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Studies in the Geology of the Vicinity of Montreal which might be undertaken by Members of the Natural History Society.

By Prof. Frank D. Adams, Ph.D.

Although much has been done towards working out the geology of the vicinity of Montreal, still more remains to be done before our knowledge of the subject is at all complete. The geological relations, which are in the main simple, nevertheless present such a mass of detail that much time and patient work on the part of many observers will be required before we shall understand fully the structure and the past history of our Island.

Much of this work is of such a character that it can be easily carried out by members of the Natural History Society, and it is in the hope of enlisting some of our members in the work that it is proposed in the present paper to point out very briefly some of the chief lines of investigation which present themselves.

The district about the city is underlain chiefly by nearly horizontal strata of Lower Silurian age. These in many places where they are well exposed, contain an abundance

of fossil remains; in fact the limestone strata are entirely of organic origin. Each of the several formations presents its special fauna, composed of creatures all of which have been long extinct, and which are therefore, for the most part very different from the forms of life now inhabiting our globe. Before a thorough knowledge of each of these several faunas can be obtained and their relations to one another satisfactorily established, large collections of fossils must be made from the several formations, so that we may have as nearly as possible all the forms which are present in these successive oceanic deposits. For these purposes complete collections should be made of all the fossils to be found in the various quarries about the city, as, for instance, the Mile End quarries, and those at Pointe Claire and St. Martin's Junction. In this connection the small occurrences of limestone at the water edge on the south side of St. Helen's Island are of especial interest, as being very much more recent than any of the other limestones in this part of the Province, and a thorough knowledge of these fossils is for this and for many other reasons of the greatest interest.

The principal fossils occurring in the quarries about the city are figured and described in the Geology of Canada, published by the Geological Survey of Canada in 1863, a copy of which is to be found in the library of the Society, while lists of the fossils found up to the present time in St. Helen's Island rocks are given by Mr. Donald and Dr. Deeks in two papers which have already appeared in the CANADIAN RECORD OF SCIENCE.

For those members of the Society particularly interested in the ancient volcanic phenomena displayed in the vicinity of Montreal, Mount Royal affords abundant opportunity for work and study. The "Mountain," as is well known, is the root or remnant of an old volcano, wasted and worn down through successive long geological ages, by the continuous action of rain, frost and the other

agents of decay. The piles of volcanic ashes, the crater, the lava streams and other superficial features have long since disappeared; only the hard basal portion of the mountain has survived; even now it is year by year falling to pieces, as can be seen at the foot of all the steep slopes on the mountain side, notably that opposite the head of McTavish Street.

There were, speaking generally, three stages in the history of the activity of the mountain, marked by the outpouring of three different classes of rock. Each of these can still be recognized and studied, and much remains to be learned concerning them. At the first eruption a dark-coloured basic rock was poured out, represented by the main body of Mount Royal, as seen in all the cuttings on the upper part of the mountain and in the cemeteries. This is a rock found in but few other places in the world, and known as Theralite or Essexite. On looking at a fresh fracture it is seen to be composed of constituents, some of which are colourless and some of which are black. The colourless ones are feldspar and nepheline, the black ones pyroxene and hornblende. The relative proportion of these minerals varies from place to place, in that part of the mountain occupied by this rock, the rock being in some places dull gray in colour, but in others black. It often shows a distinct flow structure which it acquired when moving up through the throat of the volcano while still in a semi-fluid condition.

After the rock of this first eruption had cooled, becoming hard and solid, it was rent asunder and shattered, undoubtedly with the accompaniment of violent earthquakes. On a line which runs along the back of the mountain and up through this shattered zone there came a second eruption, of rock of a different character. This is much lighter in colour, a pale gray, and is seen excellently exposed in the great quarry worked by the Corporation for road material at the back of the mountain at

Outremont. This rock is a nepheline syenite, and contains so much nepheline that if a little of it be finely powdered and boiled with acid for a few minutes it will pass into a mass of thick jelly.

The final outburst of volcanic energy on the part of Mount Royal is represented by the swarm of narrow dykes or walls of igneous rock which cut not only through the limestones of the region but also through the rocks of both of the former eruptions just referred to. These, although erupted during the final stage, are not all absolutely identical in age; in fact, in the excavation made for the reservoir on Peel Street some seven distinct sets of dykes, each cutting across, and therefore more recent than the previous ones, could be seen. These dykes are composed of a variety of rocks; all of them are very rare and found in but few other places in the world.

Now, although detailed study of these rocks requires some special knowledge of the methods of modern petrography, no study of the region can be made until the necessary materials for it have been collected. The collection of such materials, in itself an occupation by no means devoid of interest, might easily be undertaken by members of the Society, and the collections, if carefully labelled and deposited in the Society's Museum, would always be available for detailed study. Such a detailed study is now being undertaken by Dr. Harrington and the writer, who would be glad to examine and describe any carefully collected material.

It is from the dykes of the third eruption that collections of the greatest value can be made, especially where these are exposed from time to time in cuttings and excavations which are subsequently filled in again, and the exposures thus rendered inaccessible. In collecting specimens from such dykes, the width of the dyke, measured across it, that is, at right angles to its dip, if it be not vertical, should be noted, as also the direction in which

the dyke runs across the surface, and its relative age as compared with the dykes which it cuts, which age may be ascertained by examining the intersection of the two dykes and noticing which is broken across and cut through by the other. Collections from a series of dykes of different ages which cut one another, if accompanied by a note as to which each cuts and is cut by will always be of great value.

Mount Royal itself offers a most excellent opportunity for the detailed study of one of the great problems of modern geology—that of the mutual relation of igneous magmas in volcanic centres, and the collecting of material for study as above outlined would be a real contribution toward the solution of the problem.

Again, for those members of the Society whose interest lies more particularly in the domain of mineralogy, there is a field of especial interest in the Corporation quarry, above mentioned, at Outremont. Here in the cracks and crevasses of the nepheline syenite and the limestone near its contact with the igneous rock, a number of very rare and strange minerals have been found, and a careful search would probably be well repaid by the discovery of additional specimens, and possibly of entirely new species.

Another series of very interesting geological problems and studies are presented by the "Drift" which mantles the surface of the Island and constitutes its soil. This is the most recent of our geological deposits, and is well exposed in almost every excavation made in and about the city. It has been well described by Sir William Dawson in his book entitled "The Canadian Ice Age," but fresh information is continually to be obtained from new openings. Such new openings should in every case be studied, the order of succession of the various strata noted, and their respective thickness recorded. In this way information may often be obtained which later on it would be impossible to procure.

These drift deposits are, moreover, often highly fossiliferous, a great many species, especially of sea shells, occurring in them. Such occurrences are of the greatest importance, and should always be noted, the precise locality and, if possible, the height above sea-level or the relative height as compared with some fixed point, as, for instance, the McGill College Observatory, being ascertained. The presence of boulders of any peculiar, rare or striking variety of rock, at any point, is also worthy of attention, as it is often possible by means of these to determine the local direction of the ice flow during glacial time.

All information concerning the deep artesian borings put down from time to time in and about the city is of the greatest value, and should be communicated to the Society. Samples of the borings from various depths should always be secured if possible, and carefully preserved.

And, finally, the study of the influence of the geological structure of the vicinity upon the topography of the city and upon its history and development will be found to be of the greatest interest. The very location of the city, the courses of its streets and the distribution of its population will be found to have been directly influenced by geological causes, which often date back almost to the beginning of geological time.

It will thus be seen that the members of our Society have presented to them a host of geological problems, to the solution of which they may make contributions of permanent value.

Phenological Observations in Canada.

By A. H. MacKay, LL.D., F.R.S.C.

In 1890, Section IV of the Royal Society of Canada passed the following resolution:

"That the various Natural History and Scientific Societies affiliated with the Royal Society be requested by it to obtain accurate records in their individual localities of meteorological phenomena, dates of the first appearance of birds, of the leafing and flowering of certain plants, and of any events of scientific interest for collation and publication in the Transactions of the Society."

Schedules for the recording of such observations were sent to the said societies, but local observers did not become interested to any considerable extent. In 1891 the Botanical Club of Canada was organized by the said Section of the Royal Society, and one of the departments of botanical work undertaken by the Club was the stimulation of these phenological observations.

In 1892 nine observers in Nova Scotia sent in reports; one from Yarmouth County, one from Lunenburg County, one from Hants County, four from King's County, and two from Cumberland County.

In 1893 there were thirteen reports sent in; ten from Nova Scotia, and three from New Brunswick.

In 1894 there were seventeen reports; eleven from Nova Scotia, one from Prince Edward Island, four from New Brunswick, and one from Manitoba.

In 1895 there were twenty-five reports; ten from Nova Scotia, one from Prince Edward Island, six from New Brunswick, three from Ontario, two from Manitoba, one from Assiniboia, one from Alberta, and one from British Columbia.

In 1896 there were nineteen reports; eleven from Nova Scotia, one from Prince Edward Island, two from New

Brunswick, two from Ontario, one from Manitoba, one from Assiniboia, and one from British Columbia.

In 1897 there were fifteen reports; seven from Nova Scotia, one from Prince Edward Island, two from Ontario, two from Manitoba, one from Assiniboia, and two from British Columbia.

By this time the idea was extensively taken up in the public Schools of the province of Nova Scotia, the pupils of a whole school section or district being the observers, under the direction and criticism of the teacher. The observations were a part of the prescribed "Nature Studies" in all schools, although the recording of them in the Phenological Records of the locality and the sending of a duplicate of the observations to the Inspector to be transmitted to the Education Office, were entirely voluntary. While the schedule of the Botanical Club had a list of about sixty objects for the observation of their first occurrence each season, the schedule of the public schools had over one hundred objects on its list, with instructions and a column for the observation of (1) the first occurrence and (2) when each began to be common. Over two hundred fairly well filled schedules were sent in from as many localities throughout the province.

In 1898, members of the Botanical Club sent in thirteen reports on the new schedule; eight from Nova Scotia, one from Prince Edward Island, one from Ontario, one from Assiniboia, one from Alberta, and one from British Columbia. But over seven hundred were sent in from as many school sections throughout the province of Nova Scotia, fairly distributed over every county.

I quote the following from the directions and cautions printed on the back of the schedule for recording these "Local Nature Observations" to illustrate the conditions under which the work is done:

"This sheet is provided for the purpose of aiding teachers to interest their pupils in observing the times of the

regular procession of natural phenomena each season. First, it may help the teacher in doing some of the 'Nature' lesson work in the Course of Study: secondly, it may aid in procuring valuable information for the locality and province. Two copies are provided for each teacher who wishes to conduct such observations, *one* to be attached to the school register, so as to be preserved as the property of the section for reference from year to year: the *other* to be sent in with the Return to the Inspector, who will transmit it to the Superintendent for examination, and compilation if desirable.

"What is desired is to have recorded in these forms, the dates of the *first* leafing, flowering and fruiting of plants and trees; the *first* appearance in the locality of birds migrating north in spring or south in autumn, etc. While the objects specified here are given so as to enable comparison to be made between the different sections of the province, it is very desirable that all other local phenomena of a similar kind be recorded. Each locality has a *flora, fauna, climate,* etc., more or less distinctly its own; and the more common trees, shrubs, plants, crops, etc., are those which will be most valuable from a local point of view in comparing the characters of a series of seasons.

"Teachers will find it one of the most convenient means for the stimulation of pupils in observing all natural phenomena when going *to* and *from* the school, some of the pupils radiating as far as two miles from the school room. The 'nature study' under these conditions would be mainly undertaken at the most convenient time, thus not encroaching on school time; while on the other hand it will tend to break up the monotony of school travel, fill an idle and wearisome hour with interest, and be one of the most valuable forms of educational discipline. The eyes of a whole school daily passing over a whole school district would let very little escape notice, especially if the first observer of each annually recurring phenomenon

would receive credit as the first observer of it for the year. The observations will be accurate, as the facts will have to be demonstrated by the most undoubted evidence, such as the bringing of the specimens to the school when possible or necessary.

"To all observers the following most important, most essential principles of recording are emphasized: Better *no date*, NO RECORD, than a WRONG ONE or a DOUBTFUL one. Sports out of season, due to very local conditions not common to at least a small field, should not be recorded except parenthetically. The date to be recorded for the purposes of compilation with those of other localities should be the *first* of the *many* of its kind following immediately after, etc. For instance, a butterfly emerging from its chrysalis in a sheltered cranny by a southern window in January would not be an indication of the general climate, but of the peculiarly heated nook in which the chrysalis was sheltered; nor would a flower in a semi-artificial, warm shelter, give the date required. When these sports out of season occur, they might also be recorded, but within a parenthesis to indicate the peculiarity of some of the conditions affecting their early appearance."

The tendency to error is quite observable in a study of the whole of these schedules. The most serious is characteristic of the solitary observer who goes out for his walk of observation perhaps not more than once or twice a week. His plants appear to flower by weekly or semi-weekly spurts; and if certain plants are rare in his locality he may not see them in bloom until, may be, more than a week after they have been in full flower. In the school observations this tendency to error is entirely eliminated, for numbers of individuals are daily wandering to and from school every day with their eyes open for everything, especially when the discoverer of each new phenomenon for the season wins a credit of some kind before the whole school.

Again, the tyro botanist is at a disadvantage, for he does not know where to look for the rarer species, and when he accidentally comes across them they may have been in flower for some time. It is very likely that the average dates of the flowering of plants in Nova Scotia in the various counties may be slightly affected by this source of error, the counties having the oldest and most enthusiastic botanists appearing to be earlier in season. This may account for the unexpectedly advanced position of Pictou county in the table following.

Then there is the accident of local land inclination or shelter, for the warm intervals on the southern slope of the hill is earlier than the northern slope. To estimate these local effects, the schedules from each county in Nova Scotia from this year forward are to be classified into localities: (1) on the coast, (2) low inlands, and (3) highlands.

And lastly, some individual plants are naturally earlier than others even when in similar localities, and in the same individual certain twigs and branches are earlier than others. To check such peculiarities an attempt is made to fix the date when the flowering of each species may be said to be "becoming common." So that we have the two series of observations for each individual, the "first appearance" and the "becoming common."

So much for the history of the work and the general lines upon which it is being conducted.

Assuming the observers to be symmetrically placed in a country, to be competent and careful, and to put exactly the same interpretation on what constitutes the "first appearance" and "when becoming common," the averaging of the various observations would give us phenological norms for the comparison of a very important character of the country with that of another, and more especially for the comparison of one season with another in the same country, which after a series of years would contribute to

the solution of the problem of the secular variation of climate.

In order to deal mathematically with phenological dates, averages or means, it is necessary to indicate dates and average or mean dates in terms of the day of the year instead of the days of the month. For the conversion and reconversion of such dates, all that is necessary to make it convenient, is to have before the eye a list of the months of the year with the number of the day of the year corresponding to the last day of each month, thus:

DAY OF THE YEAR CORRESPONDING TO THE LAST DAY OF EACH MONTH.

January	31	July	212
February	59	August	243
March	90	September	273
April	120	October	304
May	151	November	334
June	181	December	356

For leap years each number except that for January would be simply increased by a unit. The 24th of May would be simply converted to the annual date by adding 24 to the last day of April, thus: $120+24=144$. The 165th day of the year would be found by subtracting the next smallest number in the table from the date, thus: $165-151$ (May) $=14$ (June).

Now, we may consider a phenological date to be a sort of mathematical function of variables, several of which are already being very systematically and accurately observed and recorded by the meteorological departments of most countries, such as the variations of temperature, of atmospheric pressure, sunshine, precipitation. Then there are local constants, such as latitude, elevation, slope, proximity of bodies of water, and character of the soil. All of these influences affect the phenological date, and conversely the date may be considered as a summation or integration of all these and other more or less unknown elements. We find that in the month of April the season is advancing

more rapidly this year than last year, while in May or a portion of May it may be advancing less rapidly according to the varying balance of the meteorological conditions affecting the organisms. Averages of the dates of early flowering plants, for instance, during one season might be compared with those of another season. Averages of a normally later series of flowers might be similarly treated. But to compare one spring with another spring, a series of typical flowers normally flowering in succession from the earliest date to the latest might be taken. Such an average or mean for comparison we might for convenience call a phenological norm or phenochron (a phenological *time* ordinate). Phenochrons for comparison or for the plotting of phenological curves should be based on the same number of observations taken at the same stations under similar conditions, and if they are to correctly represent any district of considerable extent, the stations should be symmetrically distributed. The following table, compiled from the observations taken by members of the Botanical Club, is defective in two respects, although we should grant that the observations individually taken were all correctly made on exactly the same lines. Twenty objects most generally observed were selected from the schedules, and we have a series of seven years, from 1892 to 1898. But the average dates for 1892 were based on observations made at nine stations, none of which were in the eastern half of the province or towards the extreme north. In later years there was a less number of southern and a greater number of northern stations. This illustrates the defect of the asymmetry of the distribution of stations. Again, while in 1892, for instance, the whole nine stations made observations on all or many of these 20 phenomena, there were many other phenomena observed at only a few stations. This defect is practically one of asymmetry also, for as the observation of the migration of birds was omitted in the most northern station this year, the average

dates of these phenomena are really those of a more southern latitude than those of the other phenomena. The phenological norm or phenochrons for each year must therefore be in error to a certain extent. But the table is given here to illustrate such results as have been obtained. Following it will be given phenochron for each county of the province of Nova Scotia, based on ten plants normally flowering from the first of April to the first of June, at ten different stations in each county.

MEAN OF TWENTY PHENOLOGICAL OBSERVATIONS, NOVA SCOTIA, FOR THE SEVEN YEARS, 1892 TO 1898.

Species common to the Tables of the seven years. (First appearance).	Average Date 1892.	Average Date 1893.	Average Date 1894.	Average Date 1895.	Average Date 1896.	Average Date 1897.	Average Date 1898.	Seven-year Normal Date or Phenochron of each species.
Mayflower, flower.	98	108	104.7	107.00	102.70	106	93.14	102.79 12 Apr.
Alder, "	..102	114	116.3	103.8	107.55	119	103.50	109.45 19 "
Aspen, "	..131	123	122.2	117.5	121.90	128	118.66	123.18 3 May
Maple, "	..123	130	126.3	123.85	124.55	124.8	121.80	124.90 4 "
Strawberry, "	..129	133	131.6	128.55	128.50	126.5	125.75	128.99 8 "
Dog-tooth V., "	..135	136	132.2	125	128.50	131	126	130.53 10 "
Cherry(Cult.)"	..146	142	146.3	136.6	143.00	146	141.80	143.10 23 "
Indian Pear, "	..145	144	146	138.35	141.65	141.8	140.71	142.50 22 "
Cherry(Wild)"	..150	144	147	138.15	145.25	142.6	143.20	144.31 24 ",
Apple, "	..146	146	152.1	143.7	151.10	155.3	148.40	148.94 28 "
Lilac, "	..154	160	162.3	153.5	160.50	157	155.14	157.49 6 June
Hawthorn, "	..163	160	160.3	148.75	160.25	156	158	158.04 7 "
Wild Goose.....	54	88	70.6	78.00	80.00	80	73.80	74.91 15 Mar.
Robin.....	96	94	73.2	99.30	96.14	91	58	86.81 27 "
Song Sparrow....	99	115	79	96.65	94.66	95.6	71	92.99 2 Apr.
Frogs piping.....	105	113	112.8	110.55	106.30	113.2	101.80	108.95 18 "
Swallow	106	119	119	125.75	117.76	(117.5)	(117.5)	(117.50) 27 "
Kingfisher..	128	137	128.7	127.50	122.00	141.6	130.50	130.76 10 May
Humming Bird...	143	159	143.0	137.25	139.30	143	143.50	144.01 24 "
Night Hawk. ...	150	144	158.8	148.00	154.33	165.5	145.30	152.28 1 June
Phenological Norm or Phenochron of each year...	125.15	130.45	126.62	124.39	126.30	129.07	120.88	126.12
(*i.e.*) May.....	5th	10th	6th	4th	6th	9th	30 Ap.	6 May 6 May

Were the above table based on perfectly even and symmetrical elements, as indicated before, we could say that the biological, or more properly speaking, phenological condition of the province on the 5th of May, 1892, occurred on the 10th in 1893, on the 6th in 1894, on the 4th in

1895, on the 6th in 1896, on the 9th in 1897, and on the 30th April in 1898. The normal for the seven years is 6th of May. The early and late seasons, so far as the twenty objects considered are concerned, would be instantly seen and measured by comparing its phenochron with the normal for the series of years—the phenochron of the year with the phenochron of the series of seven years in this case.

Below is a table of phenochrons for the flowering of ten plants in each county, and for each county, for the spring of 1898 in Nova Scotia, based on ten of the best sets of observations made in each county. The first column is the average date of the "first flowering" observed, the second is the average date when the "flowering was considered to be becoming common." The counties are arranged in the order of their phenochrons based on the average of both columns.

	YARMOUTH. 130.88		ANNAPOLIS. 132.22		KING'S. 134.19	
Mayflower	83.0	100.7	89.2	103.8	93.9	104.7
Blue Violet	113.7	126.5	122.5	130.3	122.1	133.1
Red Maple	120.6	129.1	119.0	130.2	117.7	129.2
Dandelion	113.6	126.4	120.2	130.1	124.0	134.4
Strawberry	115.0	130.6	122.3	131.3	116.6	136.5
Wild Red Cherry	137.9	146.9	134.7	142.0	141.3	146.9
Buttercup	131.5	145.3	142.6	150.7	140.3	151.0
Indian Pear	139.5	144.9	136.2	140.0	139.8	143.7
Apple	142.6	152.5	142.2	147.2	144.5	151.5
Lilac	154.7	162.7	151.8	158.1	152.5	160.2
	125.21	136.56	128.07	136.37	129.27	139.12

	DIGBY. 134.27		HANTS. 134.97		SHELBURNE. 135.13	
Mayflower	92.4	104.4	96.0	109.3	86.1	102.9
Blue Violet	122.8	132.9	122.8	131.2	120.9	128.7
Red Maple	127 9	134.8	119.2	127.0	122.7	131.5
Dandelion	111.9	127.1	124.0	133.2	121.8	129.8
Strawberry	117.5	132.1	123.4	133.5	126.0	135.4
Wild Red Cherry	140.7	150.9	141.1	145.8	144.7	150.5
Buttercup	145.4	155.8	140.3	152.5	139.9	152.1
Indian Pear	138.4	143.7	140.2	144.5	139.2	145.1
Apple	141.6	150.5	146.2	151.5	146.8	153.2
Lilac	151.7	163.0	156.0	161.8	159.0	166.4
	129.03	139.52	130.92	139.03	130.71	139.56

	PICTOU.		LUNENBURG.		QUEEN'S.	
	135.41		135.43		135.72	
Mayflower	97.9	111.6	93.4	105.5	90.8	112.0
Blue Violet	121.2	133.4	119.1	132.2	123.4	131.0
Red Maple	122.3	132.3	116.9	127.1	119.4	128.0
Dandelion	120.4	132.3	126.2	134.4	126.2	133.2
Strawberry	124.2	135.5	123.8	133.9	125.4	133.8
Wild Red Cherry	143.3	148.8	140.8	146.2	140.8	145.4
Buttercup	142.0	149.6	149.5	158.0	148.8	157.2
Indian Pear	139.2	144.5	138.2	143.7	139.0	144.6
Apple	146.4	151.7	145 0	151.3	142.6	150.2
Lilac	152.3	159.3	159.2	164.8	157.6	165.0
	130.92	139.90	131.16	139.71	131.40	140.04

	COLCHESTER.		HALIFAX.		CUMBERLAND.	
	137.23		137.29		139.20	
Mayflower	96.8	110.5	92.8	107.2	101.4	111.7
Blue Violet	125.6	136.2	123.7	131.8	132.0	139.0
Red Maple	125.6	133.9	122.7	129.7	130.4	136.1
Dandelion	125.3	134.8	124.7	132.4	131.1	137.8
Strawberry	125.5	136.5	124.9	134.0	130.9	138.8
Wild Red Cherry	141.1	146.6	146.6	151.4	142.7	146.9
Buttercup	148.0	156.8	148.4	156.5	147.1	155.7
Indian Pear	142.5	148.2	139.7	144.7	139.8	146.1
Apple	145.4	151.4	150.4	155.6	147.1	151.3
Lilac	153.7	160.2	161.0	167.7	155.6	162.5
	132.95	141.51	133.49	141.10	135.81	142.59

	ANTIGONISH.		CAPE BRETON.		GUYSBORO.	
	140.93		143.05		143.28	
Mayflower	106.2	120.8	101.5	114.8	100.2	124.2
Blue Violet	130.2	135.6	131.2	137.9	132.5	141.2
Red Maple	129.6	134.2	133.9	141.6	126.3	138.0
Dandelion	130.0	132.6	130.2	136.5	125 2	139.2
Strawberry	120.6	136.8	129.2	141.2	130.2	140.5
Wild Red Cherry	146.8	152.8	151.9	158.7	148.2	151.5
Buttercup	149.0	157.2	153.5	160.2	154.3	164.7
Indian Pear	143.6	147.8	144.9	150.1	146.5	149.8
Apple	154.2	158.8	155.6	160.5	152.0	161.0
Lilac	162.6	169.2	160.9	166.8	167.7	172.7
	134.28	144.58	139.28	146.83	138.31	148.26

	INVERNESS.		RICHMOND.		VICTORIA.	
	145.07		146.65		147.97	
Mayflower	111.0	122.4	105.2	121.7	108.2	121.6
Blue Violet	126.9	139.4	132.9	142.0	131·1	138.3
Red Maple	141.7	149.0	137.0	143.2	146.0	150.4
Dandelion	125.8	139.9	134.7	142.4	134.2	142.5
Strawberry	129.4	142.0	135.5	145.9	134.4	145.3
Wild Red Cherry	146.0	154.2	149.2	156.9	152.7	159.1
Buttercup	154.9	164.1	152.9	162.9	152.6	162.3
Indian Pear	136.0	151.3	146.0	154.4	148.6	157.3
Apple	153.6	162.2	161.4	167.6	159.5	164.2
Lilac	171.3	180.3	166.4	174.9	172.5	178.7
	139.66	150.48	142.12	151.19	143.98	151 97

An interesting irregularity in the phenochrons of the different counties is shown in nearly every part of this table. Their order is not parallel in the different counties. Very often it is reversed. As the phenochrons are averages of ten observations, it cannot be laid altogether to the charge of defective observation. The rarity of certain species in certain counties, or in the districts in which the observations were made, tends to make the phenochron later, for the plants may be in flower several days before they may be met with. But the character of the soil, the elevation, the slope, etc., must have had some influence. And, then, may it not be possible that the same species may develop a tendency to an earlier or later maturing in different regions? These are questions which careful future observations may help to answer.

To illustrate the effect of asymmetry of stations on the phenochrons of a large district or country, I select five of the best-observed plants, giving first their phenochrons for a period of seven years, 1892 to 1898, based on the few and irregularly distributed stations of the Botanical Club of Canada; giving secondly their phenochrons for the year 1898, based on the observations made at the eight stations, Berwick, Windsor, Halifax, Musquodoboit, Wallace, Pictou, New Glasgow and Port Hawkesbury; and giving thirdly their phenochrons derived from 180

stations, ten in each of the eighteen counties of the province, observed in connection with the public schools of the province.

First Flowering of the	Seven Year Phenochrons. Botanical Club.	Phenochrons for 1898. Botanical Club.	Phenochrons for 1898. 180 Schools.
Mayflower	103.0	93.1	97.0
Maple	125.0	121.8	126.0
Strawberry	129.1	125.7	125.3
Amelanchier	142.6	140.7	140.9
Lilac	155.3	155.3	159.2
General Phenochrons	131.0	127.3	129.7

From the general phenochrons we infer that the spring of 1898 in the province of Nova Scotia was according to the Botanical Club 3.7 days earlier than the average of the seven years preceding, and according to the Schools only 1.3 days earlier. But what is the cause of this difference of 2.4 days between the Club and the Schools? Not defective observation, but the fact that of the eight stations of the Botanical Club nearly all were either southern or central, while those of the Schools were evenly distributed from Cape Sable to Cape North.

To conclude this brief exhibit of the progress of phenological observations, I give a few from those made by the Botanical Club extending across Canada.

CANADA, 1898.

	Nova Scotia.	Muskoka, Ontario.	Pheasant Forks, Assa.	Olds, Alberta.	Vancouver, B.C.
Frogs (first piping)	101.8	98	112	106	41
Dandelion (first flowering)	124.4	121	150	153	84
Strawberry "	125.7	130	142	142	96
Wild Red Cherry "	143.2	136	161	...	110
Apple "	148.4	146	...	...	116
Lilac "	155.1	147	182	...	...

To further illustrate what has been done and what has not been done, I give the figures for each of the above six phenomena, so far as obtained, for Nova Scotia, New Brunswick, Ontario (Muskoka and Niagara), Winnipeg, Pheasant Forks in Assiniboia, Olds in Alberta, and Van-

couver in British Columbia, for the series of four years from 1895 to 1898.

CANADA, 1895 TO 1898.

FROGS (FIRST PIPING).

Year.	N.S.	N.B.	Ontario.	Winnipeg.	Ph. Forks.	Olds.	Vancouver.
1895 ...	110.6	120	106.5..	92.5..	...	98	53
1896....	106.3	116	104.5..	112	115	...	50
1897....	113.2	...	92	104	105	...	33
1898....	101.8	...	98	...	112	106	41

DANDELION (FIRST FLOWERING).

1895 ...	125.4	131	118.5..	123	...	143	99
1896....	128.5	133	121.5..	....	149	...	88
1897 ...	132.4	...	118	135	...	...	89
1898 ...	124.4	...	121	...	150	153	84

STRAWBERRY (FIRST FLOWERING).

1895....	128.5	126.8..	126	129	...	136	110
1896...	128.5	128.5..	127.5..	144	134	...	102
1897....	126.6	...	128.5..	140	140	...	89
1898....	125.7	...	130	...	142	142	96

WILD RED CHERRY (FIRST FLOWERING).

1895....	139.8	139.5..	128	...	...	...	124
1896....	145.2	144	130	...	...	...	126
1897....	142.6	...	137.5..	140	...	...	111
1898....	143.2	...	146	...	...	...	116

APPLE (FIRST FLOWERING).

1895....	143.7	145	129	128	...	...	...
1896....	151.1	152	131.5..	...	...	...	126
1897. ..	155.3	...	143	...	...	...	117
1898....	148.4	...	146	...	...	...	116

LILAC (FIRST FLOWERING).

1895....	153.7	150	137.5..	136	...	...	125
1896....	160.5	158	133.5.	...	...	...	136
1897....	157	...	148	145	...	...	131
1898....	155 1	...	147	...	182	...	...

The blanks in the tables above show that the great difficulty is to obtain observers who can keep up their observations regularly for a series of years.

It would take up too much space to reprint here the schedule for the recording of these observations and its accompanying directions. They have been published in the report of the Botanical Club to the Royal Society, in

whose Transactions they may be seen; and in the *Journal of Education*, Nova Scotia. In the Transactions of the Nova Scotia Institute of Science, the average county phenochrons of the province for the flowering of ten plants are plotted to scale so as to show the character of the curves.

In conclusion, I may say that this present year about 800 schedules have been sent in, classified as covering districts on (1) the sea coast, or (2) the low inlands, or (3) the interior highlands of each county of the province of Nova Scotia. This work is altogether voluntary on the part of the schools, and the Inspectors report it as being the most valuable stimulus yet given to direct teachers and pupils to the active study of nature—to the elements of the natural sciences underlying the industrial development of the country. It also tends to develop the habit of accurate observation, as necessary to a successful literary or professional career as to the industrial occupations.

Botany in the Island of Montreal.

A paper read before the Natural History Society of Montreal, March 27th, 1899, by Robert Campbell, M.A., D.D.

A glance at the map shows that the Island of Montreal is favourably situated for the production of a large and varied flora. It is a well-known fact that rivers perform an important part in the distribution of plant life. Seeds float on the water and are sometimes stranded before their germ vitality is destroyed. Boughs, bearing fruit, are wafted to our shores, and acquire a new *habitat*, it may be, for the species. Even boats and barges may be the effective agents of conveying to our island the originals of the numerous varieties of foreign plants now found flourishing among us. Railways, too, are joining in this distributive agency. At Point St. Charles several intro-

duced plants grow luxuriantly, the seed of which the Grand Trunk no doubt first carried thither; and any observant person who travels by the Canada Pacific will find growing along its line in the Eastern Provinces not a few species whose native home is in the Western Prairies; and *vice versa*, our eastern plants are making their way westward, aided by the same agency. Then, birds, it is established, carry seeds both on their claws and in their crops; and Mount Royal, it is well known, is a favourite temporary resting-place for birds of passage, as well as an attractive whole season's residence for not a few of the species that come annually northward for breeding purposes. They, too, have doubtless brought their quota of the plants belonging to other latitudes and longitudes that have made their home on our island.

To the Ottawa and its tributaries we owe most likely the somewhat numerous northern species that are collected in the district; while the St. Lawrence, fed by streams not only from Western Ontario, but also from the States bordering on its south shores, and the great inland lakes, from which it obtains its waters, casts upon our shores the germs of species which originally belonged to a warmer temperature.

The geological conditions obtaining in the island of Montreal are no less favourable than the geographical for a rich flora. There are first the alluvial plains, bounded by the present shoreline, formed by the recession of the waters which at one time covered no inconsiderable portion of what is now the island, forming a succession of terraces. These constitute the splendid agricultural lands of the district, and of course sustain a well-developed and varied plant-life. The great expanse of limestone underlying so much of the island affords a fine bed for a flora to which that particular rock is partial; while the slopes of Mount Royal, crowned with its dyked eruptive rocks, offer a great variety of soils, each of which nurses its own favourite

series of plants. There is still a good deal of the original forest on the island, and under its protection the native flora continues to abound. There are also several swamps and peat-mosses stocked with those distinctive species to which they give support; while a large part of the island is under cultivation, affording abundant scope for the maintenance of that gradually increasing variety of plants which delight in the open. It may be added in this connection that the insular situation of the district, surrounded as it is by a considerable body of water, secures for it a modified temperature; while the varied aspects of the mountain, looking in the direction of every point in the compass, offer as many varieties of climate, and these encourage the growth of a correspondingly varied flora.

Having thus set forth the features of Montreal Island which make it a most promising field for botanical research, the next matter to engage our attention is to enquire what has been done towards observing and reporting on its plant-life. As regards the collecting and cataloguing of its local flora, Montreal had the start of every other place in the Dominion. Dr. Holmes, afterwards the first Professor of Botany in McGill College, between the years 1820 and 1823, made a very large collection, especially of the Phenogamous plants of the district. Of course he had the advantage of being able to make use of the work done by others who had made observations on the flora of the Province, notably Kalm, Michaud and Pursh. But besides this, he had paid special attention as a young physician to the flora of Britain and France, and, therefore, occupied an advantageous position for entering upon his self-imposed task, but one which happily inured to the laying of an excellent foundation for the botany of the district. Considering the state of this department of science at that time, Dr. Holmes must be accorded the credit of being both an enthusiastic collector and a careful and accurate observer. His herbarium, constituting the

original nucleus of the splendid collection of plants in the Redpath Museum of McGill University, will always be quoted as showing the main body of the plant-life of this district, here at the present time, as well as eighty years ago. Dr. Holmes was one of the founders of the Natural History Society of Montreal, and in his lifetime Botany secured a fair share of the attention of the members of the society. From the year 1823 onwards, until the inauguration of the Geological Survey under Sir William Logan, and the advent of Sir William Dawson as Principal of McGill College, there seems to have been little original work done in the way of collecting and classifying the flora of the Montreal district. The scope of the Geological Survey at first did not embrace reports on the botany of the country; but the geologists all found that there was a constant relation between the strata they examined and the flora to be found growing on them, as well as between the flora and fauna; and so the group of naturalists whom Sir William Logan gathered around him, inspired and encouraged by Sir William Dawson, began also to make notes of the plant-life they encountered in their geological excursions. Some army officers and old Hudson Bay employees who had been botanical collectors in their respective fields of operations, also came to reside in Montreal and reinforced the number of persons interested in this branch of science. In these several ways our city was exceptionally favoured beyond any centre in the British Provinces, as regards the prosecution of a knowledge of botany, up to about thirty years ago. It was well on in the fifties that the late Dr. George Lawson came to Canada to be a Professor of Botany, first in Queen's College, Kingston, and afterwards in Dalhousie College, Halifax; and his advent gave a prodigious impulse to the study of the flora of the country. A host of young naturalists grew up around him, among others, Professor Macoun, the now famous head of the Botanical Depart-

ment of the Geological Survey, Dr. A. T. Drummond, Dr. John Bell, and Dr. A. H. Mackay, of Halifax. Montreal, however, kept up its reputation in this line by the work and writings of Mr. D. A. P. Watt, Dr. Kemp and others, special mention being made of Mr. D'Urban, of the Geological Survey. Mr. D. R. McCord wrote a monogram on the Ferns of Canada, embracing, of course, those of the Montreal district, and this was followed by "Notes on Canadian Ferns" by Mr. J. B. Goode, Vol. IX (New Series), p. 49 (1879); but the next most important contribution to the Botany of Canada, since Dr. Holmes' collection was made, was that of Mr. Watt, published in the *Canadian Naturalist and Geologist* in 1864. This embraced a list of the Acrogens of the country, so far as they had then been discovered and determined. In making this list Mr. Watt was assisted by Mr. J. Macoun and others, Mr. A. T. Drummond having placed a very complete catalogue of the lichens of Canada at his disposal. The next considerable addition to the knowledge of the local flora was made by Professor Penhallow, who reported on the plants he found growing on St. Helen's Island in 1891. The present writer began to make notes on the botany of the district in 1885, and has continued to do so up to the present time. Taking Dr. Holmes' list as the basis of his observations, he has found every plant on that list, with the exception of about ten species, which, with the destruction of the forests and the draining of the swamps that existed eighty years ago, have either become wholly extinct or at least very rare in this neighbourhood. But he has been able to report a great many additional species, some of which, no doubt, then grew on the island, although they had escaped Dr. Holmes' observation, many of which, however, have been introduced since 1820. Collections spread over a period of thirteen years may be expected to be more complete than such as were confined to three or four years, which seems to have been the duration of Dr.

Holmes' activity in this connection. Besides, Dr. Holmes' investigations barely touched on the *Juncaceæ*, the *Gramineæ* and the *Cyperaceæ*, three important families on which the writer, in conjunction with Dr. Harold B. Cushing, of Montreal, has made a pretty thorough report. The Phanerogamous plants of the island, it may be said, are now fairly well known, and have been pretty fully catalogued. The same may be said of the Ferns, Club-mosses and Horsetails. Dr. H. B. Cushing reported on the former in the RECORD OF SCIENCE, Vol. VI., No. 8, p. 488, while the writer has described them, along with all the ferns to be found in Eastern Canada, in the magazine published by the Horticultural Society of Montreal.

And now it remains to point out the desiderata of the botany of the district. The whole domain of the local Acrogens has yet to be reported on, with the exception of the ferns, horsetails and club-mosses. The Fungi, the Mosses, the Lichens, the Charæ and the Hepaticæ of the island of Montreal are still in large measure an unknown quantity. In Mr. Watt's catalogue and in the later and completer lists of Professor Macoun, there is no distinction made between the Acrogens of the district and those of the rest of the Dominion, so that there is here an inviting field for local botanists to enter. And a rich harvest awaits them. Professor Macoun informs me that he has found no fewer than 200 mosses in the neighbourhood of Ottawa. The district of Montreal may be expected to yield at least as large a number. And, then, in the department of microscopic Fungi the field of observation is almost unlimited. The enthusiastic microscopists of the society cannot do better than turn their attention to this vast field at present lying waste for lack of some one to cultivate it, and thus render effective service to our botanical section.

What is necessary is that the work remaining to be done should be divided up,—that some of the members of

the society undertake to collect and report on the larger Fungi, others on the microscopic Fungi, others on the mosses, others on the lichens, others on the Hepaticæ, and others on the Charæ. By such a division of labour there would be a prospect of having the local flora catalogued within a reasonably short time; whereas, if only one or two take part in the work, it will take a generation to complete it. The Natural History Society will not be true to its responsibilities, nor arise to its opportunities, nor fulfil its functions, until it is seized of at least the main facts relating to the Geology, the Zoology and the Botany of the district.

The Lake-on-the-Mountain near Picton, Ont.

By A. T. Drummond, LL.D.

Imagine a cliff about 180 feet in height, rising almost perpendicularly from the steamboat landing at Glenora on the Bay of Quinté, and immediately on the top, within 300 feet from the edge, but shut in by a fringe of trees on its shore, a lake of clear, fresh water about one and a half miles long with a width of about three-quarters of a mile! Journeying up the zigzag roadway to the top of the cliff, as the eye wanders over the wide expanse of country to the northward, with, in the foreground, the lovely Bay of Quinté, and the deep and broad inlets which branch from it on either side, and, on this sunny, cloudless day, the alternate and contrasting effects of intensely blue water, green grain fields and patches of woods, one gradually realizes that here probably is the finest scenic effect in Central Ontario. This beautiful view is the first point of interest; turning around, close at hand, is found this curious lake perched on the top of the cliff. Its waters are continually flowing out to give the power which runs the Glenora Mills; its inflow is invisible and yet is steadily

maintained from month to month and from year to year.

Various opinions have been hazarded in accounting for the inflow. Whilst the surface of the lake is nearly 180 feet above the level of the Bay of Quinté, the bottom is likewise 80 feet above that level. The source of inflow must therefore be sought for in some locality at any rate 200 feet higher than Lake Ontario. A subterranean connection with Lake Erie is a common theory in the surrounding district, but this is based on an inaccurate knowledge of the intervening geological levels and structure. One investigator, again, thinks he has found its source in the State of Ohio. Still others attribute it to springs nearer home. There is ample room for speculation, but it would be safer to attribute the source of the inflow to districts, comparatively nearer at hand, among the Trenton and Black River Limestones, in the higher ground on the northern side of the Bay of Quinté here. Immediately east of Napanee, the Grand Trunk Railway is 127 feet above Lake Ontario, and thence north-eastward there is a steady rise in the limestone area and beyond it into the Laurentian, Sharbot Lake being 389 feet above Lake Ontario, and the dip of the limestone rocks is favourable. That the source of the inflow is not attributable to springs from higher ground in Prince Edward County seems to some extent established by the fact that during the long drought in the months of August and September of this year the level of the lake changed but to a small extent. This drought prevailed seriously in the townships fronting on the Bay of Quinté, whilst further back a fair amount of rain fell. Mr. F. S. Wilson, of Glenora, one of the proprietors of the mills there, to whom I was indebted for courtesies, and on whose authority the height of the lake above the Bay of Quinté is given, wrote to me on September 18th last in reply to my enquiry as to the effect of last summer's drought: "I have watched the level of the water in the lake here and cannot see that the unusually

dry weather has affected it to any great extent. During this season of the year and for the summer months, the water draws down about so much each week. This draft may vary a trifle owing to the state of the weather; if very hot and dry the draft appears greater, which I account for by evaporation and no surface water going in in the shape of rain."

On the 28th July last I visited the lake for the purpose of ascertaining its depth and temperature, and their bearing on the origin of the inflow. The northern and eastern portions of the lake, embracing perhaps one-third of the whole area, were found to be shallow, with a rocky, slowly-shelving bottom. Towards the centre of the lake, the depth drops to about 50 feet. Proceeding thence in a south-westerly direction and at about one-quarter of a mile from the south-westerly shore, the depth is 75 feet; at 500 feet from this shore it is 99 feet; and at 200 feet from it, 93 feet. This south-western shore, which rises here precipitously to about 25 feet above the water line, appears to form a ragged cliff of probably 125 feet in height, the bottom of which is at the bottom of the lake. Proceeding from this point a quarter of a mile towards the westerly end of the lake and keeping 100 feet from the shore, the depth was found to be 72 feet, whilst 500 feet off the extreme west end of the lake the depth was 60 feet. The easterly side of the lake towards the southern shore shows considerable depths likewise. At a half of a mile from this end and 400 feet from the south shore, the bottom was reached at 96 feet, but, as this east end is approached, the water somewhat suddenly shallows, and at 300 to 400 feet from the shore reeds begin to appear. Apparently an area about one mile long by one-quarter to half a mile broad forms a sudden depression in the lake of towards 100 feet in depth, but shallowing to 60 feet as the south-west end of the lake is reached. That it arises from a fault in the Trenton limestone here is very probable,

and the forces which gave rise to this fault have extended over a sufficiently wide area to give some subterranean connection with higher ground very many miles away.

The results of the readings of the thermometer were even more interesting. Whilst the waters of the Bay of Quinté would be slightly warmer than those of the main body of Lake Ontario, the difference would not be great, and for the purpose of comparison with temperature results in the Lake-on-the-Mountain, readings in the main channel opposite Kingston may be taken as fairly representing the temperatures of the waters of both the Bay of Quinté and Lake Ontario at similar depths. In this main channel, during August of this year, whilst the surface temperature ranged generally around 72° F., the bottom temperature at a depth of 78 feet was 56½° to 57½° F. Last year, on August 18th, at 4.25 p.m., and under about the same conditions of sky, the water in the same channel was 74½° F. at the surface and 72° F. at a depth of 54 feet, and on 25th July, 1889, 67° F. at a depth of 72 feet—the water in this main channel during 1899 being much colder beneath the surface than usual. At the Lake-on-the-Mountain, on the other hand, on the day of my visit, with the air bright and warm and but few clouds in the sky, the results of numerous readings showed the temperature of the surface water to be 74¼° F.; at 30 feet depth, 69½° F.; at 45 feet, 47° F.; at 60 feet, 43½° F.; at 72 feet, 43¼° F.; and at 99 feet, 42° F. Whilst the surface of the Lake-on-the-Mountain is thus not very different in temperature from the surface of the main channel at Kingston, the temperature at a depth of 78 feet was about 15 degrees colder than at a similar depth at Kingston this year, and 24 degrees colder than at this depth in 1889.

The striking fact is shown by these results at Glenora that for the first thirty feet of depth there is comparatively little change in the temperature of the water; that at between thirty and forty-five feet there is a rapid fall in

the temperature of twenty-two and a half degrees; whilst between forty-five feet and the bottom at ninety-nine feet the further fall is only five degrees. In Lake Memphremagog, which is a deep-water lake lying in a higher altitude, in the lap of the mountains in the south-eastern sections of the province of Quebec, I found in August, 1892, the temperature of the surface water varying between 71° and 74° F. according to time of day and clearness of sky; at 36 feet depth, 57° F.; at 72 feet, 51° F.; at 288 feet, 48° F.; and at 324 feet, 44¾° F. Thus at 72 feet the Lake-on-the-Mountain waters were about eight degrees colder than those of Lake Memphremagog in the year named, and the bottom temperature at ninety-nine feet was actually nearly three degrees colder than the Memphremagog waters at three hundred and twenty-four feet depth.

The deeper waters of Lake Memphremagog, I have elsewhere suggested, do not mingle with the warmer surface waters. These—derived from the mountain streams and, more directly, from the rains—continue their course down the lake, like a surface river, over the colder waters beneath, until they discharge into the Magog River. Here at the Lake-on-the-Mountain it can hardly be suggested that the deeper waters are more or less stationary, as the height above the Bay of Quinté and the general dip of the rocks in the district rather imply that the inflow is at or near the bottom and through small subterranean crevices that must be much deeper still. The low temperature of these deeper waters would seem to show that the inflow comes from considerable depths and, especially, from a great distance away, but that it is not a large inflow is evident, not only by the outflow, which can be accommodated in a pipe rather more than two feet in diameter, but also by the fact that the inflowing colder water is not sufficient in volume to control in summer the temperature of the upper thirty feet of the waters of the lake.

The general conclusions of the paper may be stated thus:

That the extreme depth of the lake is about one hundred feet.

That the temperature of the bottom is 42° F., and that the fall in the temperature between thirty feet and the bottom is twenty-seven and a half degrees, most of this fall taking place between thirty feet and forty-five feet.

That the primary cause of the lake was probably a widened fault in the Trenton limestone, the same force giving rise at the same time, no doubt, to subterranean crevices beneath, extending over a wide area, and enabling distant waters to gradually find a passage to the lake.

That the source of the waters of the lake is to be looked for in the higher limestone area to the north eastward of the Grand Trunk Railway as it passes through the counties of Frontenac and Addington.

(In view of the present situation in South Africa, the following article will be found especially interesting,—apart from the inherent scientific value of the paper.)

The Parent-Rock of the Diamond in South Africa.[1]

By Professor T. G. Bonney, D.Sc., LL.D., V.P.R.S.

So much has been written on the occurrence of diamonds in South Africa that a very few words may suffice as preface to this communication. References to many papers on the subject are given in "The Genesis and Matrix of the Diamond" (1897), by the late Professor H. Carvill Lewis,[2] and others have been published since

[1] A Paper read before the Royal Society, June 1, 1899.

[2] Edited by the present writer.

that date.[1] It may suffice to say that the diamond, first discovered in 1867 in gravels on the Orange River, was found three years later in certain peculiar deposits, which occur locally in a region where the dominant rock is dark shale, sometimes interbedded with hard grits, or associated with igneous rocks allied to basalt. These deposits occupy areas irregularly circular in outline, and bearing a general resemblance to volcanic necks. The diamantiferous material, near the surface, is soft, yellowish in color, and obviously much decomposed; at a greater depth it assumes a dull greenish to bluish tint, and becomes harder. At the well-known De Beers Mine, near Kimberley, the works in 1898 had been carried to a depth of about 1,500 feet, and the diamantiferous material, for at least the last 100 yards, was not less hard than an ordinary limestone. It has a brecciated aspect, the dark, very minutely granular, matrix being composed mainly of serpentine (about four-fifths of the whole), and of a carbonate of lime (with some magnesia and a little iron). In this matrix are embedded grains of the following minerals :—Olivine, enstatite, smaragdite, chrome-diopside (omphacite of some authors), a brown mica, garnet (mostly pyrope, but more than one variety observed), magnetite, chromite, ilmenite, with several other minerals much more sparsely distributed.

Rock fragments are also present, variable in size, but commonly not exceeding about an inch in diameter, as well as in quantity. These occasionally, but not generally, are rather abundant. In some cases they are chips of the neighboring black shale, but in others they are greyish-coloured with a somewhat porcelainised aspect. The latter are generally sub-angular in form, and exter-

1 Jules Garnier, *Geol. South Africa Trans.*, 1897, p. 91; H. S. Harger, *ibid.*, p. 124. See also W. G. Atherstone, *ibid.*, 1896, p. 76; L. De Launay, *Compt. Rend.*, 1897, cxxv., 335. The last author, in "Les Diamants du Cap" (Paris, 1897) gives a very full account of the mines, but an even better one will be found in Max Bauer, "Edelsteinkunde" Leipzic, 1896, p. 208).

nally banded or bordered with a darker tint; crystalline rocks have also been noticed, though these appear to be far from common, such as granite, diorite, and varietes of eclogite.[1] As to the genesis of the diamond, more than one opinion has been expressed. Professor Lewis regarded the matrix as a porphyritic form of peridotite, once a lava, now serpentinised,[2] in which the diamond had been formed by the action of the molten rock on some carbonaceous material (probably the Karoo shale). Others regarded the matrix as a true breccia, comparing it with the agglomerates in volcanic rocks. But among the latter, some thought that the diamond had been produced *in situ* by the action of steam or hot water in a subsequent solfataric stage of the volcano, while others (including myself) held that it had been formed, like the garnets, pyroxenes, &c., in some deep-seated holocrystalline mass which had been scattered by explosions.[3]

The specimens which I am about to describe were obtained at the Newlands Mines, West Griqualand; from 40 to 42 miles from Kimberley, almost due N.W. Here the workmen occasionally came across well-rounded boulder-like masses of rather coarsely crystalline rock, studded with garnets, which are sometimes about a foot in diameter. Specimens of these were found or obtained by Mr. G. Trubenbach, the London manager of the Newlands Diamond Mine Company, during a visit to the mines in 1897. His interest had already been aroused by picking up a specimen, presently to be noticed, in which some small diamonds occurred, very closely associated with a garnet; so the boulders were brought back by him to

1 A. W. Stelnzer, "Sitzungsber. u Abhandl. der Isis" (Dresden), 1893 (April), p. 71, calls attention to the fact that these show signs at attrition and that they range in size from a few cubic millimetres upwards, being sometimes large boulders. Among the materials (at Kimberley) he mentions both granite and eclogite.

2 For the rock itself he proposed the name "kimberlite."

3 In other words, that the volcano (as occasionally has happened) had ejected little or no lava or scoria, discharging only steam and hot water, with shattered rock. This view is held by Max Bauer, in "Edelsteinkunde," p. 225, which however, I had not seen when this paper was written.

England. On careful examination a small diamond was detected on the surface of one of these. On breaking the boulder others were revealed. The most interesting fragment was sent by Mr. Trubenbach to Sir W. Crookes, who showed it to me. Examination with a hand lens convinced me that the rock could not be a concretion of the "blue ground," but was truly holocrystalline and allied to the eclogites. Sir W. Crookes generously waived his own claim to study the specimen, and obtained for me permission from Mr. Trubenbach to have slices cut from it. I gladly take this opportunity of expressing my gratitude to both gentlemen; to Sir W. Crookes for allowing me to carry out this interesting investigation, and to Mr. Trubenbach for his great liberality in placing at my disposal a considerable suite of specimens (including other boulders) from the Newlands mines, and for the trouble which he has taken in affording me the necessary information.

Prior to the discovery, just mentioned, one or two instances had occurred at the De Beers Mine of a diamond apparently enclosed by or projecting into a pyrope. One such, the garnet being the size of a rather large pea, is in the collection at Freiberg (Saxony), to which it was presented in 1892.[1]

The specimen found by Mr. Trubenbach at the Newlands mine was a piece of blue ground, with a pyrope projecting from one angle. A small, apparently broken, diamond seems embedded at the top. The others (five) are well crystallised, two on one side, three almost in contact on the other. The pyrope (which has a kelyphite rim) seems to be indented by two, but to have once included the others, as they are in contact with the unaltered mineral. We were thus brought so far as to associate the diamond with the pyrope; though this

[1] A. W. Stelzner, "Sitzungber. der Isis zu Dresden," 1893, s. 85, and R. Beck *Zeitsh. f. Praktische Geologie*, 1898 (May, p. 163).

proved no more than the presence of garnets in the parent rock of the diamond, and thus made the eclogite (already known to occur) highly probable, for, as observed by Professor R. Beck,[1] the specimen itself is blue ground. In confirmation of his statement I pulverised a fragment,[2] and find that the powder corresponds with the matrix of the blue ground when similarly treated. The latest discoveries enable me to complete the chain of evidence

Eclogite Boulders containing Diamonds.

The first named, that containing several diamonds, is a fragment (perhaps from a quarter to a third) of a boulder, which probably was ellipsoidal in shape, two of the axes being nearly equal and the third distinctly the longest. We may infer that it was rounded from a roughly rectangular block, since the curved surfaces are slightly flatter in the middle parts. The axial lengths in the fragment (prior to removing a piece from one end) were approximately 4 in. by 3 in. by 2 in. The rock is coarsely granular, apparently composed of two green-coloured minerals, one darker than the other (possibly only different states of a single mineral), and of rich resin-pink coloured garnets, varying in size from a hemp-seed to a pea, with slightly irregular distribution. The outer surface of the boulder, except for a very small "step" on one side, is smooth, the garnets barely, if at all projecting. The latter are covered with a rather soft, dark skin, sometimes slightly thicker than the thumb nail, which often has partly fallen off. This, as can be seen on the broken surfaces, becomes less conspicuous in the inner part of the boulder, and is sometimes invisible to the unaided eye. Two small diamonds are exposed on the curved outer surface, one about half, the other about one fifth of an

1 *Ut suprà.*

2 I could not advise Mr. Trubenbach to have a slice cut from the specimen, as I feared it might be injured, but he kindly detached a little fragment from the opposite end to that named above, which I have thus examined.

inch from the edge of the cross fracture. On the latter surface, nearly an inch below the last named, three small diamonds appear to lie in a line touching one another, and near them are two others,[1] all four within a space about three-quarters of an inch square; an eighth diamond is about an inch and a half away (on the same face); a ninth, about one-fifth of an inch from the top edge; and a tenth occurs on the larger cross-fractured surface, but near to the edge of the other one. These diamonds are octahedra in form, generally with stepped faces—one, at least, apparently twinned—perfectly colourless, with brilliant lustre; the largest being quite 0.15 inch from apex to apex, the smallest not exceeding 0.05 inch. All seem to be embedded in the green part of the rock. As the outer part of the boulder looks rather more decomposed than the inner, I had a piece removed from one end, thus enabling me to study the mass to a depth of more than an inch from the surface, and examined a strip, about 4 inches long, in a series of five slices.

The late Professor Lewis has given, in the volume already mentioned, so full an account of the minerals which occur in the "blue ground," that it will be needless on the present occasion to do more than refer to his descriptions,[2] only calling attention to any variations in the mineral constituents and their association in these eclogites. These constituents are:—

1. (*a*) *Garnet* (Pyrope.)—In the slice these appear a light tawny or yellowish red tint, retaining this tint (though much lighter) under the mioroscope.[3] They are generally clear, with frequent and irregular cracks, but are occasionally traversed by wavy bands of minute en-

[1] It is possible that these two form a twin crystal, but I think they are separate. As the point is unimportant, I have not attempted to clear away the matrix.

[2] We must also not forget the paper by Professor Maskelyne and Dr. Flight (*Quart. Journ. Geol. Soc.*, vol. xxx., p. 406), in which several of these minerals are described, analysed, and identified. In fact, the authors ascertained everything that was possible with the materials then obtainable.

[3] Unless it is expressly stated, the use of a 1-inch objective may be assumed.

closures of a pale brown filmy mineral, which is rather irregular in outline, very feebly pleochroic, and gives with crossed nicols fairly bright polarisation tints. Similar minerals sometimes have formed along the cracks. They are probably mica, or possibly chlorite, and indicate incipient decomposition. The garnets towards the outside of the boulder, as already said, are enveloped in a "skin," and the microscope shows that it usually exists inside, though there it is thinner. In the former case it is generally browner in colour and more distinctly crystalline, corresponding in cleavage, pleochroism, &c., with a mica of the biotite group; in the latter it is greener and more filmy with an aggregate habit, and seems to project into the garnet. I regard it as due to decomposition, a form of the well-known kelyphite rim, sometimes a mica, sometimes a chlorite, possibly now and then associated with a little minute hornblende. In a few cases a "rim" is brown in the outer part and green within. The constituents tend to a parallel rather than a radial grouping. The garnets occasionally contain minute branching root-like enclosures grouped in bands. Though these act on polarised light, I regard them empty cavities, and attribute this to diffraction.

(*b*) *Chrome-diopside.*—The mineral described under that name by Professor Lewis, and referred to by others as omphacite or sahlite. The individuals are sometimes about a quarter of an inch long. In thin slices it is a pale dullish green colour, inclining to olive; under the microscope, a pale sea-green, with a trace of pleochroism. It has one strongly marked cleavage, not, however, nearly so close as in ordinary diallage, and a second weaker, sometimes approximately at right angles to it.[1] On examining flakes, obtained by crushing, I find the strong cleavage to be clinopinacoïdal and the other probably basal,

[1] One may give a general idea of their relative importance by comparing them to the columns and cross-joints in some basalts.

and obtain on a clinopinacoïd an extinction of 35° with a prism edge. It is, in fact, identical with the pyroxene described by Professor Lewis[1] as chromediopside. In it (though rarely) small rounded enclosures of a greenish mineral aggregate much blackened with opacite. I regard them as alteration products of a ferriferous olivine. This diopside, at the exterior and along cracks, is often converted into a minutely granular to fibrous mineral, which gives a "dusty" aspect to that part of the crystal when viewed with transmitted light, and a whitish-green one with reflected light. This often terminates in a minutely acicular fringe, piercing the original diopside. Its grains occasionally are a little larger, showing a cleavage, dull green in colour, fairly pleochroic, and having the extinction of hornblende. A process of secondary change, as in uralite, is no doubt indicated. Now and then a tiny film of brown mica occurs in this part or even in a crack in the diopside.

It is this alteration product which gives the mottled aspect mentioned above as visible to the unaided eye, so this is not indicative of a third important constituent in the original rock. In one of the slices the mica just named attains a larger size (about 0.03 inch across), has a fairly idiomorphic (hexagonal prism) outline, and is not restricted to the margin of the garnet. In this case it is generally associated with calcite,[2] which it tends to surround, and that in one place encloses a radiating acicular mineral (? a zeolite), in another the calcite, or some other carbonate, is mixed with a serpentinous material. Distinct granules of iron oxide are practically absent from the slices, though here and there it may be indicated by some opacite. I have not found spinel, or rutile, zircon, or pseudobrookite. In fact, putting aside the diamonds,

[1] *Loc. cit.*, p. 21.

[2] From the facts I think it probably of secondary origin. It reminds me sometimes of the brown mica produced by contact metamorphism.

the rock in its unaltered condition was a coarsely holocrystalline mixture of chrome-diopside and garnet, with a few small enclosures of olivine,—in other words, it was a variety of eclogite and of igneous origin.[1]

2. A fragment (probably about one quarter) of a flattish ovoid boulder.—The two broken surfaces, which are nearly at right angles, measure 5 and 5½ inches, roughly, and it is about 3¾ inches high. The rock very closely resembles the one just described, except that mica occurs rather oftener and in larger flakes; perhaps the garnets (here also not quite regularly distributed) are slightly more numerous. The outer surface is not quite so well preserved, though enough remains to show that it also has been smooth, and a few thin veins of a white mineral (calcite ?) traverse the rock. On this surface, near the meeting of the two fractures, and exposed by the removal of a little material (*i. e.*, it might originally have been just hidden) is a diamond (octahedron), apparently about 0.1 inch in diameter. On one side it rests against a pyrope, the adjacent surface of which is incurved, the two minerals being parted by the dull green-coloured kelyphite rim of the latter, which is about 0.03 inch in thickness. Thin sections of this boulder correspond almost exactly with those from the other, the garnets showing precisely the same flaws, though traces of a cleavage (roughly parallel throughout) are perceptible on close inspection, and are distinct under the microscope. In garnet such a structure commonly indicates pressure, and the general parallelism accords with this explanation, but the other constituents show no signs of crushing. The "kelyphite" rims to the garnets are perhaps slightly broader, and the brown mica passes into a green (chlorite ?)

1 I am, of course, aware that eclogite, in the past, has been regarded by some geologists as a metamorphic rock. Apart from the fact that several rocks once assigned to this class are now, with good reason, regarded as igneous, I have had several opportunities of studying eclogite, and have no doubt as to its origin. Take away the alkali from a magma with the chemical composition of a diorite, and the result would be garnets in place of felspar, *i. e.*, an eclogite.

mineral, and occupies cracks in the garnet a little more frequently, but, as before, the constituents tend to lie parallel rather than radially. One or two of the diopsides show fine oscillatory twinning. The cracks are occupied with calcite or some altered carbonate. There is no real difference between this eclogite and the last-named one.

Eclogite Boulders without Diamonds.

3. Part of a boulder, which must have been about a foot in diameter.—In macroscopic aspect it presents a general resemblance to the rocks described above, with, however, the possibility of a second green constituent. This is not confirmed on microscopic examination. The rock consists, practically, of pyrope and diopside, as already described, except that the negative crystals are rather unusually conspicuous in the latter. Into the details of these, as the point seems not to have any bearing on the present investigation, I do not purpose to enter.

4. A fragment, more irregular in form than the others, measures, very roughly, about 7 in. by $4\frac{3}{4}$ in. by $3\frac{1}{2}$ in. It retains a good piece of the outer surface, which, though now a little corroded, was once smooth. The rock, which is rather decomposed and crumbly, consists chiefly of three minerals; garnet, not quite so large, paler and more pink in colour than the last-named; an emerald green pyroxene, and a yellowish or greenish grey, platy to fibrous mineral, suggestive of a second more altered pyroxene. In thin slices the paler and pinker tint of the garnet is very perceptible, as well as the tendency to a rude and generally parallel cleavage. But we find in it, under the microscope, a few microlithic enclosures, of an apparently colourless mineral, which occurs in long prisms crossed at about 70° by an occasional transverse cleavage, and extinguishing at an angle of about 26° with the longer edge. Many of the cracks exhibit slight de-

composition, starting from them, and are sometimes occupied by calcite. The pyroxene, under the microscope, hardly differs from the one already described, except that the green tint is slightly richer and one or two crystals contain the small dark brown negative crystals, common in hypersthene and diallag. The dominant cleavage, as before, is along the clinopinacoïd.[1]

The third mineral proves to be an altered enstatite, but I leave the details for the present as it is better preserved in another rock. A fourth constituent is also present, but more sparingly, viz., a pale brown mica, only moderately pleochroic (phlogophite ?). It occurs generally in plates, averaging about 0.1 inch long. The minerals appear to have formed in the following order: *(a)* garnet, *(b)*diopside, *(c)* mica, *(d)* enstatite. As before, iron oxides are very inconspicuous; there may be a grain or two (small) of serpentinised olivine. The marked presence of enstatite distinguishes this rock from the others, but it differs from the eulysites by the substitution of that mineral for olivine, and so links those rocks to the more ordinary eclogites. The occurrence of a little mica indicates the presence of a small amount of an alkali in the magma. If necessary we may name it newlandite, but personally I should prefer to call it an enstatite-eclogite, for I think the coinage of fresh titles more often a bane than a boon to science.

5. This boulder is almost perfect, except that the general flatness of one side indicates either traces of an old fracture or considerable loss by crumbling. The surface has been smooth, but it has suffered from unequal weathering of the minerals. Its girth, in three directions at right angles, is approximately 20½ in. by 19½ in. by 17½ in. It appears only to differ from the last-described in

[1] As noticed by Professor Lewis, *ut supra*, p. 22, in the diopside, the prism cleavage has practically disappeared, and a clinopinacoïdal cleavage replaces the orthopinacoïdal usual in diallage.

having its garnets a shade more purple, and in an approach to a banded structure; the diopside being rather more abundant in a middle zone, the garnet in one, the enstatite in the other of the outer zones. Being satisfied that it is merely a variety of the last-described rock, I have preferred to leave it as an intact boulder.

6. The next fragment, measuring about 3 in. by 2¼ in. by 2 in. and retaining part of its smooth outer surface, is labelled "Found in the yellow ground of No. 2 mine,[1] 50 feet deep." Though it is much more decomposed than the others, the purplish garnet, the emerald-green pyroxene, the altered enstatite (here very rotten), and a flake or two of phlogophite (?) are easily made out. It is obviously a more decomposed specimen of the rock represented by the two preceding specimens.

7. The last of this group of specimens is a rock fragment,[2] measuring about 3½ in. by 2 in. in length and breadth, and slightly exceeding an inch in greatest thickness. Its outline is irregular, being determined by the fracture of the predominant diallage-like mineral. The crystals of this run large, an inch or more in length, breadth, and thickness. It is greyish-green in colour, having one dominant cleavage, with a sub-metallic lustre, and close subordinate cleavages, giving a somewhat fibrous aspect to that surface. Between these large crystalline lumps, numerous small, ill-defined garnets (pyrope) seem crowded, so as to form fairly continuous partings, generally hardly 0.1 inch in thickness. As the readiness with which the rather soft pyroxenic constituent split away made it improbable that a good slice could be cut, and I was reluctant to injure the specimen, I contented myself with detaching a few flakes of this constituent for microscopic work, since the determination of its identity was sufficient

[1] The others come from another mine (No. 1).

[2] I am informed that this was not part of a boulder, but came out of the "blue ground" nearly in its present condition.

for my purpose. These show the mineral to have one easy cleavage and a rather fibrous structure; they give straight extinction parallel with this. As the usual rings and brushes can be seen on the face of easy cleavage, the mineral belongs to the bastite group. The same is true of the enstatite in boulder (4), though, as it is slightly more fibrous, and not in quite so good a condition, the optical picture is less distinct. Thus we may name the rock from which the present specimen has been broken, a garnet-bearing bastitite.

8. This specimen, said to be a fragment of a boulder, is very different from the rest. It is a compact greenish grey rock containing enclosures, which give it the aspect, at first sight, of a pebbly mudstone. Microscopic examination shows it to be a compact felspathic diabase, with vesicles, which have been filled up with calcite, chlorites, and other secondary minerals (probably zeolites), but not to have any special interest. Its relations appear to be with the rocks occurring in a conglomerate which we shall mention in a later paragraph.

The "Blue Ground" and Associated Rocks.

Two areas of diamantiferous rock are now being worked at the Newlands Mines. The shape of the one which supplied most of the specimens described in this paper is irregular, and, so far as I know, exceptional. Its outline at the surface may be roughly compared to a rounded triangle into the base of which the point of a rather short shuttle is thrust, the greatest breadth of the two being about equal. Exploratory workings at a depth of 300 feet show that the former area rather quickly narrows, and the latter terminates in clefts; the "blue ground," in fact, appears to fill a fissure, broadening in two places to vents which have been traced for some distance underground southwards from the principal mass of diamantiferous rock, as represented in the annexed section.

An igneous rock, occurs on either side. It is compact, a greenish gray in colour, not unlike some of the less acid Welsh felstones. Under the microscope it is found to be much affected by secondary mineral changes: the iron oxides alone being in good preservation. A few small crystals of decomposed felspar are scattered in a yet more decomposed matrix, of which the minor details are uninteresting. The rock may be classed with the compact, rather felspathic, diabases. These, farther to the south, turn off rather sharply to east and west.

In the interval, about 12 feet in width, between walls of this diabase, ribs of the "blue," and a mudstone alternate, the thickest one of the former being from 3 to 4 feet in width, and the inner part of it is in better preservation than the outer. Specimens have been examined from the heart of the mass (vii), a part outside it (vi), and the exterior portion (v). The first (vii) in texture, hardness, and colour, reminds me a little of the dark serpentine found north of Cadgwith, in Cornwall. In this matrix roundish spots occur, some darker than it, others a yellow-green colour, besides a few angular whitish spots. The block is traversed by two or three thin calcareous veins. Specimen (vi), while generally similar, is more decomposed, and apparently contains some fragments of shale. Specimen (v) has a stratified aspect, being a dull grey faintly mottled rock, with streaky, dark, rather carbonaceous-looking bands; the origin being doubtful, till it is seen under the microscope. A fourth specimen (iii) shows the mudstone traversed by a vein of rather pale-coloured decomposed "blue," not exceeding an inch in thickness. A fifth (ii) is from near the diabase on the western side, a dark compact rock, faintly mottled, here and there presenting a slight resemblance to a "blue" traversed by thin veins of a carbonate; and sixth (iv) from a like position on the opposite side is a generally similar rock, but with wider veins filled with more coarsely

crystalline calcite. The last specimen represents the "blue" in the "neck," a few yards to the north and at the same level (300 feet). This, inferior in preservation to the first named, includes numerous rounded fragments a little darker than the matrix, with others, angular to subangular, some also darker and some lighter than it.

A brief summary of the results of microscopic examination may suffice, as these rocks do not materially differ from specimens obtained in the De Beers mine, of which I have published a full account (*Geol. Mag.*, 1895, p. 492, and 1897, p. 448.)

The matrix is a mixture, in slightly variable quantities, of granules of calcite or dolomite, serpentine, pyroxene, and iron oxides, in which occur flakes with fairly idiomorphic outlines of a warm-brown mica, moderately pleochroic, corresponding with that described (*Geol. Mag.*, 1897, pp. 450, 451) in one or two specimens from De Beers Mine. The prisms are about 0.002 inch in diameter, and sometimes nearly as thick. This mica, which, as stated in a former paper, I consider a secondary product, occurs abundantly in all the specimens, but in that from the interior (on the whole the best preserved rock) it is locally assuming a green colour, no doubt by hydration. In the specimens from the thick rib, the one last named contains mineral grains and rock fragments, except for a few flakes of the usual mica. The former are a mixture of two fibrous minerals, the larger part corresponding with actinolite; the rest, giving lower polarisation tints, may be serpentine. This fact, and structures suggestive of the former presence of a cleavage more regular than that of olivine, make it more probable that diopside was the original mineral. Though iron oxide is present in specks and rods (especially in the worst preserved specimen), this occurs either in the outer part, or as though it had been deposited along cleavage planes. In the thin rib of "blue" (iii) some of the grains are composed partly

of a fibrous mineral, as above described, and partly of a clear one, which often affords rather rich polarisation tints, and presents some resemblance to quartz. Its precise nature is difficult to determine, owing to the absence of distinctive characters, but I believe it to be of secondary origin. Rock fragments are not common in the first (interior) specimen (vii); one, however, is probably an altered shale, and another possibly a limestone. This is bordered by a pale pyroxenic mineral piercing into the grains of calcite. In the second specimen (vi) fragments are rather common; among them are those of diabase, ranging from fine to coarse, one specimen of the latter, originally, perhaps, an inch in diameter, showing an ophitic structure; felspar and augite both being rather altered, seemingly by infiltration, and one small fragment resembles a subcrystalline limestone. Specimen (v) does not materially differ, but seems to contain more carbonate than the others. The dark streaking is due to grains of iron oxide or serpentine with much opacite; rock fragments few and small. Specimen (iii) from the thin vein contains a very few small rock fragments, mudstone, or shale, more or less altered, possibly also a compact diabase. The "country rock" is a mudstone, consisting of small chips of quartz and felspar, variable in size, embedded in a dusty matrix, including a carbonate, which is more abundant within about a fiftieth of an inch from the junction. The part is slightly stained, but I was unable to detect any signs of contact metamorphism. Specimens (ii) and (iv) are generally similar, but the former contains some small rounded bits of varieties of diabase, and one may represent a crystalline limestone. The veins are filled with calcite and other secondary products, and are bordered by a very thin film of a brown micaceous mineral, like that described as often permeating the "blue." Both specimens suggest micro-mineralogical changes, such as might be produced by the passage of hot water.

Other specimens of the sedimentary rock in the immediate neighbourhood of the blue have been forwarded to me by Mr. Trubenbach, one, from the adit on the southern side of the section mentioned above, is a grey mudstone, containing a flattish rectangular pebble, of a dark green compact rock. Two others are from No. 2 mine, or about 700 yards to the south-west. One, struck in the shaft at a depth of 200 feet, is a conglomerate, composed of well-rounded rock fragments, with some scattered grains of quartz. Each of the former is bordered by a zone of the crystalline carbonate (impure calcite), and the interstices are filled, sometimes by a clearer variety of the same, but more often by some minutely granular secondary product. Of the rock fragments, one is a sub-crystalline dolomitic limestone; two, perhaps, are chalcedony; the remainder are igneous; the majority being varieties of the diabase, sometimes rather decomposed; the rest trachytes, mainly andesites. Their general aspect and the not unfrequent presence of vesicles (now filled with viridite) suggests that they have been furnished by lava-flows. Another specimen, obtained in the same working at a depth of 400 feet, is a rather felspathic diabase, not unlike one of the varieties in the conglomerate. It is a good deal decomposed, is not improbably from a lava-flow, but does not call for a minute description.

Conclusion.

Thus the diamond has been traced up to an igneous rock. The "blue ground" is not the birthplace either of it or of the garnets, pyroxenes, olivine, and other minerals, more or less fragmental, which it incorporates. The diamond is a constituent of the eclogite, just as much as a zircon may be a constituent of a granite or a syenite. Its regular form suggests not only that it was the first mineral to crystallise in the magma, but also a further possibility. Though the occurence of diamonds in rocks with a high

percentage of silica (itacolumite, granite, etc.) has been asserted, the statement needs corroboration. This form of crystallised carbon, hitherto has been found only in meteoric iron (Canyon Diablo), and has been produced artificially by Moissan and others with the same metal as matrix. But in eclogite the silica percentage is at least as high as in dolerite; hence it is difficult to understand how so small an amount of carbon escaped oxidation. I had always expected that a peridotite (as supposed by Professor Lewis), if not a material yet more basic, would prove to be the birth-place of the diamond. Can it possibly be a derivative mineral, even in the eclogite? Had it already crystallised out of a more basic magma,[1] which, however, was still molten, when one more acid was injected, and the mixture became such as to form eclogite? But I content myself with indicating a difficulty, and suggesting a possibility; the fact itself is indisputable: that the diamond occurs, though rather sporadically, as a constituent of an eclogite, which rock, according to the ordinary rules of inference, must be regarded as its birth-place.

This discovery closes another controversy, viz.: that concerning the nature of the "Hard blue" of the miners (Kimberlite of Professor Lewis), in which the diamond is usually found. The boulders described in this paper are truly water worn. The idea that they have been rounded by a sort of "cup and ball" game played by a volcano may be dismissed as practically impossible. Any such process would take a long time, but the absence of true scoria implies that the explosive phase was a brief one. They resemble stones which have travelled for several miles down a mountain torrent, and must have been derived from a coarse conglomerate, manufactured by either a strong stream or the waves of a sea from frag-

[1] This, however, cannot have been very rich in iron, because diopside does not contain much of that constituent.

ments obtained from more ancient crystalline rocks.[1] The "washings,"[2] a parcel of which I received from Mr. Trubenbach, also show that the boulders are really water worn. Besides two unworn pieces of pyrite and a rough bit of eclogite, about three quarters of an inch in diameter, the pyroxenic constituent of which was a bright emerald green (? smarágdite), I find part of a subangular fragment of chrome-diopside associated with two or three flakes of the usual mica, a well rounded garnet fully 0.6 inch across, and half a well worn pebble of eclogite, about one inch long and half an inch thick. The rounded water-worn look of the great majority of the smaller constituents (chiefly garnets and pyroxenes), about the size of hemp seed, is very obvious. I had suspected some of the grains washings from the De Beers Mines to have been similarly treated; but here it is indubitable, indeed many of the dark green specimens are so smooth outside that they could only be identified after fracture. The ordinary diopside can, however, be recognized, with some of a clearer and brighter green. Most of the garnets are pyropes, but a few resemble essonite. I find also some grains of iron oxide and of vein quartz. Thus, the presence of water-worn fragments, large and small, in considerable abundance, shows the "blue ground" to be a true breccia, produced by the destruction of various rocks (some of them crystalline, others sedimentary, but occasionally including water-worn boulders of the former)—*i.e.*, a result of shattering explosions, followed by solfataric action. Hence the name Kimberlite must disappear from the list

1 As these eclogites are very coarsely crystalline, we are justified in assuming they were once deep-seated rocks, and so much more ancient than the date of the conglomerate. To prevent any misunderstanding, I may repeat that the matrix from which these boulders were taken (at various depths, from nearly 100 to about 300 feet) cannot be any alluvial deposit, but is the typical "blue ground," practically identical with that in the Kimberly mines.

2 The name is given to the mineral residue left after washing away the decomposed matrix of the "blue ground."

of the peridotites, and even from petrological literature, unless it be retained for this remarkable type of breccia.

Boulders, such as we have described, might be expected to occur at the base of the sedimentary series, in proximity to a crystalline floor. The Karoo beds in South Africa, as is well known, are underlain in many places by a coarse conglomerate of considerable thickness and great extent, called the Dwyka conglomerate, which is supposed to be Permian or Permo-carboniferous in age. It crops out from beneath the Karoo beds at no great distance from the diamond-bearing district, and very probably extends beneath it. If this deposit has supplied the boulders, the date of the genesis of the diamond is carried back, at the very least, to Palæozoic ages, and possibly to a still earlier era in the earth's history.

Proceedings of the Natural History Society.

Session 1898–99.

The first meeting of the Society for the present session took place with the Entomological Society of Ontario, holding their annual meeting in our city and in our rooms and museum, on November 8th.

The usual monthly meeting was held in the library, November 28th, 1898, at eight o'clock.

The President, Frank D. Adams, Ph.D., in the chair.

There were also present, Messrs. H. McLaren, Rev. R. Campbell, D.D., J. B. Williams, E. T. Chambers, Albt. Holden, Dr. H. B. Cushing, Prof. McBride, Prof. Donald, H. H. Lyman, and sixteen other gentlemen and several ladies.

Rev. Dr. Campbell read a letter from Sir Sanford Fleming *in re* a testimonial fund to Mrs. Traill, the authoress. Dr. Campbell volunteered to set the matter before a committee of ladies.

The Librarian, Mr. E. T. Chambers, then reported that there were between 200 and 300 unbound volumes collected, awaiting the means to pay for their binding. He also expressed a wish that all of our library was properly catalogued for reference.

The Hon. Curator's report was read, telling of work during the summer and up to the present date, and suggesting many useful things to be done.

The reports were received.

On motion of Rev. Dr. Campbell, seconded by Mr. E. T. Chambers, resolved: That the thanks of the Society be tendered to the donor (Dr. Springle) for a large Horned Owl (alive).

It was moved by Rev. Dr. Campbell, seconded by Mr. J. B. Williams, that the rule be suspended and that the following be elected members of the Society as recommended by the Council, viz:

Messrs. Henry G. Vennor and G. H. A. Stevenson as associate, and W. M. Ramsay, G. C. Dunlop, Lachlan Gibb and Auguste Byarelle as ordinary members. Carried.

The business of the evening being completed, the Rev. Dr. Campbell gave his special communication on "The Asters and Golden Rods of Montreal"—over fifty (50) specimens—which was listened to with great interest, and the specimens examined by all those present.

Prof. MacBride and Dr. H. B. Cushing drew attention to the trouble in collecting and arranging them, and expressed the hope that Dr. Campbell would still further pursue his researches. The nomenclature of the plants was according to the determinations of the Torrey Club. Dr. Adams, on behalf of the Society, thanked Dr. Campbell for his paper.

Prof. Adams then vacated the chair, Dr. Campbell tak-

ing it at his request, while Prof. Adams gave his paper "On the origin of certain Iron Ores," illustrated by a specimen of Iron recently presented to the "Peter Redpath Museum." Prof. Donald offered a few remarks on this highly interesting and instructive communication, after which the thanks of the meeting were tendered to Prof. Adams.

The meeting then adjourned.

The third meeting of the Society for the session of 1898–99 was held in the library, January 30th, 1899, at eight o'clock. The President of the Society, Prof. Frank D. Adams, in the chair. There were also present, Prof. MacBride, Messrs. E. T. Chambers, H. McLaren, J. B. Picken, Capt. W. Ross, J. A. U. Beaudry, F. S. Jackson and seven others.

The minutes of last meeting were read and confirmed.

The committee on canvass for funds reported progress, and, as a result, some new members.

Dr. Campbell reported that the list of Somerville lectures was now complete, and that the first would be given on Feb. 16th next.

The following specimens were added to the museum since last meeting:

Two specimens of Mantis-like Neuroptera (*Mantispa brunnea*), donor, Mr. A. F. Winn.

Interior cells of wasp's nest from Dundas Co., Ont., by W. E. Deeks, M.D.; a specimen of Clarke's Nutcracker (*Picicorvus Columbianus*) received in exchange from Mr. Jas. H. Fleming, and a Tarantula spider from West Africa, donated by Dr. J. A. Springle.

A vote of thanks was moved by Mr. J. B. Williams and seconded by Mr. E. T. Chambers. Carried.

The Librarian, Mr. E. T. Chambers, reported that some 50 more volumes had been added to the library, some of which awaited binding.

On motion of Mr. C. S. J. Phillips, seconded by Mr. H. McLaren, the rule was suspended and Mrs. W. A. P. Chipman and Messrs. Dumouchal, R. Wilson-Smith and Thomas Fyshe were elected, the first-named associate and the other three ordinary members.

The routine business being finished, Prof. Adams in a few remarks introduced the subjects that would be considered at the next few meetings; Prof. MacBride's being the first, viz: "Zoological problems for the Natural History Society of Montreal."

Prof. MacBride then delivered his very interesting and highly instructive communication, which he said should be called "Study of Evolution in Action." After some remarks by those present a hearty vote of thanks was given to Prof. MacBride.

The meeting then adjourned.

The fourth meeting of the Society was held February 27th, 1899. Dr. Frank D. Adams, the President, in the chair. There were also present, Prof. E. W. McBride, Rev. R. Campbell, Messrs. J. A. U. Beaudry, F.W. Richards, A. Holden, H. McLaren, E. T. Chambers, J. B. Williams, Dr. A. Fisher and a number of others.

The minutes of last meeting were read and confirmed.

Rev. Dr. Campbell reported on behalf of the Lecture Committee, and stated that the Somerville Course was an unqualified success, and great interest was taken in all the subjects.

The Curator reported the following donation:

Series of Mounted Plants collected in the vicinity of Montreal, by Rev. Robt. Campbell, M.A., D.D.

The Librarian, Mr. E. T. Chambers, also reported having received a number of books as contributions to the library.

It was moved by Mr. F. W. Richards, seconded by Rev. Dr. Campbell, that the rules be suspended and the following be elected as members of the Society. Carried.

Associates—Mr. Geo. Moore, Miss Phillips, Miss Fairley, Miss Cameron, Mr. J. H. Leclair, Dr. A. Fisher; Ordinary—Messrs. J. Murray, P. S. Ross, A. E. Norris, Dr. H. B. Yates, Angus W. Hooper, F. Gascoigne, A. C. Lyman, Alfred Griffin; Life—Geo. Iles.

Rev. R. Campbell then took the chair, Dr. Frank D. Adams having vacated same to deliver his paper, entitled "Problems for the Natural History Society, in connection with the Geology of the vicinity of Montreal."

At the close of the lecture a discussion took place; Prof. E. W. MacBride making some interesting remarks.

A hearty vote of thanks was tendered to Dr. Adams for what proved to be a most interesting lecture, and calculated to stimulate members to take a greater interest in that interesting study,—Geology.

The fifth monthly meeting of the Society was held March 27th, 1899, Mr. A. Holden occupying the chair. There were also present, Messrs. J. A. U. Beaudry, F. W. Richards, J. B. Williams, J. Gardner, Dr. E. D. Blackader, E. T. Chambers, Rev. R. Campbell, D.D., Dr. Cushing, A. Byarelle and a number of strangers.

Minutes of last meeting were read and confirmed.

The Report of Council was taken as read.

A communication was read from the Royal Society of Canada *re* appointing a delegate to attend the general meeting. Left over to next meeting.

The following donations were reported by the Curator:

A collection of North American Birds' Eggs, consisting of one hundred and seventeen specimens. Donor, Mr. C. N. Sonne.

A Spanish Silver Coin of Charles III, also one Chinese and one Japanese Coin. Donor, Mrs. Alfred Griffin.

Confederate Bill (1861) for $50.00. Donor, Mr. Reginald Davidson.

Two Ferns. Donor, Mr. J. B. Goode.

The rules having been suspended, on motion of Rev. Dr. Campbell, seconded by Mr. Jas. Gardner, the following members were elected :

Associates—Miss Bickley, Mrs. A. P. Drummond.

Ordinary—Mrs. A. R. Oughtred.

Rev. R. Campbell, D.D., then read his paper, entitled "What remains to be done for the Botany of the District of Montreal." He stated that Montreal was peculiarly fortunate as a place for flora from all parts. He also outlined what had been done in the past and what still remained to be done by a little effort in the future. He also gave many practical suggestions to those interested in the study of Botany.

Remarks were made by the Chairman, also by the following : Dr. Cushing, Messrs. E. T. Chambers, J. B. Williams, Dr. E. D. Blackader, Jas. Gardner and F. W. Richards.

The above discussion suggested Saturday afternoon excursions. This matter was left over till next meeting.

A vote of thanks to Dr. Campbell was then moved by Mr. J. B. Williams, seconded by Mr. F. W. Richards. Carried unanimously.

The meeting then adjourned.

The sixth monthly meeting of the Society was held April 24th, 1899, Dr. Wesley Mills in the chair. Also present : Messrs. P. S. Ross, Judge Würtele, J. B. Williams, J. A. U. Beaudry, H. McLaren, C. T. Williams, E. T. Chambers, Rev. Dr. Campbell, R. W. McLachlan, Dr. Fisher and others, 20 persons in all.

Minutes of last meeting read and confirmed.

DONATIONS.—Shells and pieces of Indian Pottery from Picton, Ont., by Drummond Price.

Coral and pieces of Stalactite, by Reginald Davidson.

Dried Leaves, Shells and Sea-Urchins, by Douglas Black.

1 Red-throated Loon, by F. C. Fairbanks.

King Eider, male and female, by F. C. Fairbanks.

Tail of Horse Mackerel, by F. C. Fairbanks.

Walking Stick made from a Cabbage Stem, by F. C. Fairbanks.

Collection of Mounted Plants from British Columbia and N.W.T., by Rev. R. Campbell, D.D.

Case of Insects (18 specimens) by F. C. Emberson.

A vote of thanks to the donors was moved by Mr. E. T. Chambers, seconded by Mr. J. B. Williams, and carried.

Rev. Dr. Campbell presented to the Society 300 botanical specimens from the Rocky Mountains, collected by himself. A special vote of thanks was very cordially passed on motion of Mr. H. McLaren, seconded by Mr. J. A. U. Beaudry.

The rule was suspended on motion of Mr. A. Holden, seconded by Mr. J. B. Williams, and the following were elected as members:

Associate—Lydia A. Sinclair and Isabel G. McBratney.

A special communication of a very interesting character by Mr. J. B. Williams on "The Color of Birds in Relation to Age, Sex, Season and Inheritance," was then made to the Society, which led to a discussion and questions by Messrs. R. W. McLachlan, Dr. Wesley Mills and others. A very hearty vote of thanks was extended to Mr. Williams on motion of Rev. Dr. Campbell, seconded by E. T. Chambers.

ANNUAL MEETING.

MONTREAL, 29th May, 1899.

The annual meeting was called for this evening, and on motion was adjourned until Monday evening, June 5th.

The following were present: Rev. Robt. Campbell, D.D., Capt. W. Ross, J. H. Joseph, Alfred Griffin, J. B. Williams, J. Hooper, Jos. Fortier, C. S. J. Phillips, A. Holden, Frank Gascoigne, H. E. Vennor, Dr. Birkett.

June 5th, 1899.

The adjourned annual meeting, according to resolution, was held this evening in the hall of the institution, at eight o'clock. The President, Frank D. Adams, Ph.D., F.R.S.C., in the chair. There were also present: Messrs. Albert Holden, J. H. Joseph, J. A. U. Beaudry, J. S. Buchan, C. T. Williams, Hon. Justice Würtele, Rev. Robt Campbell, D.D., H. McLaren, F. W. Richards, Jos. Fortier, Edgar Judge, P. S. Ross, Rev. G. Colborne Heine, G. M. Todd, G. Moore, Alfred Griffin, E. T. Chambers and Chas. S. J. Phillips.

The minutes of the last annual meeting were read and confirmed.

The following donations to the museum were reported by the Curator:

Nest and Eggs of Chestnut-sided Warbler, by Mr. E. D. Wintle.

1 Ammonite found at Outremont, near Montreal, by Walter Wilshire.

1 Ichneumon Fly (with long spines), by Dr. J. A. Springle.

2 Barnacles off a Whale's Back, by Mrs. P. Shoufeld.

The reading of the different annual reports was then proceeded with, viz:

Chairman of Council.

Treasurer.

House Committee.

Curator.

Librarian.

Editing Committee (no report).

All of which, with the exception of the last one, are on fyle.

The President then made a very excellent and encouraging address, and stated that he laid down the office held by him for the past two years with a measure of regret, and promising his hearty co-operation as far as lay in his power for the future.

It was then moved by the Hon. Mr. Justice Würtele and seconded by the Rev. Robt. Campbell, M.A., D.D., that the annual reports be received and adopted, and that they be printed in the forthcoming issue of the RECORD OF SCIENCE.

Dr. Campbell made excuse for Mr. A. Brodie in the non-issuance of the RECORD OF SCIENCE, owing to his illness and his duties at the University taking up so much of his time, and said that the publication of the first number of the new volume was under way; an effort was being made to get more contributors to it. The financial report was also encouraging.

Mr. J. S. Buchan added a few well-timed words, advocating the organizing of a series of Saturday afternoon excursions so as to excite interest for Natural History in the young; also recommended that the RECORD OF SCIENCE be made more of a popular magazine. The motion was then put to the meeting and carried unanimously.

A request was made by Dr. Lemoine through the Recording Secretary to authorize the signing of a requisition for the Montreal Street Railway extension up Beaver Hall Hill to St. Catherine Street *via* University. On motion of Mr. Jos. Fortier, seconded by Mr. H. McLaren, it was resolved that the Recording Secretary be authorized to sign the requisition, providing that the rails do not go further west on Dorchester Street than University, nor further north than St. Catherine on the same street.

MEMBERS.—The rule being suspended on motion, Mr. M. Waring Davis was then elected an associate member on motion of Mr. F. W. Richards, seconded by Mr. A. Holden.

Mr. F. W. Richards, the Treasurer, then referred to the fact that the Council had granted leave of absence to Mr. Alfred Griffin, our Superintendent, to go to England this coming summer, and testified to the good work and efforts of Mr. Griffin and his faithfulness, and moved, seconded by Mr. E. T. Chambers, that a grant of twenty-five dollars

be made to Mr. Griffin towards the expenses of his trip across. After some very favourable remarks *in re* our Superintendent, it was moved in amendment by Hon. Mr. Justice Würtele, seconded by J. A. U. Beaudry, that the amount be fifty dollars. It was carried unanimously.

The President then appointed Messrs. Albert Holden and F. W. Richards scrutineers.

The election of officers was then proceeded with.

Hon. President.—It was moved by Mr. Chas. S. J. Phillips, seconded by Mr. J. S. Buchan, that Sir J. Wm. Dawson, LL.D., F.R.S., F.R.S.C., &c., be Hon. President. Carried unanimously by a standing vote.

President.—Rev. Dr. Campbell nominated, seconded by Mr. F. W. Richards, Prof. T. Wesley Mills, M.A., M.D., as President. There being no other nomination, he was declared elected by acclamation.

Vice-Presidents.—The ballot was then taken for Vice-Presidents, which resulted as follows: Lord Strathcona, Rev. Robt. Campbell, D.D., Frank D. Adams, Ph.D., B. J. Harrington, Ph.D., Messrs. C. T. Williams, J. H. Joseph, Hon. Justice Würtele, Walter Drake and H. H. Lyman.

On motion, one vote was cast for the office of Recording Secretary, and Mr. Chas. S. J. Phillips was re-elected.

On motion, one vote was cast for Mr. J. S. Buchan as Corresponding Secretary; elected unanimously.

On motion of Judge Würtele, seconded by Mr. C. T. Williams, Mr. Alfred Griffin was elected as Superintendent and Curator.

On motion, one ballot was cast for Mr. F. W. Richards as Treasurer.

Members of Council.—As a result of the ballot, the following were elected as the Council for the ensuing session: Messrs. Albert Holden, J. A. U. Beaudry, E. T. Chambers, Joseph Fortier, Rev. G. Colborne Heine, Edgar Judge, Prof. E. W. MacBride, H. McLaren, Geo. Sumner.

It was moved by Dr. Campbell and seconded by Mr. J.

Harper that the by-law be suspended, and that the Editing Committee be appointed by the Council. Carried.

Mr. E. T. Chambers was elected as Librarian by acclamation.

On motion, Mr. Justice Würtele was requested to take the chair, when the following was proposed as a vote of thanks to the retiring President:

Moved by the Rev. Robt. Campbell, M.A., D.D., and seconded by Mr. J. S. Buchan, B.C.L., that a very hearty vote of thanks be and is hereby tendered to Prof. Frank D. Adams, Ph.D., the retiring President, for the admirable manner in which he has filled the office for the past two years and for the great assistance given and time spent for the advancement of the aims and objects of this Society. The motion was carried unanimously.

After a few remarks by Dr. Adams the meeting adjourned.

The Chairman of Council begs to submit the following report for the year ending May 30th, 1899.

During the year eight meetings of Council have been held, at which reports of the different Committees were received and all other business of the Society discussed, before being submitted to the regular monthly meetings of the Society.

The regular monthly meetings have been held as usual.

The October meeting was postponed to November 8th, on which date a Conversazione was held in connection with the Montreal Branch of the Entomological Society of Ontario, which proved most successful.

The average attendance of the meetings has been larger than formerly, and the interest taken by the members and their friends seems to have greatly increased.

The papers read were as follows:

November 28th.—The Asters and Golden Rods of Montreal. Rev. R. Campbell, D.D.

The Origin of certain Iron Ores. Prof. F. D. Adams.

January 30th, 1899.—Study of Evolution in Action. Prof. E. W. MacBride, M.A., B.Sc.

February 27th.—Geology of the Vicinity of Montreal. Prof. F. D. Adams.

March 27th.—What remains to be done for the Botany of the District of Montreal. Rev. R. Campbell, D.D.

April 24th.—The Color of Birds in relation to Age, Sex, Season and Inheritance. J. B. Williams, F.Z.S.

SOMERVILLE COURSE.—There were seven lectures given this year, as follows:

Thursday, February 16th.—"Hydraulic Mining," by Prof. J. Bonsall Porter, E.M.Am., Ph.D.

Thursday, February 23rd.—"Wireless Telegraphy," by Prof. E. Rutherford, M.A., B.Sc.

Thursday, March 2nd.—"Creatures of Other Days," by Prof. Frank D. Adams, M.A.Sc., Ph.D., President of the Natural History Society.

Thursday, March 9th.—"The Canals of Canada," by Mr. J. G. G. Kerry, M.A., E.A.M.

Thursday, March 16th.—"New Gases of the Atmosphere," by Prof. J. Wallace Walker, M.A., Ph.D.

Thursday, March 23rd.—"Water-Power Development," by Prof. R. B. Owens, E.E., Vice-President American Society of Engineers.

Thursday, March 30th.—"The Food of Fishes," by Prof. E. W. MacBride, M.A., B.Sc.

There were eight half-hour lectures to young people on Saturday afternoons, all of which were well attended, as follows:

March 4th.—"Kingfishers and Cuckoos." J. B. Williams, F.Z.S.

March 11th.—"Carlo and his Master." Dr. Wesley Mills.

March 18th.—"The Honey Bee." C. T. Williams.

March 25th.—"How Plants Live." Miss C. M. Derick.

April 7th.—"My Holidays in the Country." Rev. Thomas W. Fyles.

April 15th.—"How to know Plants." Rev. Robt. Campbell, D.D.

April 22nd.—"Corals." J. B. Picken.

April 29th.—"Ocean Currents." Capt. W. Ross.

April 29th.—"The Elephant and the Mammoth." E. T. Chambers.

All the above lectures were arranged for by the Lecture Committee, who will report on the same.

Thirty-three new members have been elected during the year,—22 ordinary, 10 associate and one life member. Some have resigned and others have been removed by death.

The number of visitors to the Museum has largely increased, owing, no doubt, to its being open free to the public on Wednesday afternoons and all day Saturday.

The Annual Field Day was held on June 4th at Rigaud Mountain, and was attended by about 170 members and their friends, who were received at the station by the Seigneur of Rigaud, Mr. A. C. de Lery Macdonald, who entertained a number of the party at the Manor House.

The Society is indebted to Mr. Griffin, the Superintendent, for the work he has done in securing many new members, and in the increased interest he has taken in the welfare of the Society during the past year. Permission has been granted to Mr. Griffin to visit his home in England during the summer months.

The different Committees will report to you on the work done by them during the year.

Respectfully submitted,

A. HOLDEN,
Chairman of Council.

NATURAL HISTORY SOCIETY OF MONTREAL,

IN ACCOUNT WITH

F. W. RICHARDS, *Hon. Treas.*

CASH SUMMARY FOR YEAR ENDING MAY 29TH, 1899.

Receipts.

To Balance cash on hand	$ 49 57
" Rents	767 00
" Members' Subscriptions	542 00
" Loan Merchants Bank	492 60
" Donations	225 00
" Entrance Fees to Museum	30 35
" Insurance, Fire Loss	10 00
	$2116 52

Expenditure.

By Superintendent's Salary and Commission	$ 498 00
" Repairs and Renovations	319 45
" Sundry Expenses	178 24
" Light	165 10
" RECORD OF SCIENCE	164 43
" Museum	163 94
" Returned Loan 1898	150 00
" Fuel	146 41
" Printing	76 30
" Lecture and Conversazione	47 50
" City Tax	33 95
" Interest Merchants Bank	10 31
" Cash on hand	162 83
	$2116 52

Audited and found in accordance with the records of the Association.

(Signed) PHILIP S. ROSS, C.A.
H. MCLAREN.

MONTREAL, 5th June, 1899.

MUSEUM REPORT FOR 1898-99.

GENTLEMEN,—The principal work done to the Museum during the past year has been the re-arrangement of the Shell Collection, which consists of about 4000 specimens. All of them (except Col. Bulger's collection from Port

Blair) have been cleaned, re-arranged and grouped together in their families, which have been labelled with their English and scientific names. The Montreal specimens have been taken out from the other Canadian series and grouped by themselves, so that they form an interesting "Local Collection."

Our series of Fossils, which occupy the corresponding cases on the other side of the Museum, greatly need to be cleaned, re-arranged and labelled in the same way that the shells have been.

The drawers of the Insect Cabinet, which contain the Canadian Butterflies, have been re-arranged so as to make room in the proper place for all recently-obtained specimens, and a number of the foreign *Lepidoptera* have been named.

Since the month of December, when the Council decided that the funds were not sufficient to allow of the Curator continuing work at the Museum, no work has been attempted save the naming and arranging to some extent of new specimens presented to the Museum, and it has been necessary to do away with the aquarium and some of the live snakes, which required continual care to keep them in a proper state.

Mr. Griffin has taken care of the muskrat and large owl since December, and they are both doing well, but we have no proper accommodation for a large bird like the owl, and it will be difficult to prevent its being a nuisance during the hot weather on account of the smell.

The donations and additions have been reported at the monthly meetings of the Society, and need not be repeated in detail. The most valuable presentations during the year have been Corals and Shells from Miss Fanny Joseph, Birds' Eggs from Mr. C. N. Sonne, and Plants from the Rev. Dr. Campbell.

The Museum Committee arranged for the usual course of Lectures to Children during March and April.

A very interesting and instructive series were given by different members and friends, four of which were illustrated by the electric lantern, The attendance was very large during March, but April seems to be too late a time for them, as the attendance was not so good after the Easter holidays.

The number of visitors to the Museum on Saturday (the free day) has often been very large, and on this day and Wednesday afternoons the total for the year has probably been about four thousand persons. The attendance on other days, when admission is charged, has been about four hundred visitors and members.

The Wednesday afternoon attendance has lately rather fallen off, owing partly to the fact that the notice boards, announcing that afternoon as free, were wrenched down and stolen from the porch in the month of January last.

The Insect Exhibition, which remained at the Museum for three days after the Entomological Conversazione, was a remarkably interesting and valuable one, but, owing partly to the bad weather, the attendance during those days was not very large.

All of which is respectfully submitted.

J. B. WILLIAMS,
Chairman of Museum Committee.

86 Union Avenue,
MONTREAL, June 5th, 1899.

REPORT OF THE HONORARY LIBRARIAN.

The Library Committee has not had occasion to meet during the past year. The time of the Librarian has been taken up with acknowledging the exchanges, making up

incomplete volumes for binding, and preparing the catalogue. Much time during the illness of the Superintendent was unavoidably lost, as without his assistance very little could be done.

Your Librarian is pleased to report that increasing interest is being taken in the Library by the members, and much more use will be made of it when it is known what scarce and valuable works are to be found in it. In this connection I am glad to state that a permanent catalogue is now well in hand. After much consideration the card system has been adopted. It becomes of use as the work goes on, and from it a printed catalogue can be easily got up on any arrangement that may be decided upon. Two of the cases are finished, and the cards will be at once arranged in alphabetical order. I must here acknowledge the great assistance received from Mr. Griffin, without whose ready and intelligent help the work I have mentioned could not have been performed. The other cases will be taken in hand at once, but the assistance of some of the members of the Society is asked in the arrangement and cataloguing the contents of the two cases containing works in the French and German languages.

Above 300 volumes of exchanges are now waiting for the binder. It is a pity that these volumes, which contain very important papers on recent science, should not be more available for the use of members in consequence of their waiting to be bound in volumes for so long a time after their publication.

The cases being filled, more shelving is urgently required, and it would be to the interest of the Society if the Council could at an early period make a liberal grant to the Library for new cases and for binding the volumes mentioned.

Respectfully submitted,

E. T. CHAMBERS,
Hon. Librarian.

President's Address.

This, I take it, should be a brief review of the work of the Society during the past year, containing possibly suggestions for the betterment of the Society's work in the year to come.

Detailed reports on the Society's work in its various departments are now before you, and I wish merely to touch upon certain phases of it.

The Society's work has during the past year been in many ways very satisfactory,—let us hope that next year its weak parts may be strengthened, and that it may be satisfactory in *all* respects.

Our Natural History Society here is placed in a position quite different to that of many similar societies elsewhere.

Our summer is short, and all field work must be concentrated in it. During our long winter our studies must be continued indoors.

Now, our indoor work for the furtherance of Natural History is well done.

It may be stated to consist of three courses of lectures (with discussions on the same), adapted to three different classes of our community, together with studies in the Museum.

These are our (1) monthly meetings, where papers on the more serious aspects of Natural History are presented; (2) the Somerville lectures, a popular course of lectures adapted to the public at large; and (3) our Saturday afternoon talks to young people.

The Somerville course this year consisted of lectures on various scientific topics of especial interest to us at present. They were good and were well attended. The improved facility for illustrating them, due to our new electric lantern, was marked.

The Saturday afternoon talks to young people were also good and were much appreciated, having been better

attended than on any previous year, the lecture hall having been crowded repeatedly.

Our Museum also has done excellent work for us. The number of visitors to it this year has about doubled in number, as many as 300 persons having visited it on a single Saturday.

The attendance at the regular monthly meetings has, however, remained about the same, and might be improved.

In summer, however, our work is practically at a standstill, one single excursion and our Museum being our only educating influence at work.

In other societies there are field classes in which, under the leadership of competent and enthusiastic instructors, the actual living face of nature is studied, and members of the society work and learn for themselves.

This is the best means of awakening a real interest in Natural History.

Such classes would not only instruct our young people and awaken in them a real interest in our sciences, but the discussion of the various things seen and specimens collected would be a source of life to our meetings all winter. This is, I believe, what our Society chiefly wants. There are many among our members who take a passive interest in the subject; we want more who are active and who will be workers. Why cannot, for instance, all our teachers in Natural Science in our schools be brought in touch with our Society, in this and other ways, and our Society be thus really strengthened in this its weakest part?

Something along this line, I might humbly suggest to the incoming Council, might be attempted by the Society during the coming year. The work might well be undertaken by the local association of our naturalists, and the result would be the bringing out of new workers, as it is for this that the Society exists. Why cannot arrangements be made during the summer months for field class work in the several departments.

I do not think it is well to lean too much on McGill University and be too frequent in our calls upon her. Professors of McGill gave (most of them not numbers of the Society) half of all the papers and lectures for the season last year. They gave the whole of the Somerville lectures, two of the lectures to children, and half the papers printed at the March meeting.

This is not a natural state of affairs. It is well that the Science Professors should aid our Society to a certain extent, but it is not right that they should be called upon to do so much of its work. The Society should, I believe, rely more upon itself and do its own work, instead of calling upon outsiders to work for it.

The RECORD OF SCIENCE has not appeared during the past year. Something must be done about it at once. We are now receiving all our exchanges and sending nothing for them. This, of course, is really dishonest, and if the RECORD is not continued notice must be given to our exchanges to that effect. If the RECORD goes our library goes with it.

We need for the continuation of the RECORD, first, financial support, and secondly, an editor who is able to devote the very considerable amount of time necessary to maintain a really good publication. If this can be supplied, publication of our RECORD, which has been, without the least doubt, a great source of strength to our Society, can be resumed.

Our appeal for financial help has not, I regret to say, been pushed with that vigour of which it is worthy. I am free to confess this, as I feel that I am one of the delinquents in this matter. The responses in the quarters where the appeal has been made, however, were in many cases so generous that we should be moved to real exertion in this matter, which is one of the greatest importance to us. With the loss of the grant from the Quebec Government, we have to rely entirely on our own resources,

and giving, as we do, so much—free of charge to the public—we have reason to believe that those amongst them who are blessed with the means of giving will in their turn be generous to us.

We should not, however, put off this matter any longer—the time to act is *now.*

Without such aid our work *must* be crippled, and some of it must be stopped.

And finally, in resigning my honourable position as President of the Society, which I have held for the past two years, I have to thank the members of the Council and the Society at large for the large measure of aid which has always been extended to me in my work. I know that my successor will discharge the duties of the office much more efficiently than I have done, and that under him the Society will take a new lease of life.

Book Notice.

An Illustrated Flora of the Northern United States, Canada, and the British Possessions, from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean Westward to the 102nd Meridian.—By Nathaniel Lord Britton, Ph.D., Emeritus Professor of Botany in Columbia University, and Director-in-Chief of the New York Botanical Garden, and Hon. Addison Brown, President of the Torrey Botanical Club. In three volumes. New York: Charles Scribner's Sons, 1898.

This is an epoch-making work in relation to the science of Botany. It will greatly help to popularize the study of the flora of the North American continent, doing for it what Bentham and Hooker's Handbook has done for the flora of Great Britain and Ireland. These volumes are an immense boon, especially to amateur botanists. Written descriptions, however accurate, do not convey to the mind so clear a conception of what a plant is like as the figured illustrations in black and white do. There is still plenty of work for the student to do after he has been put on the track of the family or genus to which a specimen belongs, through the help of the outlines furnished by these volumes. He must study the plant in detail, in order to make sure that the spe-

cimen in hand corresponds with that figured in the book and described in the text. These three volumes have taken eight years to prepare, and they have been produced with great care and at enormous cost, as will be understood when the fact is stated that no fewer than 4162 species, including 81 in an appendix to the third volume, are described and figured in them, while Bentham and Hooker's Handbook of the British Flora embraces only 1309 species. Not more than one-fourth of the plants described in this work have ever before been figured, and whatever was previously done in this connection was only in scattered monographs or local collections.

The first volume opens with a description of the Ferns and their allies, the *Pteridophyta*, and the third volume ends with the *Compositæ*. This plan reverses the order of the older treatises in Botany, which began with the higher forms of plant-life and concluded with the lower; but it is undoubtedly the true scientific method to proceed from the study of the simple to that of the more complex productions of the earth, and the authors of this work have done wisely in following the leadings of nature in this matter. Engler and Prantl of Germany had already led the way in this desirable reform. Britton and Brown have also followed the lead of these German authors as to the divisions into genera, greatly increasing their number, and correspondingly decreasing the number of species and varieties ranged under them respectively. It may be said that this is an arbitrary proceeding on the part of the botanists of the day. But much of the distribution into genera and species is largely matter of opinion as to what differences are to be deemed determinative; and this much may be said for the work before us and its German prototype, that, in lessening the number of species and varieties compared under one genus, it greatly facilitates the study of specimens, and whatever contributes to that end is to be welcomed. It is not without a feeling of reluctance that those accustomed to use Gray's "Manual of the Botany of the Northern United States" will lay it aside in favour of this new work. No one familiar with the "Manual" will ever cease to be grateful to its author. It has done noble service. But science is progressive, and we must advance with the times.

The code of nomenclature adopted by the authors of this work is that devised by the Paris Botanical Congress of 1867, modified by the rules agreed upon by the Botanical Club of the American Association for the Advancement of Science in 1892 and 1893, and published by the Torrey Club in 1894. Starting with the "Species Plantarum" of Linnæus, published in 1753, priority is asserted as the fundamental law of nomenclature. Plants removed from one genus to another retain their original specific name. A name already appropriated is not allowed to be applied to another plant. Parentheses are employed to show where a plant has been transferred from one genus to another. Specific names

derived from persons or places begin with capitals; also when a former generic name is reduced to the rank of a species, its history is traced by the use of a capital. When a variety is mentioned, it is added to the specific name, without any prefix, and there is no comma before the name of the authority.

The changes which these rules will make necessary will not all be readily accepted. For instance, the substitution of "Dryopteris" for "Aspidium" fern collectors will be disposed to resist; yet, if the principle pursued by our authors is scientifically sound, they did well to follow it thoroughly, even when it leads to somewhat startling changes that will be inconvenient to the older botanists.

Having consulted these three volumes very extensively in relation to the flora of the district of Montreal, we are in a position to say that, so far as the botany of Quebec is concerned, and, indeed, that of all Canada, this work is a prodigious advance upon anything hitherto published. A great many species grow with us which are not credited to the province; but the authors can scarcely be blamed for such omissions, if those having the means of information on the subject failed to furnish it. Nor are the descriptions faultless, at least so far as applies to those species which are found among us; although the errors we have detected are mainly those of defect rather than of positive statement.

This great work is brought out in a style worthy of the eminent publishing house that has given it to the world; and we trust that its enterprising venture has been sufficiently remunerative to warrant botanists in looking forward to an extension of the undertaking, so that we may have the pleasure of welcoming from the same firm a volume or volumes dealing also with the *Bryophyta* and *Thallophyta*.

R. C.

ABSTRACT FOR THE MONTH OF JANUARY, 1899.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet, C. H. McLEOD, *Superintendent.*

DAY	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	§Max.	§Min.	Range.	†Mean pressure of vapor.	‡Mean relative humidity.	Dew Point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY.....1	.....	— 0.7	—11.7	11.0	.....	.....	.....	.....	.....	....	....	S.W.	14.63	...	..	..	92	....	....	....	1.....SUNDAY
2	7 90	16.9	— 9.2	26.1	30.6088	30.777	30 416	.361	.0575	86 7	4.8	S.	14.67	5.7	10	0	19	....	0.5	0.03	2
3	20.50	27.9	13.6	14.3	30 3482	30 416	30.285	.131	.0943	85 2	16 7	S.E.	12.33	8.3	10	0	....	....	0.1	0.01	3
4	29.20	39.3	13 8	26.1	29.8865	30 285	29 540	.745	.1608	95 3	28.0	S.E.	19.09	10.0	10	10	0	....	....	....	4
5	34 25	49.0	22.3	26.7	29 9562	30 354	29 534	.820	.1530	72.3	26.3	S.W.	31.92	5 5	10	0	43	0.07	0.0	0.07	5
6	19.72	22.3	17.5	4.8	30 6017	30 404	29 544	.860	.0922	86 5	16.5	N.	16.38	8.3	10	0	0	....	6.1	0.61	6
7	16.65	21 3	9.4	11.9	29.7748	30.069	29 530	.539	.0748	79 0	11.3	S.W.	29.54	8.0	10	0	25	....	1.6	0.16	7
SUNDAY..... 8	.....	30.0	1.2	28.8	.....	.....	.....	.....	.....	....	....	S.W.	21.21	....	..	..	28	....	....	....	
9	— 3.52	30.6	—12.2	42.8	30.3742	30.479	30.200	279	.0315	83 8	— 7.2	S.W.	13.92	3.2	10	0	28	....	4.2	0.42	8 .....SUNDAY
10	—13.43	—10.2	—19.4	9.2	30 6222	30 636	30 479	.207	.0198	87.0	—10.2	S W.	24.79	0,0	0	0	92	....	0.1	0.01	9
11	— 7.18	— 1.1	—14.2	13 1	30.7310	30.771	30 645	.126	.0270	86 5	—10.3	S.W.	22.58	0 0	0	0	92	....	....	....	10
12	1.67	8.3	— 5.6	13.9	30 5862	30 693	30.496	.197	.0360	77.7	— 4.0	N.E.	9 54	1.5	7	0	58	...	..	....	11
13	9.45	22 4	— 1.7	24.1	30 3 27	30 496	30.108	.388	.0608	83 3	5.5	N.	11.63	8.3	10	0	0	...	1.2	0.12	13
14	27.57	34.3	21.9	12 4	29.6568	30.108	29.236	.872	.1457	96.2	26 8	N.	8 63	10.0	10	10	0	0.94	2.2	1.24	14
SUNDAY.....15	... .	35.3	26.0	9.3	.....	.....	.....	.....	.....	....	....	N.	11.83	....	..	..	0	....	3.4	0.36	15.....SUNDAY
16	33.02	37.8	28.9	8.9	29.8992	30 027	29 768	.259	.1523	81.2	27.7	S.E.	9.50	8.8	10	6	7	....	....	....	16
17	27.95	36.3	19.0	17.3	29.7602	30.001	29.656	.345	.1355	£6 2	24.5	S.W.	16.71	7.8	10	0	17	0 00	0.5	0.05	17
18	5.13	19.0	0.8	18.2	30.2903	30.367	30 001	366	.0432	78.8	— 0.2	W.	20.42	0 0	0	0	96	....	....	...	18
19	12.73	23.8	1.3	22 5	30 2937	30.393	30.203	.190	.0617	76.5	7 0	S.W.	26.17	0,0	0	0	94	....	....	....	19
20	22 93	30.5	10.2	20.3	30.0960	30.203	29.994	209	.1080	84 7	19.2	S.W.	15.96	5.2	10	0	37	....	0.1	0.01	20
21	31.75	35.2	28.2	7.0	29.7103	29.994	29.473	.521	.1538	85 5	28.0	S.	16 50	10.0	10	10	1	....	0.4	0.04	21
SUNDAY..... 22	.....	35.5	30.1	5.4	.....	.....	.....	.....	.....	...	....	S.	25.00	....	..	.	0	....	0.4	0.04	22..... SUNDAY
23	23.25	30.1	17.5	12.6	30.0423	30.148	29.867	.281	.1023	81.7	18.8	S.W.	16.92	3 7	10	0	86	....	...	....	23
24	32.90	37.2	27.5	9.7	29.5897	29.867	29 524	.343	.1417	74.7	25 5	S.	20.79	10.0	10	10	0	0.11	....	0.11	24
25	14.48	29.0	5.8	23.2	29.7705	29 901	29.519	.472	.0678	77.7	8.8	W.	17.04	1.7	10	0	98	....	....	....	25
26	13.72	33 8	0.4	33.4	29 5928	29.991	29 219	.772	.0807	90 0	11.3	N.E.	15.00	10 0	10	10	0	....	1 3	0 13	26
27	— 0.15	34 7	—10.7	45.4	29 7730	30.111	29.219	.892	.0437	88.2	— 2 8	S.W.	36.13	1.0	5	0	86	....	2.1	0.21	27
28	7.45	16.0	—11.2	27.2	29.8750	30.111	29 700	.411	.0523	80.7	2.7	S.W.	15.04	8.3	10	0	0	....	0.0	0.00	28
SUNDAY.....29	.....	17.2	— 6.6	23.8	.....	.....	.....	.....	.....	....	....	S.W.	20.00	....	..	..	94	....	0.8	0.08	29.....SUNDAY
30	— 1.40	8.1	—16.7	24.8	29 9847	30.053	29.919	.134	.0343	82.7	— 5.8	S.W.	14.88	2,2	5	0	37	....	0.1	0.01	30
31	3.58	8.5	— 3.5	12.0	30.1310	30.198	30.053	.145	.0388	75.3	— 2 8	S.W.	8.29	2.2	10	0	95	....	....	....	31
Means.....	14 24	24.46	5.55	18.91	30 0671	30.2690	29.8511	.4179	.0835	83.21	10 00	S. 46° W.	17 97	5.37	3.0	2.2	39.5	2.03	25.1	4.62	.....Sums.
25 Years means for and including this month	12.14	20.51	4.30	16.20	30.0562	.....	.....	.3285	.0737	82.07	....	....	s 16.74	6.26	.	..	¶35.23	0 84	29.88	3.67	25 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction.....	N.	N.E.	E.	S E.	S.	S.W.	W.	N.W.	CALM.
Miles	711	891	190	1273	2578	6555	823	347	
Duration in hrs..	63	63	21	83	109	315	51	30	9
Mean velocity....	11.29	14.14	9.05	15.34	23.65	20.81	16.13	11.57	

Greatest mileage in one hour was 54, on the 27th.

Greatest velocity in gusts 60 miles per hour on the 27th.

Resultant mileage, 7440.
Resultant direction, S. 46° W.
Total mileage, 13,368.

* Barometer readings reduced to sea-level and temperature 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 18 years only. *s* 13 years only.

The greatest heat was 49°.0 on the 5th; the greatest cold was —19.°4 on the 10th, giving a range of temperature of 68.4 degrees.

Warmest day was the 5th. Coldest day was the 10th. Highest barometer reading was 30.777 on the 2nd. Lowest barometer was 29.219 on the 26th, giving a range of 1·558 inches. Maximum relative humidity was 99 on the 4th and 14th. Minimum relative humidity was 55 on the 24th.

Rain fell on 5 days.

Snow fell on 19 days.

Rain or snow fell on 21 days.

Lunar corona on 8 nights. Mock suns on the 27th.

Fog on 6 days.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1899.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet, C. H. McLEOD, *Superintendent.*

DAY	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	§Max.	§Min.	Range.	†Mean pressure of vapor.	‡Mean relative humidity.	Dew Point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	4.88	11.4	— 3.7	15.1	30.1520	30.248	30.059	.189	.0417	77.0	— 1.2	S.W.	17.63	3.3	10	0	93	....	0.2	0.02	1
2	12.20	16.4	6.5	9.8	30.1955	30.240	30.130	.110	.0573	76.5	6.0	S.	15.58	0.3	2	0	82	....	0.8	0.08	2
3	7.18	15.3	— 1.2	16.5	30.0298	30.240	29.876	.364	.0550	90 2	4.8	N.	10.08	8.3	10	0	0	....	0.6	0.06	3
4	11.37	16.7	6.9	9.8	30.0262	30.165	29.876	.289	.0615	85.0	7.5	N.	10.84	3.3	10	0	49	....	0.2	0.02	4
SUNDAY..... 5	.....	19.5	6.0	13.5	.....	.....	.....	.....	.....	....	....	S.	13.88	....	..	..	54	....	0.1	0.01	5.....SUNDAY
6	8.43	16.1	4.1	12.0	30.1347	30.199	30.056	.143	.0478	74.5	2.3	S.W.	11.00	2.0	10	0	75	....	....	....	6
7	3.22	8.9	— 2.7	11.6	30.0455	30.100	29 977	.123	.0422	84 7	— 0.7	N.	7.75	0.7	2	0	92	....	....	....	7
8	3.57	7.5	— 0.5	8.0	29.6310	29.977	29 463	.514	.0485	94.7	2.3	N.W.	22.08	10.0	10	10	0	....	2.4	0.24	8
9	0.63	4.5	— 2.0	6.5	29.6273	29.815	29.493	.322	.0380	86.2	— 3.0	S.W.	31.96	3.8	10	0	74	....	0.1	0.01	9
10	— 6.50	— 2.0	—11.3	9.3	30.1027	30.287	29.815	.472	.0287	88.7	— 9.2	S.W.	32.21	4.5	8	0	0	....	....	....	10
11	— 7.68	— 2.8	—13.1	10 3	30 4805	30.540	30.287	.253	.0258	85.8	—11.0	S.W.	23.75	0.0	0	0	98	....	....	....	11
SUNDAY.....12	.....	1.6	—11.7	13.3	.....	.....	.....	.....	.....	....	....	W.	11.08	....	..	..	87	....	....	....	12.....SUNDAY
13	1.88	8.1	— 3.7	11.8	30.0170	30.333	29.617	.716	.0360	75 8	— 4.2	W.	7.21	8.3	10	0	0	....	0.0	0.00	13
14	10.05	14.1	7.8	6.3	29.9460	30.274	29.617	.657	.0458	67.0	1.2	S.W.	24.46	3.2	10	0	87	....	0.0	0.00	14
15	15.80	24.6	3.0	21.6	30.2612	30.363	30.126	.237	.0718	77.8	10.2	S.W.	18.21	8.3	10	0	0	....	0.4	0.04	15
16	31.33	36.6	24 6	12.0	30.1052	30.210	29.948	.262	.1248	71.3	23.0	S.	19.08	4.7	10	2	82	....	....	....	16
17	33.17	39.2	24.7	14.5	29.8103	29.948	29.759	.189	.1390	73.3	25.5	S.W.	15.00	7.3	10	4	34	....	....	....	17
18	37.10	40.5	35.2	5.3	29.7292	29.819	29.579	.240	.1893	85.8	33.3	S.W.	15.25	10.0	10	10	0	0.02	...	0.02	18
SUNDAY.....19	.....	38.5	26.5	12 0	.....	.....	.....	.....	.....	....	....	S.W.	20.92	....	..	..	44	....	0.0	0.00	19.....SUNDAY
20	34.88	39.5	26.0	13.5	29.4428	29.520	29 389	.131	.1762	86 8	31.3	S.W.	21.71	8.8	10	5	13	0.01	1.6	0.17	20
21	34.30	36.8	32.2	4.6	29.6853	29.740	29.520	.220	.1482	74 5	27.0	W.	11 38	8.3	10	0	33	....	....	....	21
22	33.80	39.1	29.8	9.3	29.3952	29.673	29.274	.399	.1700	87.3	30.3	S.W.	19.88	10.0	10	10	0	0.23	2.5	0.66	22
23	25.12	31.6	14.3	17.3	29.6778	29.884	29.467	.417	.1057	76.8	19 0	S.W.	24.67	6.3	10	2	83	....	0.0	0.00	23
24	12.63	18.2	6.8	11.4	30.1878	30.370	29.884	.486	.0550	71.0	4.8	S.W.	34.13	0.2	1	0	100	....	....	....	24
25	15.77	21.8	8.6	13.2	30.5230	30.573	30.370	.203	.0582	64.2	5.7	W.	13.54	0.0	0	0	98	....	....	....	25
SUNDAY.....26	.....	33.6	10.0	23.6	.....	.....	.....	.....	.....	....	....	S.E.	19.04	....	..	..	0	0.03	0.0	0.03	26..... SUNDAY
27	34.77	41.0	29.3	11.7	29 6803	29.791	29 595	.196	.1613	79.0	28.8	S.	25.13	9.0	10	5	6	0.25	0.2	0.27	27
28	29.17	36.2	19.0	17.2	29.7605	29.998	29.497	.501	.1202	73.7	22.0	S.E.	22.13	5.7	10	0	73	....	....	....	28
Means.....	16.13	21.88	9.70	12.18	29 9436	30.0961	29.7781	.3180	.0854	79·48	10.65	S. 45½° W.	18.56	5.26	3.0	2.0	48.4	0.54	9.1	1.63	.....Sums.
25 Years means for and including this month	15.66	23.64	7.40	16.24	30.0269	.....	.....	.309	.0838	80.25	....	....	s 18.17	5.91	..	..	¶41.91	0 74	23.80	2.98	25 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction.....	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	654	205	61	794	1636	7272	1000	847	
Duration in hrs..	56	16	13	41	91	319	82	52	2
Mean velocity....	11.68	12.81	4.69	19.37	17 98	22.79	12.22	16.29	

Greatest mileage in one hour was 44, on the 9th.

Greatest velocity in gusts 48 miles per hour on the 9th.

Resultant mileage, 8450
Resultant direction, S. 45½° W.
Total mileage, 12,469.
Average velocity, 18.56 m.p.h.

* Barometer readings reduced to sea-level and temperature 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 18 years only. s 13 years only.

The greatest heat was 41°.0 on the 27th; the greatest cold was —13.°1 on the 11th, giving a range of temperature of 54.1 degrees.

Warmest day was the 18th. Coldest day was the 11th. Highest barometer reading was 30.573 on the 25th. Lowest barometer was 29.274 on the 22nd, giving a range of 1.299 inches. Maximum relative humidity was 97 on the 7th, 8th, 9th and 22nd. Minimum relative humidity was 51 on the 25th.

Rain fell on 5 days.

Snow fell on 16 days.

Rain or snow fell on 17 days.

Auroras were observed on 2 nights.

Lunar halo on 1 night.

Lunar coronas on 3 nights. Mock suns on the 9th.

Fog on 3 days.

ABSTRACT FOR THE MONTH OF MARCH, 1899.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet, C. H. McLEOD, *Superintendent.*

DAY	THERMOMETER. Mean.	Max.	Min.	Range.	BAROMETER. Mean.	§Max.	§Min.	Range.	†Mean pressure of vapor.	‡Mean relative humidity.	Dew Point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	25.47	37.0	20.7	16.3	29.9212	30.090	29.497	.593	.0973	68.8	16.8	S.W.	23.46	4.2	10	0	09	....	0.0	0.00	1
2	24.88	30.8	16.8	14.0	30.1153	30.148	30.082	.066	.1100	80.3	20 0	N.E.	9.29	5.8	10	0	57	....	0.0	0.00	2
3	29.47	35.1	24.7	10.4	30.1102	30.153	30.074	.079	.1442	88 2	26.5	N.E.	6 88	8 3	10	0	24	....	....	....	3
4	33.75	36.3	30.3	6.0	30 0312	30.091	29.964	.127	.1838	94.8	32.5	E.	11.13	10.0	10	10	0	0.17	0.9	0.29	4
SUNDAY..... 5	.....	42.5	27.8	14.7	.....	.....	.....	.....	.....	....	....	S.W.	20.42	...	..	..	0	0 45	1.0	0.65	5.....SUNDAY
6	23.78	31.1	17.6	13.5	29.9973	30.137	29.726	.411	.0957	74 3	17.2	S W.	22.00	0 0	0	0	98	....	..	..	6
7	18.10	24.5	16.7	7.8	29.9298	30.137	29 815	.322	.0868	87.8	15.2	N.	36.88	8.3	10	0	0	....	3.0	0.30	7
8	17.92	21.0	15.5	5.5	30.0513	30.211	29.815	.396	.0757	77.8	12.0	W.	27.13	7.8	10	0	73	....	0.2	0.02	8
9	16.28	21.5	10.4	11.1	30.1673	30.222	30.094	.128	.0805	87.7	13.7	N.E.	4.50	5.0	10	0	0	....	0.6	0 06	9
10	20.53	26.1	10.2	15.9	30.3708	30.451	30.189	.262	.0920	83.2	16.2	N.E.	6.63	6.3	10	0	53	..	....	....	10
11	32.02	38.1	22.4	15.7	29 9568	30.333	29.815	.518	.1627	88.7	29.0	S.E.	17.88	10.0	10	10	0	0.03	0.5	0.11	11
SUNDAY.....12	.....	37.7	31.5	3.8	.....	.....	.....	.....	.....	....	....	N.W.	14.46	....	..	..	0	0 28	....	0.28	12.....SUNDAY
13	23.65	31.7	18.7	13.0	30 1977	30.442	29.812	.630	.0947	73 0	16.5	N.W.	13.92	8.3	10	4	59	....	0.0	0.00	13
14	19.28	23.2	16.6	6.6	30.5355	30.583	30.442	.141	.0797	76.2	13.3	N.	10.17	4.0	10	0	53	....	...	....	14
15	25.05	32.5	11 6	20.9	29.9712	30.538	29.543	.995	.1260	89.8	22 5	N.E.	20.33	9.7	10	8	0	....	8.5	1.70	15
16	20.37	32.5	6.0	26.2	29.9638	30.283	29.528	.755	.0945	77 0	14.3	W	22.88	3.8	10	0	71	....	1.5	0.15	16
17	1.45	6.8	— 5.0	11.8	30.3838	30.456	30.283	.173	.0357	77.7	— 4.3	N.W.	9.17	0 0	0	0	96	....	....		17
18	6.65	14.8	— 5.0	19.8	29.9412	30.318	29.631	.687	.0540	87.7	3.8	N.	18 00	8.3	10	0	5	...	3.2	0.32	18
SUNDAY.....19	.....	27.5	11.9	15.6	.....	.....	.....	.....	.....	....	....	N.	10.38	....	..	..	0	0.32	6.2	0.94	19.....SUNDAY
20	17.28	24.9	12.7	12.2	29.5650	30.007	29 085	.922	.0765	79.2	12.0	S.E.	14.79	7.2	10	4	42	....	1.0	0.10	20
21	11.60	16.3	3.3	13.0	30.3325	30.415	30.007	.408	.0507	68 5	3.2	S.	11 21	4.0	10	0	86	....	....	....	21
22	22.02	30.8	11.1	19.7	30.1493	30.286	30 025	.261	.1130	91.8	20.0	N.	11.38	8.3	10	0	0	....	1 5	0.15	22
23	28.02	33.2	23.5	9.7	29.7390	30.025	29.676	.349	.1335	86.7	24 5	S.W.	18.04	8.8	10	3	0	0.09	7.1	1.18	23
24	20.52	24.0	15.5	8.5	29.8447	29 919	29.713	.206	.0922	83.7	16.3	S.	14.75	9 2	10	7	31	....	0.3	0 03	24
25	20.77	26.2	7.8	18.4	29.8747	29.953	29.781	.172	.0880	79.3	15.5	S.E.	12.13	2.0	10	0	91	....	..	....	25
SUNDAY.....26	.....	29.7	10.6	19.1	.....	.....	.....	.....	.....	....	....	W.	12.50	....	..	..	74	....	0.0	0.00	26..... SUNDAY
27	27.70	33.5	22.9	10.6	30.1825	30.218	30 099	.119	.1167	77.0	21.5	S.	3.29	6.3	10	0	19	0.29	0.0	0.29	27
28	29.85	37.7	21.3	16.4	29 8347	30.184	29.372	.812	.1433	84.5	26.2	N.	3·67	6.7	10	0	0	0.60	8.2	1.96	28
29	28.73	34.6	23.8	10.8	29.1305	29.372	28.998	.374	.1465	91.0	26.7	E.	24.83	8.7	10	3	0	....	....	....	29
30	25.92	31.6	20.2	11.4	29.6062	29.747	29.312	.435	.1122	79.2	25.0	W.	33.00	2.3	10	0	88	....	....	....	30
31	27.13	32.4	19.7	12.7	29.7083	29.747	29.688	.059	.1097	73.5	20.2	W.	20 42	2 5	10	0	96	....	....	....	31
Means.....	22.16	29.20	15.86	13.34	29.9856	30.1654	29.7802	.3852	.1035	81.76	17 64	N. 75¾ W.	15.66	5.97	9.3	1.8	39.2	2.23	43.7	8.53	.....Sums.
25 Years means for and including this month	15.66	31.64	17.10	14.55	29.9762	.....	.....	.270	.1105	76.64	....	....	s 17.66	5.90	..	..	¶46 87	1 14	23.49	3.58	25 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction.....	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	2103	1263	634	1455	491	2470	2241	995	
Duration in hrs..	157	101	49	102	58	107	102	51	17
Mean velocity....	13.39	12.50	12.94	14.26	8.64	23.08	21.97	19.51	

Greatest mileage in one hour was 51, on the 6th.

Greatest velocity in gusts 66 miles per hour on the 6th.

Resultant mileage, 2215
Resultant direction, N. 75¼° W.
Total mileage, 11,652.
Average velocity, 15.66 m.p.h.

* Barometer readings reduced to sea-level and temperature 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 18 years only. s 13 years only.

The greatest heat was 42°.5 on the 5th; the greatest cold was —5.°0 on the 17th & 18th, giving a range of temperature of 47.5 degrees.

Warmest day was the 5th. Coldest day was the 17th. Highest barometer reading was 30.583 on the 14th. Lowest barometer was 28.938 on the 29th, giving a range of 1.585 inches. Maximum relative humidity was 99 on the 15th and 19th. Minimum relative humidity was 52 on the 1st and 16th.

Rain fell on 8 days.
Snow fell on 20 days.
Rain or snow fell on 21 days.
Auroras were observed on 1 night.
Lunar halo on 3 nights.
Lunar coronas on 4 nights.
Fog on 7 days.

ABSTRACT FOR THE MONTH OF APRIL, 1899.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet, C. H. McLEOD, *Superintendent.*

DAY	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	§Max.	§Min.	Range.	†Mean pressure of vapor.	‡Mean relative humidity.	Dew Point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	29.33	35.2	25.0	10.2	29.7230	29.786	29.677	.109	.1222	74 8	22.7	S.W.	27.71	3 0	10	4	57	...	0.00	0.00	1
SUNDAY..... 2	.....	35.9	22.2	13.7	.....	.....	.....	.....	.....	....	....	S.W.	25.58	...	..	..	13	....	...	....	2.....SUNDAY
3	33.35	38.6	27.0	11.6	30.0008	30.085	29.907	.178	.1493	78.3	27.2	S.W.	18.67	4.7	10	0	91	....	....	...	3
4	30.28	35.3	26.0	9.3	30.1502	30.187	30.085	.102	.1105	65.3	20 3	N.W.	13.58	0 0	0	0	96	....	....	....	4
5	30.12	36.6	21.5	15.1	30 3337	30.379	30.187	.192	.1122	66 5	20.5	N.	11.87	0 0	0	0	96	....	....	....	5
6	32.98	40.8	23.1	17.7	30.3385	30.409	30.244	.1	.1363	72.7	25.0	S.	8.12	2.0	10	0	80	....	....	....	6
7	35.80	42.6	29.8	12.8	30.0713	30.244	29.931	.313	.1573	74.3	28.5	S.E.	8.71	9.2	10	5	20	0.04	....	0.04	7
8	34.38	36.6	32.6	4.0	29.5523	29 931	29.479	.452	.1915	96.3	33.3	N.	11.42	10 0	10	10	00	0.83	1.2	1.02	8
SUNDAY..... 9	.....	35.6	31.0	4.6	.....	.....	.....	.....	.....	....	....	S.W.	21.29	....	..	..	00	0.12	0.7	0.19	9.....SUNDAY
10	31.62	36.6	26.5	10 1	30.0603	30.192	29 922	.270	.1242	70 5	23.0	S.W.	16.58	0.0	0	0	95	....	..	....	10
11	36.23	42.2	26.4	15.8	30 2248	30.324	30.124	.200	.1243	58.8	23.0	S.	8.58	1 3	5	0	94	..	....	....	11
12	36 02	39.2	32.5	6.7	29.8622	30.124	29.758	.366	.1705	80.8	30.3	S.E.	12.29	10 0	10	10	00	0.12	....	0.12	12
13	41.98	47.7	32.4	15.3	29 8932	29.938	29.774	.164	.2040	76.7	35.2	S.W.	17 00	5.7	10	0	47	0.01	....	0.01	13
14	44.08	52 6	36.3	16.3	29.7588	29 919	29.624	.295	.2293	79.5	37.8	S.W.	18.08	7 0	0	0	30	0.11	....	0.11	14
15	41.83	46.8	36 3	10.5	29.8985	29.930	29.853	.077	.1552	61 2	28.2	W.	20.04	1.2	7	0	97	....	....	....	15
SUNDAY.....16	.....	46.7	33.7	13.0	.....	.....	.....	.....	.....	....	....	N.W.	14.04	....	..	..	87	....	....	....	16.....SUNDAY
17	42.28	48.7	32.9	15.8	29.9950	30.082	29.906	.176	.1378	52.2	25.5	S.W.	16 58	1 5	5	0	92	....	....	....	17
18	46.65	56.2	36.1	20.1	30.1183	30.156	30.080	.076	.1680	53.0	29.8	N.E.	7.58	1.0	5	0	88	....	....	....	18
19	47 47	56.3	34.2	22.1	30.0460	30 080	30.008	.072	.2227	66.0	36.8	N.	11 96	4.2	10	0	63	0 00	....	0.00	19
20	51.28	57.8	45.3	12 5	30.0877	30.099	30.050	049	.2617	69.7	41.3	S.	16.25	7.8	10	2	69	0.05	....	0 05	20
21	44.40	53.5	35 9	17.6	30 2285	30.270	30 090	.180	.2458	83 7	39.5	N.	10.64	6.0	10	0	19	0.05	....	0 05	21
22	50.90	60.4	37.2	23.2	30.2032	30.260	30.163	.097	.2873	77 0	43 5	S.	9.12	3 2	7	0	41	0.00	....	0.00	22
SUNDAY.....23	.....	60.5	43.9	16.6	.....	.....	.....	.....	.....	...	....	N.W.	10 54	....	..	..	98	...	....	....	23..... SUNDAY
24	49.58	60.3	37.5	22.8	30.1282	30.243	29 998	.245	.2392	65.7	38.3	N.W.	8.29	0.2	1	0	98	....	....	....	24
25	54.68	69.2	42.9	26.3	29.9557	30.015	29.908	.107	.3445	79.2	48.2	N.	9.67	7.8	10	2	41	0.02	....	0.02	25
26	50.80	59.2	44.6	14.6	30.0153	30.078	29.940	.138	.3683	81.8	45.3	N.W.	9.50	2 8	10	0	72	0.02	....	0.02	26
27	51.98	65.7	36.0	29.7	30.1402	30.196	30.078	.118	.2528	64.0	39.7	N.	8.21	0.0	0	0	97	....	....	....	27
28	59.65	71 4	47.8	23.6	30 0740	30.142	29.997	.149	.3023	60.2	45.0	S.E.	15.21	1 8	7	0	88	....	....	.. .	28
29	63.60	75 7	52 5	23.2	30.0700	30.120	30.021	.099	.3472	58.3	48.5	S.	13.12	4 5	10	0	57	....	...	....	29
SUNDAY.....30	.....	82.0	58.7	23.3	.....	.....	.....	.....	.....	...	....	S.W.	10 87	..	..	.	64	0.00	....	0.00	30.....SUNDAY
Means.....	42.85	50.86	34.93	15 94	30 0372	30.1277	29.9522	.1756	.2042	70.67	33 46	S. 45 ¼° W.	13 63	4.00	7.1	1.3	63.0	1.37	1.9	1 63	.....Sums.
25 Years means for and including this month	40.35	48 88	32.56	16.32	29.9634	.....	.....	.2012	.1742	67.12	...	....	s 16.24	5.67	..	..	¶52.16	1 63	5.48	2.19	25 Years means for and including this month.

ANALYSIS OF WIND RECORD.

Direction.....	N.	N.E.	E.	S E.	S.	S.W.	W.	N.W.	CALM.
Miles	1439	153	353	687	1760	3927	964	450	
Duration in hrs..	141	22	33	46	151	222	63	37	5
Mean velocity....	10.21	6.95	10.70	14.93	11 66	17.69	15.30	12.16	

Greatest mileage in one hour was 35, on the 14th.

Greatest velocity in gusts 36 miles per hour on the 14th.

Resultant mileage, 4435
Resultant direction, S. 45¼° W.
Total mileage, 9,733.
Average velocity, 13.68 m.p.h.

* Barometer readings reduced to sea-level and temperature 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 18 years only. s 13 years only.

The greatest heat was 82°.0 on the 30th: the greatest cold was 21.°5 on the 5th, giving a range of temperature of 60.5 degrees.

Warmest day was the 30th. Coldest day was the 2nd. Highest barometer reading was 30.409 on the 6th. Lowest barometer was 29.479 on the 8th, giving a range of .930 inches. Maximum relative humidity was 98 on the 8th. Minimum relative humidity was 41 on the 11th, 18th and 28th.

Rain fell on 13 days.
Snow fell on 3 days.
Rain or snow fell on 14 days.
Lunar halo on 1 night.
Lunar coronas on 4 nights.
Fog on 6 days.
Thunder on 30th.

ABSTRACT FOR THE MONTH OF MAY, 1899.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet, C. H. McLEOD, *Superintendent.*

DAY	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	§Max.	§Min.	Range.	†Mean pressure of vapor.	‡Mean relative humidity.	Dew Point.	a WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	57.15	65.0	50.4	14.6	29.9572	29 997	29.929	.068	.3955	84 0	52.3	N.W.	12.21	8 7	10	5	13	0.02	...	0.02	1
2	53.73	69.3	45.4	23.9	29.8855	29 961	29 826	.135	.3327	81.0	47.2	N.	13.92	6.7	10	0	46	0.06	...	0.06	2
3	48.17	50.8	41.9	14.9	30 2167	30.263	29 961	.302	.2015	60 5	34 5	N.	22 75	1.8	10	0	55	0.00	....	0.00	3
4	49.02	61.3	36 0	25.3	30 2157	30 306	30.123	.183	.1625	45.8	29.0	N.	10 92	0 0	0	0	98	....	....	....	4
5	53.05	64.6	39 0	25.6	30 1845	30 253	30.136	.117	.2232	5	37.0	N.	9.42	2.0	10	0	98	....	....	....	5
6	58.55	69.5	43.7	25.8	30 0868	30 213	29 981	.232	.2717	56 0	42.3	S.W.	13.29	4.5	9	0	35	....	....	....	6
SUNDAY..... 7	.....	67.4	51.5	15.9	.....	.....	.....	.....	.....	....	....	S.W.	11.50	...	..	..	97	...	....	....	7 .....SUNDAY
8	58.23	69 9	44.2	25.7	29.8327	29.983	29 731	.252	2978	60 5	44.0	N.	7.46	2.3	6	0	98	....	....	...	8
9	54.88	65.3	47.1	18.2	29 9073	29 987	29 755	.232	.2380	55.5	38 8	N.W.	15.29	0 0	0	0	96	....	...	....	9
10	58.30	69.8	46.1	23 7	30 0203	30.099	29.949	.150	.2775	55 5	41 8	S.	10 21	0 2	1	0	93	....	....	....	10
11	56 37	70 3	48.5	21.8	29.7362	29.943	29.611	.338	.3387	75 3	47.7	S W.	18.42	5.8	10	0	37	0.35	..	0.35	11
12	60.33	69 7	47.1	22.6	29.8348	29 870	29.765	.105	.3477	67.3	49.2	S.W.	13.25	1 3	5	0	98	....	....	....	12
13	59.15	71.2	49.5	21.7	29.7998	29.501	29.690	.205	.3535	70.5	49.0	S.E.	18.96	6.0	10	0	46	0.12	....	0.12	13
SUNDAY.....14	.....	57.4	41.8	15 6	.....	.....	.....	.....	.....	....	...	S.W.	21.58	....	..	..	93	...	....	....	14.....SUNDAY
15	49 40	58.2	41 1	17.1	30.0858	30.160	30.026	.134	.1995	55 8	34.0	S.W.	10.92	3.0	10	0	80	....	....	....	15
16	50.30	59.5	40.2	19.3	29.9787	30.095	29 885	.210	.2270	61.7	37.2	S.W.	10.92	4.0	10	0	54	....	....	....	16
17	51.18	61 5	38.4	23.1	30 0575	30 132	29.958	.174	.2555	67.0	40.3	N.	12.33	1 7	8	0	100	....	....	....	17
18	50.27	55.4	45.2	10 2	29.9613	30 132	29 892	.240	.3002	82.7	44.7	S.E.	15.75	10 0	10	10	00	0.06	....	0.06	18
19	50.50	54.5	46.9	7.6	29 8748	29.893	29.857	.036	.3240	88 5	47 2	W.	3.87	10.0	10	10	05	0 01	....	0.01	19
20	49 67	56.0	47.0	9 0	29 8670	29 928	29.836	.092	.3232	91.0	47.2	S.E.	10.04	10.0	10	10	03	0.05	....	0.05	20
SUNDAY..... 21	.....	61.8	46 0	15.8	.....	.....	.....	.....	.....	....	....	S.E.	9.37	....	..	..	31	....	....	....	21..... SUNDAY
22	53 50	60.4	45.3	15.1	30 1482	30.171	30 124	.047	.2918	71.0	44 2	S.E.	6.21	8 7	10	3	00	....	....	....	22
23	62.70	72.3	51.8	20.5	30.1940	30.236	30.161	.075	.3155	55 5	46.0	N.W.	7.29	4.3	10	0	86	....	....	.. .	23
24	64.75	76.9	51.1	25.8	30.1782	30.264	30.106	.158	.3493	58 0	43.0	W.	7.54	0.0	0	0	96	....	....	....	24
25	66.43	76.6	56.8	19.8	30.0372	30.157	30 000	.157	.3105	48 2	45.8	N.W.	22.71	2 5	10	0	93	....	....	....	25
26	66.67	77.3	59.2	18.1	29 9623	30.029	29 864	.165	.4373	67 3	55 0	N.W.	23 04	6 2	10	0	74	0.02	....	0 02	26
27	53.92	63 7	48.0	15.7	29 8592	29 868	29.847	.021	.3733	89.5	50.7	N.E.	21.54	10 0	10	10	00	0 57	....	0.57	27
SUNDAY.....28	.....	64.7	47.3	17.4	.....	.....	... ..	.....	.....	...	....	N.E.	16.08	...	-	.	64	0.01	....	0.01	28 .....SUNDAY
29	59.33	70 2	55.1	15.1	29.9313	30.039	29.810	.229	.4442	87.5	55.7	N.E.	5.62	6 8	10	0	18	0.22	....	0.22	29
30	63.75	70.7	56.6	14.1	29.7252	29.810	29.670	.140	.4730	80.3	57.3	W.	23 50	7.2	10	0	37	0.10	....	0.10	30
31	67 73	78.4	56.2	22.2	29.6188	29 896	29.720	.176	.4545	68 2	56.3	N.W.	11.71	3.0	10	0	98	0.00	..	0.00	31
Means.....	56 58	65 99	47.24	18 75	29 9706	30.0590	29.8970	.1620	.3941	68.13	45 27	N. 64¼° W.	13.47	4.69	3.11	1.77	61.03	1.59	....	1.59	.....Sums.
25 Years means for and including this month	54.79	64.10	45.89	18.20	29.9330	.....	.....	.168	.29.6	66.38	....	....	S 14.19	6.10	.	.	¶50 87	2.91	....	2.96	25 Years means for and including this month.

a ANALYSIS OF WIND RECORD.

Direction.....	N.	N.E.	E.	S E.	S.	S.W.	W.	N.W.	CAL 4.
Miles	1832	9 5	81	1367	692	1543	1608	1965	
Duration in hrs..	144	72	8	110	50	104	123	121	12
Mean velocity....	12.72	12.99	10.12	12.43	13.84	14.84	13.07	16.24	

Greatest mileage in one hour was 36, on the 30th.

Resultant mileage, 2630

Resultant direction, N. 64½° W.

Total mileage, 10,023.

a wind records from the 18th to the 31st are from the City Hall.

' Barometer readings reduced to sea-level and temperature 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 18 years only. s 13 years only.

The greatest heat was 78°.4 on the 31st; the greatest cold was 36.°0 on the 4th, giving a range of temperature of 42.4 degrees.

Warmest day was the 31st. Coldest day was the 3rd. Highest barometer reading was 30.264 on the 24th. Lowest barometer was 29.611 on the 11th, giving a range of 0.653 inches. Maximum relative humidity was 99 on the 27th. Minimum relative humidity was 31 on the 24th.

Rain fell on 14 days.

Auroras were observed on 3 nights.

Lunar corona on the 21st.

Thunderstorm on the 2nd.

Lightning on the 27th.

ABSTRACT FOR THE MONTH OF JUNE, 1899.

Meteorological Observations, McGill College Observatory, Montreal, Canada. Height above sea level, 187 feet, C. H. McLEOD, *Superintendent.*

DAY	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	§Max.	§Min.	Range.	†Mean pressure of vapor.	‡Mean relative humidity.	Dew Point.	a WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max	Min.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	72.60	81.0	63.0	18.0	29.6917	29.727	29.657	.070	.5783	73.0	63.2	W.	17.62	7 0	10	0	68	0.00	...	0.00	1
2	66 00	73.2	61.0	12.2	29.9082	29.954	29.727	.227	.4365	68.5	54.8	W.	10 21	6.2	10	0	47	....	...	....	2
3	63.57	70.8	56.0	14.8	30.0727	30.127	29.954	.173	.3205	54.7	46 5	N.W.	9.92	4.7	10	0	52	....	....	...	3
SUNDAY..... 4	.....	66.0	55.0	11.0	.....	.....	.....	.....	.....	....	....	N.W.	2 12	....	..	..	1	0.01	....	0.01	4 .....SUNDAY
5	73.87	87.0	58.5	28.5	29.7588	29.814	29.718	.096	.6228	75 8	64.8	W.	20.12	6.7	10	0	73	0.82	....	0.82	5
6	75.90	86.7	68.6	18.1	29 7602	29 856	29.711	.145	.6158	69.7	64.7	W.	23.58	4.5	10	0	77	....	....	....	6
7	62.28	71.6	55.5	16.1	29.8942	30.005	29.738	.267	.4552	81.5	56.2	S.E.	10.62	7 8	10	5	37	0.00	....	0.00	7
8	70.58	80.3	59.5	20.8	29.6760	29.756	29 641	.115	.5580	74.7	61.3	W.	21.46	3.8	10	0	74	0 07	....	0.07	8
9	63.82	71.9	57.5	14.4	29.8535	29 934	29.756	.178	.3413	58.2	48 2	N.W.	21.00	3.5	7	0	85	....	....	...	9
10	60.50	68.1	52.2	15 9	30.0048	30.034	29.934	.100	.2830	54.7	43.3	W.	11.00	1.7	4	0	94	....	....	....	10
SUNDAY.....11	.....	75 0	54.2	20.8	.....	.....	.....	.....	.....	....	....	W.	6.75	....	..	..	100	....	....	....	11.....SUNDAY
12	68 00	79.6	55.0	24.6	29.9538	30.063	29.875	.188	.4855	69 8	57.3	S.E.	4.62	4.0	10	0	57	0.01	....	0.01	12
13	76.43	86.9	64.0	22.9	29.8618	29.942	29.787	.155	.6590	73.2	66.8	W.	15.83	2 0	7	0	89	....	....	....	13
14	71.48	78.5	64.7	13 8	29.8837	29.943	29.799	.144	.5800	74.5	62.8	S.E.	16.58	8.8	10	7	42	0.00	....	0.00	14
15	59.70	64 8	57 3	7.5	29.7728	29.908	29.741	.167	.4818	94.0	57.8	S.E.	6.66	10.0	10	10	0	0.28	....	0.28	15
16	56.05	60.2	52.3	7.9	29.9097	30.066	29 754	.312	.3912	86.7	52.0	W.	15 25	8.2	10	0	3	0.29	....	0.29	16
17	65.53	76.7	52.2	24.5	30.1042	30.132	30.066	.066	.4013	64.2	52.8	W.	6.50	1.5	7	0	87	0.02	....	0.02	17
SUNDAY.....18	.....	79.2	59.3	19.9	.....	.....	.....	.....	.....	....	....	W.	10.75	....	..	..	89	....	....	....	18..... .SUNDAY
19	67.10	76.5	60.0	16.5	29 8762	29 921	29.834	.087	.4535	69.5	56.2	N.W.	8.08	3.7	9	0	81	0.05	....	0.05	19
20	66.80	80.5	60.0	20.5	29.6325	29.849	29.491	.358	.4833	73.3	57.8	S.W.	16.37	7.0	10	0	50	0.53	....	0.53	20
21	61.78	68.9	55.3	13.6	29.8730	30 134	29.645	.489	.3763	68.0	51.3	N.W.	19.50	4.7	9	0	62	0.11	....	0.11	21
22	62 08	70.7	51.0	19.7	30.1813	30.227	30.134	.093	.3780	68.2	51 3	N.	4.21	5.0	10	0	46	....	....	....	22
23	67.68	79.8	56.6	23.2	29.9977	30.160	29.918	.242	.5073	74.7	59.7	S.W.	10.21	7.7	10	0	50	0.02	....	0.02	23
24	72.27	81.0	62.0	19.0	29 9970	30.063	29.945	.118	.4430	56.8	55.3	S.W.	19.21	2.8	8	0	93	...	....	....	24
SUNDAY.....25	.....	78.5	61.2	17.3	.....	.....	.....	.....	.....	....	....	S.W.	13.17	....	..	..	91	0.00	....	0.00	25 .....SUNDAY
26	64.93	72.9	57.3	15.6	30.0832	30 135	30.045	.090	.3645	69.0	50.2	S.W.	10.21	1 5	4	0	92	....	....	....	26
27	63.53	71.6	52.5	19.1	30.0580	30.089	30 028	.061	.3600	62.5	50.0	S W.	10 37	5.7	10	1	74	....	....	....	27
28	50.15	59 9	53.0	6.9	29.9742	30.060	29 942	.118	.3790	84.2	51.2	N.	6.21	7.2	10	0	03	0.25	....	0.25	28
29	63.58	72 9	53 0	19.9	29.9673	30.111	29.881	.230	.2798	49.2	42.7	S.W.	18.87	3.7	9	0	96	....	....	.. .	29
30	63.03	73.2	53.2	20.0	30.1098	30.140	30.073	.067	.2737	46.8	42.2	S.W.	16.83	0.3	3	0	99	....	....	....	30
Means	65 97	74.79	57.36	17.43	29.9175	30.0058	29.8382	.1675	.4426	68.71	54 63	s S6½ W.	12.79	4.99	8.73	0.88	63.73	2.46	....	2.46	.....Sums.
25 Years means for and including this month	64.89	73.63	56.37	17 26	29.9066	.....	.....	.1530	.4359	69.98	....	...	s 13.03	5.59	.		§53 85	3.558	....	3.558	25 years means for and including this month.

a ANALYSIS OF WIND RECORD.

Direction.....	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	CALM.
Miles	376	71	....	871	272	2196	3069	2354	
Duration in hrs..	53	17	....	5'	31	141	203	135	46
Mean velocity....	7.09	4.18	....	9.27	8.77	15.57	15.12	17.44	

Greatest mileage in one hour was 38, on the 8th.

Resultant mileage, 5630

Resultant direction, S. 86½° W.

Total mileage, 9,209.

a wind records from the 1st to the 19th are from the City Hall.

* Barometer readings reduced to sea-level and temperature 32° Fahrenheit.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ 18 years only. *s* 13 years only.

The greatest heat was 87°.0 on the 5th; the greatest cold was 51.°0 on the 22nd, giving a range of temperature of 36.0 degrees.

Warmest day was the 5th. Coldest day was the 16th. Highest barometer reading was 30.227 on the 22nd. Lowest barometer was 29.491 on the 20th, giving a range of 0.736 inches. Maximum relative humidity was 99 on the 8th. Minimum relative humidity was 30 on the 29th.

Rain fell on 16 days.

Auroras were observed on 2 nights.

Lunar coronas on the 16th, 18th and 24th.

Fog on 1 day.

Thunderstorms on the 5th, 20th and 23rd.