thoroughly protected by water and it is through this that the matte and slag flow out of the furnace as rapidly as formed. They thus escape the influence of the blast, and prevent what Livian calls "the sole objection to blast furnaces" the so-called "sows" or "salamanders" as great masses of metallic iron which choke the furnace and tie up large quantities of copper and other metals. The charging door is situated on the upper floor, as also the bins for cast ore and coke. The coke used is from Connellsville, Pa., and is brought by way of the Great Lakes and the Sault Branch of the C.P.R. The charge for the furnace consists of 1,800 or 2,000 lbs. of ore and coke mixed, one ton of coke usually sufficing for eight tons of ore. The mass as it melts gathers at the bottom of the furnace, and flows through the outlet into the well or reservoir, where the heavier and metallic portions sink to the bottom while the lighter slag remains on the surface, running in a continuous stream over the jacketed spout into pots on wheels, which are removed when filled, an empty one always being ready to take the vacant place. The matte is drawn off at intervals of 5 or 20 minutes through a separated bronze water-cooled tap-hole resting, near the bottom of the well, and which is filled as usual with a clay plug that can readily be removed with a few blows from a steel bar. The smelting of the ores is greatly facilitated by the basic character of the accompanying gangue rock, for instead of quartz and acidicates there is chiefly hornblende and very fusible felspars. This circumstance, as well as a judicious mixture of the different qualities of ore obviates the necessity of any flux, which is a very fortunate circumstance, as limestone is somewhat distant and suitable iron ore difficult to procure. The slag buggies or pots are made as strongly and lightly as possible, are case-hardened and shaped like inverted hollow cones, and before each tap are thickly washed with clay water to prevent the matte from welding to the iron mould. This matte is sampled and weighed and allowed to cool before being dumped from the pots and the slag also is sampled and assayed once every 24 hours, so that an

accurate record can be kept of the composition of both. An average of two analyses of this matte in February and March, 1889, will probably give us the usual composition: Copper, 26.91; nickel, 14.14; iron, 31.335; sulphur, 26.95; cobalt, .935. Mr. F. L. Sperry says that platinum exists in quite appreciable quantities, so that the matte contains some ounces per ton of that rare metal, while gold and silver occur in strong traces. The first blast furnace was started on the 24th December, 1888, and with slight interruptions has been running ever since. The second furnace was built in the summer of 1889, and was started on the 4th of September of the same year. On October 1st, 1890, there was about 6,500 tons of matte, and the ore on the roast beds would produce about 6,000 tons more, containing 922 and 852 tons of nickel respectively, or a total of 1,774 tons of metallic nickel, and 3,362½ tons of metallic copper.

The average daily output of matte for the month of September, 1890, was 25 tons, but the full capacity of both furnaces would be about 60 tons of matte. If the former average was kept up, the yearly production of matte would reach 9,125 tons, but if the furnaces were run at their full capacity they would average nearly 8½ tons of nickel a day, or nearly 3,066 tons of metallic nickel and 5,913 tons of copper a year. At present the matte is piled in heaps outside of the smelters, and, when wanted to be shipped, is broken up in pieces and placed in old oil barrels, the chinks between the larger pieces being filled with smaller fragments, so that the whole is packed tolerably firm and close. It is then sent to the various refiners in Europe or the United States according to their respective bids. So far no refining works have been built at Sudbury, but the vast quantity of material to treat, the tedious and costly process for the further refining of the ore, consisting as it does of alternate roastings and smeltings, in addition to the great expense incurred at present in shipping the matte to such long distances, seem great incentives to the early erection of refining works, so that the ore could be fully treated on the spot. The proposition to build nickel steel works was lately submitted to the Government by the Canadian Copper Company, and it is to be hoped that some satisfactory arrangement will be arrived at to give a further impetus to our present mining activity in this region.

Nickel is a comparatively new metal for it was not recognized as an element till 1751, when Cronstedt, the Swedish mineralogist, in examining the ores of certain veins in the German Copper mines made the discovery of the two new metals, nickel and cobalt, which names he retained as they were in use amongst the miners. Nickel in its pure state is silver white in colour, hard, tough, fusible with difficulty, and is susceptible to magnetism, although not to the same extent as iron. Its use in the industrial arts has rapidly increased since it has been produced in a pure state, as it formerly existed only as an impure alloy, and so could not be so suitable for the purposes for which it is now used. The demand has only grown at a moderate rate as compared with the growth and demand for other useful metals, and a decrease in price from \$2.60 per pound in 1876 to the present price, which varies from 50 to 60 cents per pound, seems to have had no very important influence in increasing that demand. The supply of late years has been more than sufficient for the demand and new deposits have always been found in advance of any necessity for their product. The first chief demand for this metal was for making nickel or german silver as a substitute for the more precious metal in making spoons and forks and other ware in general for which silver had been previously used, and its whiteness and the facility with which it received and held the silver, after the process of what is known as electro-plating was introduced cause it to be still more widely used. It is also made use of to plate iron, zinc, &c., and also in alloy with copper for the manufacture of small coins, which are used so extensively in the United States, Germany, Belgium, and other countries. The proposition to use rolled nickel plate as an advance over ordinary tin plate, is one which is receiving attention at present. It has also been recommended for making nickel crucibles to replace those of silver used in chemical manipulations as they would cost less and have the great advantage of melting at a higher temperature.

Nickel plated kitchen utensils are coming into general use as in Germany, and as it is well known that acids have a more or less solvent action on nickel, an investigation was undertaken which showed that $7\frac{1}{2}$ grains of nickel could be taken into the stomach and repeated for a long time without any noticeably bad effects. There is thus no ground

for uneasiness in the use of such utensils, especially if the same precautions are used as in the case of copper vessels, namely, thoroughly cleaning them and avoiding the storing of food in them. The proposition to use nickel in alloy with steel to increase the strength and quality of the latter, will, if carried out, increase the consumption very materially, and all have been eager to know the result of the recent experiments undertaken at the instigation of the United States Government. A French invention has effected the means of regulating the composition of such an alloy, and subsequent experiments in Glasgow revealed the fact that this alloy could be made in any good open hearth furnace working at a fairly high temperature as well as in the crucible. In obtaining a correct idea of the value or usefulness of alloys of nickel with iron or steel it should be borne in mind that the composition is complicated by manganese, carbon, silicon, sulphur and phosphorus, whose influence must be carefully watched, requiring a long series of experiments. A comparison of steel alloyed with 4.7 % nickel raised the elastic limit from 16 up to 28 tons, and the breaking strain from 30 up to 40 tons, without impairing the elongation or contraction of area to any noticeable extent. A further gradual increase of hardness was noticed until 20 % is reached, when a change takes place, and successive additions of nickel tend to make the steel softer and more ductile. The alloys polish well, and the colour of the steel is lightened as the proportion of nickel increases. They do not corrode as readily as other steel. The 1 % nickel steel welds fairly well, but this property lessens with each addition of nickel. It can, therefore, be seen that considerable advantage may be expected from these alloys, especially where the percentage of nickel is less than five.

The consumption of nickel and nickel alloy in the United States has increased from 294,000 pounds in 1880 to 421,000 pounds in 1888, while the total consumption of the world was estimated not to exceed 700 or 800 tons of the pure metal. The chief supply at present comes from New Caledonia, a penal colony of France (long. 165° E., S. lat. 22°). M. du Peloux states that the cost of production at this place could be so reduced that the company could sell at from 37 to 46 cents per pound, and yet have a good profit. Dr. Peters in his evidence before the Ontario Mining Commission states that the Canadian Copper Com-

pany could sell it from 25 to 30 cents per pound with a handsome profit. A commission appointed by the United States Government to examine the probable quantity of nickel in the Sudbury district has given a very glowing report to their government. It is highly probable, however, as can be seen from the above figures that our mines could supply the whole demand, even if the other sources of supply did not produce anything. It has been decided by the United States Government to make use of nickel steel armour plates, and already the contract has been awarded so that there is every prospect of a brilliant future for this mining industry around Sudbury. In view of our immense deposits it will be necessary to increase its consumption in every possible direction.

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BOOK NOTICE.

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CATALOGUE OF CANADIAN PLANTS. Part V. Acrogens. By John Macoun, M.A., F.L.S., F.R.S.C. 1890.

The fifth part of Prof. Macoun's great work appeared last autumn and would have been noticed sooner but for promises made previously with regard to other matter printed in *THE NATURALIST*. As already stated, we consider Prof. Macoun's catalogue the most important work which has appeared on Canadian botany. Nor is this appreciation of our Canadian Linnæus confined to ourselves. J. E. Bagnall, writing in the *Midland Naturalist*, published at Birmingham, England, says in the February number : "This concludes Vol. II of this valuable work, the first 45 pages being devoted to an enumeration of the ferns and fern allies, with a full account of their geographical distribution through the Dominion of Canada ; and as in the preceding portions of this work, the treatment throughout is excellent, and characteristic of the scientific acumen and indefatigable zeal of the author. The remain

ing portion of Part V is devoted to additions and corrections to Part I-IV, which occupy 103 pages, and record 155 species added to the flora of Canada since the publication of Part IV, raising the total number of flowering plants, ferns and fern allies found in Canada to 3,209 species ; of these, 2,340 are Exogens, 771 are Endogens, and 98 are Acrogens."

In the serial literature of this continent, the following taken from the March number of the "Bulletin of the Torrey Botanical Club" may be taken as a sample of many similar articles which have appeared :—
 "We congratulate Prof. Macoun on the very successful progress of his work. He is contributing more at the present time to our knowledge of North American botany than anyone else, and through his endeavours the distribution of Canadian plants is becoming thoroughly worked out."

THE BEHRING SEA SEAL COMMISSION.

Every member of the OTTAWA FIELD NATURALISTS' CLUB must feel proud that one of our most highly esteemed members, Dr. G. M. Dawson, First Assistant Director of the Geological Survey of Canada, should have been chosen as one of the two British Commissioners entrusted with the investigation of the habits of the Fur Seal in the Behring Sea. The United States Commissioner is our corresponding member, Dr. C. Hart Merriam, of Washington, who won such golden opinions from all who had the good fortune to meet him in Ottawa a few years ago when he attended our spring outing to Kingsmere, on the occasion of the excursion given by the Club to the Fellows of the Royal Society of Canada. There are no two men in America better fitted to carry out this important investigation, and the association of their names with that of Sir George Baden-Powell, the English Commissioner, ensures that the work will be done in a thorough and scientific manner. Dr. Dawson is the eldest son of Sir William Dawson, Principal of McGill University. He was born at Pictou, Nova Scotia, August 1st, 1849. Although a comparatively young man, his career has been a brilliant and useful one. Educated at McGill University, Montreal, and the Royal School of Mines, London, England, to the associateship of which he was admitted in 1872, and where he held the Duke of Cornwall's Scholarship, given by the Prince of Wales, and took the Edward Forbes Medal in Palæontology and the Murchison Medal in Geology. He was appointed Geologist and Naturalist to Her Majesty's Boundary Commission in 1873, and investigated the country along the boundary of Canada and the United States, from the Lake of the Woods to the Rocky Mountains. In 1875 he issued his report under the title of "The Geology and Resources of the 49th Parallel," and in the same year received an appointment upon the Geological Survey of Canada, since which time he has done much valuable work in exploring the unknown regions of British Columbia and the North-West Territories. In 1877 he commanded the Yukon river expedition to Alaska, making a boat voyage of 1300 miles, with one portage of 50 miles, from the basin of the Liard to the Yukon. Dr. Dawson has travelled extensively and studied in Europe. He is a member of many scientific bodies, and was one of the original Fellows of the Royal Society of Canada. He is a Doctor of Science, and is also an LL.D. both of Queen's University, Kingston, and McGill Univer

sity. In recognition of his services to the science of Geology, he was this year awarded the Bigsby Medal by the Geological Society of England, and on June 4th was elected a Fellow of the Royal Society of England, the highest honour which can be conferred on a scientific man. As a writer, Dr. Dawson is clear, terse and simple, and the chief characteristics of his work are accuracy and thoroughness.

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EXTINCT CANADIAN VERTEBRATES
FROM THE
MIOCENE ROCKS OF THE NORTH-WEST TERRITORIES
OF CANADA.

The following is an abstract of a most interesting address delivered by Mr. H. M. Ami, First Assistant Palæontologist of the Geological Survey Department, upon one of the afternoon excursions, to the Museum last winter. There were about 80 members and friends in attendance.

Amongst the more recent and interesting additions to the collections in the National Museum on Sussex Street, Ottawa, Canada, are the mammalian and fish remains from the Tertiary rocks of the Canadian North-West. These collections, which were made by Messrs. R. G. McConnell and T. C. Weston especially, have been recently studied by Prof. E. D. Cope, of the Academy of Natural Sciences, Philadelphia, and the result of his observations will soon be made known in a memoir now in print, published by the Geological Survey Department. The specimens in question are now on exhibition in the upright cases of the Museum, and from the labels attached the following interesting forms are noticed of special interest.

EXTINCT RHINOCEROS.

Menodus angustigenis—This is the name which Prof. Cope has given to the largest species of hoofed animal analogous to the rhinoceros that has ever yet been discovered, and which, in early Tertiary times, was roaming about in the extinct forests of the now treeless

prairie regions of Canada. The best portion of the skull of one individual may be seen about three feet long and eighteen inches across, with the frontal bones and snout preserved; also the two horn-cores and portions of the upper jaw with several huge molars *in situ*. The lower jaw of the same individual was also found with the teeth beautifully preserved. Some of these teeth are nearly four inches across and three inches in thickness, being nearly four inches in length, with lengthened roots and sharply cut crowns. The *humerus*, *femur*, *tibia* and many horn-cores, bones of the pelvic arch, and of various other portions of the skeleton were also found, making in all a beautiful display of fossil bones belonging to as huge and ferocious a beast as any of those which to-day are found in the jungles of an African or Indian forest.

Besides this form of *Menodus*, Prof. Cope has recognized a number more to which he has given separate specific designations, so that we find that there existed in Canada not only this huge and ferocious individual, but other allied creatures. These included *Menodus synceras* Cope; *M. Proutii*, Cope; *M. Americanus*, Cope, and *M. Selwyni*, Cope. They all belong to Miocene Tertiary strata, occurring in the vicinity of Swift Current, N.W.T. These belong to the family of the Titanotheridæ and form a group of animals analogous to the modern rhinoceros.

EXTINCT BOAR.

Elotherium Mortoni, Leidy. Amongst the specimens on exhibition and collected by Mr. Weston, may be seen an almost perfect lower left ramus of this extinct mammal, allied to the modern wild boar and domestic pig, all of which belong to the family of the Chæropotamidæ. This creature was of huge dimensions, the specimen in question being nearly 10 inches in length, and the teeth are beautifully preserved in a spotted grey and yellowish coloured lime-rock. This is the first time that this form has been found so far north on the American Continent.

EXTINCT DEER.

LEPTOMERYX MAMMIFER, Cope. This new species, and a member of the family of the *Tragulidæ*, appears to be one of the ancestors of the deer tribe, being both a ruminant and ungulate mammal, a very well preserved portion of the lower jaw, with several teeth *in situ* has permitted Prof. Cope to establish its relations and affinities, and it forms

a valuable addition to the fauna of those times which preceded the advent of the great ice age, when all these types disappeared and made room for the mastodon, the mammoth and other creatures, including the megalonyx and its allies.

OTHER EXTINCT FORMS.

Besides the above, may be seen a large *incisor* belonging to a large carnivore allied to the modern dog or wolf, the tooth of an oreodont, an extinct hare : *Palæolagus turgidus*, Cope, belonging to the family of the Leporidae, also a species of *Trionyx*, which Prof. Cope has called *T. leucopotamicus* from the fact that similar forms occur also in the so-called White River series or formation in the Territories of the United States to the south. But besides the above, we find also extinct forms allied to the squirrels : *Hypertragulus reversus*, Cope, and also a large number of bones of siluroid fishes belonging to the genera *Amiurus*, *Rhineastes*, etc.

Amongst these we find *Amiurus McConnelli*, *A. cancellatus*, all described by Cope ; also *Amia macrospondyla*, and *Amia Selwyniana*, and *Rhineastes rheas*, Cope.

Then come the remains of a species of *Stylenis*, an extinct turtle belonging to the family of the *Testudinata*, one of the Chelonians.

LAST BUT NOT LEAST

come the representatives of the two genera *Chalicotherium* and *Hemipsalodon*. The latter form, described under the name of *H. grandis*, Cope, affords another example of an extinct type of hyæna much larger than any of the modern living forms. It belongs to the family of the *Hyænodontide* and forms part of a sub-order of that family with very large representatives. The genus *Chalicotherium*, one of the family of Chalicotheridæ, has certain affinities to the rhinoceros, which in size and proportions it greatly resembled.

Thus it will be seen that from the Miocene Tertiary strata of the Swift Current River not far from the line of the Canadian Pacific Railway, as well as from the treeless prairie region, there was once a large fauna, the remains of which are entombed in these beds, and some of which now adorn the cases of the National Museum of the Capital.

REPORT OF THE ORNITHOLOGICAL BRANCH FOR THE YEAR 1890.

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

LADIES AND GENTLEMEN,—The leaders of the above named branch have the honour to report that during the year 1890 five observers reported their observations in this district, covering one hundred and fifty species and sub species, seven of which are new to our list. One of these observers, we are glad to say, was a lady member, Miss Gertrude Harmer, who, though beginning when the summer was half over, and with scarcely any previous knowledge of the birds, made a list of sixty-five species. It is also gratifying to note that four of the seven new records were made by a new hand, and one of our youngest working members, Mr. F. A. Saunders. With some assistance from his brother, Mr. W. E. Saunders of London, Ont., he made a list during the year of 122 species, whilst the two leaders who worked in the district made but 107 and 108 respectively. These figures are given to show the members of the Club what may be done during spare hours by a novice in the first year's work, and it is hoped they may encourage others to follow the example set by the members above referred to.

The additions to the list are as follows, the numbers prefixed being those of the A. O. U. Check-list:—

120. *Phalacrocorax dilophus*, Double-crested Cormorant. A young one was shot about Oct. 1st at Shirley's Bay, near Britannia, by Mr. C. G. Rogers and sent to W. J. Henry, taxidermist, to be mounted.

223. *Phalaropus lobatus*, Northern Phalarope. One obtained by Mr. A. G. Kingston, Sept. 10th, near Burritt's Rapids on the Rideau.

354a. *Falco rusticolus gyrfalco*, Gyrfalcon. One shot by Mr. E. White, Dec. 23rd, at the foot of Lt.-Col. White's garden on the bank of the Rideau in the city.

366. *Asio wilsonianus*, American Long-eared Owl. One shot by Mr. F. A. Saunders in a piece of woods north of the Experimental Farm, July 7th.

474. *Otocoris alpestris*, Horned Lark. This species was found by Mr. F. A. Saunders to be quite abundant on the Experimental Farm

from April 19th to May 25th, and again from Sept. 26th to Oct. 28th and easily distinguishable from its variety *pratricula*, which arrives here about the end of February, remains to breed, and leaves about the beginning of November. Though both were nominally recorded before this is virtually a new record, as they were never satisfactorily distinguished till 1890.

536. *Calcarius lapponicus*. Lapland Longspur. Mr. F. A. Saunders also found this species abundant at the farm in company with the last species and with Snowflakes (*Plectrophenax nivalis*) till May 25th, an unusually late date for winter birds in this latitude. The Longspurs were again seen in the fall from Oct. 3rd to Nov. 18. Till 1890 we were without a record of this species.

672. *Dendroica palmarum*. Palm Warbler. This species was found by Messrs. W. E. and F. A. Saunders on 3rd July, breeding and rather common in the Mer Blue. Both adults and young were secured and carefully identified by Ridgway's Manual as true *palmarum* and not var. *hypochrysea* which occurs sparingly here as a migrant. The former were again seen in the same locality by Messrs. Kingston and Lees, Aug. 9th.

Besides the above, the following more or less rare birds were observed, the common names and A. O. U. numbers alone being given:

231. *Dowitcher*, May 22nd, E. White.

234. *Knot* (full breeding plumage), June 4th, E. White.

239. *Pectoral Sandpiper*, Oct. 2nd, Miss G. Harmer.

272. *American Golden Plover*, Oct. 18th, F. A. Saunders.

337. *Red-tailed Hawk*, April 18th, G. R. White.

356. *Duck Hawk*, July 11th, F. A. Saunders.

357. *Pigeon Hawk*, Dec. 19th, W. A. D. Lees.

387. *Yellow-billed Cuckoo*, June 27th, G. R. White. A pair nested in Lt.-Col. White's garden and raised young. The male and young escaped. The female was shot.

401. *American Three-toed Woodpecker*, Sept. 28th and 29th, Oct. 12th and 13th, F. A. Saunders.

405. *Pileated Woodpecker*, Oct. 13, A. G. Kingston.

466a. *Trail's Flycatcher*. This species seems to have become quite common here in the last two years.

521. *American Crossbill*. On July 3rd Mr. W. A. D. Lees saw a small flock of these birds, apparently young of the year, with bills not quite fully developed. They seemed to be picking up something from the sand of a newly made road in Ottawa East.

528. *Redpoll*, May 22nd, F. A. Saunders. A late date for the species.

533. *Pine Siskin*, May 16th, F. A. Saunders. Also late.

563. *Field Sparrow*, May 6th, W. A. D. Lees.

622a. *White-rumped Shrike*. On July 22nd Capt. Veith handed Mr. Kingston a shrike which seemed to him about midway between this variety and the true *ludovicianus*.

628. *Yellow-throated Vireo*. May 10th, A. G. Kingston.

672a. *Yellow Palm Warbler*. May 10th, A. G. Kingston.

758. *Olive-backed Thrush*. Oct. 11th, A. G. Kingston.

The following warblers have been rather unexpectedly found here during the breeding season, viz.:—657 *Magnolia*; 662 *Blackburnian*; 685 *Wilson's*.

A nest of the *Florida Gallinule* (219) were taken by Messrs. W. E. and F. A. Saunders near Kars on the Rideau, July 9th, containing seven eggs, partly incubated. The same gentlemen also discovered on July 7th, that gem of all ornithological prizes a nest of the *Ruby-throated Hummingbird*. It was in process of building and they had the rare privilege of watching the bird working at it for about an hour. On the 12th the completed nest with two fresh eggs was taken.

As there is some doubt among the leaders as to the comparative abundance in this district of the *Wood Thrush* and the *Hermit Thrush*, the members of the branch will confer a favor on the leaders by making a careful investigation of this question during the coming year, taking especial care in the identification of each species.

The leaders are glad to be able to announce that they have in preparation for the pages of THE OTTAWA NATURALIST, and almost completed a list of all the birds recorded for this district up to the end of 1890.* In view of this fact it has been thought better not to publish the usual list of dates of arrival and departure. This list has,

* This was published in the June number.

however, been compiled and may be consulted by members interested. All of which is respectfully submitted.

WM. A. D. LEES,
A. G. KINGSTON,
JOHN MACOUN,

Leaders.

Ottawa, 27th January, 1891.

THE BIRDS OF OTTAWA.

Readers will please make the following corrections in the list of birds published in the NATURALIST, Vol. v, No. 2: p. 42. No. 474, after "1890" read "by Mr. F. A. Saunders": No. 48, after "*americanus*" read "American Crow." p. 43, No. 536, after "November 18th" read "(F. A. Saunders)": p. 46, No. 685, strike out the word "breeding".

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REPORT OF THE BOTANICAL BRANCH, 1890.

To the Council of the Ottawa Field-Naturalist' Club.

LADIES AND GENTLEMEN,—The leaders beg to report that active work in this branch has been maintained in a satisfactory manner throughout the season. Fresh plants have been added to the *Flora Ottawaensis*, and good work has been done by new botanists in confirming past records and discovering new localities. Many of these have already been recorded in the *Flora* now being published as a supplement to the OTTAWA NATURALIST. This work which has been of considerable assistance to beginners, will, we trust, be finished early next year. Efforts have been put forth by the leaders at the General and Sub-excursions to make their branch popular and useful to all who attend those meetings. The addresses have been attentively listened to, and the interest shown has been very encouraging. One of the series of Sub-Excursions to the Geological Survey Museum, which have been such an instructive feature of the Club's work during this winter, was ably conducted by Prof. Macoun. The leaders

take the liberty of specially drawing the attention of the members of the Club to the exceptional advantages we derive from having the Geological Survey Department located at Ottawa. This, however, we feel it our duty to mention, would be only of comparative value were it not for the great courtesies which are at all times extended to our members by the Director and officers of the survey. As leaders of the Botanical Branch, we have particular pleasure in testifying to the cordial and ready assistance always given by Prof. Macoun and his assistant, Mr. James M. Macoun. During the past season the leaders, assisted by Prof. Macoun, have been devoting some time to the study of mosses. Prof. Macoun has during the winter worked out the collections of *Sphagnum* and has furnished us with the list which is appended to this report. Prof. Macoun's Catalogue of Canadian Plants has been completed during the year and will be of inestimable value to our Botanists. Mr. Fletcher and Mr. Scott have made a special study of the willows found in this locality with good results, which will be given in the *Flora Ottawaensis*.

The leaders beg to call the attention of members to the newly formed Canadian Botanists' Correspondence Association, which has been formed by Mr. J. A. Morton, of Wingham, Ont., Mr. J. Dearness, of London, Ont., and some other botanists. The object of this association is to help botanists by giving them facilities for exchanging herbarium specimens and becoming acquainted with other botanists in different parts of the country. We anticipate that much good will result from this organization and recommend it to the notice of our botanical members.

The following plants of interest, but not new to the list, may be referred to here:

A fine fruiting specimen of the curious introduced crucifer *Neslia paniculata*, which has flowers resembling *Erysimum cheiran thoides*, a sparse stellate pubescence and small roundish seed-pods, was found in an oat field near the Hog's Back.

Nuphar Advena + *Kalmiana*. Fine flowering specimens of this magnificent hybrid were found in Brigham's Creek in August.

Bellis perennis. The English Daisy has been several times observed for one or two years after lawns have been sown with English seed, but like *Plantago lanceolata*, seldom lives many years.

Chenopodium Botrys. An interesting sub-excursion was held by the branch, and the members visited an excavation on Sandy Hill at the invitation of Lt.-Col. White, to examine the flora which had appeared subsequent to the carting away of the surface sand. An interesting feature was that, several plants not observed as growing in the immediate locality before, now appeared, and the above named attractive goose-foot was the most conspicuous amongst these.

Cornus sericea was found at Billings' Bridge.

Cornus paniculata. Several nice bushes were observed on the light-house Island above Aylmtr.

Aspidium Goldianum. A new locality for this grand fern was discovered near Kingsmere in the Chelsea Mountains.

Asplenium angustifolium. A pleasing and somewhat novel record has to be made with regard to this beautiful fern. Some 15 years ago a few plants were discovered near Hemlock Lake. When this same locality was visited last autumn the delicate and pale green fronds could be seen in large clumps extending over nearly an acre.

Amongst the new records two of the Orchids are worthy of special mention *Habenaria virescens* was found in abundance at Thurso by Mr. Scott, *Spiranthes Romanzoffiana* a beautiful and highly-scented Ladies Tresses was found by Mr. Scott at Templeton, and on Kettle Island soon afterwards by Mr. Robert B. Whyte.

JAMES FLETCHER,
R. B. WHYTE,
W. SCOTT,
Leaders.

FLORA OTTAWAENSIS.

The following is a list of the additions to the local list discovered since the last report which have not already been recorded :—

Brassica campestris var. *oleifera*, Elgin Street, Sept. 1, W. Scott.

Fragaria Virginiana, Duch, v. *Illinoensis*, Gray, Rockcliffe, May 12, J. M. Macoun.

Dianthus Armeria, L. Hartwell's Locks, July 10, J. Fletcher.

Amarantus blitoides, Wat., Hartwell's Locks, Sept. 3, W. Scott.

Centaurea nigra, L., Thurso, Aug. 7, W. Scott.

Helianthus decapetalus, L., Casselman, Aug. 16, W. Scott.

Monotropa hypopitys, L., (ripe fruit), Kirk's Ferry, Sept. 6, T. J. McLaughlin.

Scrophularia nodosa L., v. *Marilandica*, Gray, Casselman, June 21, W. Scott.

Physostegia Virginiana, Benth, Billings Bridge, Sept. 20, W. Scott.

Lobelia Kalmii, L., Skead's Mills, Aug., R. B. Whyte.

Spiranthes Romanzoffiana, Cham., Templeton, July 23, W. Scott.

Habenaria virescens, Spreng., Thurso, Aug. 7, W. Scott.

Allium Canadense, Kalm., Billings Bridge, July, J. Fletcher.

Streptopus amplexifolius, D.C., Kingsmere, May 24, J. Fletcher.

Elatine Americana, Arn., Brigham's Creek, Sept., J. Fletcher.

Eatonia Pennsylvanica, Gray, Stewarton, Hull, July, J. Fletcher.

List of the species of the Genus *Sphagnum* found at Ottawa.

1. *Sphagnum Girgenshonii* Russ. McKay's wood.
 ——— *Var. hygrophyllum* Warnst. Beechwood.
2. *S. fuscum*, (Schpr.) von Klinggraeff. *Var. fuscescens*. Warnst.
 Abundant in Mer Bleue.
 ——— *Var. pallescens*, Warnst. Abundant in Mer Bleue.
3. *S. tenellum*, (Schpr.) von Klinggraeff. *Var. rubellum* Wils. Very
 fine and abundant in Mer Bleue.
4. *S. acutifolium*, (Ehrh in part.) Russ. and Warnst. Very common in
 peat bogs Mer. Bleue, etc.
 ——— *Var. versicolor*, Warnst. Common in Mer Bleue.
 ——— *Var. pallescens*, Warnst. Mer Bleue.
5. *S. recurvum*, (Beauv.) Russ. and Warnst. *Var. pulchrum*, Lindb.
 In woods by the Mer Bleue.
 ——— *Var. mucronatum*, Russ. Wet woods near Beechwood.
 ——— *Var. amblyphyllum*, Russ. Abundant in pools in the Mer
 Bleue.

- Var. *parvifolium*, (Sendt.) Warnst. In woods along the Mer Bleue.
6. *S. squarrosum*, Pers. Var. *speciosum*, Warnst. Woods near McKay's Lake.
- Var. *semisquarrosum*, Russ. In woods along the Mer Bleue
7. *S. Wulfianum* Girg. Var. *macroclann*, Warnst. Woods near Beechwood.
- Var. *viride*, Warnst. Race Course, Oct. 11th.
8. *S. cymbifolium*, Ehrh. Var. *laeve*, Warnst. Abundant in Mer Bleue, also at the Race Course.

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EXCURSION No. 1.

“When is the first excursion to be?” is the question asked, by many anxious enquirers, every spring as soon as the leaves begin to unfold and the genial smile of nature once more greets the eager naturalist who has been impatiently waiting for snow and winter to pass away, that he might lay aside his books and dried specimens and go to the woods to worship his goddess and learn more of her creatures, and thus find the only true rest from the cares and worries of the every day world.

The first excursion is always one of the best attended of the whole year, and that held this spring, at the end of May, was no exception to the general rule. King's Mountain, in the Chelsea Mountains, has now become recognized as “the best place” for the first outing.

The weather, early in the morning of the day chosen, looked rather doubtful, and this had the effect of keeping some who would have attended from doing so. However, more than 100 ladies and gentlemen turned up and left the rendezvous at 9.15 in six large vans. The day was decidedly hot, but the cool breeze which all day blew from the mountains, rendered the trip to the woods most agreeable. Kingsmere was reached by noon, and after lunch the president, Dr. R. W. Ells,

announced the programme and gave the names of the leaders who were present. Nearly the whole party ascended the mountain, under the leadership of Mr. R. B. Whyte, who in his usual genial way answered the questions of all enquirers. The steep slopes and glades resounded with merry laughter as the eager excursionists spread out over the mountain side and vied with each other in trying to find something new. When the party re-assembled before leaving, the usual addresses were given. Mr. William Scott, the botanical leader, was first called upon by the president. He spoke of many plants in an easy and instructive manner and imbued his hearers with some of his own enthusiasm as he drew attention to the various points of interest in the various flowers exhibited. The delicate mauve bells of *Clematis verticillaris* were admired by all, as well as many other floral treasures. Mr. A. G. Kingston told of the habits of the birds seen, and described their notes. The attractive manner in which he treated his subject held the attention of all present. Mr. Fletcher spoke of the insects collected, and also on some fungous diseases and edible fungi. The edible Morell (*Morchella esculenta*) was shown, as well as a somewhat similar fungus of the genus *Helvella*. Mr. H. P. Brumell gave a simple and most interesting account of some of the more important minerals in the Laurentian formation at the conclusion of which he was loudly applauded. Before leaving, Dr. Ells congratulated the members on the success of the meeting, which every one present felt was largely due to the excellent management of the excursion committee, and also to the kindness and attention of the President and Mrs. Ells, who were untiring in their efforts to make every one present enjoy the day thoroughly.

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EXCURSION No. 2.

The second general excursion of the Club was held on Saturday, the 27th June, when Montebello was visited. Notwithstanding the somewhat unfavorable weather for a river trip—the morning being very cool with a high wind—about sixty of the members and their friends availed themselves of the opportunity of again visiting the village so

famous in civil, military, and natural history. Among those who have not been seen at previous excursions of the club were noticed Dr. Wilson and his three sisters from Cumberland, and the Rev. J. F. and Mrs. Gorman, of Ottawa.

Montebello is about 45 miles from Ottawa, on the left bank of the Ottawa River, and was during the rebellion of 1837-8 the scene of considerable military action. Here stand the old homestead and grounds of the Hon. Mr. Papineau, whose father figures so prominently in Canadian history on account of the part he took in that struggle. The house stands in a park which, to all appearance, is a primitive forest beautifully laid out in drives, foot-paths and flower beds. In this park are several other buildings, including a chapel, a museum and a lodge, each in a separate stone building kept scrupulously clean and in good order by a staff of workmen continuously employed. As the morning wore away, the day became warm and the trip enjoyable, and after a run of four hours on the "Empress" the excursionists were landed safely at the wharf. Ample justice having been done to the contents of the baskets, the party proceeded to the grounds mentioned, where the Hon. Mr. Papineau was waiting to receive and welcome them, and in his usual courteous manner threw open the museum and explained the arrangement of the armory and the various implements of war, as well as the meaning and uses of the numerous curiosities there to be seen. The whole place presents a sight of antiquity, and to those familiar with the early history of the country calls up reminiscences of the gravest nature. After viewing the many objects of interest in the museum and park, the botanical section, under the leadership of Mr. R. B. Whyte, went to the woods and mountains to the north of the village, where many rarities of the vegetable world were collected and brought back to the landing barely in time to catch the boat on her return trip from Grenville at 3 p. m. When Mr. Whyte had finished arranging his plants, Mr. T. J. MacLaughlin, First Vice-President of the club, addressed the members and passengers, and after explaining to the latter that it was customary for the leaders to give addresses on the collections and observations made by them during the day, and that the Captain had given them permission to do so on the boat, he called on Mr. Whyte to speak on botany. Mr. Whyte, in his usual forcible

and earnest manner, enumerated the various plants, which were of unusual interest, and gave interesting accounts of their habits, medicinal qualities and other uses known to science, answered questions and gave much valuable information to eager and numerous inquiries among the passengers. Mr. MacLaughlin again addressed those present, and after expressing his regret at the absence of so many of the leaders, spoke at length on the advantages of a knowledge of natural history and of the good work the club was doing for science in cultivating a taste for the subject, and emphasized the affirmation that although the club was not aided by Government, nor by any other source outside of its individual membership fees, it was doing as much for the cause of science, if not more, than any other institution of the kind in North America. The party returned to the city at 7.30, well satisfied that they had spent a pleasant and profitable day.

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HENRY EDWARDS

It is with deep regret that we have to announce the death of our highly esteemed corresponding member, Henry Edwards, who died of dropsy in New York, 9th June last. By his death, one of the most devoted lovers of science and art has passed away. As an Entomologist, Mr. Edwards had few equals, and he possessed one of the largest private collections of insects in the world. His courtesy in naming specimens, and his generosity in helping others were well known by all his correspondents. His death will be deplored by many grateful and loving friends.

Mr. Edwards was an Englishman, and was born at Ross in Herefordshire, August 27th, 1830. When quite young he showed much talent as an actor, and frequently took part in amateur theatricals. In 1853 he sailed for Australia and took to the stage as a profession. From Australia he went to South America and lived for some time in Peru and Panama. In 1867 he reached San Francisco, where he stayed ten years, during which time he took an active interest in th

California Academy of Sciences, and made many friends. In 1877 he moved to the east where he made his first appearance in Boston. In 1879 he went to New York and was for many years manager of Wallack's Theatre. In 1889 he left New York for his old home in Australia, but returned again in 1890.

As an Entomologist, Mr. Edwards had a world-wide reputation, and was recognized as one of the highest authorities in North America. Through his own generosity, we have in our club library most of his valuable papers. Amongst these his "Descriptions of Pacific Coast Lepidoptera," and "Bibliographical Catalogue of the Described Transformations of North American Lepidoptera," are very valuable to the working Entomologist. His death will deprive many of an able and kind helper, as well as of a friend, who even through his correspondence had endeared himself to those who never had the pleasure of meeting him.

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A. A. A. S.

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Beginning August 12th next, a series of meetings extending over two weeks is to be held at Washington, D.C. These meetings will be of the utmost interest. On August 12th the first meeting will be held of the Association of Agricultural Colleges and Experiment Stations. August 17th the Society for the Promotion of Agricultural Science begins its sessions, and also on the same day the meeting of the Association of Economic Entomologist, of which Mr. Fletcher of this club is the President for the year. These meetings will take two days, and on the 19th the American Association for the Advancement of Science begins its week of meetings and entertainments. Washington is undoubtedly now the scientific centre of the North American continent, and great preparations have been made to ensure the success of these meetings. Everyone who could possibly attend them should make a special effort to do so.

THE OTTAWA COLONY OF CHIMNEY SWIFTS (*CHÆTURA PELAGICA*).

By A. G. KINGSTON.

(*Read 29th January, 1891.*)

Among the many different physical powers exhibited by animal life in its endless variety of forms there is none which has so much impressed the mind of man in every age as that one so widely characteristic of the feathered class, the gift of flight. In the systems of the ornithologists a bird may take higher or lower rank according to the development or simplicity of its internal structure ; but in the eyes of mankind at large, let but the power of rapid and untiring flight be shown in a high state of perfection, and just in that measure will its possessor approach the ideal bird. Throughout the whole class there are few, if any, families which in this respect can rival the Swifts.

The Albatross and the Frigate Bird can indeed sweep over immense stretches of ocean in an hour's time, but, after all, the sea and the earth enter largely into the life of these birds. Their food is sought amid the waves, their nests are placed among the rocks along shore ; but the home of the Swift is in the upper air where he delights to spend every moment of the long summer days. By him every function of life, except sleep and the incubation of the egg, is performed upon the wing ; and every organ of the body, as we shall see, is specialized to fit it for this purpose, almost to the disregard of all others.

In most parts of Eastern Canada and the United States the Chimney Swift is one of our most common city birds, often an uninvited guest within our houses and spending the short summer nights within a few feet of our beds.

Here in Ottawa every stroller upon Parliament Hill during the pleasant evenings in spring, and again in the later summer months, is amused by the merry twittering and rhythmic whirling motion of that countless cloud of little birds circling round one of the towers of the Government Buildings. And in the height of summer no better example can be found of the power and grace of motion than to see one of these same swifts, after soaring for some time high in the air, descend and, hurrying along just over the roofs of the houses, wheel once or twice about the chimney where his nest is hung, and suddenly arresting his

onward motion, with wings raised high above the back like a shuttlecock, drop down into the darkness. This habit of theirs of nesting in chimneys, it may as well be admitted, seems at first to detract much from their claim to an ethereal nature as dwellers in the air, but it should be borne in mind that the swift never makes his habitation amongst soot and smoke, for he is always careful to choose a chimney that is not in present use. Moreover, in the days when the human lord of this continent was living in a wigwam filled with soot and smoke, the home of the swift was the shaft of a tall and hollow tree.

The *Cypselidæ* or Swifts are a family of swallow-like birds of medium size and generally of dull plumage. In the classification of the older ornithologists, on account of many superficial points of resemblance, they were closely associated with the true swallows; and as popular language even in the present day applies the name "swallow" indiscriminately to all those birds of graceful flight which live on insects caught upon the wing, it may be well to consider for a moment the reasons that have led to the modern classification; for now while the swallows are closely linked with the finches, tanagers and other singing birds of the Passerine order, so unlike them externally, the swifts on the other hand are placed in a distinct order and as intimately coupled with a family of entirely different appearance, the humming birds. For a vindication of what seems at first an unnatural classification it would be hard to find anything more satisfactory or conclusive than the words of Prof. Garrod as quoted in Cassell's Natural History. At the same time they will give us a glimpse of the internal structure of the swifts which may serve to explain some of their curious habits. I give them in abridged and somewhat modified form :

'Most of us know that unlike the hair upon a quadruped the feathers of a bird are not distributed evenly over the body, but grow in linear clusters, called *tracts*, with narrow naked spaces between. A similarity of the arrangement of these feather tracts in different species has been found to be closely associated with that general similarity of the important organs of the body which leads to the grouping of species together under one order, while the different orders frequently show different patterns in this respect. Now the arrangement of the feather tracts on the swift is found to be almost identical with that of

he hummingbird, while the swallow shows an entirely different pattern, closely resembling that of the finches.

‘Again, the breast-bone, or sternum, is a bone of great importance in all flying birds, as it gives origin to the powerful muscles which move the wings. Here, too, the swift and the hummingbird show a similar model, the swallow and the finch another.

‘The swallow is not a singing bird, yet upon dissection, the syrinx, or origin of voice, at the lower end of the windpipe, is found in one of its most highly developed forms, as in the true songsters. Ages of disuse do not seem in this instance to have caused a degeneration of the organ. Upon the swift and the hummingbird, on the other hand, no reproach can be cast for neglect of musical talent. In them the syrinx is of an entirely different and much simpler form.

‘The foot of a swallow is, though comparatively small and feeble, that of a true percher. It is covered with *scutella*, or scales, and has the power of moving the hind toe independently of the other toes; this is indispensable for the grasping of a perch. The swift’s foot, unlike that of all other birds, is covered with smooth skin. The hind toe is lacking in the power of independent motion, and in some of the genera is turned forward alongside the others, instead of having an opposing action like a thumb. Accordingly the posture of a swift when at rest is either clinging to a vertical surface or squatting flat upon a level one; whereas, a swallow may often be seen perching on a twig or wire.

‘Lastly the swifts and hummingbirds have ten primary feathers in the wing and ten in the tail, while the swallow and the singing perchers have only nine in the wing but twelve in the tail.’

For these reasons, then, among others, the swifts have been removed from their old proximity to the swallows, and grouped with the hummingbirds and the goatsuckers, or nighthawks, under an order called the *Macrochires*, or long-handed-ones, in allusion to the great length, comparatively, of the outer joint of the wing, corresponding to the hand in man.

The Cypselidæ are world-wide in their distribution, species of one or more of their six genera being found in every continent and in Australia, all remarkable for their wonderful power of flight and for their

excellence as architects. Their styles of nest-building are very various indesign, but there is one characteristic running through all which distinguishes their nests from those of all other birds. Owing to the extreme weakness of the feet and to the great length of the wings these birds are excessively awkward in any situation but their native element, the upper air. They cannot build of grass, feathers or hair mixed with mud as so many other birds do. To collect the materials would be difficult to weave them together impossible. Neither can they nest upon the ground—a common alternative, especially with non-perching birds. get him on a solid, level surface and the swift is almost helpless. He flounders awkwardly about until he can launch himself over the edge of a rock or bank, and spread those long wings again on the free air. But if nature has condemned this race to make bricks without straw, she has herself shown them how to provide a substitute, and that from a most unique source. The whole family are gifted with an unusual development of the salivary glands which in nesting time secrete within the mouth a thick viscous fluid. Of this material, wholly or in part, the nests of all the various species of swift are composed. On exposure to the air it soon dries into a glue-like substance, hard, light and elastic. So tenacious is it that in removing the nest of our own North American species from a chimney the very brick itself will often come away in scales before the nest will break. Thus equipped these children of the air are almost independent of the earth, and can fix their homes and rear their young in the most inaccessible places, far from the dangers of this lower world.

In Ceylon and the islands of the Indian Archipelago several species of the genus *Collocalia* fasten their little saucer-shaped egg-baskets against high over-hanging cliffs, or on the walls of caverns running in from the sea. These furnish the famous Salangane, or edible birds-nests, so dear to the heart of the Chinese epicure. The best samples, that is, the first of the season, are composed wholly of the salivary gum, and are so difficult to obtain that they are frequently sold in the Celestial Empire as high as three guineas (\$15) a pound. In general shape they resemble the nest of our own chimney swift, but are of a translucent white colour, and appear as if woven of threads of isinglass.

In the West Indies the long flower-spathes of the cocoanut palm often hang on the trees in a withered state for many months ; and up inside of these the Palm Swift finds a safe and convenient place to affix its nest, composed of feathers glued together with the same salivary gum. This plan of fastening the nest to the inside of a hollow tube or shaft seems to be a favourite one with several of the American species. Not only is the idea shown in the choice of the chimney swift, but there are two species which actually construct the protecting tube for themselves. *Paniptila Sancti Hyeronima* inhabiting Guatemala, attaches to the underside of an over-hanging rock a tube some feet in length, composed of the seed-down of plants caught flying in the air and glued together with saliva. Entrance to this is from below and the eggs are laid on a kind of shelf near the top, Very similar is the nest of a Brazilian species, *Chaetura poliura*, only in this case the tube is suspended from the branch of a tree and is covered with bright coloured feathers. There is no shelf within to receive the eggs, and it is believed that these are cemented against the side of the tube and brooded on by the bird while in an upright position.

Having thus referred to the characteristics of the family in general, and to some of its more interesting members in other lands, we will perhaps be better prepared to consider the peculiarities of our own bird, the American chimney swift (*Chaetura pelagica*). This bird is about 5 inches in length and 12 to 13 in extent of wings. The general colour is a dull dark gray, considerably lighter on the throat and breast and having a faint gloss of metallic green on the back. On taking either of the specimens on the table in the hand one is at once struck with the singular appearance of the tail, each of the ten quills ending in a strong sharp spine formed by the shaft being produced about a quarter of an inch beyond the vane. Such a form of tail is almost valueless as a steering apparatus during flight, but serves admirably the purpose for which it is used—that of a prop to support the weight of the body while at rest ; for the only position of rest ever assumed by this bird is a vertical one, as it clings to the inside of a chimney or hollow tree braced up by this strong spiked tail. A woodpecker at work on the outside of the tree would assume much the same position, but in his case the spineous nature of the tail is less marked, while the

foot is suitable for climbing, that of the swift being weaker and fitted mostly for clinging.

The next striking feature is the great length of the wings, the distance from tip to tip when fully extended being more than $2\frac{1}{2}$ times the extreme length of the body. The ratio of these two measurements in most land birds is about as $1\frac{1}{2}$ to 1. In the swallows it only reaches 2 to 1; and the proportion shown in the chimney swift is only exceeded, if at all, by one or two of the hawks and some of the long-winged sea-birds, as the frigatebird and the wandering albatross.

Referring to the latter it is worthy of notice that in these seabirds the great stretch of wing is due to the lengthening of the inner joint or *humerus*, the other bones being comparatively short, while in the wing of the swift and all birds of the same order the proportion of the bones is exactly reversed. The *radius* and *metacarpals*, or forearm and hand, make up almost the whole of the wing, the inner joint being so short that the carpal angle is almost covered by the feathers of the shoulder. And there is a corresponding difference in the style of flight. The sea-bird propels itself by long measured sweeps, or soars for whole minutes without a movement, whereas the wing of the swift is constantly aquiver as he darts and dives hither and thither after the insects that make up his food. Much as the swallows resemble the swifts in colour, size and habit, it is not difficult to distinguish between them when on the wing. The motions of all the swallows are more measured and graceful, being guided by the long rudder-like tail, while the swift might be compared to a short boat without a rudder but having very long oars, not quite suited for following a perfectly straight track, but making splendid time and brilliant steering on a very tortuous course. The small flattened and curved bill looks at first sight ill-suited for its duty of capturing insects in rapid motion, but it will be noticed that the mouth is cleft far beyond the base of the bill, reaching to a point just below the eye, and when wide open the gape is really very great. There is an eyebrow or shade over the eye to protect it from the glare of the sun. A similar feature is seen in some eagles, which have a prominent bony shelf above the eye. That of the chimney swift, however, is formed entirely of feathers.

These birds are late comers with us, most of the swallows generally

appearing some time before them, but they atone for tardiness by remarkable regularity. The records of a number of years show that they may be looked for in Ottawa almost with certainty on one of the first six days of May ; and when they come they come altogether. To-day, perhaps, not a swift is to be seen, or at most but a couple of pioneers; to-morrow the whole colony is with us. They take up their abode at first in what may be called the swifts' immigrant shed. I call it by that name because none of the birds have any intention of making it a home in which to bring up a family. This temporary shelter is a ventilating tower at the northeast corner of the Western Departmental Building. Here on any fine evening in May they may be seen in countless numbers, sporting and chasing each other high in air, at first extending their gambols over the whole of Parliament Hill, waiting for the stragglers to come home, perhaps from an afternoon's trip to the St. Lawrence, or far back over the Laurentian Mountains, for distance is nothing to them. As the evening advances, however, the whole flock commences to take up a circling motion round the favourite tower, though still high above it. Gradually the circle becomes narrower and a few birds will now and then dash down at the windows of the tower as if about to enter ; but these are only "false offers," for the birds sheer off and rejoin the twittering stream above, which is all the while drawing lower down and closer together, until now the sun has fallen behind Chelsea Mountain, and just as the twilight comes on, the stream narrows to a living whirlpool whose vortex is the tower window. Then with the roar of many wings beating together they pour into the opening. There are four such windows within a few feet of one another, but the swifts use only one, the eastern ; and as it is too narrow for the multitude of birds pressing in, many flutter against the stone work and eddying off at the sides heighten the resemblance of the whole to a whirlpool. These fall into the main current again when its force slackens, and soon the last swift has entered for the night.

The great Audubon and several other ornithologists describe the chimney swifts as prolonging these gambols after sundown far into the dusk, and Nuttall even calls them nocturnal birds ; but with us they always retire with, or soon after, the setting sun, and when the last straggler has disappeared there is still light enough to read a book without

much difficulty in the open air. The observations of most of these naturalists were made in the Central and Southern States, where even in summer the nights are of considerable length. In our northern latitude, on the other hand, the short duration of the hours of darkness at this season compels the birds to seek more promptly the rest so much needed after the incessant activities of the long bright day.

At this hour the inside of the ventilating shaft is too dark to permit one to see anything of its occupants, but on the 20th of May last I was fortunate enough to find them almost all at home in the daytime. The weather was cold with a light rain, and, as the swifts are very susceptible to a fall in the temperature, only a few score ventured out to circle round the building or take a short turn over the city. Entering one of the ducts through a trapdoor in the attic, a journey of a few feet on the hands and knees was well repaid by the view within the shaft. The tower is an octagonal one, built of stone lined with bricks, the space within being about 8 feet across. Up through the centre passes an iron smoke-pipe from the furnaces in the basement. This is about 3 feet in diameter, so that the intervening space leaves ample room for a view of the wall lighted by the little windows at the top where the swifts find entrance. All round the inside the birds were clinging against the wall, shoulder to shoulder, covering every available inch from a short distance below the windows down to about 10 feet above my head, a space of probably 18 feet in height. Many were continually fluttering in and out, knocking each other off and beating about in the dim light with endless flapping and twittering. The wall surface covered would be about 470 square feet. Audubon in making a rough computation of the number of a flock roosting within a hollow tree which he visited near Louisville, Ky., allows 32 birds as the number resting on each square foot of surface. At this rate the census of the Ottawa colony would reach 15,040. I believe, however, that this is considerably over the mark. On several evenings I took the time occupied by the flock in entering the tower, which proved to be about 16 minutes. If there were as many as 15,000, it would require something over 15 birds to pass in during each second. The opening is a small one, about 1 foot by 3, and it seems hardly possibly that they can crowd in at such a rate, though they certainly go faster than one can count. Probably 9,000

or 10,000 would not be far from the true number of the flock. There is at the bottom of the shaft a mass of droppings and feathers, evidently the accumulation of several years, but no sign of a nest anywhere. This place is not made use of by them for that purpose.

Inspection of the tower during daylight on a number of other occasions when the weather was fine showed not a single swift within. It is well known that they never rest in the open air, and as there appears to be no other roost in this neighbourhood the conclusion is almost unavoidable that these tiny creatures spend the whole 16 or 17 hours of the summer day upon the wing. What restless energy in those little pinions! And what a vast quantity of insect food, in the aggregate, must be consumed in order to sustain such untiring muscles!

In the year 1869 the late Lt.-Col. Wiley read a paper on "Swallows" before the Ottawa Literary and Scientific Society, in which he gave an interesting account of this same colony. Their favourite rendezvous was then a tower in the Eastern Block, from which they were afterwards excluded by placing a wire netting over the openings. It is to be hoped that they may long remain undisturbed in their present quarters. The good work done by such a flock in clearing the atmosphere of insects must be almost incalculable. And for this we are now more than ever dependent upon the swifts, since almost all the swallows and other insect-eating birds have been driven from their city homes by the European sparrows.

There are several other similar towers about the Government Buildings, but none of these are ever occupied by the swifts, so intensely gregarious are they in disposition. When nesting time comes, however, the case is exactly reversed. The birds are scattered over the city and probably far into the country, and seldom, I believe, is there more than one pair found nesting in any one chimney.

Amongst all the feathered tribes, at the nesting season, the males are endowed with some distinguishing mark of beauty or some accessory power of display which serves to point out to the other sex the most vigorous and desirable among many suitors. The brilliant colours, the wonderful growths of ornamental plumes, the sweet songs or extraordinary calls of many birds in spring time are all to be accounted for upon this principle. In other species the same end is served by curious

feats executed, generally on the wing, but sometimes on land or water. The drumming of the partridge is a familiar instance of this kind of performance; and though very different in style, the courtship of the chimney swift may be classed under the same head. At all other seasons they hunt singly or in pairs, twittering frequently; but during the latter half of May they are almost always to be seen in groups of three. The twittering becomes almost a continuous trill, and the lines of flight more graceful. Neglecting those zigzag darts after insects which mark their course at other times, and keeping for a long time the same relative positions, the little trio sail low down over the houses and tree-tops in long sweeping curves as if conscious of being on exhibition. By the first week in June these preliminaries are over. The unfortunate rejected has given up the suit and has retired to spend the summer in celibacy, with others equally unlucky, at the tower; and the mated ones at once set about the selection of a suitable chimney, free from fire and smoke, and tolerably clean from soot for the firm attachment of the nest. The few necessary building materials are supplied by any tall tree having dead twigs at the top. The birds while on the wing seize the twigs, and by a sudden twist break off short pieces and carry them away to the site already chosen. These are glued to the side of the flue and to each other with the mucilage secreted in the mouth of the bird as already mentioned, and are formed into a light and strong saucer-shaped nest. No down or other soft material is placed within, but the eggs are laid upon the bare framework of the nest.

On the 3rd July, 1890, I was fortunate enough to discover the nest of a pair of these birds in one of the chimneys of my house. By removing the stopper of a stove-pipe hole and placing two small mirrors in suitable positions in the flue I was able to see a good deal of the household management of my little guests. The nest was about three and a half feet above the pipe hole and eight feet from the top of the chimney; and was when unoccupied nearly hidden from sight by a slight "jog" in the chimney. Although during several weeks before that the birds had been heard in the flue and careful watch had been kept, the operation of building had not been seen; and indeed the exact location of the nest was only made known by the long wings of the bird projecting from it after egg-laying or, perhaps, incubation had begun.

Whether both birds or only the female took part in the nest-building is uncertain, but it appears to have occupied more than a fortnight. During the nine or ten days of incubation the mate did not appear to roost in the chimney and seems to have been rather remiss in his attentions. Indeed, I did not see the two birds together in the chimney during all this time. After the young were hatched, however, which took place on the 13th July, the male became less neglectful of his family duties, taking a fair share of the task of feeding the young, and always spending the night within the flue, not far from the nest. These observations are in accord with the fact that the birds resorting to the tower of the West Block, though somewhat reduced during the latter part of June and the first half of July, still formed a large flock, perhaps half of the original number ; while after the time of hatching out they rapidly dwindled,—no doubt, by the calling away of the males to assist in the care of the young. On the evening of the 2nd of August not more than forty or fifty were seen to enter the tower.

For the first week the young were kept constantly covered by one or other of the old birds, who relieved each other at intervals of half an hour or an hour. Contrary to the descriptions given in most of the books treating of the swift, these birds seemed to be but poor climbers. They would flutter down from the entrance with wings half open above the back and alight at some little distance from the nest, generally below it. Then after a moment's rest, they would scramble up to the nest, half climbing, half flying, being never seen to ascend the wall without the assistance of the fluttering wings.

There was something about their manner of feeding the young which struck me as remarkable. When one of the parent birds returned from hunting and took its place on the nest, as I have just described, it would not proceed to feed the nestlings until after an interval of several minutes. Then without uncovering the nest it would put its head down and make a sort of contortion of the whole body, and at the same time the young would be heard to peep. This action would suggest that the food, instead of being carried in the bill, as is done by other birds when feeding their young, is disgorged from the crop after the manner of the vultures and some seabirds. And may it not be possible that the mucilaginous secretion, so useful to these birds in

nest-building, plays just as important a part in the nourishment of the young? What yields such delicious soup for a Chinese mandarin ought surely to make good pap for a young swiftlet. Something analogous to this is well known to take place in the pigeon family where the nestlings are fed with a material disgorged from the crop of the parent and consisting largely of a milky and nutritious fluid secreted by the walls of the crop.

In such works as treat of the swifts the subject of nourishment of the young is touched but lightly, if at all, though some writers express a suspicion—it is never stated positively—that they are in the habit at this season of hawking during the night for insects to supply the often recurring demands of the nestlings. It is true that the roaring of wings in the chimney and the voices of both old and young birds are to be heard several times every night; but I believe this may be accounted for by the movements of the parent birds in exchanging places as they take turns in the care of the young. The mate generally roosts at some little distance from the nest, and, as remarked before, they always move either by actual flight or by a half-flying, half-climbing movement which is sufficient to occasion all the noise that is heard. Moreover, though bats and night-hawks are visible enough any summer night, I do not know any record of a chimney swift having been seen in pursuit of prey, even by the brightest moonlight, after nine o'clock; and so far as my observations extend they seem to show greatest activity and highest flight during the sunniest hours of the day. The presence of the shade over the eye, too, seems to mark this bird as a lover of sunshine rather than of dusk.

The regular complement of eggs is from 4 to 6, but only three were hatched out in this case. The young grew rapidly, however, and soon filled the nest to overflowing.

By the of 4th August the stiff tail feathers were plainly visible, and as the young seemed to be crowding each other over the edge, I took a stick and dislodged the nest, catching it and its contents on a cloth fastened across the flue for that purpose. The little birds were not at all injured and started at once to climb up the side again, using claws, wings and tail with much vigor. One taken out and kept in the room a few minutes proved to be about half fledged and was in colour and mark-

ings exactly a miniature of the old birds. On the floor it struggled about helplessly, but when put near the window curtain it would climb quite rapidly with outspread and fluttering wings. The parent birds on returning and finding the nest fallen and the family scattered did not make as much commotion as most other birds would do under like circumstances. Such accidents are said to be a matter of common occurrence with them, especially in rainy weather when the water trickling down softens the gum which holds the nest to the wall. I replaced the third nestling in the chimney, and after he had crept up a little distance, one of the old ones came down and, putting its head under the angle of the outstretched wing of the little one, helped it up to the ledge above, on which the nest had formerly stood, and where all three seemed now much more comfortable than when crowded together in the nest.

I had hoped that after the fall of the nest the young would remain below where, having a better view of them, I should be able to see the process of feeding more plainly. On the contrary, I saw but little of them from this out, as they were continually moving from place to place and only one mirror could be brought to bear on them. They soon grew so large as to be almost undistinguishable from the parents, though they did not yet attempt flight in the outer air. On the 14th and 15th of August, however, I noticed them mounting on the wing toward the top of the flue and then settling down again. Perhaps this is their usual manner of learning to fly. Unable as they are to rise from a flat surface, a first lesson in the open air, which would probably result in a fall to the ground, might prove disastrous, or even fatal, to them.

About this time the numbers resorting to the tower were rapidly increasing again, showing that the nesting season was almost over. On the 19th of August I was called away from town, and on my return at the end of the month my little visitors had disappeared. Even at the rendezvous of the tower only a few remained, and these soon followed the main army to its winter quarters.

Where do they go when they leave us?

A poet tells us that when these northern shores become bleak and stormy :

"Far over purple seas,
 They wait in sunny ease
 The balmy southern breeze
 To waft them to their northern homes once more."

Ornithologists, however, though able to point out with a fair degree of certainty the winter resort of each of the American swallows, as well as of most of the other birds on the Check-list, have nothing to tell us of the wherabouts of the chimney swift at this season. He has never been reported from Central or South America, and from the beginning of November, when he is last observed at the southernmost stations of the United States until his reappearance there about the middle of March, his written history is a blank. To account for this mysterious disappearance the old theory of hibernation has been partially revived by some ornithologists.

In the days when the swallows were supposed to spend half the year buried in the mud at the bottoms of lakes and ponds, the chimney swifts were assigned winter quarters somewhat more congenial in the hollow tree from which they used to be seen issuing in such vast flocks on the sunny mornings in spring. Alexander Wilson writing in 1810-13 found it necessary vigorously to combat these ideas. But our knowledge has made but little progress in this direction in the meantime, and Dr. Coues in his "Birds of the Colorado Valley," discusses the question of possible hibernation seriously and at some length. The trouble is that nearly all the evidence on either side is negative; and to this shadowy array of facts we in Ottawa can add our little quota—that the swifts certainly do not spend the winter in the tower which is their favourite home in spring and autumn. This has been proved by inspection for two successive winters.

Before saying farewell to this little bird let us again place him for a moment side by side with his rival and imitator, the swallow. Even in the points of superficial resemblance, which at the beginning of this paper we took such care to overlook, there is, I believe a lesson for the student of natural history; for they show how creatures of very different origin and structure may take on a great degree of external similarity through living upon similar food and under similar outward conditions. The swifts are probably the older family in their present form, and as we

have seen, have become almost perfectly adapted to the life which they have chosen. But apparently they had not taken up the whole ground, for in the course of time there appears another family radically different in structure and belonging to a much higher order, the Passeres. It covets the food of the swifts, which can be taken only in one way—on the wing, as those birds take it ; so it adopts their manner of life, and in time, without losing its passerine characteristics, the swallow becomes superficially so like the swift that to the casual observer they are both as one. Not only does the resemblance of these families cover the general colour of the plumage, the shape and proportion of the wings and consequent style of flight, the form of head and wide-gaping mouth, adapted for scooping in the fluttering prey, but even the voices of the two, in spite of the great difference in the structure of the syrinx, are really so much alike as to be easily confounded. A still more interesting point of similarity is seen in the way both the swift and the swallow have changed their manner of nesting to suit the change caused by the advent of civilized man. As long as this continent was under the domain of the red man the chimney swift, as has been shown, found a place both for roosting and nesting in a hollow tree, closed at the bottom and with a narrow opening at the top. The barn and cliff swallows fastened their castles of mud and straw against a lofty rock, while the purple martin and the white-belly nested in crevices of the rock or in deserted woodpecker-holes in the trees. The white man came upon the scene, and long before his progress had cleared away, even, any large fraction of the forest, the swift had found out the superior advantages of protection and stability afforded by an empty chimney ; for even Wilson at the beginning of the century knew the bird only as the chimney swift and spoke of the hollow-tree habit as a thing then long passed away. The barn swallow and the martin were almost as prompt in seeking the shelter offered by the outbuildings of the farmer ; and now the cliff swallow, the white-belly and the rough-wing, though a little behind, are fast following the example. The bank swallow alone still clings to the home of his fathers, a burrow in the side of a bank of sand or gravel. The tunnelling out of such a nesting place must often involve heavy labour. Perhaps those little feet of his, feeble as they look, have retained something of the strength of his pas-

serine ancestors, and, if so, he is in this respect less swift-like than his brethren who have, with the swifts, adopted the ways of civilization.

Other examples could be cited of this principle by which a superficial likeness is produced in really different birds by similar environment, as for instance the resemblance of the shrike or butcher-bird to the hawks: but, perhaps, in the whole class there is no case where the real difference and the apparent similarity are at once so great as in this of the swift and the swallow.

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EXCURSION No. 3 (1891).

The completion of the first section of the Gatineau Valley Railway, running into the heart of the Laurentian Mountains, will afford easy access to a district which has always possessed great attractions for the collector and observer in almost every branch of natural history. The excursions of the Field-Naturalists' Club to King's Mountain have usually been amongs; the most satisfactory outings of each season both from a scientific and financial point of view; but attempts to penetrate *en masse* further into the hills have generally proved unsuccessful owing to the wearisome length of the drive. The Excursion Committee expect shortly to complete arrangements with the Railway Company for an excursion of the Club to the village of La Peche, or Wakefield, which is pleasantly situated in a widening of the valley, at a point where a smaller stream, the Rivière de la Peche, empties into the Gatineau, about twenty-one miles from Ottawa. Several members of the Club can vouch for the beauty of the scenery upon the route, running, as it does, in and out of the hills along the river bank.

To be transported to the midst of the Laurentians in an hour's time will be a novel experience for Ottawa excursionists, and it is hoped that a large number of members and their friends will attend. The event will probably take place within the first fifteen days of September. Due notice will be given by circular.

MONDAY AFTERNOON POPULAR LECTURES—BOTANY.

THE EDUCATIONAL VALUE OF BOTANIC GARDENS.

By James Fletcher.

Read January 26th, 1891.

One of the influences which has affected materially the progress of the science of Botany, has been the institution in various parts of the world of Botanic Gardens. The importance of public Botanic Gardens has for centuries been recognized by the governments of civilized states. In an article on this subject in the *Encyclopædia Britannica*, we find as follows: "The foundation of Botanic Gardens during the XVI and XVII centuries did much in the way of advancing Botany. They were at first appropriated chiefly to the cultivation of medicinal plants. This was especially the case at universities, where medical schools existed. The first Botanic Garden was established at Padua in 1545. The *Jardin des Plantes* at Paris, was established in 1626. The Botanic Garden at Oxford was founded in 1632. The garden at Edinburgh was founded by Sir Andrew Balfour and Sir Robert Sibbald in 1670, and, under the name of the *Physic Garden*, was placed under the superintendence of James Sutherland, afterwards professor of Botany in the university. The park and garden at Kew date from about 1730. The garden of the Royal Dublin Society at Glasnevin, was opened about 1796. Gesner states that at the end of the 18th century, there were 1600 Botanic Gardens in Europe." (*Ency. Brit.* IV, 80.)

"The Royal Botanic Gardens of Kew originated in the exotic garden, formed by Lord Capel and greatly extended by the Princess Dowager, widow of Frederick, Prince of Wales, and by George III., aided by the skill of the Aitons, and of Sir Joseph Banks. In 1840 the gardens were adopted as a national establishment, and transferred to the department of woods and forests. The gardens proper, which originally contained only about 11 acres, have been increased to 75 acres and the pleasure grounds and arboretum adjoining extend to 270 acres." (*Ency. Brit.* XIV. p. 55.)

It may be well now to consider what a Botanic Garden is. In a report of a committee appointed by the British Parliament, in 1838, to enquire into the management, etc. of the Royal Gardens at Kew

previous to their being taken over by the Government as the National Public Botanic Gardens, we find that Dr. Lindley, who signed the report, defines a Botanic Garden as "A Garden of Science and Instruction," which means, I take it, a garden where science, that is knowledge, concerning plants may be accumulated and there applied for educational purposes. In order that these objects may be attained in the most satisfactory manner, there are certain features of the work which must always be borne in mind. The means of gathering together the material to be grown in the garden, by purchase, by exchange, by communication with correspondents at other gardens or who live in different parts of the world, although of great importance in the management of a botanical garden, do not come within the scope of my subject to-day. One of the chief sources of supply however is, of course, by exchange with other Botanical Gardens, of which there are many, both public and private, in all parts of the world where education and culture are cherished. In the first instance Botanic Gardens were merely collections of plants which were deemed useful for their medicinal qualities, later general utility, beauty, variety, or even curiosity were considered, and it is only comparatively lately that the most important development of all, the educational value of these institutions, has been recognized. One thing which should be conspicuously apparent on entering a Botanic Garden is systematic arrangement, not necessarily any particular arrangement, but an arrangement by which something is illustrated. A feature of the utmost importance also, is that every plant should be labelled plainly, both with its scientific and vernacular names. In addition to this any further information should be given which can be put on the label without confusion, such as its native country and date of introduction, for foreign plants, and more definite localities in the case of indigenous species. When a plant is the source of some useful product, and this is not shown by the name, it should be indicated on the label. In short the label should give as much information to a visitor as is possible without loss of clearness. In a scientific garden record books, giving full particulars, must of course, be kept, as to the source, age and condition of every individual plant grown. This is of great value and may be the means of saving much loss by preventing the

introduction of trees or other plants into districts unsuitable for their proper development. Many plants are peculiarly affected by climate, the fact that such will grow even luxuriantly in a certain locality makes it by no means sure that they will produce in paying quantities any useful products derived from them in their natural habitat. Most plants show impatience of being grown in unsuitable soil or climate by their behaviour as to flowering or fruiting. Many of our wild plants when grown in England, flower very seldom or not at all, as the Virginian Creeper and Wax Works Vine (*Celastrus scandens*). The charming British Columbian shrub *Nuttallia cerasiformis* although it flowers frequently and profusely in England, will not produce the exquisitely beautiful waxy berries, with their shades of pure white, yellow, pink and black, all growing on the same bush and at the same time, which make it such an attractive object in the Vancouver Island hedgerows and woods. Similarly the production by plants of alkaloids, aromatic oils, and other products, which may be utilized in the various arts and sciences, is much affected by change of climate. But, on the other hand, many most useful members of the vegetable kingdom can, and have been introduced from one part of the world to others where they were not found naturally. Tea from China, and coffee from Arabia, the banana from Africa, the peach from Persia, and many other luscious fruits; our own indian corn, the sugar cane and numerous grasses are now grown over far wider areas on the globe's surface, than were originally adorned with them by nature. Forest trees and trees and shrubs for hedges and ornament, are frequently being imported from one country into another or from other parts of the same country. But all plants, even from the same locality, do not thrive similarly when placed under the changed conditions of soil and climate consequent upon their introduction into another country or locality. In this way thousands of plants have been destroyed and much capital squandered, which might have been obviated had there been a botanic garden, where careful experiment could have been made beforehand with all the particulars recorded for reference when required. Certain trees will thrive well in some localities for a few years and then suddenly their development will cease—instances of this are found in the attempted cultivation of certain

kinds of apple and pear trees in some parts of Canada, where they seldom attain to any great age or size. The black walnut again is a tree which has disappointed some of its admirers. For a few years after germination, being a vigorous grower, the rapid production of wood gave so much promise that experimenters were induced to devote considerable areas to its cultivation, only to find after 10 or 15 years that the trees rapidly decreased in vigour and retrograded. This may be due to their having penetrated through the upper layer of suitable soil and reached a colder or less congenial stratum ; but, I do not wish to discuss that point now ; the unnecessary outlay would not have been made, had it been possible to examine trees of a known age, grown under similar circumstances in a botanic garden. Again on the other hand, a botanic garden would be the means of introducing and distributing through the country new and valuable plants, with the great advantage that those who acquired them would know beforehand whether they were likely to succeed. Botanic Gardens to be of the greatest educational utility should be, of course, thrown open to the public as much as possible, and for that reason should be laid out in an ornamental manner, so that not only botanists, gardeners and specialists may be satisfied when they visit them to study and examine new or rare plants, but, also that they may form attractive places of recreation for the large and important class of mechanics and other labouring classes and their families, consisting in this country of people possessed of considerable education, and, who, when once attracted to one of these gardens, could not but find in it an efficient instrument for refining the taste, increasing their knowledge and augmenting in a very high degree the amount of rational and elevating pleasure available to them. A fertile source of interest in Botanic Gardens is the cultivation and exhibition of the various plants from which foods and other economic products are derived. Interest in these will soon extend to other plants. In the same line of thought is the fostering of a love for flowers in children, and I believe that every child should be taught to wish for a garden of its own. I know of nothing at all which will give such continued and wholesome pleasure to a child as a small plot of garden of which it considers it has the sole proprietorship. If any one wishes to see true pleasure, let them take a seedsman's catalogue, about the

month of May and give it, together with a small amount of money to spend on seeds, to a child who has had a garden of its own and learnt to love flowers. Do not give any help in the choosing unless especially asked to do so, and limit the choice to about three or four packets. For a child to get the most pleasure out of a garden it should not have too much assistance, either in plants or work. The soil should be well dug up to begin with, all else should be done by the juvenile proprietor, and for the garden to be of the most use, it should not be made too easy to get plants, so that each one may be cherished and new ones grown from seeds or cuttings. I know from my own experience when a child, what a source of delight my garden was. On coming home from boarding-school to spend the holidays, the first thing to be looked at was my garden. The associations with flowers are all good and enlightening, and a love for them should be most carefully engendered and cherished in those unhappy children where it does not exist naturally. Such however, are exceedingly rare. The greatest encouragement to a child who has a garden of its own, is for the elders to take an interest in it, never decline to go and look at it whenever asked to do so, and above all things do not interfere in the arrangement and management except to prevent disastrous mistakes; small mistakes will do good, by teaching their own lessons. Now, what these gardens are to children, public gardens are to the masses, furnishing them with, at the same time, innocent and beneficial and also engrossing and satisfying occupation.

All public gardens should be scientific to the extent of having everything properly named and plainly labelled. The first demand when anything creates interest is to know its name, and it is a great disappointment when this cannot be obtained. As a matter of history it is interesting to learn that the Royal Botanic Garden at Kew, now the most extensive scientific garden in the world, was far from being scientific at the time it was taken over, and the committee appointed to investigate the matter, when referring to the fact that few plants were properly labelled, expressed the following opinion of a garden in that state: "It is not easy to discover what advantage except that of a pleasant walk has been derived, by the public, from the privilege of visiting the garden."

The value of plants as food and medicine is a legitimate field of

enquiry for the botanist and the one by means of which he comes most frequently in contact with the unscientific public. Now, there is no place where such investigations can be carried on so conveniently as at a properly equipped Botanic Garden, where plants can be grown under observation and examined, at all stages of development, by investigators specially trained to understand and make the most of what they see, and also fully equipped with the necessary apparatus and literature. Such knowledge as we have, as to the value for food of most of the more important products of the vegetable kingdom, has been derived from the aboriginal inhabitants of the countries where the plants producing them occur in a state of nature ; but the scientific botanist has added very much indeed to this list of useful plants from his knowledge of other species in the same or closely allied families. On the other hand in medical botany the useful knowledge derived from aboriginal sources is comparatively small, by far the larger proportion of the valuable vegetable remedies having been discovered by the scientific chemist as a result of direct chemical analysis of plants, aided by experiment or actual knowledge of the effects produced upon the human frame by the various products obtained.

A subject of great interest to everybody and one which is frequently made an excuse by ill-informed people for not studying wild plants, is the fear of being poisoned. Strangely enough this fear never troubles them with regard to cultivated and greenhouse plants where a much larger proportion of poisonous species is to be found than is the case in the woods around us. As a matter of fact poisonous plants in Canada are exceedingly rare. The Poison Ivy (*Rhus Toxicodendron*) is the only plant in this part of Canada, which is poisonous to the touch, and even with regard to this, although it is so virulent in the southern states it is, as you all know, an extremely rare thing to find anyone affected by it here. There are, also, far fewer plants than most people think which are actually poisonous, even when taken internally ; and anyone with a very small amount of knowledge and common sense is warned against these by their acrid taste or nauseous odour. This, I have no doubt, is the reason why cattle and wild animals which feed on vegetation are so seldom poisoned. The poisonous plants are distasteful to them and are not eaten in any quantity when their dangerous

nature has been detected by the keen senses of taste or smell. For this reason I can make no excuse for people, who are old enough to think, who allow themselves to be poisoned, and I do not believe any sensible person ever will.

I quite agree with my friend Professor Macoun who a few years ago, in speaking of the vast supplies of good wholesome food going to waste all round us every year in the shape of various fungi, touched on this subject and speaking of the small number of poisonous plants in any locality said: "I have no patience with the stupid people who allow themselves to starve to death in a country clothed with grass, plants, and trees, nearly all of which are capable of sustaining life." With regard to such plants as contain noxious principles there are a few general rules, which may be borne in mind by those who travel in the wilds and are liable to require such knowledge, and to which, without going into undue detail, it may not be amiss to refer here. Plants belonging to the same natural order, as a rule, contain similar constituents. There are large orders of plants every member of which makes wholesome food, notwithstanding the occasional presence of acrid principles; such we find in the cress family which may always be recognized by their cruciform flowers, made up of four separate petals. The same may be said of all the rose family which have the stamens standing on the calyx as we find in the rose and apple. All grasses as wheat and corn, and all plants bearing papilionaceous flowers as the bean, the pea, and clover, produce wholesome food for man and beast.

Mrs. Lincoln in her "Familiar Lectures on Botany" says "Such plants as have five stamens and *one pistil*, with a corolla of a dull livid colour, and a disagreeable smell, are usually poisonous; the thorn apple (*Stramonium*) and tobacco are examples. The umbelliferous plants, which grow in *wet* places, have usually a nauseous smell: such plants *are poisonous*, as the water hemlock. Umbelliferous plants which grow in dry places, usually have an aromatic smell and are not poisonous, as caraway and fennel. Plants with labiate corollas, and containing their seeds in capsules, are often poisonous, as the foxglove (*Digitalis*); also such as contain a *milky juice*, unless they are compound flowers. Such plants as have horned or hooded nectaries, as the columbine and monk's hood are mostly poisonous. Amongst plants which are seldom

poisonous are the compound flowers as the Dandelion and Boneset (*Eupatorium*): such as have labiate corollas, with seeds lying naked in the calyx, are seldom or never poisonous, the mint and thyme are examples of such plants."

Plants containing mucilaginous matter are, as a rule wholesome and in British Columbia the Indians eat almost any bulbous root, making regular annual trips to districts where certain liliaceous plants abound. Amongst those roots which they collect in this way are the camass (*Camassia esculenta*) *Lilium Columbianum*, *Fritillaria*, the small bulbs of *Calypso borealis* and, as Professor Macoun tells me, the bulbs of nearly all bulbous-rooted plants, which they designate by the general name of *muck-a-muck*. Another article of food to which they are very partial is the inner bark of young trees of *Pinus Murrayana*.

With regard to the poisonous properties of the parsley family referred to above, Dr. Trimen says, "The properties of the *Umbelliferae* are of three principle and remarkably different kinds. In one section a watery and acrid matter is present; in a second a milky gum-resinous secretion; and in a third, an aromatic and oily one. When the first of these predominates, they are poisonous; the second in excess converts them into stimulants; and the third renders them carminative and serviceable as pleasant condiments. If both the acrid and gum-resinous secretions be absent they are often useful articles of food, as happens with the sweet roots of the carrot and the parsnip, and the foliage of the samphire, fennel, chervil, parsley and celery."

Before closing I should like to say a few words concerning the Botanic Garden and Arboretum at the Central Experimental Farm. I have there in my charge a tract of 65 acres of rolling land admirably suited to the purposes of a Botanic Garden. The higher portion is virtually a plateau with a wide bottom running round three sides of it and with banks sloping down to the bottom land. This variety of aspect is very convenient for the purposes to which it has been assigned. The soil is not particularly good but will improve with treatment. The different natural orders and families of plants will be represented by groups, many of which have been already located. There are at the present time about 400 species of trees and shrubs planted out, and of most of these there are two specimens—all are labelled and a record has been

taken of their time of planting. Special efforts will be made to have the collection illustrating the Canadian flora as complete as possible, and I now appeal to the members of the Ottawa Field-Naturalists' Club to help me in securing roots of as many as possible of our native plants for cultivation. Every working botanist knows the difficulty of deciding specific limits from dried herbarium specimens. I shall, therefore, make a specialty of trying to clear up some of the botanical problems, which now bother botanists, by growing several specimens from seed, where possible from various localities. I have already several species under cultivation, the seeds of which were collected by Professor Macoun, myself or some of my correspondents, and I shall be glad to experiment with any seeds sent to me for that purpose. I would particularly request now the seeds of *Asters* and *Solidagoes*, as I am convinced there is yet much to be done, in working up the Canadian representatives of these two genera, which can only be satisfactorily accomplished by growing them from the seed.

Besides the solution of such scientific problems as the above, economic plants from other parts of the world will be tested as to their suitability for profitable cultivation in Canada. Forestry now becoming so important in Canada, will also receive attention. Already enormous numbers of young trees have been grown from the seed and distributed to settlers on the treeless prairies of Manitoba and the North-West Territories. Before long it will become necessary in Canada to grow trees for timber, in the same way as is now systematically done in Germany. This however will not be done for many years to come and by that time, I hope, valuable data will be available from the growth of the specimens on the Experimental Farm to show what kinds of trees can be profitably grown.

Many other benefits, I trust, will come from this Botanic Garden now begun, by which general botanical knowledge, economic and scientific, will be advanced, and I look forward to the time when the Botanic Garden of Ottawa, shall be one of the chief attractions of this part of the Dominion.

LIBRARIAN'S REPORT, 1890-91.

To the Council of the Ottawa Field-Naturalists' Club.

Ladies and Gentlemen,—I have the honour to report that since our last annual meeting the library of the Club has been removed from its old quarters in the Literary and Scientific Society's rooms to a room kindly provided for that purpose in the Normal School building by Principal MacCabe, Partly owing to lack of time on my part and partly to the delay of a carpenter intrusted with the making of a set of shelves, the books have not yet been placed in order, for which an apology is due and is hereby tendered to Principal MacCabe as well as to the Council of the Club. I am assured, however, that the shelves are now being made and will shortly be completed. Their cost is not to exceed \$6.00. An appropriation of \$10.00 has been made for binding periodicals received in exchange for the OTTAWA NATURALIST, and arrangements will be made for the binding of fourteen volumes, which will probably contain upwards of twenty volumes of periodicals, as some of them are small enough to be bound two or more together. Eight names have been added to our exchange list during the year, as follows:—

Botanische Gessellschaft, Munich, Bavaria.

Iowa Academy of Sciences, Des Moines, Ia.

Jardin Botanique, Rio de Janeiro, Brazil.

Natural History Society of British Columbia, Victoria, B.C.

Natural History Society of P. E. I., Charlottetown, P. E. I.

Rochester Academy of Sciences, Rochester, N.Y.

Scudder S. H., Cambridge, Mass.

Victoria University, Cobourg, Ont.

The total number of exchanges now on our list is 71.

A list of publications received as donations and exchanges during the year is appended to this report.

Respectfully submitted.

WM. A. D. LEES,

Librarian.

OTTAWA, 17th March, 1891.

PUBLICATIONS RECEIVED 1890-81.

- Auk, The (organ of the American Ornithologists' Union).
 American Museum of Natural History—Annual Reports and Bulletins.
 American Association for the Advancement of Science—Proceedings.
 American Geologist.
 Botanical Gazette.
 Bulletin of the Torrey Botanical Club.
 Boston Society of Natural History—Proceedings
 Canadian Entomologist.
 Canadian Record of Science.
 Cincinnati Society of Natural History—Journal.
 Central Park Menagerie—Report.
 California Academy of Sciences—Proceedings and Occasional Papers.
 Department of Agriculture, Canada—Reports of Experimental Farms.
 Elisha Mitchell Scientific Society—Journal.
 Entomological Society of Ontario—Annual Report.
 Entomologica Americana.
 Essex Naturalist.
 Geological Survey of Canada—Reports and Maps.
 Hummingbird, The.
 Iowa Academy of Sciences—Proceedings.
 Illinois State Laboratory—Bulletin.
 Johns Hopkins University—Circulars.
 Journal of Comparative Medicine and Veterinary Archives.
 Kansas Academy of Sciences—Transactions.
 Kansas Naturalist.
 Manitoba Historical and Scientific Society—Transactions.
 Massachusetts Historical Society—Transactions and Prize Lists.
 Meteorological Service of Canada—Weather Review.
 Nautilus, The (Conchological).
 Natural History Society of New Brunswick—Bulletin.
 Natural Science Association of Staten Island—Proceedings.
 Nova Scotian Institute of Natural Science—Proceedings.
 New York Microscopical Society—Journal.
 New York State Entomologist—Sixth Report.

North Staffordshire Field Club—Annual Report.
 New York Academy of Sciences—Transactions.
 Ohio Agricultural Experiment Station—Bulletin.
 Ornithologist and Oölogist.
 Ormerod, Miss Eleanor A.—Reports on Injurious Insects, 1889, 1890.
 Physik-Oekonomischen Gessellschaft (Konigsberg, Prussia)—Schriften.
 Psyche (Entomological).
 Queen's College—Calendar.
 Royal Society of Canada—Proceedings and Transactions.
 Rochester Academy of Sciences—Transactions.
 Smithsonian Institution—Reports and Price List of Publications.
 U. S. Department of Agriculture—Insect Life—Journal of Mycology—
 Bulletins and Circulars.
 U. S. Geological Survey—Monographs I, XV, XVI—Mineral Re-
 sources of the U. S. 1889—Bulletins 54 to 66.
 Université Laval—Annuaire.
 West American Scientist.
 Wisconsin Naturalist.

Non-periodical publications have also been received from the following :—

American Ornithologists' Union.	Ormerod, Miss E. A.
Chamberlain, Montague.	Piers, Harry.
Edwards, Henry.	Scudder, S. H.
Ells, Dr. R. W.	Smith, John B.
Forster, Dr. E. J.	U. S. Department of Agriculture.
Farlow, Prof. W. G.	White, Lt.-Col. William.
Geological Survey of Canada.	

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WINTER SOIREES.

The Soiree Committee requests such members of the Club as are willing to read papers during the coming winter to send in the titles to the Secretary as soon as possible, and at the same time to indicate approximately the date when they prefer to present them.

CANADIAN GEMS AND PRECIOUS STONES.

By C. W. WILLIMOTT.

(Read January 29th, 1891.)

The subject of this paper is Canadian Gems and Precious Stones ; and although I shall touch briefly on such materials, available for the purposes of the Lapidary, as have come under my observation during the past nineteen years, I cannot hope to accomplish anything more than a general outline of their distribution, together with some of their most important characters. Before I begin the enumeration of the various minerals, I had better first of all define what a gem really is.

For the sake of convenience I shall divide the various minerals into two classes—1st, Gem material ; 2nd, Semi-Gem material. Now it sometimes happens that the conventional value put upon a gem of the second class, through richness of colour, transparency, etc., is much higher than belongs to a gem of the first class : hence to draw a line between these two classes may often be attended by some difficulty. The real gems are represented by the Diamond, Sapphire varieties, Chrysoberyl, Spinel, Beryl, Topaz, Zircon, Garnet, Tourmaline, Iolite Quartz and Chrysolite. All others are considered as semi-precious stones.

The origin of the taste for gems is lost in the most remote ages ; it is very evident that the gems mentioned in the scriptures, and other early accounts, do not correspond with ours of to-day. Pliny describes a Sapphire as a stone spotted with gold ; this is thought by some authors to be the mineral we call Lapis-Lazuli.

The ancients must have included a number of minerals under the same name. Carbuncle, for instance, included all gems of a red colour, such as the Hyacinth, Ruby, Garnet, etc. Much superstition has existed in all ages regarding the various gems. The following extracts from Emanuel's "Book of Gems" may be interesting :— "Serapius," he says, "ascribes to the Diamond the power of making men courageous ; also, if this gem is placed in contact with a loadstone, it nullifies its power. According to Boetius the Ruby is a sovereign remedy against the plague and poison ; it also drives away evil spirits and bad dreams. The Jacinth procures sleep and brings riches, honour and wisdom. The Amethyst dispels drunkenness and sharpens

the wit. The Balais Ruby is a protector against lightning. The Chrysolite was said to cool boiling water and assuage the thirst, and if placed in contact with poison it lost its brilliancy until removed."

It was not until chemistry began to be fairly understood that the system of classifying all stones of one colour under the same name was abandoned, and although science has made rapid strides and much light has been thrown on this subject, yet the investigators of the near future may look upon our labours and theories with the same doubtful appreciation as we now entertain of those of our forefathers. I have been diverted somewhat from my original intention, in pointing out the superstitions of the ancients regarding certain gems, but in so doing we are enabled to see the existing link still unbroken, with the superstition of the present day. Concerning the Opal you will find that not two ladies out of six will wear this stone, because they say it is unlucky.

The present time may be considered an age of artificial gems, owing, no doubt, to their insignificant value and bright colours, which frequently almost equal those of real gems, and thanks also to the skill of the artificer, whose designs have been immortalized by the appreciation they have received. I know of no more unpleasant business than to be called upon to give an opinion of an old family heirloom, perhaps a ring or a brooch, from the age or make-up of which one could infer without much doubt that the setting once contained a costly gem; years of wear had, however, weakened the delicate claws, and it was then handed to a workman for repair, so as to avoid its loss; but alas, too often some unscrupulous person had abstracted the jewel and replaced it with one of glass. The imposition may remain unnoticed for a great many years, and at last, when the fact is known, it is then too late to recover the gem. The workman that was guilty of such fraud had either left for other parts of the world or was dead—(personal experience).

Another way in which the unsuspecting public can be defrauded is known to the trade as "Growing a Diamond." This consists of abstracting a Diamond from a piece of jewellery that has been left for repair and replacing it with a smaller stone. Another fraud which is very prevalent, is the substitution of a "doublet" for a real gem. In

this instance the top of the stone is genuine and the under part glass, joined together neatly by transparent cement, or in other cases the top may be Sapphire and the bottom a less expensive gem, such as the Garnet. In these cases, when set, they are difficult to detect, and often deceive the most experienced. Doublets are sold by the Cingalese to Europeans, and even plain blue glass is cut into facets, and sent there from Birmingham and Paris, and palmed off for the real stones.

In throwing out these hints I am convinced that to no jeweller in this city can these prove prejudicial, but on the contrary, as the public are enabled to test for themselves the truth of statements made to them, so also are they able to appreciate the genuine gems. We must not forget to mention the coloured glass, or "pastes" as they are usually termed, which are made to do duty for all the different gems, and which vary in brilliancy according to their mode of production. Some are merely moulded and their angles sharpened on the wheel of the Lapidary; others are cut direct from blocks of crystal glass, which are sometimes very brilliant, termed "Rhine Stones," etc. You will, perhaps, say, how are we to know a real gem from the artificial, we cannot submit it to the chemist, who must break it up before he can pronounce on its nature; it is true he can take its specific gravity, but in this he may fail to identify the mineral after all. Dr. Feutchwanger says he took the specific gravity of an artificial Topaz and found it fully corresponded with the Brazilian Topaz. He, however, found that by employing the simple breath test he was enabled to pronounce on its true character. If an artificial and a real gem be breathed upon at the same time, it will be found that the genuine will become clear much sooner than the false. Having drawn your attention to the dangers of a gem I will now pass on to Nature's store-house where the original or crude minerals lie hidden, ready to be fashioned into the coveted jewel.

We shall first of all consider such minerals as constitute, when cut, gems (proper).

Sapphire.—In the Geology of Canada is mentioned the occurrence of light rose-red Ruby and blue Sapphire in grains, on lot two of the ninth range of Burgess. I should imagine, however, that the quantity is not very considerable, as I examined the rocks myself on two different occasions without finding a trace.

Beryl.—This mineral has been noticed at a few places in Canada, more particularly in the County of Berthier, where crystals several inches in length occur in a granite vein, and although these are often of a good colour (various shades of green), they are not transparent enough for cutting, except, perhaps, in small portions of a crystal which will sometimes cut into small gems. The pale bluish-green transparent varieties of this mineral are called Aqua-Marine; the emerald-green, Emerald. Sometimes the name Aqua-Marine Chrysolite is applied to the yellowish-green varieties. The Emerald and the Aquamarine are sometimes introduced as oriental, which, of course, enhances their value considerably, and, if genuine, are really the green and the light bluish-green Sapphire.

Tourmaline is another gem of some importance, and although its name is seldom heard from the jewellers, it is nevertheless often sold under various names. The yellow transparent variety is often sold in Ceylon for the Topaz. The blue variety is sometimes sold for the Brazilian Sapphire, the green variety as the Brazilian Emerald, and the greenish-yellow as the Ceylon Chrysolite. The carmine or hyacinth-red variety (Rubellite), which is, perhaps, the most valuable, retains the name of Tourmaline.

This mineral is widely distributed in the Laurentian rocks either in crystals or crystalline masses; its predominating colour is black, although such colours as hair-brown, various shades of green, light rose-red and yellow also occur. The black crystals from the Township of Bathurst will cut into fine mourning gems. Small stones of one to two carats, of transparent green of various shades, sometimes a bright emerald, also a yellow and a yellowish-green variety, have been cut from the Tourmaline of Wakefield. The crystals at this locality are seldom more than a quarter of an inch across, but often many inches in length, aggregating together in large masses. I have seen bunches of these slender crystals that would measure eighteen inches in length, exhibiting such colours as black, red, green, yellow and colourless in the same crystal, and graduating from opaque to transparent. Light yellowish-green crystals of Tourmaline are met with in the Township of Chatham in a vein of quartz, but these are opaque and too small for cutting.

Some of the brown varieties found at Lachute, Calumet Island, and other places, might contribute small gems.

Zircon is of frequent occurrence in Ontario and Quebec, and constitutes such gems as the Hyacinth, Jacinth, and the Jargoon. The latter variety has not been met with in Canada. It comes principally from Ceylon, it is perfectly transparent and almost colourless, and on account of its peculiar smoky hue is sometimes passed off for a Diamond. At the Colonial and Indian Exhibition in London specimens were shewn under the name of Ceylon or Matara Diamonds.

In the Counties of Renfrew, in Ontario, and Ottawa, in Quebec, magnificent crystals of the brownish red variety have been found from time to time, but with the exception of a few very small hyacinth coloured crystals from Sebastopol, not fit for cutting.

Independent of the cutting qualities of this mineral, and partly on account of its crystallographic forms, single and twinned, it has been greatly sought after by mineralogists. Forty dollars has been paid for a single crystal from the Township of Brudenell. Small crystals of an inch and under have no value, but large and well-defined crystals command a good price.

Spinel is thought to have been included under Carbuncle by the ancients, and even to-day it is often sold in Ceylon for the Ruby. This mineral is known to jewellers and others under various names, such as Spinel Ruby, when of shades of red; Balais Ruby, when pale red or rose-pink; Almandine Ruby, when red bordering on shades of blue; Sapphirine, when blue, and Pleonast, when black.

In the Township of Wakefield large cubical crystals of a dark green and purplish colour occur in a vein of Calcite, and at times afford small dark green and blue transparent gems. In the same neighbourhood octahedral and cubical crystals of pink Spinel (Balais Ruby) occur sparingly, sometimes three-quarters of an inch across, and although marred with numerous cleavages, afford small pieces from which fair transparent gems may be cut. The blue variety is said to occur in limestone in the Seigniorship of Daillebout. Black octahedral crystals, often grouped together, are mentioned in the Geology of Canada as occurring in Burgess in flesh-red limestone.

Garnet, which is introduced to us under various names by jewellers

and others, is of frequent occurrence in Canada, distributed through the Laurentian rocks in crystals and lamellar pieces, as well as constituting veins and bedded masses of some magnitude. Garnet, however, as a mineral, is one thing, and Garnet, as a gem, is another. Many persons are, perhaps, not aware that this mineral, owing to its various colours, is often made to represent such minerals as the Ruby, Topaz, Chrysolite, Amethyst, or, in fact, any gem that its shade of colour happens to imitate. This imposition is generally confined to closed settings. Independent of the several gems it may be said to represent, it is itself known under various names in the trade according to its colour.

The brownish-red variety known as Almandine is found at several places in Canada, and will at times afford gems. On the river Rouge this mineral occurs in a highly feldspathic rock, in light pinkish-red cleavable masses or imperfect crystals. At Bay St. Paul it occurs of a good colour in mica schist, and in the neighbourhood of Ottawa the red Garnet that is frequently met with in the gneissic rocks probably belongs to this variety. This is the Syrian, also the Oriental or Precious Garnet of the jewellers.

The blood-red Pyrope, Bohemian or Ceylonese Garnet, has not yet been, to my knowledge, found in Canada.

The variety Essonite, or Cinnamon Stone, and at one time called Hyacinth, occurs in the Township of Wakefield of a yellowish and brownish-red colour, from which small gems might be cut. This mineral is mentioned in the Geology of Canada as occurring in the Township of Orford, but is not of gem quality. Another lime Garnet, in well-defined crystals, occurs in limestone in the Township of Wakefield, the crystals of which are sometimes two to three inches across, and vary in colour from colourless through various shades of yellow and green, pieces of which, perfectly free from cleavage joints, will often cut into two carat stones, which are exceedingly brilliant, and might often be mistaken for the Topaz or Chrysolite.

The variety known as Spessartite, a mangesian Garnet, occurs in Muscovite, in flattened brownish-red transparent crystals, in the Township of Villeneuve, and may yet possibly contribute a handsome gem.

Chrome Garnet, which occurs in large aggregated masses of minute emerald-green crystals in the Township of Orford, has not yet presented specimens large enough for cutting. In the Township of Wakefield, however, this mineral presents more promising prospects from a gem point of view. During the past summer preliminary preparations were made with a view of developing a property in this township for gem material.

If crystals of a large size were found, I think it doubtful if they would be cut, as the demand for fine mineralogical specimens of this mineral is very great, and they would realize a greater price than the cut stones, although, if this mineral is perfectly transparent, it would surpass the Emerald in value.

The largest crystal obtained last summer would be about a quarter of an inch, but translucent, yet some of the smaller ones were perfectly transparent.

Chrysolite.—This mineral is mentioned in the Geology of Canada as occurring in well-defined yellowish-green crystals in Basalt, in Rougemont. This is the Peridot of jewellers and lapidaries.

The yellowish grains mentioned in the same work as occurring in the Dolorites of Montarville and Montreal are the Chrysolite proper, although jewellers will persist in confining that name to Chrysoberyl.

No gems have thus far been cut from either of these varieties.

Mr. A. P. Low mentions the occurrence of a yellowish-grey opaque variety in rock masses in the Shickshock Mountains, but this is of no value as an ornamental stone.

Quartz.—Several varieties of this mineral suitable for cutting are found in different parts of Canada, foremost of which is the Quartz Asteria, found in the neighbourhood of the Gatineau. It occurs as a constituent of a granitic vein, in pieces the size of a pea to that of a pigeon's egg, together with other translucent quartz. The quantity of the gem material to the quartzose mass would not be more than one per cent., and even with the available material much of it is marred by inclusions of web-like markings, which often escape observation until after the stone is cut. This stone is perfectly transparent, and by transmitted or reflected light exhibits a star of six rays. This may also be seen in a first-class stone in ordinary light.

The name *Asteria* applied by me to a certain variety of Quartz, will require some explanation, as individual opinions are somewhat diversified on this point. I will endeavour to give my reasons for adhering to this name. I have been informed by one scientist that I could call these gems *Asteriated Quartz*, but not *Quartz Asteria*, which certainly seems to me a distinction without a difference.

Pliny described the Star Sapphire under the name "*Asteria*." This latter name is still retained to designate varieties of *Asteriated Corundum*, such as the *Sapphire Asteria*, *Ruby Asteria*, *Topaz Asteria*, etc. I think we may safely infer that the word *Asteria* was used to particularize a variety depending on physical properties, which were then known to occur only in the corundum mineral, and as *Cats-eyes* are described under Quartz by many authors, when the real stone is *Chrysoberyl*, *Asteria* applied to Quartz would be no more misleading. Emmanuel says the Quartz *Cats-eyes* are frequently confounded by jewelers with the true or *Chrysoberyl Cats-eye*, which they persist in calling the *Chrysolite Cats-eye*. The *Corundum Asterias* or star stones are peculiar to Ceylon. By skilful cutting the natives produce a star of six rays, which by sunlight or artificial light is vividly shown. A top light is best to judge them by. Fine stones command a high price.

Dr. Feuchtwanger says that certain translucent varieties of Sapphire, when cut convex, and when the principal axis of the crystal stands perpendicular to the base of the convex cut stone a white light running in six rays, resembling three white planes or stripes crossing one another at one point is seen.

We feel assured as the properties of the Canadian *Asteria* become better known to jewellers and others, and the prejudice against its being Canadian is overlooked we shall have more admirers of this handsome gem. It compares in some way with the Ceylonese Moonstone, but is much harder and will retain its polish much longer, and on the other hand the Moonstone does not come within the category of true gems.

Probably if these stones had been introduced by some organized ring as new Ceylonese gems and high prices asked for them, they would have been held in higher estimation by some persons. Take for instance the Moonstone, above referred to, which material is far more plentiful, and more easily cut and polished and cheap enough in its

own country, and yet for a two-carat stone and not perfect at that, I was asked the moderate sum of \$7 by a prominent jeweller in Montreal. This stone would be worth in Ceylon about twenty five cents.

You will perhaps rely more on the weight of my statement if I read you an abstract from the Hand-book of Exhibits of Ceylon at the Colonial Exhibition: "Moonstones were credited to other countries in past ages, besides Ceylon, and were known to the ancients, who associated the moonlike lustre with the phases of the moon. These stones are found in large numbers in several places and are not of any considerable value; indeed the large quantities found prevent their commanding a high price." I do not mention this to throw any more reflection on the Moonstone, but merely as a comparison between the intrinsic value of it and the Quartz Asteria.

The taste for the one has been acquired; for the other it has yet to be acquired. You will say, if the stone with its attractive qualities is what you claim for it, why is it not more in demand? To which I would reply, that vendors of precious stones are not generally mineralogists, they therefore decline handling gems that are not known in the market until the demand on the part of the public forces them to do so; and again, the introduction of a new stone may perhaps seriously retard the sale of a large stock of gems on hand, not to mention the many vexatious questions that might be put by customers concerning its durability, etc.

Besides the above variety, the colourless transparent crystals of Quartz found in many parts of Canada will afford at times clear gems.

The brilliant crystals found in the neighbourhood of Quebec and known as Quebec Diamonds look well when mounted in their natural state, and when cut as brilliants are exceedingly bright.

The rose and smoky varieties of Quartz are occasionally met with, and according to Prof. Howe, some years ago, large crystals of the latter kind could be found in the stone heaps of the fields in the neighbourhood of Paradise Village, N.S. I have also seen some fine crystals of this variety from British Columbia, fit for cutting.

Rose Quartz although occurring at a number of places in Canada, has not yet to my knowledge been met with as a gem material.

The perfectly transparent variety, Rock crystal, referred to above

as occurring at several places in Canada, has not, however, been found sufficiently large, I think, for the needs of the optician, who designates this mineral pebble, and who prefers it to glass on account of its superior hardness and coolness to the touch.

I shall here call your attention to some erroneous ideas concerning different coloured Quartz.

The Cairngorm (named from the Cairngorm Mountain in Scotland) is a smoky variety of Quartz--although this name is often applied to the same mineral of other tints. Such names as the Brazilian Topaz Mexican Topaz, Spanish Topaz, False Topaz, Citrine, Smoke Stone Cairngorm, etc., are all applied in turn to coloured Quartz by jewellers and others, who appear to have a name always ready, according to the shade of gem in demand. If this loose nomenclature were confined to varieties of Quartz it would not be of so much consequence, but regardless of their composition, they call all stones of a pale green colour Aquamarine, and all pale yellow ones Topaz.

Amethyst is another variety of Quartz, found principally at Lake Superior and Nova Scotia, although at the former locality it is much more abundant and is found lining cavities in groups of large crystals that are often coated with Jasper, Pyrite, Fluorite, etc. Its colour is of various shades of purple in blotched markings, which prevents their use to any extent as gems, owing to the difficulty of getting an evenly coloured stone. On the Bay of Fundy a more uniformly coloured stone is met with, although comparatively rare, which will at times cut into a costly jewel.

Amethyst is valued according to the depth, richness and uniformity of colour, and its transparency. "This stone like most gems appears less brilliant at night, but when surrounded with pearls it appears at all times to its best advantage." In 1652 Emmanuel says that an Amethyst was worth as much as a Diamond of equal weight.

Cats-Eye Quartz is reported to have been found on the Bay of Fundy. Sometime ago I was shown a rolled specimen from Partridge Island, N.S., which the owner prized very much, but which I was convinced was nothing but a pebble of Heulandite. However, notwithstanding this single mistake, we are informed on good authority that the

real mineral does exist on Partridge Island. But no specimen of it, as yet, has come before our notice.

Opal has been found by Dr. G. M. Dawson in British Columbia in small faintly iridescent pieces in Trachyte. They, however, were too small for cutting. But possibly if this locality were examined more closely for gem material the result might prove more favourable. The same gentleman found the variety Hyalite in small globular aggregations also in British Columbia.

Kyanite.—This mineral has been noticed at two or three places in Canada. In the Sudbury district it occurs in light sky blue crystals in a triclinic felspar, and would cut into handsome gems if found transparent.

Topaz.—According to the late Prof. Howe, of Nova Scotia specimens of this stone were exhibited in London in 1862, both rough and, cut, by Mr. McDonald—the locality given was Cape Breton, and the cutting is said to have been done in Pictou. The cut stone was rather more than half an inch in length, its colour yellow.

Having come to the end of the gems proper, we will now refer to those minerals which constitute Semi-precious stones, and which form a much larger proportion of our gem material than the former.

We will first notice the siliceous varieties.

Quartz.—This mineral has been referred to as a real gem ; we shall now consider it in connection with other minerals, such as—

Gold Quartz.—When native gold is dispersed through a white translucent quartz it makes a very pretty gem.

Thousands of dollars worth of this material have been cut up in the United States during the last few years. We have not as yet been fortunate enough to see much of our Canadian gold quartz fit for the purpose, although, no doubt, suitable specimens are often consigned to the crushers. It is not the scarcity of gold in our Canadian specimens that makes this material hard to obtain ; they are too rich if anything, but it is due to the rusty coloured nature of the quartz. A few stones have been cut, with small nuggets attached, from the Nova Scotia quartz.

Silver Quartz will often afford good material for cutting when the base is evenly coloured.

Thetis Hair Stone.—I noticed this mineral some years ago filling a vein in the Township of Hull. In the rough state it is not a very prepossessing mineral, but when cut tolerably thin it displays its peculiar hair-like markings, floating in a greasy transparent quartz. These inclusions are filaments of Actinolite, and when sparingly distributed and less defined they would assist in producing Catseye Quartz.

Chalcedony.—Under this heading we must include a number of minerals that differ only in their translucency and colour, such as Agates, Onyx, Sardonyx, Hornstone, Chrysoprase, Plasma, Prase, Jasper, Bloodstone and Cachelony, which will be described separately.

Chalcedony includes those clear, translucent varieties of bright red, yellow and white, often called *Carnelian*; when of brownish red it is called *Sard*.

These varieties may frequently be found in rolled pebbles on the shores of the Bay of Fundy, Baie des Chaleurs and Lake Superior, also at a few places in British Columbia.

Hornstone is improperly applied to a cellular cherty mineral from Grenville, of no value for cutting; but in the neighbourhood of Two Islands, Nova Scotia, a beautiful white translucent variety occurs, which, owing to its extreme toughness and its susceptibility to a high polish, is well suited for Signet rings, etc.

Agate.—A description of this mineral alone would fill a good-sized volume were we to make any attempt to elaborate on its varieties and occurrence. The three principal localities where it is obtained are Nova Scotia, Lake Superior region in Ontario, and British Columbia.

From Two Islands, in Minas Bay, to Cape Chignecto, in the Bay of Fundy, and from Digby Gut to Blomidon, on the south side of the Bay, may be called the home of the Agates, occurring at intervals in veins and pebbles, the latter being generally the finest. The varieties mostly met with on the Bay are the variegated and brecciated Agates, although the Fortification and Moss Agates are frequently found, the latter both yellow and green.

In the neighbourhood of Lake Superior the Fortification Agates predominate, although pretty Moss Agates are often found. In British Columbia the Agates are also of the Fortification type, but generally

light coloured or white : not unfrequently stalactitic markings may be seen in a transparent base.

It is a pity that our Agates, which have been so lavishly distributed over the Dominion, beautiful in their natural colours, should be ignored for the more spurious and gaudy articles imported, and palmed off on tourists and others at the Lake Superior and Niagara resorts as Canadian. These Agates come principally from Brazil and India, and, according to some authors, may be recognized from the German by being water worn, whereas the German are generally coated externally with delissite. They are, however, all cut in Germany, and after being polished are steeped in oil, and finally boiled in sulphuric acid, by which process they are often converted from the pure white Fortification Agate to the black Onyx with its white concentric rings. This is caused by the oil entering the more porous portions of the stone and then being carbonized by the sulphuric acid.

Onyx.—This variety is found occasionally at the Agate localities before mentioned, and differs only from that mineral by its colours being arranged in parallel layers, which are either black, brown, red, yellow, etc., striped so as to exhibit alternate colours, arranged like a sandwich, it is then termed Sardonyx. However, rarely more than two colours are seen in the imported stones. It is on this particular mineral that some of the finest masterpieces of art are still preserved in some of the European museums. A marvellously fine antique Sardonyx Cameo of five strata, representing the bust of Faustina, was said to have been sold at the sale of the effects of the Marquis of Dree for 7,000 francs.

We often hear from jewellers and others of the "Oriental Onyx." This name enhances its value considerably, and yet these are identical with the German stones, and as there is every reason to suppose that the same process coloured the stones from India as those from Germany, their quality and translucency is identical, and more particularly as no lapidary or jeweller can tell one from the other, why should there be any difference?

Some fine Onyx pebbles were brought from Queen Charlotte Island, B.C., by the Marquis of Lorne. They were of a pale yellowish colour striped with white. But perhaps the finest specimens of this

variety have lately been found by Dr. G. M. Dawson in British Columbia. These are made up of several strata, and as these layers are exceedingly thin, of different colours, conspicuous among which is a bright green, they would cut into handsome Sardonyx gems.

Chrysoprase occurs of various shades of green, and is translucent. Its colour is due to the presence of a little nickel. This stone was formerly greatly esteemed in Europe, but now is almost valueless. This may be owing to the fact that its colour gradually fades in the course of time. The mineral was found by Dr. Bell, of the Geological Survey, in the Hudson Bay Territory.

Prase has been noticed by Dr. Dawson, in British Columbia, of a dark green colour. It would contribute a curious gem, but although it takes a good polish, it is said to become spotted by long exposure to the air.

Jasper.—Another mineral of the many varieties of Quartz, may be said to be quite common in Canada, and indeed only a few miles from our doors, a band of variegated Jasper occurs, from bright red to various shades of brown and yellow, with often the three colours intermingled. Ribbon Jasper is of frequent occurrence in the Bay of Fundy, often of a brownish base with yellow bands. At Two Islands, Minas Basin, in Nova Scotia, a peculiar white porcelainous looking Jasper, interspersed with rose coloured markings, occurs in veins of Basalt. It takes a high polish and some specimens resemble hand-painted Porcelain. Jasper of various colours may be found almost anywhere on the Bay of Fundy, either in loose pebbles among the debris of the shore or in veins intersecting the Basalt.

The occurrence of this mineral at Sherbrooke and Rivière Ouelle in the Eastern Townships in beds and veins is mentioned in the Geology of Canada. This is, however, very uncertain in its polish at the former locality, where this mineral is of various shades of red. Specular Iron ore, together with numerous small holes, render it entirely useless as an ornamental stone. The Rivière Ouelle specimens, which are often beautifully variegated, will occasionally take a good polish. The so-called "Gaspé Pebbles" are generally Jasper. In the Lake Superior district, in Ontario, Jasper of different colours is found, both in veins and pebbles, the latter enclosed in a translucent quartzite, forms large

beds, and were it not for its vespicular nature would make a handsome ornamental stone. However, small pieces, sufficiently compact, may be obtained which work up into a curious and pretty gem.

In British Columbia, Jasper is often found of a green colour, constituting Heliotrope ; also at the Lake Superior district and Two Islands in Nova Scotia a similar mineral occurs, sometimes interspersed with thin seams and dots of red Jasper, called Bloodstone.

Silicified Wood is merely wood that has been saturated with Silica, either in the form of Quartz or Opal, and some varieties of which are very handsome. It is frequently found in the Tertiary and Cretaceous rocks of the North-West and British Columbia in large pieces.

Cachelony is a hydrous variety of Quartz or Opal occurring at several places on the Bay of Fundy, associated with Agate. This stone would cut into small gems of a white translucent colour.

Chiasolite.—This mineral is worthy of a place among the gem materials ; if its sombre colour does not introduce it as a general favourite, its quaint dark coloured cross, which is revealed when the crystals are cut at right angles to the longer axis, would obtain for it some admirers as a curious gem. This mineral, according to the Geology of Canada, is found on Lake St. Francis, and boulders of a schistose rock of some hundreds of pounds in weight, thickly studded with these crystals, were observed by Dr. Ellis in the Eastern Townships.

Staurolite, is another mineral that may be mentioned in this connection as it is sufficiently hard and takes a good polish, and when of a reddish-brown colour and translucent, will make rather a pretty gem. Crystals of this mineral occur at Moore's Mills in New Brunswick, and it has also been observed in Nova Scotia and the Eastern Townships, but judging from specimens I have seen, none of gem quality.

Feldspar, is made to include a number of minerals such as Orthoclase, including Adularia, (Moonstone) and Porphyry ; Microcline, including Amazon Stone and Perthite ; Albite, including Moonstone and Peristerite ; Oligoclase, including Sunstone and Moonstone ; Labradorite and Obsidian. You will therefore see that the Moonstone may consist of three different feldspars. The transparent variety from Ceylon is Oligoclase. The milky variety from St. Gothard is Ortho-

clase, and the similar Canadian variety is Albite, although some of our Orthoclase is quite luminous when cut.

Orthoclase occurs in Canada of different colours the more conspicuous of which are pinkish, white and brown, the latter variety often beautifully crystallized in the Townships of Sebastopol and Ross, and sometimes the crystals when cut parallel with certain planes are quite luminous. They at the same time, reveal minute spangles of a glistening yellow colour, thus combining the properties of the Moon-stone and Aventurine. This constitutes a neat and pretty gem, and it is a pity that prejudice should prevent these stones from taking the place of the gaudy imitation trash that is at present glutting our market.

It is stated in the Geology of Canada that a reddish-brown Orthoclase with cleavages of half an inch across, which exhibits golden-bronze reflections of great beauty, was brought from the coast of Labrador. Another Aventurine variety was noticed by Dr. Bigsby on the north east shore of Lake Huron, twenty miles east of the French River.

Porphyry, more properly is a rock mass, composed of two or more minerals. This material of various colored bases, interspersed with white, rose red, and greenish spots is found at many places in Canada. A rock of this description covers a number of acres in Grenville and Chatham, and could be utilized for ornamental purposes, and also, as a gem stone, portions of it being as pretty as a Bloodstone.

Felsite. I should here mention another rock that occurs at Chamcook, N.B., under the name of Felsite. It is thoroughly homogenous and takes a high polish. Its colour is of various shades of brown, sometimes veined with lighter or darker shades, giving to the mass the aspect of rosewood.

Microcline or "Amazon Stone," is found in the Townships of Hull, Wakefield, Sebastopol and in the neighbourhood of Paul's Island, Labrador, of various shades of green, often verging on blue. This stone from the neighbourhood of Wakefield when cut convexly often reveals a bright, silvery lustre and in artificial light has a pretty effect.

Ferthite, is the name given by Dr. Thompson to a variety of Feldspar from the Township of Burgess, and according to Bauerman, is made up of different laminæ of Albite, Orthoclase and Microcline, the latter being rendered iridescent by inclusions of Specular Iron. This

compound mineral together with Quartz forms a granite vein, which covers a large area, although the proportion of the Perthite to the rock mass would not be very great. Its colour varies from a light flesh-red to a dark brown and it will at times cut into very handsome gem stones, the surfaces of which are brilliant with golden reflections. Mr. George F. Kunz the author of "Precious Stones in America," says: "Perthite forms a very curious and rich coloured gem, with its bright Aventurine reflections." This mineral has not been observed at any other locality than that given above.

Albite has been found at several places in Canada, but there is reason to suppose it has a much wider distribution than we are aware of at present. In the townships of Wakefield, Hull and Villeneuve, in Quebec, and Drummond and Bathurst in Ontario, this mineral occurs with broad and striated cleavages, the surfaces of which are beautifully chatoyant with such colours as blue, green and yellow and will rarely cut into fine Moonstones with pearly and bluish reflections, and first-class stones will compare with those from St. Gothard.

Peristerite is a name given to the opalescent Albite at Bathurst, where it occurs associated with Quartz. The mineral from this locality although pretty with its bluish reflections is nevertheless marred by being generally stained by the oxidation of the Pyrites that is associated with it.

Oligoclase—This mineral constitutes the Ceylon Moonstone, and although a vein of this material occurs in the Township of Hull it has not proved to be of gem quality.

Sunstone, possibly Oligoclase associated with Titaniferous Iron Ore, was brought in by a farmer from the Gatineau region.

Labradorite—Although abundant throughout Northeastern Canada, as a constituent of the Anorthosite rocks, and at times affording large cleavages, is nevertheless devoid of those bright coloured reflections which so characterize those specimens brought from Paul's Island, Labrador. Some specimens from the neighbourhood of Perth, gave fiery red reflections, but not so vividly as those from Labrador, which at times are entirely blue, at others green, sometimes the two colours are interblended with the addition of purple and bronze, but the rarest

colour is the coppery or fiery red, and in cut stones, with convex surfaces, this mineral will vie with the Fire Opal.

Obsidian is a volcanic glass, often beautifully mottled with various colours. The Canadian varieties, however, are usually dark. It is found in British Columbia and Nova Scotia, at the latter place in small rounded pebbles, coated with a blue mineral embedded in Amygdaloid. These when cut take a brilliant lustre and are jet black, sometimes bordering on blue.

Chrome Pyroxene, which is found associated with the Chrome Garnet in the Township of Orford, is occasionally of an emerald green tint and semi-transparent and might afford small gems. In the Township of Wakefield, at the other Chrome Garnet locality, a massive sea-green variety interspersed with emerald green dots occurs. It takes a high polish and could be utilized for ornamental purposes.

Scapolite. This mineral is found widely distributed in the Laurentian, of various colours, such as pink, lilac, bluish, yellow and white, and when sufficiently clear from cleavages, cracks and foreign minerals, takes a good polish, making rather a neat and pretty gem stone.

Wilsonite, which is mentioned as a material suitable for gems, is occasionally found of a pink colour, associated with Scapolite and from which, according to some authors, it has resulted. The difficulty with this mineral is to get it sufficiently free from foreign inclusions, which are generally of a harder nature, and consequently after being polished, stand out in relief. I have also noticed that its colour after exposure to the air for some time becomes much paler. This mineral is of frequent occurrence in the Apatite deposits of Ottawa County, the best specimens however, come from the Township of Bathurst.

Hypersthene as a gem material was introduced some time ago by the French jewellers. It is said to take a high polish, with an iridescence of copper, red, bright brown, gold yellow, and greenish shades. Dr. Feuchtwanger says he saw a stone of this nature, twelve lines long and six broad, sold in Paris for 120 francs.

This mineral is of frequent occurrence in the Anorthosite rocks of Canada.

Idocrase or *Vesuvianite* is cut occasionally at Naples, and there sold under the name of Italian Chrysolite, where it occurs in transparent green and brown crystals. The Canadian Idocrase, observed in

the Townships of Grenville, Wakefield, Templeton and the Calumet Islands, is usually in hair-brown crystals, except in the first named Township the colour is a yellow, all of which are translucent only on their edges, except in the case of some very small crystals from Wakefield, which were semi-transparent. No gem material of this mineral has yet been met with in Canada.

Lazulite.—This mineral was found by Dr. R. Bell on the Churchill River of a cobalt-blue colour. This material is sometimes employed as a substitute for Lapis-lazuli, which it resembles somewhat in colour.

Sodalite is another blue mineral, which occurs associated with granite on the Rocky Mountains in British Columbia. It varies in colours from light to dark blue, from translucent to opaque. From a large number of specimens examined I should think that fair-sized blocks of the Granite, interspersed with veins and patches of Sodalite, could be obtained which would make a very handsome ornamental stone. As a gem material it compares with the Lapis-lazuli, is the same hardness, and takes a higher polish. The largest stone of this material, free from any adhering rock, that has been cut in Canada, would be about one and half inches by three-quarters, and three-quarters of an inch thick.

Chlorastrolite was thought, until recently, to be confined to Isle Royal, but has lately been found in a place I believe on the Canadian side. In the neighbourhood of Lake Superior they are often called Turtle Agates, owing to the markings of the stone, resembling the grotesque designs often seen on some species of turtles. They occur in rounded pebbles of various sizes, of dark green colours mottled and veined with white; they are perfectly opaque, and a stone of a good colour and marking makes a very pretty gem.

Prehnite, of which the former Chlorastrolite is supposed to be a variety, occurs at several places in the Lake Superior district, also at the Baie des Chaleurs in New Brunswick, and at the Bay of Fundy in Nova Scotia. In the first named area, independent of the important veins of this mineral which sometimes form the gangue of rich native Copper deposits, pebbles of various colours, sometimes radiating, are found among the debris of the shore, generally enclosing scales of the same mineral. The pale greenish variety of the Baie des Chaleurs, and

the somewhat darker shade from Nova Scotia, also afford material for cutting. This stone, when translucent and prettily mottled, will cut into curious and pretty gems.

Jade or Nephrite is a tough compact translucent mineral graduating from a greyish white to dark shades of green. It takes a high polish, having a somewhat greasy lustre. This is not much known in this country, but is very popular in Asia. It is found in Corisca, China, Egypt and New Zealand, in the latter country it is called Greenstone.

In British Columbia numerous implements and tools, fashioned by the Indians out of a beautiful translucent variety of this mineral equal to that from New Zealand, are often found, but no occurrence of this mineral in situ has yet been observed.

Epidote, when in translucent crystals and of a good colour will sometimes cut into a very curious gem. Our Canadian mineral is generally of a hue of greenish or yellowish colour; some small crystals, however, from Wakefield are translucent, but not of gem quality. The massive variety although widely distributed in the Pre-Cambrian rocks is rarely met with in large pieces, but as an accessory to the Gneissic rocks it sometimes lends a pleasing tint when these are polished. Fine slabs of a reddish colour, veined or clouded with light green Epidote, might be cut from the Gneiss of Ramsay. Epidosite from the Shick-Shock Mountains will also cut into fair stones of a pale yellowish green colour somewhat resembling Chrysoprase. According to the Geology of Canada this mineral is also of frequent occurrence in the Silurian rocks.

Rutile is mentioned as a gem material, sometimes cutting into Ruby red stones, and others of a black colour, more closely resembling the Black Diamond than any other known gem. Some of the lighter coloured ones cut into gems closely resembling the common Garnet.

This mineral occurs in Canada in Ruby red grains distributed through the Ilmenite at Bay St. Paul, but I have not heard of any pieces being found large enough for cutting. It also occurs in geniculated crystals of a reddish colour in a mixed bed of Barite and Calcite at Templeton, but not of gem quality.

Chondrodite occurs of various shades of yellow to hyacinth red, also green and brown in massive varieties. In Canada the only occur-

rence of this mineral I am aware of is in the Township of South Crosby where it is found as yellowish grains dispersed through a crystalline limestone, but not large enough for cutting.

Pyrite, which is occasionally cut abroad, and was formerly much used in jewellery, is of very common occurrence in Canada. But material suitable for cutting is much more limited although sufficient quantity is available to supply the demand for some time to come. The Townships of Wakefield and Elizabethown probably afford the best material for this.

Hematite and certain varieties of Limonite will at times cut into curious and pretty gems. At the Iron mining districts of Michigan large quantities of these stones are sold to tourists and others as souvenirs of the locality, but it is said that they are cut abroad from foreign material. Some of the Limonite from Londonderry, N.S., will cut into curious stones of brown colour with concentric markings of yellow and a metallic lustre. They also take a high polish.

Titanite, which is found in Tyrol and the United States, in transparent yellowish and greenish crystals, will at times cut into fine gems, and although Canada has probably afforded the finest twin and single crystals of this mineral found in any part of the world, the sales of which in the United States have netted the various dealers thousands of dollars, even to-day good crystals of this mineral command a high price but small and inferior crystals are of little value. Their colour is usually hair brown to black, and from translucent to opaque, with, occasionally, aventurine reflections on their planes. The Townships of Sebastopol, Grattan and Ross, have probably afforded the best specimens, although it is also quite common in many of the Apatite deposits, in single crystals. No material fit for the Lapidary's use has yet been observed from any of the above localities.

Natrolite occurs in the Amygdaloids of Nova Scotia and may be met with, in some form or other, almost anywhere on the Bay of Fundy, where this rock is found. At one remarkable locality on Stronach Mountain, near Margaretville, large masses of this mineral in radiating acicular crystals, may often be found piled up with the stones of the field. The largest individual crystal that I have seen is about one-fourth of an inch across, and translucent, but not fit for cutting. A

often banded or zoned with lighter or darker tints. This mineral, like the Agate, seems to offer facilities for the introduction of the skill of the artificer, as the manufactured articles often seen are not of natural hue, but are brought to that state of perfection by subjecting them to a certain degree of heat before polishing.

Crystals of this mineral are often found of large size and richly coloured, and have been employed in making rings, stones, etc., known in the trade as False Amethyst, False Emerald, False Ruby, False Topaz, etc., according to the colour. This mineral is much too soft for any purposes of jewellery.

At Lake Superior large cubical crystals of a dingy green colour are often found associated with Amethyst. Emerald green and purple cleavable varieties are often met with in the brecciated veins that are now being worked for Silver in the Port Arthur district. In the Township of Ross, in Ontario, a beautiful purplish-red granular variety occurs, with a more compact semi-transparent whitish fluor. In the Township of Hull a single crystal of semi-transparent green colour, and which must have been four cubic inches, was found by a farmer in developing an Apatite deposit, who, being of a liberal disposition, broke up the crystal to give pieces of it to his friends, thereby robbing the scientific world of one of the finest crystals ever found in Canada.

A portion of this crystal is in the Geological Museum.

Several other localities in this and the neighbouring Townships afford this mineral.

Aragonite, *Satin Spar* and *Alabaster*, are minerals used to a large extent abroad for making fancy ornaments, and as the two latter are often represented by various minerals, it may be as well to point out their difference.

Satin Spar, or fibrous limestone, is found largely in the coal formations of Cumberland and Derbyshire; it is also found in Hungary, United States and Canada. I have seen several specimens from the Lake Superior district that would cut into beads and other ornaments. Beads of this mineral were, some years ago, in great favour in England, but owing to the introduction of an imitation, made from hollow glass globes, filled with fish scales, which very nearly resembled the originals, they have of late years gone out of fashion.

more compact fibrous variety, often zoned with pink, found at Cape Split and elsewhere on the Bay, will sometimes cut into neat and pretty gems.

Thomsonite is reported to have been found on the Bay of Fundy, in N.S., but these specimens are considered by some authors to be a variety of Mesotype. The pretty little pebbles of Thomsonite that are brought from Lake Superior, are really from the State of Minnesota, at a place called Grand Marais. They occur as pebbles in the Amygdaloid, and are often beautifully variegated with such colours as flesh red, zoned and mottled with green, red, brown and white, and when perfectly free from holes, make very handsome gems.

Apatite, which is destined to become the backbone of the Ottawa Valley, cannot be left altogether out of this category. If we have not yet found any material from which gems or ornaments may be cut; and though we have seen during the past few years so many different varieties developed, we may still look forward to better results in the future, and possibly some of them may yet yield a more compact variety suitable for this purpose. I have seen both yellow and blue transparent crystals, but too small for cutting, from the Township of Wakefield.

Since writing the above, some fine olive green transparent gems have been cut from this mineral from Portland.

Apophyllite, sometimes called Fish-eye Stone, (this name is also applied occasionally to Adularia,) is met with at several places on the Bay of Fundy, the more noticeable of which, for gem purposes, is on the Blomidon shore, where it occurs in greenish-white, semi-transparent to translucent crystals often an inch across. On the other side of the Bay, at Cape D'Or, large modified white crystals, two inches in diameter are found. These are however, perfectly opaque and unfit for cutting. This mineral also occurs at Lake Superior, of a reddish colour, but of no value as a gem.

Fluor.—Derbyshire Spar, or Blue John, as it is sometimes called, has been employed extensively in England for the last century, and even to-day there are more manufactories of this material in Derby than anywhere else, engaged in making such ornaments as vases, cups, plates, candlesticks, etc. The variety from which the above articles are made occurs in compact and granular masses of some shades of blue,

Satin Gypsum, sometimes called *Satin Spar*, which bears a strong resemblance to the former, is much softer, and consequently not so often used.

Fine specimens of this material are found at various places on Minas Basin, more particularly at Cape Blomidon, Cape Sharp and Swan Creek.

Alabaster is represented by Limestone (carbonate of lime), and Gypsum (sulphate of lime). The purest material used in Italy, and from which source many of the ornaments of this mineral come, is derived from a bed 200 feet deep at Castelino, in Tuscany. One of the principal manufactories of Alabaster ornaments is at Valterra, thirty miles from Leghorn, where about 5,000 persons are dependent upon this industry. This variety of Limestone has not yet been observed in Canada.

Gypsum Alabaster is found at Hillsborough, N.B., and is susceptible of a good polish. Large blocks, hundreds of pounds in weight, are often taken out, consisting of translucent white anhydrite, which are generally veined with Gypsum; the latter mineral, being softer, wears away faster in the polishing, leaving a somewhat uneven surface. This, however, should not be sufficient to detract from its value as an ornamental stone, as the effect produced by the sunken veins is often very grotesque.

Malachite.—This beautiful carbonate of copper which comes to us from Australia, Hungary, Tyrol and Siberia is also met with sparingly in Canada associated with other ores of copper. In the County of Hastings nodules of this mineral as large as a cricket ball are said to be found occasionally in the loose soil. From some of the copper mines of the Eastern Townships and New Brunswick, handsome small specimens are sometimes met with and would contribute small gems.

Serpentine.—This mineral with its rich colour has always been an attractive ornamental stone. In Saxony several hundred people are employed making boxes, trinkets and other ornaments out of this material. Our Canadian Serpentine, more particularly those occurring in the Laurentian, are often of rich yellowish and greenish colours and might be utilized for all purposes of interior decoration. Some years ago an enterprising machinist established himself in the vicinity of the

Grenville Serpentine, where he turned by a foot-lathe a number of very pretty ornaments such as vases, doorknobs, etc., but owing to his method of cutting up the stone with a hand-saw we need hardly mention that this enterprise was not attended with much success.

Calumet Island, Wakefield, Templeton, Bowman and Grenville probably afford the best translucent variety, although it is largely distributed over other parts of Canada, especially the Eastern Townships.

Amber is occasionally found in rounded pieces in the lignites of the cretaceous and may possibly afford material suitable for beads, etc. The North-West Territory and British Columbia have both contributed small specimens.

Jet is a variety of cannel coal, not yet observed at any Canadian locality, and judging from the many so-called imported Jet ornaments that I have seen lately, if the Whitby mineral is much used, black enamel and glass constitute the Jet of the present time.

I have now called your attention to the various minerals available for gems and semi-gems scattered over the Dominion and given the localities of the more important material, and at the same time have drawn comparisons with those of other countries. Some persons have an idea that our crude material has no value before cutting and that it might be sold by the ton or hundredweight instead of by the carat, as most European or Oriental gems are. Now this vague idea might lead some persons to infer that our gems in Canada are comparatively worthless, owing to the great abundance of cutting material, and only after being polished are they of any value. Certainly several of our semi-gems, such as Agate, Jasper, Amazon Stone, &c., might be obtained by the ton, and consequently are of little value, and even after being cut are quite inexpensive. But before we begin to gauge our material for gem cutting, we must provide ourselves with certain facts, respecting its uniformity of colour and transparency, and its freedom from flaws and cavities; then when blocks of six inch cube of such material can be obtained, we may talk of selling it by the ton. It is true of certain minerals, that large masses often occur, and perhaps one per cent. of this might be utilized, but then this large percentage only applies to a very few of our semi-gem minerals. And, on the other hand, the uncertainty of some minerals makes it almos-

impossible to tell what sort of gems they will produce, and consequently only about twenty-five per cent of the cut stones may be considered fair samples. This therefore raises the price of manufacture one hundred per cent. Neither does it follow, that the few selected stones are equal in value, as one, through richness of colour, transparency, &c., may realize more than ten of the others. This system of valuation will serve to illustrate the low prices of certain gems in the market; and those who are in the habit of buying these grades of stones, and at the same time are unaware that the low prices, are caused by the sale of a few called No. 1 at fancy prices, should understand that the price of production of each stone is often greatly in excess of the prices paid by them for this class of gems.

In mentioning the word Oriental, many persons, I presume, would infer that it signifies gems from the east. Many authors, however, apply this appellation to the Corundum species, such as Blue Sapphire, (Oriental Sapphire,) Green Sapphire, (Oriental Emerald,) Yellow Sapphire, (Oriental Topaz,) Red Sapphire, (Oriental Ruby.) &c., and others apply the word Oriental to the Emeralds from Peru, which are neither Corundum species, nor yet from the east, and as the word Oriental as applied to certain gems, is somewhat ambiguous, it should not be considered in purchasing a gem, except from very reliable dealers.

As to our crude material being of no value, this must depend entirely on the collector, who should be the best judge of the requisite material available. Now, as some of our local stones are sold by the carat on account of their scarcity, you will understand why the erroneous idea, that they may be obtained by the ton, should be pointed out. I can assure you we have not yet arrived at that stage when we can build our houses of Tourmaline, Moonstone or Quartz Asteria.

MONDAY AFTERNOON LECTURES. Nos. 7 & 8.

THE CHEMISTRY OF FOOD.

BY FRANK T. SHUTT, M.A., F.C.S., F.I.C.

(Two Lectures delivered Feb. 23rd, and March 2nd, 1891.)

He, indeed, would be an unreflecting and unthankful individual who would not be willing to admit that the higher civilization of later times has given us great and innumerable blessings. We might, perchance, find such an one among those who have grown up amid the comforts and luxuries of wealthy modern life, an unconscious recipient of good things and ignorant of the life of our forefathers; or among those who, from long-continued poverty or degradation, can hardly be said to enjoy those blessings. To recount the triumphs of science and enterprise—not to speak of other and not less important factors of our civilization—during the last fifty years would be a more than Herculean task. Triumphs of the Natural and Applied Sciences—great triumphs in the art of healing and no less great in electricity, and mechanics, and agriculture, and a host of sister sciences—triumphs that have added to our comforts and have alleviated our sufferings, attend and surround us on every side.

But yet, while confessing all this with ready lips, a moment's serious reflection tells us that there is scarcely a blessing without its concomitant evil—an evil too often the result of the abuse of the blessing. Evils whose origins may easily be traced to the wrong or excessive use of things in themselves good and wholesome, pervade all ranks of society. It is only when we view exclusively this side of the picture—as too many of us occasionally do—that we are apt to conclude that our boasting of the achievements of the nineteenth century and the so-called betterment of the race, is worse than vain.

But what has all this to do with the subject under discussion—the chemistry of food? A little careful thought may show us the applicability of these remarks as an introduction to a lecture on such an important matter as food; for although my title might be considered, strictly speaking, to confine me to the composition of foods, I propose to incorporate with the chemistry somewhat of the physiology of food.

In this way I hope to make these lectures not only more interesting but more instructive than they otherwise might be to a general audience. By learning the functions of the constituents of foods in the system we may—as we shall see more clearly later on—be the better able to practise economy and preserve health.

To many of us civilized life has brought with it the accumulation of wealth, and wealth grants us comparative leisure and the means of obtaining not only necessities but luxuries in abundance. It gives us plenty of good, nutritious and palatable food, but it also gives us the opportunity of indulging in those luxuries of the table, the excessive use of which is so disastrous to our health. Leisure takes from us the *necessity* of that wholesome amount of exercise, which promotes a normal and healthful condition of the system.

On the other hand the conditions of society make us ambitious and encourage us to strain every muscle and nerve towards the attainment of more money and power, and thus it is that often we overwork ourselves, body and mind—become physical wrecks, not from the want of an ample supply of food, but because from the mode of our living we have not allowed it to nourish us properly.

I, therefore, wish to emphasize the great and, I may say, vital importance that a knowledge of the requirements of the human body and of the composition and character of our daily foods is to everyone nowadays. In the first place we are confronted with the statement on good authority that more suffer from over-eating than from over-drinking, though the number of victims of the latter vice, we must all admit, is not small. Over-eating is a term used not only to designate the more than sufficient use of simple, wholesome food but also to include the taking in excessive quantities of rich and concentrated foods, most of which may be called luxuries, and lastly, one-sided diets adopted either from necessity or from mere fancy. Such diets are sooner or later inevitably followed by disease or a disordered system. That dyspepsia and allied ailments, especially on this side of the Atlantic, are very prevalent, and that the same are due to an abnormal or excessive diet, is well known, but that probably over fifty per cent. of the common disorders now afflicting mankind are from the same causes, and which are preventable by a proper care of the body and a judicious diet, is cer-

tainly not widely recognized by the laity, though the medical profession have repeatedly attested the truthfulness of the statement.

From a hygienic standpoint, therefore, we must admit the usefulness of that knowledge which tells of the true nutritive value of the different foods and the amounts of them required to sustain health and vigour—a knowledge that will enable us to use with discretion those foods best suited to our wants and as a result experience *mens sana in corpore sano*.

But the importance of the subject may be urged from another aspect—the economic one. “Half the struggle of life is a struggle for food,” says Edward Atkinson, and though this may appear an extreme statement, reflection assures us of its truth. Evidence in its support is supplied in abundance by our large cities where competition is rife and the inhabitants are massed together. When the scourge of famine overtakes a country, the misery and horrors which attend such a catastrophe emphatically attest its accuracy. Surely, then, food-economy is a subject well worthy of study, for from it governments and individuals may learn how to obtain the most nutritious food for the least outlay, and thus in times of distress be enabled to alleviate much suffering. But nearer home there seems to be ample room for improving our own condition in this matter of food-economy. I do not here refer to that wilful waste of food in our homes, which I must designate a sin against mankind, nor to that excessive use of food that engenders disease. I wish, rather, to direct your attention to the study of contrasting the money value of foods with their nutritive value. For by such we shall be enabled to make choice of the most nutritious and palatable viands at the least cost. Then, perhaps, while spending a little less on our stomachs, we should have somewhat more to expend on other and no less noble objects in life—the improvement of our faculties and mental enjoyments—to say nothing of the noblest of all, the benefitting of our fellow man in one or other of the many ways now open to us.

And there is yet a third side to the question—that of pleasure. This is, undoubtedly, a legitimate one for our consideration. The pleasure of eating and drinking of the good things provided for us is assuredly a right one, and one that has been so recognized from all

times. But my subject is rather with foods themselves, and I must hasten on, having briefly outlined the reason why I deem a knowledge of what we eat so important, so necessary as to warrant my impressing upon you so urgently the value of its study.

It is the food we eat that forms the tissues and develops the heat and energy of our bodies. The body creates nothing, neither matter or force. The physical life is dependent directly upon the digested food, water, and the oxygen we breathe. The changes the food undergoes in the life functions are simply and truly transformations. We shall therefore do well at the outset to consider briefly those elements and compounds that compose the body structure.

THE CHEMICAL BASIS OF THE HUMAN BODY.

Chemical analysis has proven that only fifteen, or at most seventeen, of the elements enter into the composition of the tissues of the body. In the following table, from Brubaker's Physiology, they are enumerated together with the relative quantities in which they exist and the tissues in which they are found.

CHEMICAL COMPOSITION OF THE HUMAN BODY.

Oxygen,	72.00	}	O. H. C. are found in all the tissues and fluids of the body, without exception.
Hydrogen,	9.10		
Nitrogen,	2.50	}	O. H. C. and N found in most of the fluids and all the tissues, except fat.
Carbon,	13.50		
Sulphur,	.147		In fibrin, casein, albumen, gelatine of the tissues, in sweat and urine.
Phosphorus,	1.15		In brain, saliva, blood and bones.
Calcium,	1.30		In bones and teeth, in blood, saliva and chyle.
Sodium,	.10		In all the fluids of the body.
Potassium,	.026		In muscles.
Magnesium,	.001		In bones, associated with calcium.
Chlorine,	.085		In the fluids and solid tissues.
Fluorine,	.080		With calcium in bones and teeth.
Iron,	.01		In blood corpuscles and in muscles.
Silicon	traces,		In blood, bones and hair.
Manganese	traces,		Probably in hair, bones and nails.

These elements do not exist in the body in the free state, if we except traces of uncombined Oxygen, Nitrogen and Hydrogen, but in various combinations with one another forming exceedingly complex compounds. These, for the sake of convenience, fall into two great classes:—ORGANIC and INORGANIC, though the distinction is no longer a strictly accurate one. The organic compounds may be considered under the divisions, (a) NITROGENOUS, (b) NON-NITROGENOUS, according as to whether Nitrogen enters into their composition or not. Many of the elements above cited are common to both the Organic and Inorganic compounds.

The NITROGENOUS COMPOUNDS are the most numerous as to their number as well as most complex as to their quantitative composition, though they are made up of but four elements, Carbon, Hydrogen, Nitrogen and Carbon, with occasionally small amounts of Phosphorus and Sulphur. We can here only mention certain large groups of these compounds.

Albuminoids or *Proteids*, a generic term including a number of substances having the same percentage composition but different physical properties. Sub-divisions comprise, (1) *Native Albumens*, of which the white of egg is an example; (2) *Globulins*, chief among which is Myosin, the organic basis of muscle; (3) *Derived Albumens*, the casein or curd of milk and certain substances formed in the stomach during digestion; and (4) *Peptones* or *Soluble Albuminoids*, formed by the action of the digestive fluids on food, and which pass into the blood to nourish the body. Besides these there are the *Gelatins* found in bones, etc., and certain other waste products formed by the life functions of the various organs of the body.

The NON-NITROGENOUS ORGANIC COMPOUNDS are made up entirely of Carbon, Hydrogen and Oxygen. They consist of (a) Carbo-hydrates, in which the Oxygen and Hydrogen are in proportion to form water; (b) Fats, richer in Carbon and Hydrogen than the Carbo-hydrates, (c) Fatty acids and (d) Alcohols.

Carbo-hydrates, Sugar, Starch, are represented in comparatively small quantities in the body, though found in many of the fluids and

tissues. The forms of sugar are Glycogen of the liver, Lactose or sugar of milk, Glucose (grape sugar) and Inositol or sugar of muscle.

Fats and Oils—Palmitin, Olein and Stearin. These are really salts of the alcohol Glycerins with the fatty acids Palmitic, Oleic and Stearic. The fat of the body is made up chiefly of Palmitin and Stearin (solids) with small quantities of Olein (liquid).

The *fatty acids* require no special discussion here. Mention of the three principal ones has already been made. These with Butyric acid in milk and Propionic acid in sweat, exist in combination with certain bases, e.g., Potassium, Calcium and Sodium in various parts of the body.

Alcohols:—Glycerine, a true alcohol has already been spoken of under "fats;" it is also produced during digestion; Cholesterine, a crystallized uncombined alcohol, is present chiefly in bile. Ordinary alcohol has been detected in the body—probably the result of a fermentation in the digestive tract. Under normal conditions, however, it is doubtful if it is produced.

INORGANIC OR MINERAL COMPOUNDS.—The chief of these is WATER (Oxygen and Hydrogen), present to a very large extent in every fluid and tissue. Its great importance and function will be spoken of later on. Calcium phosphate (phosphate of lime), another essential compound, is the basis of bones and teeth, but also found in other parts. Chloride of Sodium (common salt) is to be met with in all tissues and fluids. Iron in minute quantities enters into the composition of hæmoglobin, the colouring matter of the blood. It is also to be detected in many of the body tissues.

The foregoing outline may serve as an enumeration of the more important body substances. Their origin and physiological function will be discussed when speaking of the nutritive ingredients of foods and the processes of digestion and assimilation. A knowledge of the relative amounts of the chemical elements and of the compounds already alluded to, as they exist in the body, will be found to be of interest and value. I, therefore, subjoin the following admirable tables compiled for the United States National Museum, Washington, by Messrs. Welch and Pomeroy.

WEIGHTS OF CHEMICAL ELEMENTS IN THE BODY OF
A MAN WEIGHING 148 LBS.

Oxygen	92.4	pounds
Carbon	31.3	"
Hydrogen	14.6	"
Nitrogen	4.6	"
Calcium	2.8	"
Phosphorus	1.4	"
Potassium .....	.34	"
Sulphur .....	.24	"
Chlorine .....	.12	"
Sodium .....	.12	"
Magnesium .....	.04	"
Iron .....	.02	"
Fluorine .....	.02	"
<hr/>		
Total	148.00	"

COMPOUNDS IN THE BODY OF A MAN WEIGHING
148 POUNDS.

Water	90.0	pounds
Protein (Albuminoids)	26.6	"
Fats	23.0	"
Carbo-hydrates (starch, sugar) ....	.1	"
Mineral matters (inorganic)	8.3	"
<hr/>		
Total	148.0	"

THE NUTRIENTS OF FOOD.

Having learnt somewhat of the compounds of the body and that the latter is built up by the functions of the organs of the body from the digested food, we may go on to consider the composition of foods, vegetable and animal. In view of what has already been said we shall not be surprised to hear that the edible and nutritive portions consist, in varying proportions, of those ingredients or compounds already considered, viz: Albuminoids, Carbo-hydrates, Fats and Mineral matters

(including water). These are termed Nutrients, and the composition of the three classes of organic compounds is roughly as follows :

	Albuminoids.	Fats.	Carbo-hydrates.
	Per cent.	Per cent.	Per cent.
Carbon.....	53.0	76.5	44.0
Hydrogen.....	7.0	12.0	6.0
Oxygen.....	24.0	11.5	50.0
Nitrogen.....	16.0	None	None
	<hr/> 100.0	<hr/> 100.0	<hr/> 100.0

These Nutrients are by no means equally distributed throughout the food materials. The animal foods—meats and fish—while very rich in albuminoids and fats, possess but traces of the carbo-hydrates. They may be considered, therefore, essentially nitrogenous. Vegetable foods as a rule contain a large percentage of Carbo-hydrates, starch and sugar, and small quantities of albuminoids and fats, and consequently may be considered as essentially non-nitrogenous. An exception to the latter is to be found in peas and beans, which contain a notable amount of albuminoids. Very fat meats on the other hand, by reason of the large amount of fat they possess, cannot be considered as highly nitrogenous.

This great distinction between these classes of foods is one worth remembering as helping us to arrive at their true nutritive value. To enable us to do this the better, however, we may now proceed to state the physiological functions of these nutrients, whether they be derived from animal or vegetable foods. For this purpose I shall take the liberty of placing before you another chart from the National Museum.

USES OF FOOD IN THE BODY.

Food supplies the wants of the body in several ways. Food furnishes :

1. The materials of which the body is made.
2. The materials to repair the wastes of the body and to protect its tissues from being unduly consumed.

Food is consumed in the body as fuel to

3. Provide heat to keep it warm ;
4. Produce muscular and intellectual energy for the work it has to do

The body is built up and its wastes repaired by the nutrients. The nutrients also serve as fuel to warm the body and supply it with strength.

Ways in which the nutrients are used in the body :

The albuminoid of food	{	Form the nitrogenous basis of blood, muscle, sinew, bone, skin, &c.
		Are changed into fats and carbo-hydrates.
		Are consumed for fuel.
The fats of food	{	Are stored in the body as fats.
		Are consumed for fuel.
The carbo- hydrates of food	{	Are changed into fats.
		Are consumed for fuel.
The mineral matters of food	{	Are transformed into the mineral matters of bone and other tissues.
		Are used in various other ways.

This is a very instructive table, and it will be well before passing on to consider in more detail what it means. It emphatically tells us in the first place that we cannot exist for any length of time on any one class of nutrients—a fact amply proved by actual experiment. No one nutrient is a complete diet. A diet consisting entirely of albuminoids, or of carbo-hydrates, or of fats, is an impossible one, though a glance at the table shows that the albuminoids are more universal in their functions than the other two nutrients. We shall learn later on somewhat of the proper ratio in which they should be used in order to preserve health. The tissues of the body are continually undergoing disintegration, heat is being dissipated and muscular and intellectual energy constantly expended. Let us examine for a moment the different classes of food as to their power to supply these wants.

We have already said that animal foods—meats of all kinds and fish—are principally nitrogenous. The albuminoids they contain are often called flesh formers, because such go to form in the body the muscle and the blood. They also possess more or less fat, which may be laid up or converted into adipose tissue or used up in the production of heat.

The vegetable foods consist largely of the carbo-hydrates, and

cannot be said to assist in the formation of new tissue—muscle, blood, &c., but are of service as fuel in developing the necessary heat and energy. Of course, the fats they contain may be so used, or deposited as such in the adipose tissues.

Water and mineral matters are common to both classes of foods. While both are absolutely necessary, they can scarcely be called nutrients. Water is the universal solvent. Dependent upon its presence are the processes of digestion and assimilation. The blood and lymph are largely water, and by them the nutritive matter is conveyed to every part of the body. It also takes part in the elimination of waste products. Mineral matters, especially common salt and phosphate of lime are required for tissues and bones. "The salt in the blood holds the albuminoids in solution, and by regulating the amount of water in the blood corpuscles and the cellular elements of the tissues, preserves their form and consistence." Phosphate of lime gives solidity to the bones and teeth, and is also present in muscle, milk, &c.

COMPOSITION AND DIGESTIBILITY OF THE MORE COMMON FOODS.

We may now consider the composition and digestibility of some of the more common foods. In the subjoined table, obtained from the same source as the preceding, the percentage indigestible, as well as the total amount of each nutrient is given. It is a very instructive chart and one that well deserves a careful study. It shows most clearly the large amount of albuminoids, entirely digestible, in the animal foods (meats and fish), and that in such, increased fat generally means decreased water. This is exemplified in the case of fat pork. The carbohydrates (starch and sugar) are practically absent in these foods. Eggs we see to be a highly concentrated food, being rich in albuminoids and fat, but containing no starch or sugar. Fish, generally speaking, is a very nutritious food, being easy of digestion. Its value as a brain food will be spoken of later on. Cod may be considered albuminoids and water. Milk is shown to be a well balanced food—*i. e.* it contains all the materials in good proportions and approaches most nearly the composition of a 'perfect food.' Its almost total digestibility makes it a most important factor in the diet of the young and aged. It has been found that boiling milk somewhat impairs its digestibility. Butter may

TABLE showing composition and proportion of indigestible materials of the more ordinary foods.

	Albuminoids.		Fats.		Carbo-hydrates.		Mineral Matters	Water.
	Total.	Indi-gestible.	Total.	Indi-gestible.	Total.	Indi-gestible.		
Beef, rather lean....	23.0	0.0	9.0	0.9	0.0	0.0	1.3	66.7
“ rather fat.	20.0	0.0	19.0	1.9	0.0	0.0	1.0	60.0
Mutton, fat	15.0	0.0	40.0	...	0.0	0.9	1.0	44.0
Pork, very fat.....	3.0	0.0	80.5	6.0	0.0	0.0	6.5	10.0
Cod	15.0	....	1.0	....	0.0	0.0	1.5	82.5
Salmon	22.0	....	14.3	....	0.0	0.0	1.7	62.0
Mackerel	18.8	0.0	8.2	0.8	0.0	0.0	1.4	71.6
Eggs	13.4	0.0	11.8	2.4	0.7	0.0	1.0	73.1
Milk	3.4	0.0	3.7	0.1	4.8	0.0	0.7	87.4
Butter	1.0	....	87.5	1.7	0.5	....	2.0	9.0
Cheese, whole milk .	27.1	0.0	35.5	0.9	2.3	0.0	3.9	31.2
Wheat, flour.....	11.6	2.1	0.8	....	72.2	1.8	0.4	15.0
“ bread.....	8.9	1.2	1.9	....	55.5	0.6	1.0	32.7
Oatmeal	15.0	....	5.0	....	69.0	....	1.0	10.0
Pease.....	22.9	3.2	1.8	....	57.8	2.1	2.5	15.0
Cornmeal	9.1	1.2	3.8	....	71.0	2.3	1.6	14.5
Sugar.....	0.3	....	0.0	0.0	96.7	0.0	0.8	2.2
Potatoes	2.0	0.5	0.2	....	21.3	1.6	1.0	75.5
Turnips.....	1.0	0.3	0.2	....	6.9	1.3	0.7	91.2

be considered pure fat, which is easy of digestion and assimilation if the condition of the stomach be normal and too much be not taken. Cheese is a highly nitrogenous and exceedingly valuable food. It not only is easily digested but also assists in the digestion of other foods. Its price, when we consider these important desiderata, recommends it for more extensive use than it at present enjoys.

The vegetable foods are characterized by low albuminoids and high carbo-hydrates. The amount of fat in most of them is small, and need hardly be taken into account as a nutrient. Peas and beans (fruit of the Leguminosæ) stand out as exceptions in containing large percentages of albuminoids. Oatmeal also more closely approximates animal foods than any of the other cereals. The starch and sugar of vegetable foods is as a rule very digestible. The vegetables proper consist largely of starch, or allied substances, and water. Potatoes, cabbage and many other vegetables are also valuable for the mineral salts they contain. Asparagus, lettuce, celery and some others contain but little nutritive matter, but play a very important hygienic rôle, aiding the digestion of other viands, diluting the more concentrated foods, and thus rendering them more easily assimilable; the salts and active principles many of them contain have a beneficial and medicinal effect on the system. Vegetables must form a large part of every wholesome diet. Fruits are largely water, and are divided into (*a*) Sweet, in which sugar predominates when ripe; (*b*) Acid, containing tartaric and citric acid, generally refreshing and giving a healthy tone to the organs; (*c*) Starchy; and (*d*) Oily, the essential oils in which give the peculiar flavour. Fruits, though having a low nutritive value, are, when ripe, easy of digestion. The pectose of green fruit is indigestible. This as the fruit ripens turns to pectin, akin to sugar, which, as before stated, is easily digested. The odour and flavour of fruits, due as before mentioned to oils and volatile ethers, chiefly abundant in the pericarp, seem to enhance their palatability.

Here a word may be said of a large class of substances which act rather as stimulants than nutrients. Tea, coffee, spices and alcohol come under this category. They act as appetisers, and in moderation as useful and proper excitants of the digestive organs, especially in cases of enfeebled digestion.

AMOUNTS OF THE NUTRIENTS REQUIRED.

The quantity and kind of food eaten must depend largely on the age, the weight, and the kind and amount of work of the individual, taking into consideration the climate and the peculiar characteristics of the person's digestion—a most important factor. The amount of food required per diem by the body is measured by the amount of carbon and nitrogen eliminated daily from the system. These represent the final and waste products of the food compounds. The weight of carbon excreted by a healthy person in one form or another doing a fair amount of work is about fifteen times heavier than that of the nitrogen. The carbon daily eliminated is about 4,600 grains, the nitrogen about 300 grains. These numbers are the results of many experiments, but for many reasons are only approximate. In order to retain health it is necessary to preserve as closely as possible this ratio in our diet, for not only do we wish to avoid an excess or lack of food, but also the excess or lack of any one ingredient. If we supply the nitrogen (Albuminoids) altogether from vegetable foods, such a large quantity has to be consumed that there would be a large excess of carbon—a state of affairs seriously affecting the health. On the other hand, if the required amount of carbon is to be obtained from an exclusive meat diet, about four times as much nitrogen as needed would be furnished. This would seriously impair the digestion and be apt to induce disease.

As I have before emphasized, no one class of nutrients is in itself a complete food, and it is only when they are in proper proportions that a healthy and vigorous system can be maintained. Though there is strong tendency in the system to eliminate any excess of food, yet, as I have pointed out before, too much food acts deleteriously. The habitual use of large quantities of meat and albuminous foods induces a diseased condition of the liver, gout, &c., while excessive amounts of the fats, starch and sugar cause obesity and dyspepsia.

Professor Ranke found that when doing no muscular work, his weight was maintained with the following per day.

Albuminoids, 3.5 ozs.; Fats, 3.5 ozs.; Carbo-hydrates, 8.5 ozs.

Professor Voit, an eminent German scientist, gives the following

amount is per day for an adult doing an ordinary day's (muscular) work, supposing neither to gain nor lose weight.

Albuminoids, 4.2 ozs.; Fats, 2 ozs.; Carbo-hydrates, 17.6 ozs. Professor W. O. Atwater, of Washington, U.S.A., who has written a splendid series of articles in the "Century" for 1887, on the subject of foods, to which I am largely indebted for material in these lectures, estimates that an average man doing muscular work requires—

For moderate work, Albuminoids, 4.4 ozs.; Fats, 4.4 ozs.; Carbo-hydrates, 14.4 ozs.

For hard work, Albuminoids, 5.2 ozs.; Fats, 4.4 ozs.; Carbo-hydrates, 14.4 ozs.

Professor Parkes says that the food required for a healthy adult is : For laborious occupation, Albuminoids, 6 to 7 oz; Fats, 3.5 to 4.5 oz; Carbo-hydrates, 16 to 18 oz; Salts, 1.2 to 1.5 oz.

At rest, Albuminoids, 2.5 oz; Fat, 1 oz; Carbo-hydrates, 12 oz; Salts, .5 oz.

The harder the work the more nitrogenous (albuminoids) should the diet be.

The heat of the body in order to be maintained necessitates the combustion of a large proportion of the food, probably about $\frac{9}{10}$ of it. This heat, together with the work expended internally in the functions of the heart, respiration, &c., and the external muscular action in locomotion and other voluntary work, represent an amount of energy calculated at about 3,400 foot-tons, *i.e.*, the force required to raise 3,400 tons 1 foot high. The heat of the body represents in amount that required to raise 48.4 lbs. from the freezing to the boiling point, or in mechanical power would be sufficient to raise 150 lbs. through a vertical height of $8\frac{1}{2}$ miles. All this must be provided for by food and oxygen before making any demands on the system for muscular or brain labour.

FISH AS A BRAIN FOOD.

I may here allude very briefly to the common, but erroneous, opinion that brain work requires or is benefitted by a liberal fish diet. This has arisen from statements made to the effect that thought and brain work in general used up a large quantity of phosphorus, and secondly, that fish supplied in abundance this element. Neither of these assertions appears on investigation to be true. The brain tissue consumed by

mental activity contains no more phosphorus than that of other parts of the body—not so much as the bones and teeth. Fish does not furnish this element more abundantly than other animal foods. Good head work like good hand work requires a good digestion, and as fish is easily assimilated it may, for this very reason, be found of great value to brain workers, especially if such do not take sufficient muscular exercise to induce a vigorous digestion.

Before bringing these lectures to a close I wish to give you an outline of the process of digestion, the changes that take place in cooking food, and a few practical remarks drawn from a consideration of the whole subject.

DIGESTION.

Mastication or trituration of the food in the mouth serves by a thorough division of the material to present a greater surface to the solvent action of the digestive fluids. An increased digestion is the result. Saliva, secreted by certain glands of the mouth, softens and moistens the food and converts the insoluble starch into soluble sugar. In this reaction the active principle is Ptyaline.

The gastric juice, the secretion of the true peptic glands of the stomach, has a physical and chemical action. It dissolves and disintegrates the food, reducing it to a liquid condition, and converts the albuminoids into peptones, which are assimilated by the blood. Its composition is:—

Water.....	97.5
Pepsin	1.5
Hydrochloric acid.....	.5
Salts .....	.5
	<hr/>
	100.0

It has an acid reaction.

The intestinal digestion is promoted by the pancreatic juice, which has an alkaline reaction. It has a fourfold function:—

- (1) Converting starch into sugar.
- (2) Converting albuminoids into peptones.
- (3) The emulsification of fats.
- (4) Conversion of cane sugar into grape sugar.

Bile, formed in the hepatic cells, assists in the emulsification of fats and promotes their absorption and stimulates the secretions of the intestinal glands. It also serves to prevent putrefactive changes in the food. The digested food or chyme is absorbed by the blood as the food passes through the intestines, the undigested portion entering the large intestines.

THE CHEMISTRY OF COOKING.

The changes induced by cooking are manifold, some increasing, others decreasing the digestibility of the food, while others only serve to render the same more tasteful by the production of certain substances which pleasantly excite the palate.

Meats are more readily digested when "underdone" than well cooked, though undoubtedly very tough meat by its disintegration is rendered more tender and easy of mastication by the process. Certain empyreumatic substances are developed by roasting and boiling meats which give agreeable taste and savoury odours. These act rather as stimulants than nutrients, and render the food more palatable than in the uncooked condition. Roast beef, beef tea and soups owe their piquancy to these compounds. Eggs and milk are rendered less digestible by cooking, for the reason that coagulated albumen is not readily acted upon by the digestive fluids.

On the other hand, most vegetable foods require cooking to increase their digestibility. The cells containing the starch in the raw material have walls of cellulose, difficult of digestion. By cooking, this cellulose is softened and the starch grains are burst. The contents then are more completely exposed to the digestive fluids.

In summing up I would offer the following remarks and deductions. Their importance, I think, merits your consideration.

1. That in the choice of viands care should be taken that the diet consists of both vegetable and animal foods. The proportion of nutrients may roughly be stated at three times the weight of carbohydrates to equal weights of fats and albuminoids. Excess of any one nutrient is likely to be injurious to health.

It would seem that nature teaches what science confirms—a proper combination of materials. The Irishman with his potatoes (carbo-hydrates) and buttermilk (albuminoids), the Englishman with

his bread and cheese (carbo-hydrates, fat and albuminoids), and many others, exemplify this inference.

2. Starch, sugar and fats are essentially heat and energy producers. As heat producers fats are about $2\frac{1}{2}$ times more valuable than carbo-hydrates. In cold climates we find the inhabitants existing largely on fatty foods. Esquimaux and lumbermen are notable examples.

The albuminoids are the most costly of all the nutrients. While performing to some extent the functions just mentioned, they have for their chief office that of building up the tissues of the body and repairing the waste continually going on. The albuminoids cannot be replaced in the diet by any other material.

3. Fruits and many vegetables while not rich in nutritive material should form a large part of the diet, as they assist in digestion and, acting medicinally, give a healthy tone to the system. Salads of lettuce, celery and beets, if not too rich, have a cooling and refreshing effect.

4. Condiments and stimulants are often desirable as appetisers and in moderate amounts excite the flow of the digestive fluids, and thus aid digestion. Excess of alcohol, tea and certain other articles of this class is well known to have injurious physiological action.

5. Cooking, while, as a rule, rendering the animal foods rather less digestible, makes vegetable foods more fit for consumption.

6. Mastication should be thorough in order that the food may be well mixed with saliva, and for this purpose slow eating is to be recommended.

7. The process of digestion is a continuous one. Active work retards somewhat the digestion of a heavy meal, and such should, therefore, be taken rather after the work of the day than during it. The times of meals must largely be regulated by the amount and kind of work. It is better to eat a little and often than to overload the digestive apparatus at any one meal. Though the digestive process is not so vigorous during sleep as in the day time, light refreshment is to be recommended before retiring—the stomach thereby is kept from being totally void of food in the morning. To those who are not robust eaters this advice is more particularly given.

8. The blood which conveys the digested food to every part of the body is largely water. On this account and because all the tissues contain

a large amount of this compound, and the waste of the body is partially eliminated in a fluid form, it is necessary that as such, or under the guise of some drink, a considerable quantity of water be daily taken. Very cold water lowers the temperature of the stomach, retarding digestion. In excess, water dilutes detrimentally the gastric juice. The aged, therefore, and those whose digestion is not vigorous should avoid too much water, especially of a low temperature. For such, a light wine or other stimulant in moderation is undoubtedly beneficial. In drinking as in eating the appetite is a safe guide. As a rule it is wise not to satiate the appetite for solids or fluids. The old adage "Rise with an appetite and you will always sit down with one," is a wise one.

9. Pastry and sweetmeats. Hot rich pastry and cake are excessively indigestible, and in no sense can be considered as complete foods. They should be sparingly eaten, if at all. Excess of sugar, as in sweetmeats, deranges digestion.

10. Many "made dishes" are very rich and concentrated, and can scarcely be considered as having a place in a wholesome diet.

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PROGRAMME.

1891.

Dec. 17—President's Inaugural Address, (The work of the Geological Survey) Dr. Ells

1892.

Jan'y 14—Notes of a trip in Japan, Mr. Harrington
Report of Ornithological Branch.

Jan'y 28—The Educational value of Natural Science, Mr. Cowley

Feb'y 11—Microscopical Soiree. (Normal School Students particularly invited).
Four short papers of not more than ten minutes each, by Messrs. Ferrier,
Harrington, Shutt and Fletcher, to be illustrated by microscopes.

Feb'y 25—On some New Chazy Fossils, Mr. J. W. E. Sowter
The Spring Flowers of Ottawa and Vicinity, Mr. James Macoun
Report of the Entomological Branch.

March 10—Water: its properties and functions, Mr. Lehmann
Report of Zoological Branch.
Report of the Geological Branch.

INAUGURAL ADDRESS.

THE WORK OF THE GEOLOGICAL SURVEY OF CANADA.

(R. W. ELLS, LL.D.)

(Delivered December 17th, 1891.)

Mr. Chairman, Ladies and Gentlemen,—In attempting to prepare the opening lecture of the course for the present season, I have been considerably exercised as to what subject would be of most interest to the members of the Club. It has, however, been suggested to me that to those of us who live in this city, where the Geological Survey has its location, as well as to many of our members abroad, some facts relative to the work of such a department, as annually carried out, might be of interest. Very often it has been asked: What is the work of the Geological Survey? What does its staff find to do year after year, and what great purpose does it serve in the country's progress and welfare? To discuss this subject fully would require a very long chapter, but I hope to be able to lay before you a few ideas regarding the general character of this work that may to some extent at least be an answer to the questions propounded.

In the opening paper which I had the honour of giving before this Club two years ago, I reviewed very briefly the subject of geological progress in Canada for the fifty years subsequent to the first recognized work done in this country in connection with that branch of science. In this, the work was divided into three periods, viz: 1st, that prior to the establishment of the Geological Survey; 2nd, that under the direction of the late Sir William Logan, and 3rd, that subsequent to his retirement; the latter of which could not, owing to lack of time, be then considered.

The confederation of the Lower Provinces with Ontario and Quebec in 1867 very greatly extended the field of the Survey's labours, and changed, very materially, the then existing arrangements of the staff and methods of operation. It brought into the work of the Department the study of the geology of New Brunswick and Nova Scotia; and this was speedily followed by the extension of this work into British Columbia and the great Northwest; thus furnishing a field for geological exploration of the most magnificent dimensions, comprising an area

second to that of no other colony or nation in the civilized world. This enormous and sudden increase in the work thrown upon the Survey necessitated an almost complete change not only in methods but a very considerable change in the personnel of the staff itself; an amount of work, in fact, which can scarcely be estimated by anyone without careful study and comparison with similar work done in this branch of science by other countries. For while the importance of a systematic geological survey has for many years been recognized by all nations and regarded as a very considerable factor in connection with the national progress and development, the areas embraced in the several countries in which such surveys have been carried on are, for the most part, of very limited extent as compared with the great stretch of country called Canada, and the entering upon the geological study of half a continent by so comparatively young a nation may well be regarded as one of the greatest and most important events in the history of the science.

Probably one of the most elaborately conducted surveys in recent times is that of the British Islands, in which we have an area embraced in the three divisions of England, Ireland and Scotland, scarcely two-thirds the extent of the Province of Quebec alone; densely populated and so arranged that the work of the geologist was facilitated to the utmost degree by the open character of the whole country and by the presence of the most carefully constructed large scale maps possible to be obtained; yet for more than half a century the combined skill of the geologists of England, Scotland and Ireland, aided by the most recent improvements in instruments and in appliances for conducting all necessary examinations, and by a financial backing sufficient to meet every requirement, has been devoted to the determination of their geological structure and mineral resources. Even the great Geological Survey of India, which, with the exception of the United States and Canada, is probably on the most extensive scale of any in the world, embraces in the whole Indian Empire an area of only one and a half million square miles, while the gigantic colony of Australia, even were the confederation there complete, would still in the whole island fail to approach the area embraced in the Survey's operations in Canada by half a million of square miles. In point of fact we here in Canada

have so acquired the habit of looking upon such immense areas as of every day occurrence, that an initial journey of three or four thousand miles to begin operations is regarded with no greater feeling of excitement or uneasiness than one of a tenth that distance in a much smaller country. In Australia, however, the work of the geological surveys has been comparatively local, and has never been applied to the enormous areas with which we are familiar in this country. The only survey, then which in point of extent can at all compare with that of Canada is that of our gigantic neighbour to the south, where the area of surface to be covered by its operations is not very different from our own, but where certain conditions exist which render a comparison of the work of the two surveys interesting from several standpoints. Thus, in the United States, owing to their more southerly position, field parties are enabled to spend a very much longer period in exploration than in Canada; in fact there is no reason why their field work cannot, in many portions, be carried on throughout the entire year. In Canada, on the other hand, owing to an early and often excessive snowfall, and to the extreme cold of winter, the period in which field operations can be carried on with profit in some years scarcely exceeds a third of the whole time. Then again, in many of the American states local or state geological surveys are, or have been, carried on, by which the structure and mineral resources of each have been investigated by the state authorities and at the state's expense, and thus the work of the general survey has been greatly facilitated. It is true, in the earlier days, before the confederation of our own provinces, local surveys were carried on, to a limited extent only, in Nova Scotia, New Brunswick and Prince Edward Island, but the amount of time and money expended in these was comparatively insignificant, although the work done by the local geologists was of very considerable value; while in the provinces of Ontario and Quebec, which have enjoyed legislative union for half a century, the work was done by the Geological Survey of Canada with a very limited staff indeed, for years scarcely exceeding in number more than half a dozen persons in all. Contrasting also the facilities for work of the British surveyors, and to a certain extent of the Americans as well, with the difficulties which the members of the Canadian staff have to encounter, the unfavourable position of the latter becomes most striking

Thus, instead of a thickly settled country, opened up in all directions, and easy of access by railways or by ordinary roads, millions of square miles of our Dominion are at the present time inaccessible, except by means of canoes or boats and by the help of the hardy voyageur or hunter; and not only must the means of transport be provided for, but the means of obtaining subsistence, either from the woods or waters, by hunting and fishing, must also be taken into the account; and, in point of fact, with the exception of the more thickly settled portions of the older provinces, this mode of exploration must of necessity be constantly employed. To most people unacquainted with our country, and to many even in our midst, it will perhaps be news that even here in the Ottawa district, in the exploration of the area to the north of the rivers Ottawa and St. Lawrence, beyond a distance of twenty to twenty-five miles, where occasional settlement roads penetrate, the only means of carrying on the work to day is by the aid of the canoe and the Indian guide, by traversing the several rivers and the many lakes which lie so thickly scattered over the surface of the mountainous Laurentian country, communication between which is made by numerous and often exceedingly difficult portages, over which canoes and supplies must be carried upon men's backs wherever the route of the survey may lead; and all this in the very heart of the oldest province of our Dominion.

If now we compare the personnel and the financial outlay of the world's two greatest surveys in point of extent of area to be surveyed, we can see more clearly under what additional disadvantages the Canadian brethren of the hammer labour. Thus the expenditure for the year 1887-88 of the American Geological Survey, exclusive of publication, was about half a million dollars; that of the Canadian Survey for the same year about one-fifth of that amount, including publication and all expenses of management. A portion of this sum, amounting to about \$20,000 only, was divided among sixteen parties, whose operations extended from eastern Nova Scotia to Alaska, and included surveys in all the provinces, with special examination of the country east of Alaska and the Mackenzie River Basin, Hudson and James Bays and Lake Winnipeg and vicinity. In numbers the staff of exploration comprised in all, including assistants, thirty-five persons. In addition, work was carried on in the branches of Paleontology, Botany, Chemistry and

Natural History, the results of that year being comprised in twelve scientific reports, besides that of the Director, which were published in two volumes of 1364 pages, in addition to the bulletins on Paleontology and Botany. The American Survey during the same year employed in the Geographical branch alone eighty-five assistants, in addition to the chiefs of the several divisions, of whom there were fifteen in connection with the outside or geological work proper, and twelve for the associated branches, among whom are many of the leading professors in the different universities, men most distinguished in their special lines of work. With such a command of men and money magnificent results may be confidently looked for, yet in the published volume for the year mentioned there are only four scientific reports, besides that of the Director, with twenty-four administrative reports, corresponding with the summary reports of the Canadian Survey, and describing only the season's operations as carried on by the different parties, but not giving the scientific results, the whole being comprised in a magnificently printed and illustrated volume of 710 pages. In addition to this, as in the Canadian Survey, bulletins containing special reports on the work on the various associated subjects were also published. Comparing results, then, in so far as these can be ascertained, it is evident that the Canadian Survey has continued to maintain the high standard of work which it has ever enjoyed from its commencement and is giving at least full value for the amount of money expended thereon.

But many persons have asked the question: Of what does the work of the Geological Survey consist? and what is the object of sending out these parties of exploration all over the Dominion? what practical benefit does the country receive from such explorations? Some even appear to consider the fitting out of the field parties each spring as something preparatory, on the part of the staff, to going on some grand pic-nic, in which all that the persons engaged have to do is to enjoy themselves in the most perfectly epicurean manner. Now, while to the scientific explorer who enters upon the work in hand with the proper amount of interest there must ever be a certain amount of enjoyment, and that often of a very high order, in the unravelling of the complicated problems which are presented in the study of the wrinkled face of old mother earth, there is very little of the pic-nic character ob-

servable, taking that word in its ordinary acceptation. The work of the Geological Survey is of various kinds. In its inception it was held to include more particularly the study of the rock crust of the earth, and the determination of its mineral resources, since the relations between these two subjects are exceedingly close. Gradually attention was directed to the study of plants and insects, collections of these being occasionally made by some assistant attached to one of the regular exploring parties. Chemistry, which embraced not only the analysis or the assay of important ores, but of rocks as well, together with the analysis of mineral waters, and other kindred subjects also received a large amount of attention. But the rapid development and extension of the country and its various interests have in time necessitated a corresponding change in the operations of the Survey, so that it has gradually come to embrace not only Geology, Paleontology, Chemistry and Topography, but the Natural History of the country as well, including the subjects of Botany, Ornithology, Entomology, Zoology, Ethnology, Mining Statistics, and other kindred subjects—the proper carrying out of which is, however, at the present time very seriously interfered with, not only by great lack of space for displaying collections when made, but by a lack also of workers in the several fields.

In the American Survey the different lines of work are carried on in much the same way as the Canadian department, though on a much more elaborate scale. Thus the work of the interior department is arranged under certain divisions, of which the principal are those of Topography or Geography, Geology, Paleontology, Mining Statistics and Technology, Chemistry and Physics, Illustrations, Library and Documents, &c. Of these the topographical division has charge of the surveys proper, and the preparation of the maps connected therewith, with the care of the instruments, &c., and for the year 1887-88 their field parties were distributed over twenty states, extending from the Atlantic to the Pacific. The geological work is also arranged in divisions, of which there are thirteen, named principally on grounds of location, as the Atlantic Coast division, the Mountain division, &c., but also in some cases from the character of the work, such as the division of *Archæan geology*.

In paleontology also the work is specialized, and instead of pla-

cing upon the shoulders of one man the work of half a dozen, the American Survey has this subject so arranged that to one person is entrusted the division of the vertebrates as distinct from the invertebrates, the latter also being divided into the Paleozoic or ancient and Cenozoic or recent divisions, while in the case of fossil plants, fishes and insects, these are for the most part assigned to specialists in each of these branches, and in this way the very highest results are attained in each subject.

The division of geography or topographic work is one of the most important of the whole. Finding, as in Canada, the exceeding difficulty of doing accurate geological work without a good ground plan or map on which the observations made can be systematically recorded this division has been organized to meet the required want. This work employs nearly one hundred persons alone in the scientific work relating to the making and arrangement of the surveys, including ten draughtsmen, but the very great utility derived from having good and reliable maps of the country ready to hand for the work of the geological staff proper is such that whatever extra expense is incurred in their construction is amply repaid. Of course, in the comparison of countries like the United States and Canada, the conditions of which are alike principally as regards area, while the one has already an enormous development of wealth and population and the other an immense territory and a scattered population, such comparison appears to place Canada in a very unfavourable aspect unless the diverse conditions are thoroughly comprehended.

Although the work of the Geological Survey of Canada has been going steadily forward for almost half a century, it is surprising how few persons really understand what is the legitimate scope of the labours undertaken by its staff or in what direction the field work should actually extend. Thus many persons apparently have the impression that one part at least of its duties should be the examination of every locality where minerals may be fancied to exist by any person who may indulge the often foolish notion that there should be unlimited wealth in the rocks which may constitute a large part of his real estate. Such persons entertain the idea that not only should surface indications be carefully explored for their own particular benefit, but that even excavations, shafts or bore holes should be put down, and in fact that

the Survey should completely develop their particular mining areas and open up their properties at the government expense. The absurdity of this method or the fallacy of their logic never appears to be considered by these individuals, since two very important obstacles would be presented at the very outset, the first of which would probably be the protest made by every mining engineer against the encroachment on the part of the government, through its staff, upon the rights of the private individual and the consequent interference with his profession; and secondly, the fact that very few treasures could be found which would stand the enormous drain put upon their resources if the government should attempt the development of every mining location, real or fancied, and at the instance of every proprietor or company, while the staff necessary to undertake so extensive a system of work would speedily assume such enormous dimensions as to be beyond control. There are, however, certain cases where the advice of the government geological expert may be sought, and that with propriety, although it frequently happens that when such advice has been asked and obtained, the person giving it receives very little credit for ability either as a mining expert or geologist. Very often this by no means flattering result arises from the fact that some mining quack has already visited the spot, and in the hope or expectation of finding a job, more or less permanent, in the development of the property, has, by means of a judicious employment of certain technical terms, concerning the meaning of which he is very often ignorant, done his best to persuade the owner that great stores of mineral wealth lie just beneath the surface, waiting only for the application of the skill which he may possess for their successful extraction. How often this story has been told concerning certain areas, when upon a careful examination not the slightest indication of mineral wealth has been revealed, but such is the credulity and the peculiar bias of the human mind that the opinion most in accord with its own desires, is accepted, no matter how great its improbability.

It would appear desirable, also, that government advice should be given when requested in cases where large interests are involved, which are of more than a merely private importance; as, for instance, where the mineral resources of an entire district are in question, as in the case

of the great deposits of nickel at Sudbury, of asbestos in Quebec, of coal in Nova Scotia, or the North-West, or the mode of occurrence and geological horizon of apatite or any other mineral of great economic value, in which the welfare of large portions of the country is involved ; or on the other hand the conducting of certain lines of assays where the fullest and most reliable tests should be made for the common good, such as the assays of gold bearing rocks or of silver bearing veins from certain areas not yet entirely passed out of the public domain. To those of you who have examined the great collections in the Geological Museum the wonderful variety of our mineral resources from every province of the Dominion must have been matter for astonishment, yet in very many cases these great stores of mineral wealth are even yet lying idle and undeveloped, owing to lack of capital or enterprise on the part of our investors.

Were the immense territorial extent of Canada which has been traversed in the collecting of these representatives of our economic mineral resources, often at large expense and with much labour, as easily accessible as the countries of Great Britain, France or Germany, the work of the geologist, botanist and naturalist would be a comparatively easy matter. I say comparatively easy, for while the intricate problems of structure would yet remain to be solved by the geologist, the facilities presented for their solution would be so great that much of the hardship and uncertainty which now prevail in the examination of a new and unsettled country would be done away with.

In the absence of such aids, however, to geological exploration, and in fact very often without any aids at all in the shape of maps, even over many portions of the older provinces, much of the time of the geologist in charge must now be devoted to deciphering his path through the tangled wilderness, and in getting together sufficient materials as regards topography as will enable him to place on paper and to render intelligible the scientific observations, geological or otherwise, which it is his peculiar province to obtain ; for it can be readily understood by anyone, even but slightly conversant with the subject, that to attempt to delineate the geology or structure of any country on a projection, without the topographical features of river, lake or mountain, is almost a hopeless task. Thus it comes about that,

owing to the necessity of obtaining topographical data, which has been laid upon the staff of the Geological Survey, over very large portions of Canada, the ground work for many of our best maps has been derived from their labours, and great areas in all the provinces from the Atlantic to the Pacific have been mapped in detail, first of all by the officers of that staff, as can be seen in the large published maps of eastern Nova Scotia and in New Brunswick, in each of which many thousands of miles of roads, streams and coast lines were carefully measured and platted before the map necessary for the depicting of the geology of these countries could be laid down with any attempt at accuracy. In the newer and western sections, the well executed map of the Sudbury district, the Lake of the Woods, large portions of the Northwest plains, and great areas in the Rocky Mountains and British Columbia, testify to the labours of the Geological survey in this capacity. In the province of Quebec even, the celebrated map of the Eastern Townships, which includes also a large portion of the province west of the St. Lawrence as well, has formed the foundation of all subsequent maps of that province since it was first carefully compiled in the Geological Survey office from materials drawn from Crown Land plans, supplemented and bound together with infinite pains and labour, by surveys made by the different officers of that department, a work the difficulty of which can only be properly understood by those who have attempted similar compilations.

Probably in no country under the sun do more complicated geological problems exist than in Canada, nor are such problems anywhere on a grander scale. A territory embracing three and a half millions of square miles, or very nearly the extent of the whole of Europe, and extending from the 49th parallel of latitude to far within the arctic circle, and embracing the extremes of heat and cold, in the northern part especially, where the fierce heat of the short summer is sufficient to ripen wheat almost to the 60th degree of latitude. Here we have the oldest known rocks of the globe, the solid backbone of the western hemisphere, extending from Labrador, in a great V shaped area, to near the mouth of the Mackenzie River, and including in its survey large portions of the provinces of Quebec and Ontario, and with great overlying areas of all the systems and formations of rock strata down to

the Cretaceous, with the finest opportunities for the study of the more recent geological phenomena, such as pertain to the glacial and post glacial times. Here we have the broad areas of the Silurian lying against the buttresses of the old Laurentian hills in as horizontal a position as when first deposited, and there we have the same series of rocks, folded and twisted, overturned and faulted, and metamorphosed to such an extent that all traces of their early and original character have apparently departed. Wonderful displays of the enormous foldings to which the earth's crust has been subjected are visible in the Rocky Mountain uplift on the west, and in the fractured and crumpled character of the rocks in the sections east of the St. Lawrence with their tangled complex of strata of widely separated horizons.

To attempt to give even an outline of the work of the Survey during the past twenty years would require a far longer time than we have at our disposal this evening, and we can but point out some of the most prominent points in the policy of exploration which have been pursued. Prior to the admission of the North-West Territory into the Dominion we were practically destitute of any knowledge of that great country. What information we possessed was derived from the travels and explorations, principally, of the Palliser-Hector expedition of thirty-five years ago, from the Hind Saskatchewan expedition of the same date, as well as from the journals of Hudson Bay Factors and the story of search parties in the quest after Franklin. At best it was sufficiently meagre. Its great wealth of soil and minerals was almost entirely unknown, and the general consensus of opinion appeared to be that the greater part of the immense plain country, bounded by a sea of mountains on the west, and with its great inland seas and streams, navigable for many hundreds of miles, as fitted only for the support of the Indian, the buffalo and the fur bearing animals, and likely to be of but little prospective importance to the white settler. Directly following its incorporation into the Dominion, exploratory parties were fitted out by the Geological Survey which traversed the great plains, the passes of the Rockies, the country of the Peace River, and the Saskatchewan. Year after year has this policy been carried on till now these scientific explorations, geological and botanical, have explored a very large area indeed, reaching northward nearly to the mouth of the

Mackenzie River and traversing the hitherto unknown area between that river and the Pacific Ocean. As the result we know very accurately the botany, the natural history and to a large extent the general distribution of the several geological formations which there occur. We now have ascertained the welcome fact that in acquiring the North-West Territories we have become possessors of millions of acres of the choicest soil, adapted to the raising of the finest cereals, while its mineral wealth is widely distributed and practically inexhaustible, as we can witness in the great coal seams of the eastern Rocky Mountain slopes in which larger and even more important seams have recently been discovered, which will furnish a supply of the most excellent fuel, sufficient for the wants of the country for thousands of years. Consider also the wonderful extent of the great petroleum basin of the Athabasca River district where, for many miles the sands and gravel are cemented by thickened oil, and present a succession of black cliffs along the course of that stream, with indications which point to this area as probably, in the near future, likely to become one of the greatest oil producing districts in the world. Consider also the rich silver mines in the western section of the Rocky Mountain chain, along the Illicillawatz, and more recently the great developments of the Kootenay district and vicinity which bid fair to rival the great Comstock deposits south of the boundary, with the great deposits of salt, the rich areas of placer gold, and the great masses of iron ore, concerning the existence and importance of all which but little was known prior to the labours of the Geological Survey fifteen years ago, and in some cases even at a much later date.

You will remember two years ago, in a lecture before this club by Dr. G. M. Dawson on "the unexplored areas of Canada," the fact was pointed out that there yet existed in our Dominion, at least one million of square miles of which it may be said we know practically nothing. While this is true, it may also be said of many other hundreds of thousands of square miles, that our information has been obtained only by traverses along river courses or lakes, and that the great resources of these portions must as yet of necessity be practically unknown. But such a lack of information about so much of our Dominion in spite of the fact that the labours of the Geological Survey

staff and of various explorers from the other departments have been carried on for nearly fifty years, as well as of hundreds of private parties, will cease to be matter for astonishment when we consider the enormous extent of our territory and the limited force available to carry on such work. Even in the older provinces of Quebec and Ontario, where these operations have been carried on most continuously, the great succession of mountain country to the north of the St. Lawrence and Ottawa, constituting the height of land between these rivers and those of Hudson and James Bays, is to a large extent comparatively unknown. True, sections have been made across this country here and there along the various water courses but these only afford us a knowledge of our mineral wealth over limited areas. Exploration under such conditions is necessarily slow and great areas must remain practically unknown until greater facilities of transport are presented, an instance of which is presented in the discovery of the mining district of Sudbury, within a short distance of Ottawa, a discovery due to the opening up of the country by the Canadian Pacific Railway, and in Quebec also in the discovery of the asbestos mines of the eastern townships, in a section opened up by the passage of the Quebec Central Railway, the localities in both cases being practically inaccessible prior to the building of these roads. It is not yet twenty years since the importance of the phosphate mines of the Buckingham district was ascertained. When such wonderful stores of mineral wealth at our very doors have so recently been brought to light, who can say what further enormous developments may be looked for in the extension of those mineral bearing rocks which have so enormous a development in our country, and which owing very often to present difficulty of access are entirely unknown. Thus if we contemplate the situation ever so briefly we find before us a problem pertaining to the development of our country and its mineral wealth which requires clear heads for its inception and brave hearts and strong hands for its successful accomplishment. In the elucidation of this problem it is needless to say the staff of the Geological Survey, in making known to the world at large the mineral and agricultural resources of our land, has performed and must continue to perform no unimportant part. With the utmost cheerfulness, in the simple discharge of their duty, the members of that

staff have never hesitated to penetrate into the most forbidding areas, fertile in resources to find or invent means by which unexpected difficulties may be overcome. In canoe, in cart, by boat, or on the trail they have gone forward year after year, "by dint of thought and hammering" they have collected great stores of information and have by their collections and researches made easily accessible to any who may choose to examine, the geology, the mineral resources, and the natural history of the northern half of this continent from ocean to ocean, and have displayed all this information in the most attractive and instructive form in the rooms of the Museum in this city.

But the geological aspect of the work of the Survey department, is at the present day only one of many. Here, stowed away in cases and high presses can be found one of the largest and finest collections of plants, illustrative of the botany of all parts of our Dominion possible to be obtained. Much of the work of this branch of the department is invisible to the ordinary visitor to the Museum, since, unlike rock specimens or masses of ore, dried plants are perishable things and cannot endure exposure to the light and open air. They must be carefully laid away and precautions taken to guard against the ravages of insects and other enemies of the botanist's handiwork. Yet here in the cases of the Museum are stored more than 100,000 specimens illustrating the distribution of our flora from the foggy shores of Anticosti to the green valleys of the Island of Vancouver. The flora of the Peace River district, of the great plains, and of the Rocky Mountain steeps on the west, of the shores and islands of the Atlantic on the east, as well as of the country about the great inland lakes and of distant Labrador, are here rendered available for study to any one interested in the botany of our country, and who may wish, for purposes of comparison or for any other cause, to examine the plant growth of any district whatever. The enormous value of such a collection can scarcely be overestimated, and its practical utility in determining the fitness of certain areas for the growth of wheat or other cereals, as determined by the flora of the district is an admitted fact, not now called in question by anyone at all familiar with this branch of science. To the botanists of the Survey, then, great credit and praise are due for the magnificent collections made and for the careful way in which this

branch of the Survey work has been executed, and the publications on this subject are regarded as of the greatest value by the learned societies, both of Europe and America. Equally inconspicuous with the botanical collection in the rooms of the Museum building are the magnificent collections, illustrative of the insect life of our country; and probably most of those who wander through the corridors of that building are unaware that such beautiful specimens are there stored. These have been brought together in various ways, since the resources of the Survey have not yet permitted the employment of a regular entomologist. The great importance of this branch of science is, however, acknowledged by the Government, and at the Central Experimental Farm the study of the insect life, of certain areas at least, is carried out and their benefit or injury to plant life carefully ascertained; but while these studies are of the greatest practical importance to the agriculturist they cannot, of course, fill the place which the science of entomology requires in a purely scientific department.

In the division of ethnology also much work has been done. Extensive collections, illustrative of the manners, customs and institutions of the various Indian tribes which now inhabit our country, have been made, as well as large quantities of remains and relics of former races. The ornithology and to a certain extent the zoology also of the Dominion are well illustrated by means of a good collection of the principal birds and mammals, the further expansion of which is sadly hindered by a lack of space for their display. The various species of land and marine shells are exhibited and though in but few of these are the collections by any means exhaustive, and though the Museum space at the disposal of such branches of the department's work is of necessity utterly inadequate, sufficient has been done to show that the comparatively newer branch of natural history has not only not been neglected, but that the results already obtained are large and important.

But while the main purpose of a geological department may be held to lie in the work of the geologist, very frequently that work is so clearly associated with the investigations of his confrere, the paleontologist, that the work of the one generally involves the assistance of the other. In this branch, and in mineralogy also, the Geological Survey of

Canada has always maintained a high place among similar institutions. Thirty-five years ago Billings set himself earnestly to the task of deciphering the history of our country as written in its fossil remains. How well he succeeded is evidenced by the fact that the work of E. Billings not only reflected the highest lustre on the Survey in his branch while he remained a member of its staff, but the determinations then made have never ceased to be regarded as authoritative. Since his day the opening of the North West has introduced a new feature into the study of Canadian paleontology by the accession of great collections of fossils from the Cretaceous and other closely associated formations of that area, and less attention has in consequence been directed to the study of the older paleozoic fossils; but this change in policy has only been in accordance with the rapidly growing importance of our western country. The result of the fifty years' collecting in this branch of the Survey work has been to gather together one of the finest and most comprehensive collections, illustrative of the life of past ages in the earth's history, that can anywhere be found; a collection of such value to the scientific world that if by chance it should be destroyed its loss would be regarded as a great calamity by everyone interested in science the world over.

Of the internal economy of the Survey we have as yet spoken but in general terms. Here much work of the highest importance must be carried out. The collecting of facts relative to structure and the making of surveys in the field would not possess one-tenth of their real value, were no provision made by which these surveys and facts could be presented in compact and visible shape to the general as well as the scientific public. Hence the necessity of a topographical corps, whereby not only can the work of the field staff be arranged in map form for publication, but connecting surveys can be made to render these more intelligible. Then there is the careful arrangement of the Museum by which everything deemed worthy of exhibit can be so placed as to show to the best possible advantage the relation between the rock structure and the contained fossils where such exist, and the minerals or ores also which may therein be contained; in order that anyone in quest of information can most readily obtain such to the fullest possible extent and with the least possible delay.

The library division also is one of importance, in which the working scientist can find the most recent helps to enable him the better to profit by the researches of his brethren in other, but similar, fields, and so become the better fitted to work out the problems he may himself encounter; and here it may be said that the library of the Geological Survey is probably by far the most complete in scientific literature of any of the libraries in the Dominion, and, in as far as practicable, is kept well abreast of the age as regards the current literature in the subjects concerned.

The financial management of such an institution is also a most important item in its general scheme of successful work and the proper disposition of the funds by which the necessities of the several widely scattered parties can be best met, calls for a wise discrimination of the needs of each, and the expense peculiar to each locality to be explored; the prime object being the most judicious expenditure of the funds at the disposal of the department consistent with the highest and most satisfactory results obtainable.

I trust in this very imperfect description of the work done by the Geological Survey department I have shown you that in the old building on Sussex Street many kinds of work of great importance to the nation are being carried on. The structure and contained wealth of the rock masses from the Laurentian or fundamental crust of the earth to the most recent formation of drift sand, gravel and peat are being systematically studied and their actual value, in so far as this is possible, ascertained. The importance of each system as a source of mineral supply is carefully weighed and the mode of occurrence and probable extent and value of each element of economic importance sought out where practicable, to some extent in the field and in more detail in the laboratory of the Museum. Not only are the analyses of the rocks and of the contained ores there conducted and their probable value, from many localities carefully proven, but the chemical composition of the mineral waters from various provinces of the Dominion is carefully ascertained and their probable beneficial effects noted. Many of these have proved already to be large and important sources of revenue to the localities in which they occur, as at St. Leon, Caledonia St. Catharines and other points. Much of this work though presented

annually in published volumes fails to reach the general public, being by some curious reasoning apparently regarded as of more importance to scientific bodies and institutions of learning abroad than to those who are most directly interested in the development and growth of our country's mineral wealth—a condition of things which doubtless to a large extent accounts for the oft repeated question: "What is the work of the Geological Survey?" In the present arrangement of publication, however, far greater facilities now exist for obtaining desired information on any particular area.

While it would be folly to assert that the work of the Canadian Survey or of any other similar institution has always been free from mistakes, since that would imply a degree of infallibility and accurate scientific knowledge, not yet enjoyed by mortals, it will, I think, be admitted by anyone conversant with its method of operations that the attainment of the truth, in regard to the geological questions presented, has ever been the chief aim of those associated in the work. That the Geological Survey has ever borne an excellent reputation both at home and abroad is due probably, first of all, to the excellent reputation of its founder, the late Sir William Logan, and secondly to the fact that the great majority of its staff have laboured to their utmost with hearts filled with a love for the profession and with the desire to achieve great results. While we may now be able to say that we have a fairly good general knowledge of the geology of our country, and can depict on the map the lines of the several systems, and in some cases even of the geological formations, yet as settlement and advancement increase, new fields will be constantly opened up which will call for further detailed examinations. The geological study of a country embracing three and a half millions of square miles may be truly said to be a great work. The field certainly is large and the labourers are lamentably few to accomplish it, and many more years must elapse before we can hope to see a complete geological and topographical map of this our great Dominion. The work which as members of the present staff we cannot hope to see successfully accomplished will we trust be handed down to our successors, who, imbued with the true scientific spirit and under more favorable conditions, as the development of this great country progresses, and with accommodations enlarged, and better

adapted to the necessity of the work and the preservation of the valuable records belonging to the department, will continue to do still nobler deeds in the cause of geological science.

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SOME NEW MOSSES FROM THE PRIBYLOV ISLANDS, BEHRING SEA.

(Jas. M. Macoun.)

While with the British Behring Sea Commission last summer a number of plants were collected among which were several mosses new to America and a few new to science.

Dr. N. C. Kindberg has already described six new species and varieties which are given below. All were found on St. Paul Island, in about 57° N. Lat. and 170° W. Long.

CERATODON HETEROPHYLLUS, Kindb. n. sp. Agrees with *Ceratodon purpureus* in the shape of the capsule and the stem leaves, the not excurrent costa and the revolvable annulus, but the capsule is often more curved and distinctly strumose; agrees with *Ceratodon conicus* (Hampe.) in the peristomial teeth having few articulations; differs from both in the blunt perichetial leaves, is also very peculiar in the short, concave, sub-oval leaves of the long shoots.

DIDYMODON BADEN-POWELLI, Kindb. n. sp. Differs from *Didymodon rubellus* in the dioecious inflorescence, the blunt, conic, very short lid, scarcely $\frac{1}{3}$ of the capsule, and the distinctly dentate leaves (as in *Didymodon alpigenuus*, Vent.) The tufts are compact, about 2 cm. high, the leaves revolute nearly all around, short-acuminate, the lower pale brown, perichetial ones longer acuminate or subulate entire. The capsules are (unripe) more or less curved, the pedicel pale red. Named for Sir George Baden Powell, one of the commissioners.

WEBERA CANALICULATA, C. M. & Kindb., var. *MICROCARPA*, Kindb. n. var. Differs only in the much smaller capsule.

BRYUM BRACHYNEURON, Kindb., n. sp. Agrees with *Bryum pendulum* in the synœcious inflorescence, the peristomes orange, the

segments adhering to the teeth, the apiculate lid and the large spores (about 0.04 mm.); differs in the decurrent leaves, short-ovate, the costa broad, abbreviate, not excurrent, the sterile shoots bearing globose buds (gemmæ), the very much broader peristomial teeth. Stem red, very short, the pedicel about 1 cm. long or shorter, often scarcely emerging above the tufts; costa of the lowest leaves red, percurrent only in the leaves of the shoots and the perichetial ones; capsule ventricose, short-necked constricted below the mouth. *Bryum fallax*, Milde., resembling it in habit, is dioecious; the segments are free, the spores smaller. *Bryum lacustre* differs in not having decurrent leaves, the capsule not being constricted below the mouth, the pedicel longer, the peristome pale, etc.

BRYUM FROUDEI, Kindb., n. sp. Habit of *Webera nutans*. Agrees with *Bryum inclinatum* in the syncœcious inflorescence and the symmetric capsule, etc.; differs in the leaves being long-acuminate, cells long and narrow, the upper sublinear (nearly as in *Webera*), costa very long-excurrent, peristomial segments quite free from the teeth, spores smaller, scarcely 0.02 mm.; the cilia are wanting. Named for Mr. Ashley Froude, secretary to the commission.

POLYTRICHUM (POGONATUM) ALPINUM, Roehl., var. MICRODON-TIUM, Kindb., n. var. Differs in the leaves being nearly entire or indistinctly denticulate.

NOTES OF TRAVEL IN JAPAN.

(By W. HAGUE HARRINGTON.)

(Delivered January 14th, 1892.)

On Thursday, the 14th of January, Mr. W. Hague Harrington delivered an address on some of the physical and natural history features of Japan as observed by him in his visit to the Sunrise Kingdom during the preceding summer. Hilly and well-wooded land was seen from the *Empress of India* on the 11th August, some three hundred miles northward of Yokohama. The following morning at daylight the Gulf of Tokio was entered, and the run up this capacious bay about thirty miles to Yokohama (Tokio lying at the head several miles beyond) was very charming, the shores on either side being clothed with foliage and with a succession of villages lining the bays at the foot of the hills. Great numbers of junks and fishing craft enlivened the waters, and when the steamer anchored off Yokohama, the water being shallow, she was immediately surrounded by scores of sampans and other craft, with military, police, customs, medical, post-office and other officials, and the scene was very animated and interesting. Mr. Harrington was met by his two brothers (Rev. F. G. Harrington and Rev. C. K. Harrington), who reside in Yokohama, and from his landing to the termination of his visit, ten weeks later, enjoyed every moment and found ever new features of interest. To be in a country where the people, dress, customs, dwellings and almost everything observed are so strikingly different from those of America was in itself a guarantee of pleasurable excitement.

An early visit was made to Hakone, the favourite summer resort of many foreigners, and a district of a very beautiful character. The village of Hakone is situated on a lake (nearly four miles long and 2,400 feet above sea level), which apparently lies in the crater of an ancient volcano, and which is surrounded by fine wooded or grass-covered hills. In the vicinity are many hot springs of varied temperature and qualities, while about two miles from the head of the lake is an extensive solfataras or volcanic gorge from which rise steaming vapours. The native name is Ojikoku (Big Hell), and beneath the decomposed surface may be heard the boiling waters. It is necessary to

walk carefully, as the ground is often undermined and lives have been lost here.

Japan exhibits many of these and other forms of volcanic action, and there are several important volcanoes still more or less active. The principal of these is Asama, nearly one hundred miles N. W. of Yokohama. Mr. Harrington and his brother ascended this mountain (8,280 feet high), and found that the present crater lies in the centre of a much larger and older one, the broken rim of which is well marked, although it has been nearly filled up. At the time of their visit the volcano was more than usually active, the vapours filling the crater (said to be one-quarter of a mile in diameter) and rising several hundred feet above it. After the great earthquake of 28th October the mountain was emitting flames and ashes. This mountain, like many of the others, evidences that the craters of remote times were much larger than present ones, and in some cases a series of cones and craters has been built up.

Among the other mountains climbed by Mr. Harrington was the sacred cone of Fuji, which rises to a height of 11,365 feet, with the outline of an inverted fan. Although the slope is not very great, the footing is for much of the way very trying, and toward the summit the climb becomes difficult. Starting from Gotemba at 6.30 a.m., the top was reached about 5.30 p.m., and the night was passed there. This mountain is climbed annually by great numbers of pilgrims during the months of July and August. It has not been in eruption since 1707, but although the crater is partly filled with snow and ice, there are signs that it is not completely extinct, as steam sometimes issues from cracks outside the crater on the east side.

Japan at first sight appears to be a very fertile country, but closer examination shows that tillable land forms the smaller part of the Empire, and that much of the land cultivated is of a very poor quality, being largely composed of volcanic tufa and debris. According to recent authorities, it was found that 37% (not including Yezo, which is thinly populated), is classed as desert, including volcanoes, solfataras, scorix covered plains, etc. Mountain forests cover 23%, so that these two divisions include about two-thirds of the country. Cultivated forests cover 18%, and are an evidence of the attention paid to forestry,

the Japanese in this respect being much in advance of Americans. Along the sand dunes of the coast Mr. Harrington observed the extensive planting of pines, showing specimens from a few inches upward, while older forests showed by the regularity of the trees that they were planted by man. Farming lands proper occupy 15% of the country, and are classed as Ta and Hata, the rice fields and the dry fields. To these may be added 5% of land under other forms of cultivation, such as fruit and nut trees, etc., making in all 20%, or one fifth of the land devoted to agriculture of all kinds.

From this area, careful and systematic tillage furnishes food for the large population of 40 000,000, besides a considerable quantity for export. Wherever water can be obtained, rice is the staple crop, and the plains and valleys are carefully levelled and irrigated, so that they may be kept wet during the growth of the rice. When Mr. Harrington arrived, the young rice covered the plains with a beautiful verdure, and before his departure the harvesting was well advanced. The annual yield in favourable years is about 200,000,000 bushels. No fences are needed, and as the farmers chiefly live in villages on the edges of the rice plains, these present a wide expanse of vegetation.

Along the ridges which bound the rice plats are generally planted beans, which are also extensively grown in the dry-fields, and form a large element of the food. They are generally known as Soy-beans, because certain varieties are used in making the sauce of that name (Shoyu), so much used as a relish. Of other crops, the mulberry was described as largely grown in some districts where the silk worms are bred, an industry employing a large part of the population. In other districts, tea was a chief product, and the plantations of these shrubs were described as being very attractive in appearance. The cotton which in some districts is very largely grown, and for the spinning of which several large mills were seen, is a smaller plant apparently than that cultivated in America.

Mr. Harrington regretted that his knowledge of geology was not sufficient for the full appreciation of the phenomena which, in a land where the forces of nature are so actively in operation, must be of a most instructive character. The Hakone district exhibits both well wooded hills, and others covered with a very vigorous tall grass, a

species of *Eulalia*, several feet in height, and in the north, as at Nikko, the country is mountainous and wooded. At Nagano (in the Shinshiu district) he had seen hills of chalk or plaster and described how hot had been the road cut along the face of those hills. In the south the ranges of hills were largely barren, sometimes formed apparently of coarse diluvial drift and conglomerate, at others largely of sand.

The rivers from the mountains frequently do great damage in the plains when suddenly swollen by the rains, or melting snows, and large sums of money are spent yearly on embankments and improvements in the channels. On some of the plains the rivers have been raised by the silt deposited by their waters, and the continual heightening of the embankments, until (as at Lake Biwa) the railway across the plain goes under the beds of the rivers by tunnels. When unusual floods, or earthquakes occur the embankments may be burst and much loss of property and life result.

The flora and fauna of the empire were described by Mr. Harrington as very rich in interesting species, and he had often thought how the botanists especially of the Field-Naturalists' Club, would have revelled in the scenes presented. Trees were very numerous, of great variety of foliage and often of very large size. Of conifers the most striking had been seen at Nikko, where the famous temples and tombs in honour of the first and third Shoguns, are embowered in magnificent groves, and the avenues and courts are lined with gigantic specimens, with trunks four, five, six or even up to eight feet in diameter. These trees are about 250 years old, showing that the growth of this species is rapid. At one of the shrines at Nikko stands a beautiful Koya-maki, or umbrella pine (*Sciadopitys verticillata*), now several feet in diameter, which is said to have been a pot plant belonging to Iyeyasu, the first Shogun. The old highways of Japan were generally lined with fine trees forming veritable avenues, thronged by the travelling multitudes. Such an avenue of *Cryptomerias* (*C. japonica*) leads up to the sacred groves of Nikko, the last six miles being especially imposing.

It is a favourite habit of the Japanese to train out on supports the branches of one of the species of pines, until the extent of their spread is wonderful. Such a tree was seen at the Kurodani monastery (Kyoto), upon which, the priests relate, Nazane hung his armour when, about

800 years ago, he abandoned the military for the monastic life. The most famous, however, of such trees is that at Karasaki on the shore of Lake Biwa, which is of great unknown age, and hence very sacred. The trunk has a circumference of 37 feet and gives off nearly 400 branches, the spread of which from east to west is 240 feet and from north to south 288 feet. There are many varieties of cedar, cypress, pine and fir, and the residences of foreigners in Yokahama are much beautified by well trimmed hedges and shrubberies.

Next to the conifers, the traveller's attention is arrested by the abundance of glossy leaved trees and shrubs, which present in summer a bright vigorous foliage, and which are chiefly evergreens. The camellias grow to considerable size, and blooming late in the year are a feature of the winter scenery. The cinnamons are represented by several species, the most important being *C. camphora*, which is widely distributed and of great economic value, as it grows to a large size, and yields wood very valuable for cabinet and box making, in addition to the camphor obtained by distillation. A camphor tree seen near a temple on the path from Hakone to Atami was found to have a circumference of of fifty feet. It was centrally split and decayed, but was a majestic tree, and the priests stated its age to be some eight hundred years.

Keyaki (*Zelkova keaki*) was another large tree, yielding very valuable timber in demand for many purposes. At a new temple being built at Kyoto fine sticks of this wood had been seen, about four feet square, and the pillars supporting the roofs were of the same material. When new, the Japanese buildings exhibit very well the different beautiful woods used in their construction, but, not being varnished nor painted, all outside work soon becomes dingy from the effects of the weather.

A very remarkable tree is the Ichu, a member of the Taxaceæ or yew family, the scientific name being *Salisburia adiantifolia*, the specific name derived from the great resemblance of its leaves to those of the maiden-hair fern. It is a large tree of handsome growth and in autumn the leaves turn of a fine golden colour. It has probably been introduced into Japan, as the trees are usually near the temples. Good specimens were seen in Kyoto, etc., but the largest was at the Hachi-

man temple at Kamakura, which is claimed to be over a thousand years old, and of which the trunk has a circumference of twenty feet. The fruit is about the size of a damson, and the nut-like kernels are used as food. This tree is also called *Ginko biloba*, the word *gin* signifying gold in Japanese. The Japanese yew (*Taxus cuspidata*) is a fine tree, and furnishes a much valued and beautiful wood.

Among the many interesting trees observed were several varieties of oak; fine walnuts, magnolias (the wood of *M. hypoleuca* being very close-grained and valuable); maples of various species and very pretty foliage, much prized for the autumn tints, which, however, do not equal those of Canadian maples; birches, like our white birch, upon the mountains; and a wonderful variety of other fine trees.

A remarkable feature of the forests is the great abundance of strong climbing plants, which festoon the trees, and frequently entirely hide them. Of these the Fuji (*Wisteria chinensis*) is the most striking species and winds its thick coils high around the lofty trunks, or even, when support is absent, about itself. This fine vine is much admired and forms a fine screen for verandahs and summer-houses, and when the immense clusters of bloom are pendent from it the effect is very fine. Curious trees are *Stuartia* and *Lagerstroemia*, which have red smooth trunks, and in Japanese are called *Sarusuberi* (from *Saru* a monkey and *suberu* to slide), because the trunks are so slippery.

Of fruit trees the principal are peach, plum, pear and persimmon. Peaches are by no means equal to American ones; plums are large and of good appearance, but the flavour is not so good as might therefrom be expected. Of pears enormous numbers are grown, and many of these are of large size and very pleasing colour, often a rich golden hue. They are much esteemed by the natives, but foreigners accustomed to other varieties find them very insipid, although when one is thirsty their juicy flesh is very refreshing. The persimmon, or *kaki*, is very largely grown and appears to be the favourite fruit of the Japanese. The fruit ripen late in the year, and until perfectly ripe are dreadfully astringent. When ripened fully, however, they are very good, especially those in which the flesh becomes a soft juicy pulp that has to be eaten with a spoon. Many of these fruits are dried and pressed like figs for winter use. The Japanese oranges are said to be

very good, but were not ripe when Mr. Harrington left. In the southern provinces the Pompelo or Shaddock (*Citrus decumana*) is abundant, the fruit being very large and the pulp very agreeable. Pomegranates are very handsome in flower and fruit, but the latter does not offer much except the acid pulp around the seeds.

Although the time of Mr. Harrington's visit was not the period of flowering for many plants, he saw, especially in the mountains, some fine species in bloom. Of these may be especially mentioned the lotus, which grows luxuriantly in the temple ponds, and often in moats or ditches, lifting its large leaves and beautiful flowers high above the water. On the Hakone hills the grand white lily (*Lilium auratum*) grows in abundance, and the root bulbs of this and of other fine species are largely gathered for food. Near the foot of Asama had been observed a beautiful yellow lily on a stalk some three feet high, and in the *hara* (dry plain) below Fuji many examples of fine tiger-lilies occurred. Other smaller lilies, and other closely related forms had frequently been seen, showing how extensively these beautiful plants are distributed.

A very conspicuous species in the early part of October, from Kobe to Yokohama, was one about $1\frac{1}{2}$ to $2\frac{1}{2}$ feet high, with a fleshy stem and no leaves. Each stem bore several bright cardinal or scarlet blossoms of a lily-like form, but with the petals narrow and twisted. This plant grew in abundance along the irrigation ditches or in any uncultivated spot, and its bright colour sometimes showed in large vivid patches. Of flowering shrubs *Hydrangea paniculata* was a good example, as it was seen in large masses along the mountain paths, and showed at once its relationship to the cultivated form, although in nature flowering in the fashion of our Canadian *Viburnum lanianoides*.

Of the varied flora perhaps no plant is so attractive in appearance as the giant of the grasses, the bamboo, which is also as useful as it is beautiful. Fine groves were seen, especially in the south, where the stems rise forty or fifty feet, and have a diameter of three to six inches. The uses of these stems are innumerable, and it would be difficult for the people to get along without them. Upon the mountains the underbrush often consisted almost solely of a dwarf species, forming an almost impenetrable scrub.

But little time remained to say anything of the fauna, although this had been found of the greatest interest. As was to be expected, very few mammals were seen in their native haunts, the exceptions being a large black squirrel and weasels. In the northern portion of the country, however, especially in Yezo, there are many deer, bears, etc., and at Nikko the fur shops exhibited great quantities of pelts, largely martens, with otter, badger, fox, monkey, etc. The monkey, Saru (*Inuus speciosus*), is one of the most interesting species, inhabiting a large portion of the country even well northward, and is said in some places to be rather a serious pest of the farmers. It was frequently observed in captivity at the temples, theatres, etc. In the beautiful parks surrounding the temples at Nara are numbers of tame deer which feed out of the visitor's hand, and assemble at the call of a trumpet. The stags are handsome animals of brownish colour, the fawns and does lighter and spotted. Great numbers of hairpins, chopsticks and other trifles are manufactured from the horns. This town was also a great producer of ink, enormous numbers of tablets having been seen.

Next to agriculture, the fisheries of the kingdom are of the greatest importance, and the immense fleets of boats engaged in this industry afford beautiful pictures all along the coasts; many hundreds of them may at all times (except in heavy gales) be seen reaping their harvest from the capacious waters of Tokio Bay. Fish and vegetables form almost the entire food of the inhabitants, and of the former a great variety is fortunately found, it being stated by some authorities that about 700 species frequent the Japanese waters. Many of these are very valuable for food, including some forty species of the mackerel group, of varying size and quality, some of them very good.

A favourite fish is the Tai, a beautiful deep red gold-bream (*Chrysopus cardinalis*), the delicate flesh of which is most delicious. It is frequently served up raw in delicate flakes, and is very palatable in this fashion. The Japanese are, however, very skillful in cooking fish, and the traveller enjoys this part of his diet,

Herrings occur abundantly, and some species are much used in the manufacture of fertilizers for the rice fields, for in Japan the art of manuring is well understood, and every available material is made use of and nothing allowed to be wasted. The odour arising from this

fish-guano is far from pleasant, as was experienced by Mr. Harrington at Bakan, where the steamer up the Inland Sea had a large quantity of sacks of it on board.

Mollusca are also largely used for food, especially cephalopods, haliotis, and the larger shell fish, of which immense numbers are taken for home consumption and export to China.

A visit had been made to Enoshima, where a large trade is done in shells and other marine productions, and many articles manufactured from shells, corals, etc. Specimens of the celebrated glass-rope sponge (*Hyalonema Sieboldii*) can always be obtained in this interesting place, and form favourite souvenirs for visitors.

The waters of Japan contain great numbers of crustaceans, the most remarkable of which is *Macrocheirus Kämpferi*, called by the fishermen Taka-ashi (long legs) the limbs extending ten or more feet from tip to tip. A very large specimen was seen in the Ueno Museum, Tokio. A curious little crab found down in the Inland Sea has on its back a striking resemblance to a human face, and has connected with it interesting legends. At Yokohama and elsewhere small crabs may be seen running about the roadways, and scuttling into their burrows in the damp ditches. At Chofu a larger and more handsomely marked species abounded so much that, despite its agility and wariness, many were killed on the road by passing jinrickshas.

Of reptiles the most frequently observed were two species of lizards, one of which has the hinder part of the body and the tail of a very bright greenish blue. In Hakone lake a red-bellied newt was very abundant in shallow water. Other species of newts also occur, and, like the lizards, are caught in large numbers and dried for medicinal purposes. A curious little Gekko (*Pterodactylus Yamori*) frequents houses, subsisting upon insects and hiding by day in crevices. Snakes of several species abound, but only one poisonous species is found, viz., *Trigonocephalus Blomhoffi*, which is considered to be a good nerve strengthener when skinned and cooked. Small green tree-toads were common, and one specimen was seen of a very large toad with whitish belly, white blotches along the sides and reddish markings on the head.

In the ponds and tanks which frequently adjoin temples may be

often seen great numbers of turtles (a species of *Emys*) which are fed by the visitors with small fish, lizards, etc., purchased for a few *rin* from the attendants. The turtle is a very frequent object in Japanese art work, and is often represented as if with spreading plumose tail. This is apparently meant to represent old individuals in which the shell is often covered with confervæ that stream out behind as the animal swims along.

Birds also furnish abundant themes for the Japanese artist, who knows so well how to depict them in lifelike attitudes, and with the greatest fidelity to nature. In the cities great numbers of a large kite, the Tombi (*Milvus govinda*), may always be seen circling slowly round, and acting the part of useful scavengers, without fear of man. In Yokohama they were very numerous about the harbour, seeking their food from land and water, and resting in the rigging of the ships. Ravens are also abundant, and with the sparrows are very troublesome. The latter (*Passer montanus*) swarms in the rice-fields in spite of scare-crows, nets, traps and rattles, and much resembles in appearance and destructiveness the English sparrows. The most interesting birds are perhaps the storks and cranes, of which several fine species abound. They are protected and hence may be seen more frequently than might be expected. Tsuru is the name applied to the cranes, but each species has likewise a special name, as the Tancho (*Grus leucauchen*), a noble white bird with a red crown, black neck and tail. There are three species of silver heron, Sagi, very beautiful birds, seen upon the mud flats near Tokio, at Hiroshima and elsewhere.

In the moats surrounding the castle at Tokio were seen great numbers of ducks, which of course are never molested, and swim about in all the beauty of their various plumages. Jays, thrushes, finches, wagtails, doves and many others were observed, including pheasants, of which two species are common, and in some districts so numerous that great numbers are killed.

* Insects were very numerous and about 600 species had been collected, about half of which were beetles. There was no time to discuss

* A paper had already been read by Mr. Harrington before the Entomological Society of Ontario upon the Japanese Insects and is being printed in the annual report of the society.

these collections or the many fine insects observed, but reference was made to the abundance of large wasps, and to the Semi or Cicada, whose noise is so obtrusive during the hot weather, and which is captured by the children with slender bamboos tipped with rice glue.

The address having occupied an hour and a half it was moved by Mr. Kingston, seconded by Mr. Lees, "that the reading of the Ornithological Report be deferred until the next soiree." Carried.

At the request of the members Mr. Harrington attired himself in a Japanese costume, explaining, however, that fine feathers do not make fine birds, and that he was afraid the clothes would not make him look like a Japanese, or show to advantage their graceful qualities.

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CORRESPONDENCE.

THE JAPANESE GLASS-ROPE SPONGE.

To the Editor of the Ottawa Naturalist.

DEAR SIR,—In anticipation of any report you may make of my "talk" upon Japan will you permit me to briefly supplement the reference then made to the exhibited specimens of *Hyalonema Sieboldii*. I find that some of those present received the impression that this interesting form is an artificial "plant" instead of a *natural* curiosity. The specimens shown, of which one was complete and the other stripped of the sponge proper, were obtained at Enoshima, where they may be had in abundance, of varying sizes and degrees of perfection. The trifling price at which they are sold would at once negative the idea that they are manufactured, even were the object of such manufacture apparent. They are obtained by dredging, in about 200 fathoms, on reefs situated near the mouth of the Gulf of Tokio. During my stay in Yokohama I read in a volume of the transactions of the Asiatic Society of Japan a very interesting paper on these sponges, and the only point on which the author asked for further investigation was the relationship borne to the sponge by the polyps surrounding the stalk. Various theories have been held by naturalists as to the growth of these

sponges but they were based upon imperfect specimens. The first specimens examined consisted merely of the stems with the sponge scraped off, and were supposed to be the skeletons of the parasitic polyps (Palythoa). Later it was supposed that the stalk grew upward from the sponge. As more perfect specimens were obtained, and closely allied species were obtained in other seas, the true method of growth was determined. I have no time to refer to authorities, but will quote from the brief account of Prof. Hyatt in the Standard Natural History :

"The sponge itself is * * * of a light brown colour, and friable when dry. The top is usually occupied with a number of cloacal apertures surrounding a central prominence which is in reality the end of the stem. The stem is spun by the tissues, as a supporting column, of elongated spicules bound together and growing in a spiral as the animal progresses upwards. The lower end of the stem becomes frayed out, and sinks into the mud as the animal grows, but constant additions to the upper end compensate for this and form a column which sometimes reaches a foot in length.

W. HAGUE HARRINGTON.

O tawa, Jan. 15, 1892.

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REPORT OF THE ENTOMOLOGICAL BRANCH FOR 1891.

(*Read March 12th, 1891.*)

To the Council of the Ottawa Field-Naturalists' Club.

GENTLEMEN.—The leaders are pleased to announce an increased interest in this branch. Several of the younger members have collected regularly throughout the season, and have been remarkably successful in obtaining rare and valuable species.

In this connection special mention may be made of Mr. Willibert Simpson, Mr. Reginald Bradley and Masters Tommy and Beverley McLaughlin. The joint collection made by the last named took the prize at the Central Canada Exhibition. With reference to this association and the prizes that have been offered at the annual exhibitions, the leaders trust that greater efforts will be made to exhibit larger

collections and thus keep up the interest of the public in this important branch of study.

A large part of the collections of Messrs. C. P. Bate, W. Simpson, and R. Bradley was made at Kingsmere in the Chelsea mountains. Amongst the beetles collected were some not previously recorded as having been taken in this locality, e.g., *Myas cyanescens*, 2 specimens Mr. Bradley, *Encydlops ceruleus* and *Xylotrechus sagittarius* Mr. Bate. Mr. Simpson took a fine female of *Pityobius anguinus*, another specimen, a male, was taken by Mr. Fletcher and Mr. Harrington bred a female from a larva found in a decaying log in Beechwood in May, showing that this insect, one of the finest and largest of our Elaters is not so rare here as previously supposed. *Saperda calcarata* the large poplar borer was found in injurious numbers by Messrs. Simpson and Bradley at Kingsmere. They have now a barrellful of intested poplar stems containing many of the larvæ.

The leaders regret exceedingly the loss this branch has sustained, by the return of Rev. G. W. Taylor to British Columbia. Before leaving he had made a critical study of the *Carabidæ* with good results; many of the doubtful species in this difficult order were satisfactorily determined and several additions were made to the Ottawa list, particularly in the genus *Bembidium*. In the early spring diligent search was made for the members of this order and large series of specimens were taken. Amongst those not before recorded were *Cythrus Brevoortii*, *Lachnocrepis parallelus*, *Nebria pallipes*, and *Loricera cœrulescens*.

Two interesting occurrences of exotic insects imported with fruits were brought to the notice of the leaders by Mr. C. P. Bate. *Blaps mortisaga*, a California beetle, he had found alive walking across a floor in the city. This, from what we could learn, had probably been introduced in a case of dried fruit. A small scorpion was also found by Mr. M. McVeity in a consignment of pineapples from the West Indies. In taking them out of a barrel he was stung on the hand. The weather was cool and the scorpion was sluggish or he would probably have suffered more severely than he did from the sting. As it was, the wound was extremely painful for several hours.

Some attention has been given to the local Hemiptera, and Mr. Harrington gave an afternoon lecture on this order and submitted a

preliminary list, which will appear in a future number of the OTTAWA NATURALIST. The large families of Aphididæ and Coccidæ, which embrace a large proportion of the species of this order, have not so far been much studied and must for the present be omitted. The study of some families of the Hymenoptera has been so far advanced that the leaders hope soon to begin the publication of the list of this order which was promised in a previous report; but the printing of which has been postponed, owing to the great number of new species constantly turning up and the difficulties attending their accurate determination.

Mr. McLaughlin has collected several new species of dragon-flies, but they are not yet identified.

In the order Lepidoptera several rare species have been collected. A few specimens of *Nisoniades Horatius*, not previously recorded from this locality, were taken at Beechwood by Mr. Fletcher, ovipositing on *Aquilegia Canadensis*.

A small but interesting collection of moths was taken at the dynamo house of the Electric Light Co. This contained two specimens of *Heptialus argenteomaculatus*, *Sphinx Kalmia*, *Smerinthus modestus*, *S. geminatus*, *S. excrucatus* and *Tolyte vellela*. Two of the large sphinx caterpillars, *Philampelus Achemon* and *Sphinx Chersis*, were injuriously abundant on the Experimental Farm, the former on grape vines and the latter on ashes.

A serious attack on the wheat crop by a small fly (*Oscinis variabilis*) has to be recorded. It is being specially studied by Mr. Fletcher.

T. McLAUGHLIN,	} <i>Leaders.</i>
JAMES FLETCHER,	
W. H. HARRINGTON,	

SOME NEW MOSSES.

(By Nils. C. Kindberg. Communicated by Mr. J. M. Macoun.)

1. *DICRANOWEISIA OBLIQUA*, Kindb., n. sp.

Differs from *D. crispula* in the capsule being asymmetric, obliquely curved, substrumose in a dry state, the leaves with an excurrent costa, the perichetial ones being longer acuminate the peristomial teeth longer subulate, cleft above.

On rocks along Asulcan Creek, near the Asulcan Glacier, Selkirk Mountains, B. C., Aug. 7th, 1890 (Macoun).

2. *DICRANELLA POLARIS*, Kindb., n. sp.

Tufts dusky green not shining, fuscescent below; stem 1-3 mm. in height. Leaves rigid, nearly straight, erect-patent from the ovate-oblong base narrowed to the subulate acumen, which is furnished with 2-3 indistinct teeth; lower marginal cells narrow, upper sub-oblong; costa broad, often $\frac{2}{3}$ of the lower part, faintly marked, filling the whole acumen; perichetial leaves larger, entire, broader at the base, with more numerous marginal cells. Capsule asymmetric suboval, finally sub-clavate, curved, smooth, short-necked, orange; lid with a long oblique beak; peristomial teeth nearly entire, slightly cleft above, orange with paler tips; annulus not distinct; pedicel yellow, 10-12 mm. long. Spores small, about 0.015 mm. Calyptra short dimidiate. Dioecious.

This species differs from *D. heteromalla* in its smaller size, the rigid leaves, the broad costa (broader than in the European *Mettrleria alpina*, Schimp., and resembling it in habit) and the smooth capsule.

St. Lawrence Island, Behring Sea, 15th August, 1891 (J. M. Macoun).

NOTE.—St. Lawrence Island, situated in N. Lat. 63°30', W. Long. 170°, is a barren rocky island covered with a scanty growth of vegetation, principally lichens of a few species. At the date of our visit there snow still filled the ravines and covered the northern slopes.

3. *DICRANELLA CERVICULATULA*, Kindb., n. sp.

Agrees with *Dicranella cerviculata* in the strumose capsule, the yellow pedicel and the dioecious inflorescence, differs in the leaves not suddenly acuminate, the cells short quadrate, only the inner basal

rectangular, and the costa narrow, well defined and not filling the acumen, only in the perichetial ones distinctly excurrent. The tufts are very dense and compact, dark green, the leaves not spreading, rather sub-erect or patent, the stem about 5 mm., the pedicel 7-8 mm.

Nottingham Island, Hudson Strait, August 24th, 1884 (R. Bell.)

4. *BARBULA SUBCUNEIFOLIA*, Kindb., n. sp.

Differs from *Barbula cuneifolia* in very much larger subacute leaves, reddish in the older state, costa very stout. elevate and blood-red, larger capsule with more twisted teeth, very twisting and dark-red pedicel; inflorescence probably diœcious.

Mixed with *Pottia Heimii*; St. Matthew Island, Behring sea, August 10th, 1891 (J. M. Macoun.)

NOTE.—St. Matthew Island, 60°30' N. Lat., 173°30' W. Long., resembles St. Lawrence Island in general appearance, but there is on it a much greater variety of plants. The interior of the island is hilly and covered with grass.

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MICROSCOPICAL SOIREE.

On Thursday, the 11th of February, at 8 p.m., a microscopical soiree will be held in the Normal School, to which the students of that institution are particularly invited. Four short papers, of not more than ten minutes each, will be read by Messrs. Ferrier, Shutt, Fletcher and Harrington. The subjects discussed will be illustrated by microscopes.

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SUBSCRIPTIONS.

The Club year having nearly expired (the third Tuesday in March being the date of the annual meeting), any members who have not yet paid their subscriptions will oblige by sending them to the Treasurer, Mr. A. G. Kingston, Dept. of Public Works, Ottawa.

A BOTANICAL EXCURSION TO "THE CHATS."

AN ADDRESS DELIVERED BY MR. R. B. WHYTE JAN. 28, 1892

Mr. Robert B. Whyte gave an account of a botanical excursion he had taken with Mr. R. H. Cowley to the Chats Rapids, Falls and Island during the past summer. The address was illustrated by a map of the county of Carleton showing part of the Ottawa River, upon which the various places mentioned were pointed out. The Mississippi River divides south of the Chats Island, one branch flowing straight north, and the other called the Snye, flowing east, and emptying into the Ottawa River at Fitzroy Harbor. The interest attached to the Chats is not only on account of the many plants found there; for just at the northern point of the island a series of wild rapids begins, which ends near Fitzroy Harbor in a lovely waterfall of thirty feet. This extends right across the river, and is of great beauty, being a succession of falls with wooded islands between them. Indeed Mr. Whyte thinks it is the prettiest fall in Canada. Some years ago the construction of a canal was started on the north side of the rapids, and nearly half-a-million of dollars were expended on it, but the rock was found to be so hard that the builders decided it was not worth the trouble, and gave it up. This is the original Laurentian rock which forms the islands at the falls, and from there runs down past Galetta and Perth to the St. Lawrence. Near the proposed route of the canal there was formerly a horse tramway from Pontiac to Bristol, but it is now almost in ruins. About twenty-five years ago Mr. Whyte took a trip on this railway, and was then struck by the profusion of wild flowers of all kinds which lined both sides of the track. On this occasion Messrs. Cowley and Whyte took the train to Arnprior, from which place they proceeded by steamer. The water was too shallow to land on the island, but through the kindness of Mr. Cowley's brother, they were set down about a mile from shore, and rowed in a small boat to land. Here they met Capt. Cowley, who accompanied them in a walk along the north shore, a beach formed of shingle and broad flat stones, amongst which they found some of their most interesting specimens, a previously unrecorded *Aster* and the shrubby *Potentilla*, with yellow flowers, which would be well worthy of cultiva-

tion as an ornamental shrub in gardens ; also the beautiful *Lobelia Kalmii*, *Prenanthes racemosa*, *Pycnanthemum lanceolatum*, and other interesting plants. After lunch they walked down an old road which Capt. Cowley said was made to connect Deschènes Lake with Chats Lake, completing the line between Aylmer and Portage-du-Fort. This was the only road between 1837 and 1847. He also said that where Mr. Whyte had found some of the rarest plants he had once had an old storehouse, which in those days was used for storing merchandise from Montreal, and he suggested that some of the seeds might have been brought from that region. Subsequently they rowed up the Mississippi River to Galetta, where they spent the night. Starting early the next morning before breakfast they went out to search for the *Ceanothus Americanus*, which Mr. Whyte had found growing there the year before, but at this time they could not discover a single specimen, although a great many were discovered later in the day. After breakfast they had a delightful row down the Mississippi again to the Snye, where both banks of the river were lined with arrow heads, water lilies, cardinal flowers and many other beautiful flowers. After rowing for some time down the Snye they landed on the north side, where they found *Helianthus divaricatus*, *Helenium autumnale*, *Pycnanthemum*, and *Ceanothus* in great abundance. Before returning to the boat they visited a Galena mine which is situated to the south-west of the island ; it is worked by a man from Montreal, and sends out many dollars worth of lead every year. After leaving the Snye they rowed down the Mississippi to a place on the lake called "The Camp," where people from Arnprior and Galetta often spend the summer. Here within one hundred yards they found almost all the plants seen during the two days. Mr. Whyte then described the new plants, of which he had mounted specimens with him. The first was *Aster ptarmicoides*, which has not been found before east of Belleville, but it is known in many places in the North-West. It is however scarce and local, and the Chats Island may be the nearest place to Ottawa where it grows. The *Potentilla fruticosa*, or Shrubby Cinquefoil, which grows on the rocky margins of rivers, is common in Eastern Canada, having been found even in Northern Labrador. Another plant was the *Prenanthes racemosa*, or Rattlesnake-root, which is found at Montreal and Lake Huron ;

it is common also in the lower provinces, and would likely be found a little north of the city, The *Helianthus divaricatus* has never before been found by any member of the club in this locality, but in McGill College Herbarium there is a specimen of it, said to have been found in the vicinity of Ottawa. It is common at Prescott, and to the west of this place. The *Pycnanthemum lanceolatum*, commonly called Mountain Mint, was found at Montreal fifty years ago, and in later times at Weller's Bay, Lake Ontario, by Prof. Macoun, although it has not been found here. *Lobelia Kalmii* is a pretty little plant which grows on rocky points below waterfalls. There were fifteen new plant^s found last year, most of them near Ottawa, and Mr. Whyte thinks they would have been found before if they had been looked for more closely, and he reminded the members that there is plenty of work for many years yet in places that have not been thoroughly gone over.

At the conclusion of Mr. Whyte's interesting address, remarks were made by some of the members present. Mr. Fletcher thought it was hardly likely that the seeds of the plants found by Mr. Whyte had been introduced in stores taken to Capt. Cowley's depot, and he agreed with Mr. Whyte that although the locality had been well worked up, there was still plenty of opportunity for the members of the club to distinguish themselves by finding plants as yet unrecorded from this locality. Most of the collecting so far had been done in only a few different localities, and there were many large districts close to the city which were never visited. He congratulated Messrs. Whyte and Cowley on their success, and felt sure it would spur others on to use their eyes better next year.

Mr. Ami spoke of the peculiarities of Montreal Mountain as a botanical locality.

NOTE.—The above excellent report of Mr. Whyte's lecture was kindly prepared by one of our lady members, to whom the Editor begs to tender his thanks. J.F.

REPORT OF THE BOTANICAL SECTION, 1891

(Read Jan. 28th, 1892.)

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

GENTLEMEN,—The leaders in botany have pleasure in reporting that there has been continued activity in this branch during the past season. Some additional plants have been added to the local list, new localities discovered for rare species previously recorded, and interesting observations made in growing native plants from seed. In this connection the leaders would draw attention to the work now being carried on at the botanic garden on the Central Experimental Farm, where a large number of native plants have been grown from seed from various parts of the Dominion, and which are always available for study by visitors and students. A magnificent collection of seeds of prairie flowers has during the past season been presented to the botanist in charge by Mr. T. N. Willing, of Calgary, N.W.T., a member of the club. Some of these have been sown, and many others are ready for planting in the spring. All members are invited to assist with seeds and roots of rare plants. The importance of studying plants in a growing condition cannot be too strongly urged. Of particular interest to botanists are several plants, the seeds of which have been presented by Prof. Macoun, concerning which there was some doubt as to specific identity, or for the observation of other points of scientific interest. As an instance of the value of this work mention may be made of an investigation made by Mr. J. M. Macoun last spring, by which it was found that the *Camassia*, abundant around Victoria, in Vancouver Island, is not, as was supposed, *Camassia esculenta* but *C. Leichtlinii*, a fact which had previously been suggested by Prof. Macoun. The true *C. esculenta* was collected by Mr. Macoun near Sproat's Landing, and grows in low land quite close to the river, growing, in fact, in the early part of the season when discovered, in the water by the riverside. *C. Leichtlinii* has larger and darker purple flowers, with the lowest segment of the perianth conspicuously deflexed. A collection of great interest to the botanical student is the large collection of native and foreign grasses—about 150 different species—which are being cultivated at the Experimental Farm.

Sub-excursions by members of the branch to localities at some distance from the city have been made during the past season: to High Falls, on the Lièvre; to Templeton and Buckingham down the Ottawa River; to Casselman, on the Castor River; to the Chats Rapids, to be specially reported upon by Mr. R. B. Whyte, and also, as well, to less distant points. At High Falls *Epigwa repens*, the May-flower, sometimes miscalled the Trailing Arbutus, was found in magnificent profusion, and large bunches of the exquisite flowers were brought back to the city. The lovely *Calypto borealis*, a deliciously-scented but very rare orchid, was also obtained there in unusual abundance by Mr. R. B. Whyte. At Templeton Mr. W. Scott found *Spiranthes Romanzoffiana* in profusion in a hay field close to the East Templeton wharf, and between the wharf and the lighthouse keeper's house; also *Thalictrum purpurascens*. Casselman, and Moose Creek a few miles beyond that place, have again this year provided rich treasures for those who went to seek them. *Cardamine rhomboidea*, the tall erect form, with stiff and almost sessile leaves, only previously recorded from Hull, was there found in great abundance. A violet taken to be *Viola rotundifolia*, was found at Moose Creek. Perhaps the most interesting find of the year was *Fierkea proserpinacoides*, found by Prof. Macoun at Casselman early in the season. A trip to Buckingham by Prof. Macoun and Mr. Scott in October gave new localities for *Potamogeton Robinsii*, and what also is very rare here, *Polygonum dumetorum* var. *scandens*. On the mountain at the back of Old Chelsea *Carex Hitchcockiana* and *Aspidium Braunii* were discovered, while on the slope of the mountain running up from the north shore of Kingsmere, *Carex Houghtonii* was collected. This is the only locality yet found near Ottawa, and it is very rare here. Nearer home some other interesting discoveries were made. Prof. Macoun collected *Eleocharis intermedia* near Leamy's Lake, and Mr. J. M. Macoun at Hull found *Viola rostrata*, the rarest of all our violets in this locality. It has only once previously been collected here, when two plants were found growing in the Governor-General's Bay at New Edinburgh. Mr. Scott found undoubted specimens of *Ranunculus circinatus*, the stiff water crow-foot, in Patterson's Creek. *Claytonia Virginica* frequently sought for unsuccessfully in this locality, was last spring found in abundance in the woods

running from Billings Bridge to Dow's Swamp by both Mr. Fletcher and Mr. J. M. Macoun. In a field near the same place Mr. Fletcher also found this season large numbers of plants of the yellow-flowered form of *Verbascum Blattaria*, the Moth Mullein. This field he had passed through several times the previous year at the same season, but did not observe a specimen. Mr. R. H. Cowley also found a similar occurrence near Skead's Mills on the Ottawa River. Mr. Scott found several fine specimens of *Goodyera pubescens*, the Rattlesnake Plantain, at Ironsides, and in Dow's Swamp *Cypripedium arietinum* and *Microstylis monophyllos*, two of our rarest orchids. Mr. Fletcher collected at Rockcliffe true and very characteristic specimens of the Glaucous Meadow Grass, *Poa caesia*. This resembles somewhat *Poa compressa*, the Canada Blue Grass, but the whole plant is covered with a bluish white and conspicuous bloom, and the stems are round instead of flattened. The following introduced plants have been collected in the neighbourhood of the city by Mr. W. Scott :

Sisymbrium Sophia. A fine plant of this very distinct crucifer was found on made ground near the artificial lake on Major's Hill Park.

Sisymbrium Alliaria. A colony of this European plant has established itself and spread considerably during the last few years in Beechwood.

North-West Prairie Flowers. An interesting instance of western plants having become well established is found near Capt. Cowley's house at Skead's Mills, on the banks of the Ottawa, where the following plants were found by Mr. R. H. Cowley :

Grindelia squarrosa, in large numbers, extending for about an acre in all directions from a deserted house.

Lepachys columnaris, a handsome composite of a distinctly western type, in almost as great abundance as the above.

Erysimum parviflorum. Several specimens were collected by Mr. Scott on the Canadian Pacific Railway bank near the Union station and submitted to Prof. Macoun.

Conium maculatum.—To the north of Beechwood Cemetery and between it and the lake hundreds of specimens of this intensely poisonous plant were found growing in great luxuriance. This is the true Poison Hemlock, and it would be well for all members of the Club to

make themselves familiar with its appearance, so as to avoid it themselves and warn others against its poisonous properties.

Mr. R. H. Cowley discovered new localities for the Walking Fern (*Camptosorus rhizophyllus*) and the Maiden hair Spleenwort (*Asplenium Trichomanes*). These were growing together on rocks to the west of the Beaver Meadow at Hull.

It will be noticed that no less than fifteen new plants have been added to the *Flora Ottawaensis* during the past season, and these were all found in localities which had been previously worked over. There are still several plants which should occur in this district, but which so far have not been discovered. The leaders would suggest the advisability of a special systematic search being made for these one by one in the most likely places.

A curious case of poisoning in the city of Hull, Province of Quebec, was traced up by the leaders to the rare introduced plant *Datura Tatula* or Purple-flowered Thorn-apple. This plant is of rare occurrence here; but when once introduced seems to be able to live and spread. This was the case in the streets of Stewarton some years ago. Specimens kindly procured for the leaders by a gentleman connected with the Ottawa DAILY CITIZEN were distinctly recognizable as this species by their purple stems. *Datura Stramonium* is not uncommon in waste places about the city, but *D. Tatula* is rare. There appears to have been a large patch growing on a piece of waste land in the city of Hull, and some five or six children ate the seeds, and all of them were made extremely ill, so that it was feared for some days that all would die. Ultimately, however, all recovered. The curious part of this case is that anyone, even children, should eat the seeds of this uninviting plant. Not only are the pods covered with sharp spines; but the whole plant has a most nauseous and sickening odour.

JAMES FLETCHER,	} LEADERS.
WILLIAM SCOTT,	
R. H. COWLEY.	

FLORA OTTAWAENSIS.

ADDITIONS MADE SINCE LAST REPORT.

Ranunculus circinatus, Sibth.	Patterson's Creek,	W. Scott.
<i>Erysimum parviflorum</i> , Nutt.	Chaudiere,	"
<i>Sisymbrium Alliaria</i> Scop.	Beechwood,	"
<i>Sisymbrium Sophia</i> , L.,	Major's Hill,	"
<i>Viola blanda</i> , var. <i>palustriformis</i> , Gr.		J. M. Macoun.
<i>Viola rotundifolia</i> , Mx.,	Moose Creek,	John Macoun.
<i>Flörkea proserpinacoides</i> , Willd.,	Casselmann,	John Macoun.
<i>Claytonia Virginica</i> , L.,	Dow's Swamp,	J. Fletcher.
<i>Potentilla fruticosa</i> , L.,	Chats Island,	{ R. B. Whyte. R. H. Cowley.
<i>Aster ptarmicoides</i> , T. & G.,	Chats Island,	"
<i>Helianthus divaricatus</i> , L.,	"	"
<i>Prenanthes racemosa</i> , Mx.,	"	"
<i>Pycnanthemum lanceolatum</i> , Pursh,	Clats Island,	"
<i>Poa cæsia</i> , Smith,	Rockcliffe,	J. Fletcher.
<i>Aspidium aculeatum</i> , Swartz <i>var.</i> <i>Braunii</i> , Koch., Chelsea		"

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CANADIAN LAND AND FRESH WATER MOLLUSCA.

A very complete list of the shells of the Ottawa valley was published in the OTTAWA NATURALIST, Vol. IV, p. 52. A list of the land shells of Vancouver Island was also published in this periodical (Vol. III, p. 84 et seq.) and I have in MSS. a list of the fresh water shells of the same district.

If we add together the numbers of the species named in the above papers we have a total of about 160 species of Canadian mollusca.

There are a number of species, however, occurring in Canada which do not find a place in either the Ottawa or Vancouver Island lists—probably some 40 or 50 kinds—and I am trying to compile for publication a catalogue that will include all these.

I have already in hand a good deal of material for such a compilation; for instance, Mr. Whiteaves's early papers; a capital list of Ham-

ilton shells by Mr. A. W. Hanham; several smaller lists in the Reports of the Geological and Natural History Survey; a list of Manitoba shells by Mr. Christy; and a most interesting little collection of specimens from near Winnipeg received from Mr. N. H. Cowdry through the kindness of Mr. James Fletcher.

Much, however, remains to be done before a complete check list can be prepared, and I am writing this note in the hope that the members of the Ottawa Field-Naturalists' Club, who are scattered through the length and breadth of the Dominion, will co-operate with me.

I should like observers in different parts of Canada to send me, not names merely, but actual specimens of all the species they can find, no matter how common, and in return I will name the specimens sent, as far as I can, for those who are not able to do this for themselves, and will also try to reciprocate by sending Western specimens, if so desired.

If the members of the Club will help me in this way during the coming summer, I think that in the autumn, all being well, I can publish a tolerably complete catalogue of our Canadian mollusca.

GEO. W. TAYLOR,

Victoria, B.C.

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MICROSCOPICAL SOIREE.

On Thursday, the 18th February, a very successful microscopical soiree was held in the Normal School, for the students of which it was in a large measure arranged, in acknowledgment of the courtesy shown to the club by Principal MacCabe. A large number of the students availed themselves of the invitation to attend, and with the members present completely filled the lecture room. By request of the committee brief elementary papers were prepared by the following members in explanation of the preparations exhibited:—

Mr. Harrington—Entomology.

Mr. Ferrier—Petrography.

Mr. Shutt—Forms of Animal and Plant Life in Swamp water.

Mr. Lehmann—Parasitic fungi.

At the close of each paper an interval of fifteen minutes was allotted to the examination of specimens illustrative of the subject introduced. Messrs. Whiteaves, Weston, Ferrier, Ami, Craig, Shutt,

Lehmann, Odell, Whitley, Tyrrell, McConnell and Fletcher supplied and arranged the microscopes and slides, and explained to the observers the objects exhibited. The Club is much indebted to these members for the assistance given, and the Council tenders them its sincere thanks.

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THE MICROSCOPE IN ENTOMOLOGY.

BY W. HAGUE HARRINGTON.

(*Read at Microscopical Soiree, 18th February, 1892*)

To the student of Entomology a good microscope and the knowledge of its use are indispensable when he desires thoroughly to decipher the characters upon which are based the determination and classification of his specimens. Many insects are so small that the naked eye can scarcely determine even the order to which they belong, and even the large species are separated frequently by the formation of the mouth parts, or other structures which require to be much magnified before they can be satisfactorily distinguished. The microscopist, therefore, can always, in the extensive field of Entomology, find ample scope for the useful employment of his valued instrument, and can always obtain abundant interesting slides for his cabinets. Hundreds of the smaller species can advantageously be mounted whole, and will make very fine slides. Especially suitable for this treatment are the minute parasitic hymenoptera, many of the smaller diptera, the plant-lice and scale-insects among hemiptera, various families of minute coléptera, etc. All the orders will, in the earlier stages of the egg and the larva, furnish unlimited supplies of curious, beautiful and instructive mounts.

Of special organs or structures which may form worthy objects of examination, there is a wonderful variety, a portion of which only can be now indicated. Each insect, as you are aware, is composed of three distinct regions—the head, the thorax and the abdomen—although in some species these may be so modified and consolidated as not to be readily apparent. The insect also bears externally certain appendages, and is furnished with an elaborate apparatus for digestion, sensation, respiration, motion and generation.

The head varies endlessly in size and shape, and the mouth-parts are correspondingly diversified. In some orders they consist of mandibles and maxillæ, which work transversely between the labrum and labium, and there are also attachments known as maxillary and labial-palpi. Several of these parts are again subdivided, and in all there are nearly a score of parts, each with its distinguishing name, to be studied in connection with the mouth alone. Then there occur many modifications of these organs, in which certain parts are so altered that the entire form of the mouth is changed. Then the lepidoptera, diptera and hemiptera have the mouth-parts transformed into a rostrum or proboscis which serves to suck the nectar from flowers, or the vital juices from plants and animals. The head also bears the eyes, which consist generally of two large aggregations of facets, often to the number of several thousands, besides which the majority of insects have two or three simple eyes, or ocelli. The antennæ, also placed upon the head are movable sense organs which perform very important functions, and which vary in form. They are composed of small rings or segments the number of which varies in the different groups, and averages perhaps ten or twelve. In the simpler forms of antennæ these joints are merely short cylinders placed end to end, but in numerous families one or more of these joints may be enlarged or modified so much, that the antenna becomes very different in appearance, and many terms are employed to indicate the modifications, such as serrate, flabellate, pectinate, clavate, lamellate, etc.

The thorax is formed of a number of plates, more or less solidified and united, and bears the organs of locomotion, usually three pairs of legs and two pairs of wings. The legs consist of several segments, ending usually in a pair of small claws, and may be variously armed or ornamented with spines and hairs. The wings are formed of two thin transparent membranes stiffened by an interposed net work, more or less complicated, of nervures or veins, and upon this venation of the wings is based the classification of many groups. In beetles one pair of wings is modified and hardened to form protecting sheaths for the hinder pair, and a somewhat similar, but partial, thickening is observed in grasshoppers and bugs. Butterflies and moths have the wings greatly developed and covered with scales and pubescence, which are so

coloured as frequently to make these insects marvellously beautiful.

The abdomen is composed of several ring-like segments, but in common with the other regions of the body, is often greatly changed, and has the segments welded together or atrophied. From the tip of the female abdomen frequently projects the ovipositor, which is most conspicuous in some hymenoptera, and which is modified in many interesting directions. The male abdomen in a large number of insects differs in shape from that of the female, and the sexual organs are more or less conspicuously developed.

In addition to the structures which have been so briefly indicated, there is often much of interest in the sculpture or vestment of the body. Some insects are smooth and highly polished, deriving their beauty from brilliant metallic or other colours of the body wall ; others depend for their adornment on dense coverings of pubescence or scales, which, as in the case of those which beautify the butterfly, make exquisite objects for microscopical examination.

The internal anatomy of insects is no less a favourite study for those who desire to see the mechanism which enables each of these tiny creatures to fulfil its destiny in this world. For anatomical study with the microscope insects are peculiarly well adapted, as they can always be obtained, are easy to kill and handle, and have elaborate muscular, nervous and digestive systems.

A BIOLOGICAL STATION IN JAMAICA.

A letter has been received from the Hon. Adam Brown, Dominion Commissioner at the late Jamaica Exhibition, enclosing a copy of the following letter from Lady Blake, which will be read with much interest by the readers of the OTTAWA NATURALIST. The Marine Biological Station at Naples, now under the able direction of its founder, Dr. Dohrn, is the most important in the world, and students attend the course of study from all parts of Europe and America. The following is from *Science* of Sept. 18th, 1891, and will show how highly the work of these stations is valued :

“At present, as we learn from a statement recently made by Professor Sclater in *Nature*, the zoological station at Naples rents continuously about twenty tables, each at \$500 a year. These tables are rented to different States and universities of Europe, as follows : Prussia, 4 ; Baden, 1 ; Bavaria, 1 ; Saxony, 1 ; Hesse, 1 ; Wurtemberg, 1 ; Italy, 7 ; Switzerland, 1 ; Hungary, 1 ; Holland, 1 ; University of Cambridge (England), 1 ; British Association, 1. Besides these twenty-one regular rents, a number of others, varying from eight to sixteen, are made every year to some or all of the following governments : Russia, Belgium, Austria, Spain, and some Italian provincial governments. The average number disposed of in this way is estimated at ten, making the total number thirty-one. The annual income from the tables would thus amount to about \$15,000 a year. The revenue from the sale of preserved specimens amounts to about \$3,500, while the receipts from the admission of visitors to the aquarium amounts to about \$5,000. The whole income is thus approximately \$24,000. But the annual expenditure of the station has now reached \$32,000, so that there is a deficit of from \$8,000 to \$10,000 to meet. This heavy deficit is met every year by a subsidy from the German government.

‘This is a good example,’ says Professor Sclater, ‘of the liberal way in which science is encouraged and supported in the “Fatherland,” and is the more noteworthy because the object of its well-bestowed bounty in this instance is localized on foreign soil.’

Indeed, this is a splendid example of the high appreciation in which pure scientific research is held by an enlightened government—an example which we should be glad to see followed in this country.”

Lady Blake's letter is as follows :—

KING'S HOUSE, JAMAICA, 1st Feb., 1892.

Dear Mr. Brown,—

My husband and I are at present much interested in a scheme on behalf of which I am anxious to enlist your energetic assistance. It is proposed to establish here a Marine Biological Station, on the lines of the Stations at Plymouth and Naples. The Station is to be founded as a Memorial of the fourth Centenary of the discovery of the New World, and to be named "The Columbus Marine Biological Station." In England the scheme is supported by Professor Huxley, Professor Ray Lankester, M. A., Professor Flower, Gunther, (British Museum) Dr. Ball, F. R. S., and many other eminent scientific men. The Hon. Walter Rothschild has undertaken to act as Honorary Secretary; Messrs. Coutts & Co. to be Bankers and the Editor of the "*Times*" has promised a prominent position to correspondence on the subject. We have also promises of support from many leading scientific men in America and are most anxious to secure the assistance and countenance of leading men in Canada. We shall be so much obliged if you will do anything in your power to push the scheme there. We are anxious that the Institution should be as international as possible in its scope, and it would be a great matter to have a meeting place in common for scientific students from the old and new worlds. Jamaica is within easy reach of both, and appears to offer every advantage for the proposed institution. Your advocacy of the plan in Canada would be of great value. Please let me know if you think we may hope for any assistance from there.

Believe me,

Yours truly,

EDITH BLAKE.

Adam Brown, Esq.,

Hamilton, Canada.

The value of such a station is undoubted and the Island of Jamaica is particularly suitable for its location. The accessibility and convenience of this station for American students would assure its

being appreciated and made use of by the large number of specialists in the United States.

His Excellency the Governor of Jamaica, Sir Henry A. Blake, and Lady Blake, have received so many promises of help from eminent Biologists in Britain and elsewhere that they are sanguine as to the feasibility and great value of such a station, which is to be international in its objects. The Hon. Adam Brown with his characteristic energy in patronizing and helping measures tending towards scientific advancement is corresponding with the leading students in Canada asking for their co-operation in forwarding this important project which has our fullest sympathy.

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BOOK NOTICES.

THE MONTH is the title of a neat little monthly magazine which has been sent to us by the editor, Rev. A. Dontenville, O.M.I., who is now living in New Westminster and is presiding over St. Louis College. The *Month* is an attractive little magazine, well printed and well edited, and we feel sure will be well patronized. Father Dontenville who was a frequent attendant at our botanical and entomological lectures when in Ottawa, is well known to many of our members; and we wish him every happiness and success in his new home and hope to see in the pages of the *Month* some papers upon the natural history subjects which he made so attractive to his students when teaching at the Ottawa University.

ENTOMOLOGICAL SOCIETY OF ONTARIO.—Twenty-second annual report. The last annual report of this flourishing and useful society has just come to hand. It is one of the most valuable from the standpoint of the agriculturalist and fruit-grower which the society has ever issued.

The annual address of the president, the Rev. Dr. Bethune of Port Hope is full of useful information. Notice is first taken of the various injurious insects which have been most troublesome throughout the Province during the year and the best remedies are suggested for each in turn. The reports of the London sections and the Montreal branch show that the work is being pushed vigorously and that good results are being obtained. A subject which is being studied by the ornithological

section is the food-habits of wild birds. In the present report is given a list of birds known to breed in Middlesex County, Ont., and a classification is made under the heads: *A, Beneficial; B, Neutral or nearly so; C, Open to doubt as possibly injurious.* Of these three classes there are *A 78, B 12, C 7.* Interesting papers read at the annual meeting by Messrs. H. H. Lyman, Rev. T. W. Fyles, G. Geddes, J. A. Moffat and J. Fletcher are printed as well as a most entertaining article by Mr. W. H. Harrington entitled "Notes on Japanese Insects." This paper forms with the paper already published in our February number a very complete record of Mr. Harrington's trip to Japan. The proceedings, together with the papers read, at the meeting of the Association of Economic Entomologists held last August at Washington under the presidency of Mr. J. Fletcher of this Club are printed in full, from *Insect Life.* These proceedings are of great value and were excellently reported by the secretary Mr. L. O. Howard, the assistant United States Entomologist. They contain concise papers by some of the most eminent Entomologists in America.

This report is made to the Ontario Government, and besides being issued to the members of the Entomological Society will also be sent to members of the Fruit-Growers' Association.

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THE ANNUAL MEETING.

Members are reminded that the annual meeting will be held on the afternoon of the third Tuesday in ~~March~~ (the 16th inst.) It will be held in the Normal School lecture room at 4.15 p.m. The importance of every member attending the annual meeting is manifest. The officers for the ensuing year are then elected, and arrangements made for carrying on the work we have undertaken in the most satisfactory manner. Unexpected matters of interest always turn up at the annual meetings, and the Council is particularly anxious that every member should consider that he has a voice in directing the management of the Club.

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