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THE CANADIAN OYSTER.

(Read before the Natural History Society of Montreal, February 1, 1904.)

The following paper contains some impressions on the Oyster Fishery of Canada, gained during a six-weeks' sojourn at the Canadian Marine Biological Station at Malpeque, P.E.I., during the summer of 1903. The Oyster, as most are aware, belongs to the bivalve section of the Mollusca or shell-fish, and is a relative of the Clam. This division of the Mollusca is usually designated Lamellibranchiata from the lamellar (plate-like) character of the gill. The shell is secreted by a fold of skin hanging down freely at the side of the body, termed the *mantle*, and the bivalve character of the shell is due to the fact that in Lamellibranchiata the mantle consists of a right and left fold, each of which secretes one valve of the shell, whilst the flexible horny hinge which unites the two valves is secreted by the skin of the back of the animal, just between the points of origin of the two folds constituting the mantle.

The Oyster however differs from the Clam and indeed from most of the Lamellibranchiata in several important respects. As a rule in bivalve Mollusca both valves are precisely similar in size and shape, and the animal during life assumes an upright position with the valves resting on their edges. To maintain this position it is necessary that the bivalve should be partially or completely buried in the sand or mud of the bottom on which it lives. Through this material it slowly moves by means of a muscular projection of the under surface of the body shaped somewhat like a ploughshare, called the *Foot*. The Lomellibranchiata are sometimes termed Pelecypoda, literally axe-footed Mollusca, on account of the shape of the foot. The exceptional character of the Oyster is at once seen when we state the foot is entirely atrophied and the animal lies on one side on the superfical layer of the bottom. The valve on which it lies is differently shaped from the other, being usually flat or slightly convex whilst the upper valve may be slightly concave. To a certain extent the edible character of the Oyster is due to the absence of a foot, for this organ with its tough muscles is often found to be a somewhat indigestible morsel in the case of other Mollusca which are used for food.

However different in appearance, practically all Lamellibranchiata have the same method of gaining their food. They all depend for a livelihood on the small organisms which swim or float in the sea and which are swept into their gaping mouths by the currents produced by the cilia which cover the gills and certain folds near the mouth termed the palps. Feeding and breathing are, one may say, performed at the same time, for the inrushing water brings also the oxygen, without which no animal can live.

It will, therefore, be seen that the Oyster is a peculiarly helpless Mollusc, for if it be situated in a place where the water is poor in food material, it is unable to leave it and starves to death. But a far greater danger is that of suffocation. If the water be too muddy, the particles of silt swept in will clog the interstices of the delicate gills; and the deposition of mud may soon bury the animal alive. In the case of other bivalves, no such catastrophe can occur, for they can move so that the hinder part of the shell through which the current enters, always protrudes into clean water. The only resource left to the Oyster when it finds itself on a muddy bottom, and the mud is being deposited slowly, is to maintain upward growth of the edges of the mantle and shell, so that the gaping slit between them is kept above the mud level. In this way is to be explained the curious crimped and curved edges of the so-called Mud-oysters, which form a considerable proportion of the Malpeque Oysters, and which since they are very difficult to open do not fetch so high a price as those of more regular shape grown on clean hard ground.

But other dangers besides starvation and suffocation threaten the Oyster. The starfish is a deadly enemy. This animal has the power of turning the stomach inside out, and of digesting alive anything with which this organ comes into contact. When the starfish gets the chance of introducing his out-turned stomach between the valves of an Oyster's shell it is all over with the Oyster.

To guard against the danger the Oyster has the power of closing the valves of the shell by means of a powerful muscle, the adductor, which runs straight across from one valve to the other. Closing the valves is equivalent to what in Man is holding the breath, but the Oyster can hold its breath for several days without suffering damage. This, nevertheless, requires a continuous effort on the part of the Oyster, for the "hinge" which unites the two valves is so placed with reference to the teeth with which the one valve articulates on the other, that it is compressed when the valves are closed, and its elastic recoil tends to open the valves as soon as the pull of the adductor muscle is relaxed.

In most Lamellibranchiata there are two adductors, but the anterior one has been lost in the Oyster; the hinge, too, is usually so placed that it is stretched and not compressed when the valves are closed, but of course the effect is the same.

Everyone knows that it is necessary to cut the adductor in order to "open" a live oyster. When, however, the Oyster, placed under unfavourable circumstances, spontaneously opens, it is a sign that it is dead. But here several questions may be asked; for instance how does the Oyster know that a starfish is coming? And if it is able to know and to shut up, how do starfish live?

Oysters are apparently devoid of sense organs; nevertheless if the edge of the mantle be examined it will be found to be fringed with innumerable little tentacles in which there is deposited a certain amount of pigment. If now a healthy Oyster be observed whilst it is feeding with open valves in a tank, it will be seen that when the slightest shadow falls on these tentacles the valves are instantly closed. The tentacles enable their possesser to distinguish between light and shade, and it, is by means of its sensitiveness to slight shadows, that the Oyster learns to close in time.

The starfish, however, manages to destroy quite a large number of Oysters. Armed as this creature is with thousands of minute suckers, it is able whilst holding firmly on to the ground with some of these to forcibly raise the upper valve of its victim by means of the remainder which adhere firmly to the ground in the neighbourhood. It seems incredible, when one reflects what force is necessary to insert a knife between the valves of a closed oysqer, that a starfish should be strong enough to forcibly pull them apart. But it is nevertheless true, for the starfish has staying power, and the long steady pull lasting for a quarter of an hour or more, effectively overcomes the resistance of the oyster, although the latter is able to withstand a much greater force if exerted for a shorter time. Nevertheless, the bigger the Oyster the bigger must the starfish be which opens it, and from the size of the starfish found on the Malpeque beds it is not probable that they can do much damage to the larger Oysters, and we may perhaps conclude that the Oysters are safe from their attack once they have passed their third or fourth year.

The Oyster possesses a simple alimentary canal. A short gullet leads into the stomach into which two groups of branched tubes, termed the *liver* empty their contents, and following the stomach is a coiled intestine opening by an anus situated posteriorly above the gills. The so called liver really secretes the digestive juice; and the Oyster has an amazingly good digestion, for its rate of growth is astonishing. At the end of the first year of its life it is about an inch in length, at the close of the second year it has reached between two and three inches, whilst in five years it may attain a length of five to six inches.

The organs by means of which the Oyster creates the current which brings it its food are, as already mentioned, the gills and the palps. The first-named are familiary known as the "beard" of the Oyster, they each consist of a long axis fringed on each side with a number of filaments hanging down parallel to one another, and all thickly clothed with cilia. The ends of these filaments are turned up and fastened to the mantel-lobes in the case of the outer ones, and to the corresponding filaments of the other gill in the case of the inner ones. In most Lamellibranchiata the filaments of one row are welded together so as to form a coherent plate or lamelle, from which circumstance indeed the term "lamelle-brandicate" is derived, but in the Oyster the filaments of the same row cohere only by means of the entanglement of their cilia, so that a touch is all that is necessary to disengage them and hence the comparison of the gill to a frill of hairs or beard. The palps are two pairs of triangular folds situated one pair above and the other below the mouth; they are furrowed by a large number of parallel grooves lined with cilia. It used to be supposed that their purpose was to direct the current of water into the mouth, but it is now known that their chief purpose is to remove the surplus food that the Oyster cannot swallow. Even the appetite of the Oyster it would seem has its limits.

Situated in front of the adductor muscle is a cavity covered on each side with a thin membrane, which is generally torn in carelessly opening the Oyster. This cavity is the body-cavity or *pericardium* of the animal, and contains the heart. This organ consists of a single pear-shaped *ventricle* above, from which arises an artery which divides into anterior and posterior branches, and supplies the whole body with blood. The blood enters the ventricle from below through a pair of auricles (partly communicating with each other) which receives it from the gills. The blood is colourless, and there are no regular veins, the arteries opening into irregular spaces amongst the organs.

Beneath the body cavity on each side is situated the kidney. This organ has the appearance of a membranous sack—difficult to see except when a perfectly fresh Oyster is examined under water, when one can distinguish it by the yellowish green colour of its contents. It is then seen that it sends out a number of branches radiating out over the surface of the liver. The kidney has two openings, one leads into the body-cavity, the other to the exterior underneath the adductor.

Radiating out over the surface of the liver and intermingling to a certain extent with the branches of the kidney are another series of tubes which, gradually uniting with one another, form a duct which opens by the same aperture as the kidney. These tubes are the organs of sex, and at the period of sexual maturity they assume a milky white colour owing to the colour of their contents. In the European Oysters the same tube produces in succession milt and spawn, and the animals are therefore hermaphrodite; but in the Oyster that inhabits the Canadian and American coasts, the sexes are separate, although it is almost impossible to detect them by the naked eye. There is no difference in colour, but there is a slight difference in the amount of branching of the reproductive tubes, and after some practice it becomes possible to be pretty certain about the sex of an individual even before the test of the microscope is applied.

There is another most important difference between the Canadian and the European Oysters. In the latter the milt alone is discharged into the sea; the eggs are retained within the folds of the gills of the parent and there fertilized. The young Oyster undergoes the first stages of its development there, and when cast forth has a well-developed shell, and has only an adventurous life of 24—48 hours to undergo before settling down.

It is far otherwise with the Canadian Oyster. The eggs are very much smaller than those of its European cousin, and they are discharged into the sea, and there fertilized, and in 24 hours enter on their free-swimming life. How long this lasts it is impossible at present to say, but it must be a considerable time—a fortnight at least—so that the young may in this time travel very far from the parent. Prof. Brookes, of Baltimore, who was the first to artificially rear the larvae, was able to keep them alive for six days, and I was able to repeat this experiment at Malpeque. At the end of this period there is a well-developed shell, but judgfng from the size of free-swimming larvae caught by the tow-net, at least a week or ten days more must have been required by these to attain their size, taking the size of the artificially raised larvae as a point of departure.

It was my special object at Malpeque to determine the time at which the Oyster became sexually mature, as it is the object of the Government so to frame its regulations as to protect the oyster during this period of its existence.

The summer of 1903 was a somewhat cool one in the Maritime Provinces, so that it is possible that the period of ripeness was unduly delayed, but however that may be, the following were the facts which I determined. When I commenced to take observations in the end of July, only those oysters which inhabited the shallow water at the depth of 1—2 fathoms were ripe. As August progressed, those at Curtain Island at a depth of from 5—6 fathoms became ripe, and towards the end of the month only the Oysters taken from the greatest depths in Malpeque Bay were still emitting spawn; all the rest were spent. During the latter part of the month the waters were swarming with larvae which, from their exact agreement in shape and appearance with the larvae of the European Oyster, were doubtless the later stages of the free-swimming young of the Malpeque Oyster. It is evident then that the attainment of sexual maturity is dependent on the temperature of the water; for the deeper the water, the more slowly it becomes heated up.

The fact that by the end of August in a cool summer the spawning was over seems to show that the oyster could be fished without damage to the spawn in September, and that the close season is unnecessarily long.

I was not able to secure enough material for a thorough study of the development owing chiefly to the absence of proper facilities for rearing the larvae at the station, but some of the facts gleaned may be of interest. The egg when shed out is pear-shaped—when fertilized it becomes round and separates off two polar globules. These globules are by many eggs—notably those of the sea-urchin—separated out before fertilization and as concidently with their separation the nucleus of the egg loses its distinct membrane and shrinks in size, it becomes possible to discriminate ripe eggs from unripe ones. This is impossible in the case of the Oyster—the only available test is fertilization: if the eggs do not develop they are unripe. After fertilization, the eggs divides into a number of sequents termed blastomeres and out of these the future organs of the animal are built up.

It is characteristic of the eggs of all Mollusca, so far examined, that a number of smaller blastomeres should be budded off from one pole of the egg, out of which are formed the skin and nervous system. In the Oyster this is well seen; the peculiarity to notice is that the rest of the egg remains undivided as one large blastomere, whereas in other Mollusca the whole egg first divides into four equal parts when then bud off smaller blastomeres. The larger blastomere however divides later and forms a central mass of cells the rudiment of the gut and internal organs, and this central mass covered by the smaller cells. Soon the little larva rises to the top and begins to swim, and it is then seen that there is a hat-shaped anterior part surrounded by a thickened belt of skin armed with powerful cilia. This organ is termed the *prototroch*, and is found in the young stages of nearly all Mollusca and worms. About this time the rudiment of the shell becomes visible. The first trace is a large pit called the shell-gland on the back of the animal, mistaken by Brookes for the gut. This pit flattens out and forms on the second day a saddle-shaped area, at the sides of which two small calcareous particles (Fig. 2) show the incipient shell.

The shell grows larger day by day till on the sixth day it half covers the animal. On this day, the last to which the artificially reared larvae lived, the solid mass of cells originating from division of the larger blastonieres becomes hollowed out, and constitutes the stomach, and the mouth opening can be seen. There can also be seen behind the mouth on each side a little hollow vessel with a vibrating sphere within it. These are the otocysts, the so-called ears, which are found throughout all Mollusca in the region of the foot. As the Oyster has no foot they are not found in it when adult, and it is an interesting fact here recorded, so far as I am aware for the first time, that they are found in the larvae. They are called ears, but their principal function is not hearing, but keeping the animal informed of its position with regard to the vertical, and so enable it to balance itself. One is reminded of the fact that the semi-circular canals in the human ear have a similar function. The later larvae which were captured by the tow-net are characterised by possessing a straight hinge to the shell totally unlike the hinge of the adult. The front part of the animal can now be completely withdrawn within the valves. The ridge of skin bearing the powerful cilia, the prototroch, has grown into a pair of lobes and is now termed the "velum." It is suspected that the velum is later transformed into the palps when the Oyster settles down, but this so far as I know, has never been proved. The beginnings of the liver, as two yellowish outgrowths from the sides of the stomach can be seen, and also the intestine can be made out.

A few words on the general situation of the Oyster Fishery in Canada may now be in place. Abundant oysters constitute one of the many gifts of Providence which made Canada a desirable place to live in.

"Natives," as they are termed in England, are a delicacy confined to the table of the rich, here they are within the reach of all.

Like so many of the magnificent natural resources of this country, the Oyster Fishery is being most wastefully carried out, and we may before long regret in vain the time when Malpeque oysters sold for 25 cents a dozen.

Richmond Bay or Malpeque Bay, as it is sometimes called, is a somewhat quadrangular inlet of the Gulf of St. Lawrence on the North Coast of Prince Edward Island. It is roughly about ten or twelve miles long by about nine in width, and is throughout comparatively shallow, never more than about 7 or 8 fathoms in depth, for the most part 2—4 fathoms. The bay is studded with islands, of which Curtain Island, which has given its name to the best variety of the Malpeque Oyster, is one. To the north, where it opens into the Gulf of St. Lawrence, the entrance is obstructed by islands, and navigable channels are very few in number, for great sand flats and shoals connect up the islands with one another.

The whole North Coast of Prince Edward Island is fringed by a series of parallel sand-bars, and it is owing to this circumstance that the oyster is able to flourish there. All who know the coast of the Gulf of St. Lawrence are aware that the water even in summer is very cold; so cold indeed that though the adult Oyster could live in it, it could not reproduce itself, for the larvae would perish. But as the Gulf water flows over the sand-bars and shoals alluded to, it becomes heated up by the summer sun, and reaches a temperature which permits, in favourable years at least, of successful spawning. Oysters are accordingly confined to such places on the coast of Canada, as present conditions similar to those mentioned above. They exist in the Baie de Chaleur, in some of the shallower inlets on the New Brunswick Coast, at a few points on both shores of Prince Edward Island, and on the Northern Coast of Nova Scotia. In every case, however, we have to do with isolated colonies inhabiting warm spots surrounded by a great belt of cold water, so that although the larvae could be carried to great distances in the fortnight of their free-swimming life, they are all killed off by the cold. Consequently it follows that if in any place the Oysters are destroyed or fished out, no natural re-stocking will take place; and large heaps of oyster-shells where there are now no oysters testify to the fact that this has often taken place. In the natural home of the Oyster, the coast of Virginia, the water everywhere is warm, and if the Oysters are exterminated at one spot sooner or later larvae from adjoining beds will settle and found new colonies. It is supposed that the Oyster must have reached Canada in pre-glacial times, when the water was warm, and that the few colonies remaining are remnants from the time when a mild sub-tropical climate reached to Greenland.

Now the great dangers to which the Canadian fishery are exposed are over-fishing, and the use of Oyster shells as a fertilizer. As the demand increases so does the number of boats crowding into Richmond Bay, and inevitably the oyster-supply will grow less. There exists in the minds of the oyster fishermen a tremendous prejudice against permitting the cultivation of Oysters, an industry which has reached great proportions both in England and France. No more unreasonable prejudice could well be conceived. It is not for a moment suggested that the natural Oyster beds should be made private property, but if permission were given to private individuals to control small stretches of the foreshore now barren of oysters, the expenditure of a little capital might lead to the formation of a new Oyster bed. The larvae, which are scattered by the million from the natural beds, doubtless settle everywhere, but only when they reach a suitable substratum can they survive. Suitable "spat catchers" as they are called are made by planting in stakes of birchwood. The larvae, or "spat," settle on these, and when the little Oyster has reached a size of an inch or so in length it can easily be removed, and laid in a sheltered pool, where it will fatten. The Mic-mac Indians, who have a reservation on one of the islands of Richmond Bay, collect what are called "seed-oysters," adhering to the stones of the gravel beaches of Ram Island, and lay them on their own beds. One farmer, who is fortunate enough to have a tidal pool enclosed by his grounds, has done the same, and these people have shown the way. It is unfortunate that whilst the regulation of the Fishery is in the hands of the Dominion Government, the ownership is in the hands of the Island Government, and the pressure exerted on the local house by the oyster fishermen is very strong.

A still greater danger than over-fishing is however the use of Oyster shells as fertilizer. Prince Edward Island is almost wholly composed of New Red Sandstone—a formation almost unknown elsewhere in Canada, found only at Richibucto in New Brunswick, Pictou in Nova Scotia, and one or two other points on the coast immediately opposite the Island. This rock consists of a soft red shale, too soft indeed to deserve the name of rock, which is very deficient in lime. In the winter, therefore, when Richmond Bay is frozen over, the farmers go out with teams on the ice, cut holes in it, and using a kind of dredge similar to that used in dredging the River St. Lawrence, but worked by their horses, scoop up masses of Oyster shells. If the Oysters happen not to be dead no doubt they make the better manure. Attempts are made by the Dominion authorities to confine the farmers to places where they will do least damage, but as old Oyster shells make the best possible substratum for the extension of the beds, it is difficult to see how damage can be avoided. One sees in such actions the same thoughtless and improvident spirit, which destroyed so much valuable timber by fire, and which in utter heedlessness of the future of the country, sees only the immediate profit of to-day. It surely is the duty of the Government, to whom the care of the future is committed, to prevent such waste of the country's resources, and it is satisfactory to learn that negotiations are proceeding between the Dominion and the Island Governments to buy out the interest of the latter, and so gain the means of effectively controlling the fisheries.

Some Mushrooms Found in Canada [1]

By Mary Van Horne.

A few years ago an article written by William Hamilton Gibson, on Mushrooms and Toadstools, appeared in Harper's Magazine. This article created such an interest in the subject, or met a need so long felt, that the author was induced to publish a book, which came out a little later under the title of "Our Edible Mushrooms and Toadstools," and proved a most delightful introduction to the study of this form of plant life.

The book is well illustrated with many colored plates, the descriptions are carefully written and are very clear. As the species described are comparatively few, and those which are quite common, abundant and widely distributed, we were enabled to identify a number of them very quickly, which added keenness to our interest.

Gibson also gives a long list of works on the various forms of fungi, most of which were published years ago in England, France and Germany, and which describe plants peculiar to those countries, but as the same or nearly allied species are often found in America, these books are of some use to the student in this country.

Some articles on the American species had been written previous to this time, but as most of them were published in the reports of the Natural History Societies of various States, they were available to the few only.

Professor Peck, the State Botanist of New York, has made extensive research in this branch of Botanical Study, and is reported the best authority on the subject of the American species.

In his various reports, particularly in that for 1895, are many descriptions and illustrations.

[1] Being a communication to the Natural History of Montreal by the late Miss Mary Van Horne, April 2, 1902.

He has also published a little book describing all the Boleti at present known.

We owe him many thanks for naming for us difficult specimens which we have sent him.

I would also call attention to a little book called "British Fungi," by M. C. Cook, which, although describing plants found in the British Isles, is very useful to the student in Canada, as many of the same species are found here, and it has the further merit of being small enough to be carried with one on excursions in search of specimens.

Another useful and interesting book is "Fungi, their Nature and Uses" of the International Scientific Series.

A work by Professor Farlow, of Harvard, has been promised for some years past, but has not yet appeared. It is to be on a large scale, and the illustrations will be remarkably fine, as you may see from some plates of the illustrations I have been so fortunate as to secure.

Among the books spoken of by Gibson, was a French work "Les Champignons," by Moyen which contains a most satisfactory Analytical Key which we have found very useful, and which we still continue to use, although we have now the two latest American publications which claim to have good keys.

These two American books, published in 1900, are "Studies of American Fungi: Mushrooms, Edible, Poisonous, &c.," by George Francis Atkinson, and "One Thousand American Fungi," by Charles McIlvaine. The former is the smaller, handier and less expensive of the two but, of course, does not describe so large a number as the latter.

The lantern slides I have to show you to-night have been prepared from the illustrations in Professor Atkinson's work, which, having been made from photographs give very true impressions of the plants.

I have selected from the illustrations only such as show the species which we have found in Canada, and only representation types of these.

I hoped, before preparing a paper on the subject, to have colored slides of the actual specimens found, but have not been able to get them prepared.

My brother, Sir William Van Horne, made a few photographs of some varieties, but the plates were not available at the time these slides were prepared. He has, however, made some very fine water-color drawings of a number of plants, which, with some less perfect ones by my niece and myself, I have here to show you.

We found in trying to preserve specimens according to the usual instructions for drying and pressing, or preserving them in formaline, they lost so many of their characteristics that they did not pay for the trouble, so have decided that the best way to preserve a record of our work is:—

First, to make a water-color drawing of the plant as a whole, then of one or two sections.

Second, to make a good spore-print.

Third, to preserve a few spores on a glass slide for the microscope.

These with a written description are easily kept, and if systematically followed, will, I think, give a very good record.

The book by Mr. McIlvaine is a very large one, describing one thousand species with many illustrations. Of these one thousand species over seven hundred are edible, the others included have been described chiefly to warn the student against their use, or to make clear the characteristics of the edible ones.

I have given so much space to the books on Fungi, because when we began the study there were so few books available and we found it difficult to get any practical information about them, but when once well started, it was surprising to find how many persons were interested in the subject.

So far as I know there has been no record of research in this branch of Botanical study in Canada, except the publication of a "Preliminary List of Fungi" in the Report of the Natural History Society, of New Brunswick, by G. U. Hay, Esq., in 1900. This list contains the names and a few items regarding some sixty-six species found in the Province.

We shall, I hope, hear something on this subject from Professor Macoun before long, as I am told, he has given it some attention during the past three or four years.

All fungi are plants belonging to the lowest order of Cryptogams, and being devoid of chlorophyll are unable to decompose the carbon di-oxide of the atmosphere, and consequently depend upon other organisms for their carbonaceous food, and, according as these organisms are living or dead they are classed as Parasites or Saprophytes.

The number of known species in 1889, was estimated at 32,000, of these 8,500 were known as fungi imperfecti, as only certain stages of their growth were known, and it was thought they might prove to be corresponding stages in the growth of higher forms.

My remarks will be upon the higher or more conspicuous forms known as Mushrooms and Toadstools.

You will notice in all the titles of books or articles that these terms are interchangeable, as they mean exactly the same thing to the Mycologist and the Mycophagist, although those who have given no study to the subject usually restrict the term "Mushroom" to the one known as the field mushroom or to its cultivated form found in the markets. I think it would be well to use this term to indicate the edible species, and the word toad-stool to indicate those which are poisonous or otherwise unfit for food.

Perhaps I might explain here that a Mycologist is one who studies mushrooms, a Mycophagist is one who eats them. The latter term suggested to a young member of our family, the warning that we should be careful in our experiments or we might become subjects for a Sarcophagus.

We find fungi of all sizes from the minute dust-like Coniomycetes to the large Polypores which sometimes weigh many pounds, and of very great variety in form and color.

Fungi are divided into two classes; Sporifera in which the spores, which correspond to the seeds in higher plants, are naked, and Sporidifera in which the spores are enclosed in cells or cysts. The class Sporifera is divided into four cohorts; Hymenomycetes, Gasteromycetes, Coniomycetes and Hyphomycetes.

In Hymenomycetes the hymenium or spore surface is always exposed in the mature plant as in the agaric.

In Gasteromycetes the hymenium is always enclosed within a covering which bursts at maturity, as in puff balls.

In Coniomycetes there is no hymenium. The spores are produced on the ends of inconspicuous threads, free or enclosed in a bottle-like receptacle, as in rusts, smuts, &c.

In Hyphomycetes the spores are produced on conspicuous threads as in moulds, &c.

The Sporidifera are in two cohorts, Physomycetes and Ascomycetes, of which I shall have occasion to speak only of the latter, in which the spores are produced in asci formed from the fertile cells of a hymenium.

The Hymenomycetes contain by far the greatest number of large and conspicuous fungi, which are divided into six orders.

Agaricini—Gill bearing.
Polyporei—Tube bearing.
Hydnei—Spine bearing.
Auricularini—Leathery.
Clavaria—Club-bearing.
Tremellini—Gelatinous fungi.

The Agaricini are divided into five series according to the color of the spores. The names of these series differ with the different authors, but the colors of the spores are white-salmon or flesh color—rusty or tawny—brownish, purple or brown—and black, and may be determined by allowing a plant to lie with its spore surface in contact with a paper until a sufficient number of spores have been deposited to show the color.

I shall begin my descriptions with the fourth series, as that contains the well-known field mushroom or Agaricus Campestris. This is found in many parts of Canada. I have found it at Banff and am told that it grows in great profusion about Winnipeg, Toronto and Montreal, and in favorable seasons we find a great many about St. Andrews, and on a trip through New Brunswick and Nova Scotia some few years ago we saw them in abundance in many pastures.

It is the type of the Agaricaceae, and as such I shall give it a fuller description than any other.

It is the fruit of a vine-like tangle of white threads, called the mycelium which penetrates the soil just below the surface. From little joints in this mycelium, tiny white dots like pin-heads are formed, and under favourable circumstances or conditions of warmth and moisture, they develop into little button-like knobs, which push through the ground and quickly develop into the full grown mushrooms and as quickly perish, the preparation for their existence has, however, been going on for weeks or months.

The parts of an agaricus are the stem or stipe, the cap or pileus, the ring or annulus.

The cap is the expanded part which bears the hymenium or spore-surface, which in all of the Agaricaceae is on the under surface of the cap, and consists of plates or folds called gills, this in the button stage of the Agaricus and a few other genera is covered by a membrane which connects the edge of the cap with the stipe, and as the plant expands the membrane breaks away, some portions remaining attached to the stem forming the ring or annulus, and some remaining connected with the cap, giving a ragged appearance to its edges.

In the early stages the gills are pink, gradually becoming darker until they become a dark chocolate brown and later nearly black.

This change of color is caused by the gills becoming covered with the brown-purple spores.

If the stem of a mushroom is cut off and the cap is placed gills downward on a sheet of white paper and closely covered for a short time, when removed, a print of the gilled surface will be found on the paper, if this has been previously covered with a thin coat of glue and allowed to dry, before the mushroom is placed on it, a permanent print will be obtained. If left uncovered the spores are so light that they will be scattered about or fall irregularly, and a blurred print will result.

The appearance of the Agaricus campestris varies greatly, depending upon the conditions surrounding its growth. Sometimes it is quite white and again quite brown, it may be smooth or rough, but the gills should always be noted, being pink, brown or black according to age. Its season is September and October, but I have found it at St. Andrews as early as July. To the brown or purple spored group belong Agaricus arvensis, otherwise known as the Horse or Plowed-Land Mushroom, a large and coarse species, Agaricus plycomycus, and Agaricus silvicola, the two latter grow in woods. The silvicola has a very thin smooth cap. Hypholoma perplexum, which has a yellow cap tinged with red and greenish gills, also belongs to this group.

I shall now go back to the first or white-spored group, called by all authorities Leucosphoræ.

Among the white-spored agarics are the Amanitas, the earliest, most persistent, most abundant and most pernicious of all toadstools, and which should be carefully studied that their characteristics may be thoroughly learned and so one may know what to avoid. There is no rule by which one may distinguish between the harmful and harmless species, but we must learn to know them as we learn to distinguish the poison-ivy from other plants.

The Amanitas start from a mycelium, as does the Agaricus campestries, but the young button of the Amanita is entirely covered by a membrane, as well as having its cap attached to the stem by one. As the plant expands this enveloping membrane breaks away, one part remains attached to the base of the stem forming a cup which, as a warning, is called the "poison-cup." The upper part of the membrane remains attached to the cap, where it forms patches or warts upon its surface. At the same time the membrane covering the gills breaks away from the cap and forms an annulus or ring which envelops the stem like an apron or skirt. It is much more conspicuous than the ring on others.

This genus contains some edible species, but it also contains the most pernicious.

Nearly all the cases of mushroom poisoning, it is said, can be traced to two species of this genus. The chief danger lies in the fact that under some conditions they may be mistaken for agaricus campestris.

Amanita muscaria or "Fly Agaric," as it is sometimes called, a decoction for killing flies being sometimes made from it, is the most beautiful of fungi. The pileus from four to seven or more inches across, is bright yellow with dashes of crimson near the center, and scurfy or warty with the scattered remnants of the veil or volva. The flesh is white, yellow just under the skin.

The gills are free from the stem, white sometimes changing to yellow. The stem is slender, white, scaly, and has a bulbous base, which is margined by concentric scales which represent the poison cup.

In its perfect state it differs very greatly from the Agaricus, but in its button stage it may very easily be mistaken for it, and even in its later stages it may lose its scales and annulus, change in color, and if pulled carelessly, the cup may remain in the ground, so one must constantly exercise great care and learn to know it and its allied species under all their forms.

Although so poisonous, it is said to be eaten by the people of Kamschatka, and it is used as an intoxicant by the Russians in Siberia. Its narcotic properties are greatly increased by drying, and the juice of the whortle-berry, in which this substance is steeped, acquires the intoxicating properties of strong wine.

Amanita phalloides has a whitish or lemon colored cap, fewer patches on the top, white gills, stem rather smooth and bulbous, the volva or cup deeply buried in the ground, this with its variety verna, which is wholly white, is the most dangerous, because it may also be mistaken for the Agaricus campestris, and there is no known antidote for its poison, while for poisoning by Amanita muscaria, hypodermic injections of atropine have in some cases proved successful.

The effect of the poison from these is very slow in manifesting itself, sometimes no evil is felt until 16 or 20 hours after eating the toadstool, and a very tiny portion may cause serious results.

Amanita muscaria often grows in grassy places along the road side. The phalloides and verna are more frequently met with in woods.

Amanitopsis vaginata has white spores, white gills, a thin pellicle which is striate at the edges. In the variety "fulva" the color of the cap is buff, in "livida" it is gray. The stem is without a ring or bulb, is long and slender with a scurfy surface, and the base of the stem is enclosed in a volva which wraps it closely. It is an edible species, but as there is a poisonous Amanita which resembles it very closely, but differs from it in having an annulus, which, however, is wrapped so tightly about the stem as to sometimes escape notice, it is well, therefore, for the Mycophagist to pass this by.

Lepiota naucinoides is a white-gilled, white-spored mushroom, which we found last September for the first time. It was growing on the soil of a garden from which vegetables had been removed. It resembles the field mushroom, and is said to be equal to it in every way. Its gills turn to a dingy pink when full grown, and it has a ring which is double on its outer edge. McIlvaine thinks it is possible and probable that it may be cultivated and become a rival to Agaricus campestris.

Clitocybe infundibiliformis is funnel-shaped, grows in woods in summer and autumn, is pale red tinged with buff, and often has white cottomy mycelium at the base of the stem.

Clitocybe ochropurpurea grows in grassy woods and open places.

Clitocybe laccata var. pallidifolia Pk. is a very variable species.

In the genus Hygrophorus the gills become waxy with age; it has some very pretty bright colored species. We have identified Hygrophorus miniatus and Hygrophorus cantharellus.

The Lactarii form a very abundant and interesting genus. They are distinguished by having a milky juice. The gills are more or less decurrent, that is, they run down the stem when the plant is full grown, giving it a funnel shape. The spores are globose with a roughened surface.

Lactarius piperatus is white with abundant white milk, which is very acrid but does not change color.

Lactarius deliciosus is orange yellow, with zones of a darker color or shade on the cap. Milk bright orange, the gills and broken flesh turn green. It is eaten wherever it is known. Most writers claim that it is delicious, but we have not found it so.

Lactarius affinis and Lactarius theiogalis we also find; the latter has white milk which turns to sulphur yellow upon exposure to the air.

There are a great many more that we know as Lactarii but their specific names have as yet baffled us.

Closely allied to these are the Russulas, which, however, are destitute of the milky juice. Of these we find Russula alutacea, heterophylla, aurata, virescens, brevipes and emetica.

They are all rather fragile, and except the emetica, have a pleasant nutty taste when raw, and are really delicious when cooked. They appear at various times throughout the summer, but seldom in sufficient abundance at one time to make a dish, except the aurata, which grows in the woods and has a golden pileus and white or cream colored gills. Care must be taken not to mistake for it an Amanita muscaria that has lost the patches from its cap.

Russula heterophylla and alutacea are very similar to each other, the pileus varies in color from bright red to a dingy purple, the gills from a pale cream to a deep buff color. They have a thin pellicle which is easily separted from the cap, except in the centre, and it is very viscid in moist weather. The stem is white, sometimes tinged with red, and there is no ring or volva. The spores are cream color and resemble those of the Lactarii, being round and roughened.

Russula virescens differs from them only in having a greenish, mouldy looking pileus.

Russula emetica usually has a bright red cap, snow white gills, and though attractive looking should be avoided, as it might have a harmful effect. It is very peppery to the taste.

Russula brevipes puzzled us for a long time. It is very large and grows in abundance. It seems more like a Lactarius than a Russula, but has no milky juice. I think it is the species which is covered and distorted by Hypomyces lactufluorus as shown in the water color drawings. The smaller one is by Sir William, and shows the granular appearance of the surface caused by the parasite, the larger one which is about three-fourths the size of the original, shows the shape less changed.

We found these on a hillside in spruce woods near Chamcook Lake one September day, when it looked as if a cart-load of pumpkins had been overturned and broken into pieces of all sorts of shapes and sizes. I judge the host plant to be Russula brevipes, because I found portions only partly covered by the parasite, and these I thought were of the same species as the plant we found so frequently, but of which I did not then know the name.

Insects are very fond of all the Russulas, and it is difficult to find any that they have not attacked.

Another drawing shows Russula alutacea covered and changed by Hypomyces viridis. The original of this came from Metis, where my niece found this Russula and R. virescens quite abundant during a week's visit there one July.

The next genus Cantharellus differs from the other agarics in having blunt gills, which have the appearance of branching veins. It contains one of the best of edible fungi, Cantharellus Cibarius or Chantarelle, which is orange, yellow in color, looking like a patch of sunshine under the spruce trees where it grows. It is solid, irregularly funnel-shaped with a flattened top, which is sometimes slightly depressed in the center and surrounded by a fluted edge. The first time we found it we placed it in a basket with other specimens, a little later one of the party remarked there is something here which smells like apricots. This recalled a description I had read in Gibson's book, and when we returned to the house we had no difficulty in identifying it, and every summer, since making its acquaintance, we have it served at table very frequently.

Berkely and Cook say of it that it is almost universally eaten in all countries where it is found, England excepted, where it is only to be met with at the "Freemason's Tavern" on state occasions, when rare dishes are served at great cost, and at the tables of pertinacious mycophagists.

Tatternnick, a German authority, says "not only this same fungus never did any harm, but might even restore the dead," and Baltarra, another authority, says that "if properly prepared the Chantarelle would arrest the pangs of death." This is rather extravagant praise, but it certainly is a delicious mushroom.

We find three others of this genus; Cantharellus floccosus, of which I have a photograph. It is large and coarse and hardly fit for food.

Cantharellus aurantiacus is a smaller plant which might be taken for cibarius. The color of the cap is paler, varied with smoky brown tints.

Cantharellus brevipes looks like a deformed cibarius. It is short and solid, and seems as if it might be only the stem of another plant.

Marasmius oreades or the Fairy Ring Mushroom, grows on lawns and pastures where the grass is short. It is small with a buff cap and gills, leathery in substance, it dries easily, but under moisture assumes its original form. The taste when raw is pleasant and when cooked it makes a very palatable dish. Care must be taken not to confound it with Marasmius urens, which grows under nearly the same conditions; its cap is very similar, but its gills are yellow and closer together, and the base of the stem is clothed with a white down. Its taste is acrid.

Marasmius personatus is another pernicious species which resembles oreades, but as it usually grows in the woods, is not likely to be mistaken for it. The base of its stem is clothed with stiff hairs or bristles.

Of the genus Lentinus, we have Lentinus lepideus growing on the end of a log three years in succession. Its mycelium penetrates the ties of railways, upon which it frequently grows, causing them to decay.

Armillaria melleus grows in masses upon tree trunks, and its mycelium penetrating the body of the tree causes its death. Whole forests are said to be sometimes destroyed in this way.

Of the pink-spored we find Clitopilus orcella, also called the sweet-bread mushroom, and Clitopilus subvilis.

Among the rust colored spores we have the Cortinarii, which have a cob-webby membrane covering the gills in the young plant. Of these we find Cortinarius violaceus, lilacinus, armillatus and cinnamomeus, variety semi-sanguineus.

Paxillus involutus also has rust-colored spores, its peculiarity is in its anastomosing gills, which form pores near the stem. It is edible, but does not make a tempting dish.

Of the black spored agarics we find Coprinus micaceus, comatus and atramentarius.

Coprinus micaceus appears along the sides of the streets in Montreal in early June, and may be found at various times throughout the summer. When it first pushes through the ground its cap is round, of a buff color, and if closely examined may show little sparkling mica-like particles, which is a distinguishing feature and gives it its specific name. Its gills are white or grayish white, with a tinge of pink, but become black with age, when the whole plant melts away into an inky juice. Before this last stage is reached it makes a very delicious dish.

In October Coprinus comatus and Coprinus atramentarius grow in large quantities near Montreal. These are both black-spored agarics which melt away into an inky juice, which is sometimes used as ink.

Coprinus comatus, sometimes called the shaggy maned mushroom, is from three to seven inches high, oblong, becoming bell-shaped. When the deliquescing stage is reached, the cuticle of the cap splits into brownish scales which curl up, and as it hangs on its slender stem it resembles a barber's wig, which accounts for its specific name. Its gills are free from the stem, crowded, white with a pinkish tinge becoming black with age, when with the whole cap they melt away. It has a ring or annulus, but this frequently drops off as the plant develops.

I have a drawing of one, part of which was done with the juice of the original, the inky drops represented as falling from the cap are the actual spores. This juice works very much like sepia.

Both this and atramentarius are edible if used before the gills turn black. I have found the latter plant as early as July in St. Andrews, New Brunswick, where this year a few of the plants came up on the opposite side of a well beaten road, from where they grew last year. It is very like the comatus, except that the cap is more bulbous, and smooth or striate and gray in color.

One often sees growing on the trunks of trees a gilled mushroom in groups or singly; it is a Pleurotus but I have never been able to decide whether it is Pleurotus ostreatus, ulmarius or sapidus, as I have never found it in a condition to drop its spores, the color of which is a distinguishing feature.

In Polyporaceæ the hymenium consists of tubes, on the interior of which the spores are formed and escape through their mouths.

In the genus Boletus these tubes are easily separated from the hymenophore and from each other. They are fleshy putrescent fungi, most of them edible, a few are poisonous. Those having any red color about the pore surface are considered harmful. Boletus edulis has a cap, which in dry weather looks like undressed kid, its pores are at first yellow and later olive in color.

Boletus scaber has a bulbous rough stem and dingy white pores.

Boletus cyanescens has white flesh, turning a deep indigo blue when broken.

Boletus luridus has yellow flesh, turning green when broken or bruised, and has red pores and dashes of red on the stem. It is pernicious, as is also *Boletus piperatus*, which has a brown cap reddish pore surface, yellow flesh becoming red just under the skin when broken— its taste is peppery.

Boletus sub-tomentosus, bovinus, versipellus, chromapes, clintonianus and flavus are others we have found. All become infested very early by insects and worms, so that it is seldom that any are found in a fit condition for food.

Polyporus betulinus is a white fungus seen frequently on birch trees, when dry it is said to make razor strops.

Polyporus borealis is another woody species as is Polyporus lucidus, which when grown has a hard shiny surface like mahogany.

A few years ago we found a specimen of Polyporus Sulphureus on Mount Royal. It had been broken from its support and scattered about in small pieces, probably by some one imbued with the idea that all toadstools are harmful and should be destroyed. It is of a bright yellow color, is without a stem, as the cap is attached by the side to the trunk of a tree, where it grows in layers. When in the fullest vigor it is filled with a sulphur yellow milk. It has a decidedly acid taste, and is said to show phosphorescence at night. It is to be found from August to October. McIlvaine says it is a delicious fungus, and tells of a cluster on an old willow which was eighteen inches across and afforded a dozen meals. It was left attached to the tree, and portions were cut off as wanted.

The *Hydnaceae* produce their spores on spines or teeth which cover the under surface of the cap. Of these we find Hydnun repandum, rufescens, imbricatum and compactum.

The Clavariaceæ bear their spores on the entire surface of club like branches.

Of these we find Clavaria formosa, of which the water color drawing will give you some idea, although the original was a rather old and dry specimen. It is of a bright yellow color, looking under the spruce trees as the Chantarelle does like patches of sunshine. It branches somewhat like a cauliflower and is edible.

Clavaria amethystena is small and of a lilac color.

Clavaria coralloides looks like bits of branching white coral.

Spathularia clavata is a small paddle-shaped bright yellow fungus growing among moss. It belongs to the Ascomycetes, as does Peziza aurantia which has thin brittle flesh, no stem, a cup-shaped cap expanding close to the surface of whatever it grows upon. It is of a brilliant orange yellow color, with a tinge of pink.

My introduction to the study of Mycology, was the finding of a group of Morchella esculenta on Mount Royal under a group of birch trees. I had seen the description of this plant in a little leaflet we chanced to have and readily recognized it. I took the plants home to have them prepared for the table, but our cook never having seen such queer mushrooms objected to cooking them, and as I felt a little doubtful, I did not press the point, but buried them in a shady place in the yard, hoping for a future crop, when I could make further study of them or gain more confidence. However, I never saw more of those particular plants, but have found others at several places visited by the Natural History Society on its annual field day. And in Toronto I once found a group in one of the parks, and am told that it is often on sale in the markets of that place, and that it grows in abundance near Port Hope.

The Morchella when once seen will always be recognized. It has a short, rather smooth stem, surmounted by a deeply pitted bulbous cap, which gives it the name of "Honey-comb Mushroom." The whole plant is hollow. The spores are developed on the entire surface of the cap in little sacs or asci, hence it belongs to the Ascomycetes. It is very safe to use it for food, as there is no harmful one at all like it. It begins to appear in June. Two years ago I found Morchella conica on the edge of a lawn in Sherbrooke, in early June. On the same grounds and at the same time I found coprinus micaceus. My friend whom I was visiting accepted my authority for their edible qualities, and we had them served at table a number of times. The following year they again appeared and furnished an extra dish many times. Morchella conica differs from esculenta, in having a cap shaped like a bent cone and is usually smaller.

Gasteromycetes, and bear their spores within the body of the plant, something as the blossoms and seeds of the fig are born on the interior of an inflated receptacle. All puff-balls are edible when the interior is white and firm, but this soon changes to a yellow color, then to an olive, and later becomes an oozy olive mass, finally turning to a dry powder, which escapes through chinks or pores according to the nature of the species. In this state children find pleasure in stepping on them to see the smoke puff out. I remember, as a child, being warned not to allow this powder to get into the eyes as it would cause blindness. Of the Lycoperdons we have identified Lycoperdon giganteum, gemmatum pyriformæ. The two latter I have found at St. Andrews, but never the former. Two years ago a Lycoperdon giganteum was sent us from St. Anne's de Bellevue, where they were found growing on a lawn one morning. The one sent us measured thirty-eight and one-half inches in circumference, and was fourteen and one-half inches in its greater diameter. The epidermis readily peeled off and resembled a piece of heavy white kid.

Slices were cut from it and served at several meals during the week. Last year two largé ones were sent us from Odelltown, Quebec, and two smaller ones from the vicinity of Montreal, and in September I purchased one which weighed six pounds when fresh. I have a newspaper clipping describing one found near Three Rivers, which measured fifty-five inches in circumference.

McIlvaine says that if a large puff-ball is left attached to the ground and a slice is taken from the top, its development will be arrested and it will remain firm and white, so that pieces may be taken from it when wanted. When sliced, seasoned, dipped in egg and fried, it is quite like a light omelette.

Scleroderma vulgare belongs to this group. It has a very tough warty brown coat, is very hard when white, and turns to a blackish slate color, when it smells quite like a tuffle; later it is filled with a dark powder, which escapes as in the puff-ball through a chink in the top. Phallus impudicus seems a quite common fungus. It is very beautiful in color and structure, but has a loathsome odor. It is commonly called the Stink-horn fungus, or Fetid Wood-witch.

We *have identified about seventy species, and* are able to place others in the proper genera, but have only made a beginning in the study. There is a wide field for work in this branch of Botany, particularly in this country where so little has been done as yet.

In the States a number of Mycological clubs have been formed, which are adding materially every year to the recorded knowledge on the subject.

The Boston Mycological Club sends out bulletins frequently during the year to its members, describing the various species found from time to time. Meetings are held every week during the summer months in Boston, when specimens are exhibited and lectures and talks on them are given. During the winter, meetings are held once a month. Members have the privilege of sending plants to be named or identified, and they can also obtain books on the subject to advantage, through the Cambridge Botanical Supply Co., at which place the Club Herbarium may be consulted. The annual fee is one dollar.

I have given in this paper the actual result of the work we have been doing during the last three or four summers. We have taken it up as time and opportunity presented, not always as systematically as it should have been done to lay before a Scientific Society.

Many specimens gathered have spoiled before the time could be given for their identification. Sometimes weeks passed when almost none were found, then again plants sprang up in such numbers and variety, that it seemed a hopeless task to try to make them out. We have tried to be very certain about every plant placed on the list, and before sending any away for identification, have in almost every case placed them in the proper genera.

There are many interesting items we have gleaned from the various works consulted, that might have been introduced, but as they were not connected with our own investigation, we have omitted them.

The effects of fungoid growths on other plants and on animals, as the cause of disease have only incidentally come under our observation, and we have made no practical study of them.

Some Conspicuous British Columbia Summer Plants.[1]

I had the pleasure of exhibiting to the Society and of placing in the museum specimens of plants collected in the Rocky Mountains in the summer of 1897, reported in the "Record of Science," Vol. VIII., pp. 163-192, but these were mainly found in what is known as the Arid Region, east of the Columbia river, a very few being reported from as far west as North Bend. The plants now catalogued and placed in the museum were obtained chiefly on the Pacific slope. A new and remarkable flora is encountered as soon as one gets west of the coast range of mountains. The moisture of the atmosphere and the genial climate conditioned by the Japan current produce a most luxuriant vegetation wherever the soil admits of it. Introduced plants attain vast proportions compared with those they reach in their native home. For instance, the Scotch broom (*Cytisus scoparius*), furze (*Ulex Europæus*), ivy (*Hedera helix*), foxglove (*Digitalis purpurea*) and even the daisy (*Bellis perennis*)—all of which have become naturalized and are spreading rapidly about Victoria and Vancouver—grow to twice the size they attain in Great Britain. And then the trees are phenomenally large, especially the conifers; but even the alders, which are never more than large shrubs with us in the east, are seen two or three feet in diameter, with a corresponding height. British Columbia, therefore, offers a most nviting field for botanical research. Something has been done in the way of cataloguing its flora by enthusiastic field-workers like Mr. Anderson, of the Agricultural Department of the province, and Mr. A. J. Hill, of New Westminster, over and above the information contained in the reports of the Geological Survey of the

[1] Read before the Natural History Society of Montreal, April 5th, 1901.

Dominion, under the superintendence of the Messrs. Macoun, father and son, but much in this direction remains yet to be accomplished in a territory so large and only so lately begun to be occupied. More progress has been made in the states lying to the south of British Columbia—Oregon and Washington—and the publications issued by the Agricultural Bureau of the United States are of essential help in determining the flora on the Canadian side of the International boundary. Besides, the works of Coulter and Howell, although they do not profess to give a complete list of the plants of British Columbia, are available for use in our limits, although doubtless there must be species away to the north that are not found in Oregon, Washington or California. There are not a few species west of the mountains which are common to the rest of Canada, and these are not included in the subjoined list. I have confined myself in large measure to those plants which caught my eye as unfamiliar, as they showed themselves on all hands. The collections were made in the months of June and July, 1903, for the most part by myself, although I am indebted to my friend, Mr. A. J. Hill, for a few specimens collected at a later date. The *Gramineæ* and *Cyperaceæ* which I collected I will have to report on in another paper, as well as on the Fungi, Musci and Lichenes, of which I have obtained a large number of specimens, for many of which I am indebted to the kindness of Mr. Hill.

EQUISETACEÆ.

EQUISETUM TELMATEIA EHRH. Stanley Park, Vancouver, June.

EQUISETUM ROBUSTUM A. Braun, Victoria, June.

POLYPODIACEÆ.

POLYPODIUM FALCATUM KELLOGG. Esquimault and elsewhere, July.

LOMARIA SPICANT DEW. Stanley Park, Vancouver, June.

ASPLENIUM VIRIDE HUDSON. Sulphur Mt., Banff, July.

DRYOPTERIS OREOPTERIS SWARTZ. Stanley Park, July.

DRYOPTERIS MUNITUS KATIF. Stanley Park, June.

WOODSIA SCOPULINA EATON. Banks of Fraser River, July.

SELAGINELLACEÆ.

SELAGINELLA APUS SPRENG. Moosejaw, June.

PINACEÆ.

PINUS MURRAYANA OREGON COM. Side of mountain, near Vancouver, July.

PINUS CONTORTA LOUDON. Coast near Vancouver, July.

PINUS ENGELMANNI ENGELM. On mountain side, North Vancouver, July.

TSUGA.

TSUGA HETEROPHYLLA SARGENT. Vancouver, June.

TSUGA MERTENSIANA CARR. Vancouver, July.

ABIES AMABILIS FORBES. Cascade Mountains, July.

ABIES GRANDIS LINDL. Stanley Park, Vancouver, July.

THUJA PLICATA DON. Stanley Park, Vancouver, June.

JUNIPERUS OCCIDENTALIS HOOK. Heights near Vancouver, July.

JUNIPERUS COMMUNIS L. On heights near Esquimault, June.

TAXACEÆ.

TAXUS BREVIFOLIA NUTT. Common at Vancouver and Victoria, July.

JUNCACEÆ.

JUNCUS TRIFIDUS L. Olympia Mountains, July.

JUNCOIDES COMOSUM SHELDON. Heights near Vancouver, July.

MELANTHACEÆ.

TOFIELDIA GLUTINOSA PERS. Near Lake Louise, June.

ZYGADENUS VENENOSUS WATSON. Banff, July.

ZYGADENUS ELEGANS PURSH. Near Calgary, June.

STENANTHELLA.

STENANTHELLA OCCIDENTALIS RYDBERG. Vancouver, July.

CONVALLARIACEÆ.

CLINTONIA UNIFLORA KUNTH. Side of mountain, North Vancouver, July.

STREPTOPUS BREVIPES BAKER. Glacier, June.

LILIACEÆ.

FRITTILLARIA LANCEOLATA PURSH. Park, Victoria, June.

LILIUM PARVUM KELLOGG. Esquimault, June.

CAMASSIA ESCULENTA LINDL. Near Victoria, June.

BRODIÆA GRANDIFLORA SMITH. Park, Victoria, June.

ALLIUM ACUMINATUM HOOK. Park, Victoria, June.

ALLIUM CERNUUM ROTH. Medicine Hat, June.

ALLIUM RETICULATUM DON. Dunmore, June.

ORCHIDACEÆ.

PERAMIUM MENZIESII MORONG. Near New Westminster, July.

SPIRANTHES PORRIFOLIA KUNTZE. Near Coast, Vancouver, July.

HABENARIA GRACILIS WATSON. Vancouver, June.

HABENARIA LEUCHOSTACHYS WATSON. Near Washington border, July.

HABENARIA ELEGANS BOLANDER. Northern Vancouver, July.

ORCHIS ROTUNDIFOLIA PURSH. Banff, July.

CYPRIPEDIUM PASSERINUM RICH. Banff, July.

SALICACEÆ.

POPULUS TRICHOCARPA T. & G. Near Vancouver, July.

SALIX SITCHENSIS SANSON. North Vancouver, July.

CORYLACEÆ.

CORYLUS CALIFORNICA ROSE. Vancouver and Victoria, June.

CHENOPODIACEÆ.

SALSOLA TRAGUS L. Port Angeles, July.

SARCOBATUS VERMICULATUS TORR. Port Angeles, July.

SALICORNIA AMBIGUA MICHX. Vancouver, June.

POLYGONACEÆ.

OXYRIA DIGYNA CAMPD. Banff, July.

RUMEX OCCIDENTALIS WATSON. North Vancouver, July.

POLYGONUM BISTORTOIDES PURSH. Banff, July.

PLANTAGINACEÆ.

PLANTAGO ASIATICA L. Vancouver and Victoria, June.

LABIATÆ.

STACHYS CILIATA DOUGL. Victoria, June.

LENTIBULARIACEÆ.

PINGUICULA VULGARIS L. Banff, July.

OROBANCHACEÆ.

OROBANCHE COMOSA HOOK. Park, Victoria, June.

SCROPHULARIACEÆ.

PEDICULARIS RACEMOSA DOUGL. Banff, July.

CASTILLEIA MINIATA DOUGL. Victoria, June.

CASTILLEIA HISPIDA BENTH. Near Vancouver, July.

CASTILLEIA LUTEA HELLER. Victoria Park, June.

CASTILLEIA ANGUSTIFOLIA (NUTT) DON. Victoria Park, June.

CASTILLEIA OREOPOLA GREENMAN. Olympia Mountains, Port Angeles, July.

MIMULUS GRANDIFLORUS HOW. Port Angeles, July.

MIMULUS LEWISII PURSH. Ross Peak, July.

PENTSTEMON DEUSTUS DOUGL. Ross Peak, July.

PENTSTEMON LEWISII BENTH. Ross Peak, July.
PENTSTEMON ATTENUATUS DOUGL. Port Angeles, July.

BORAGINACEÆ.

MERTENSIA PANICULATA DON. Vancouver, June.

HYDROPHYLLACEÆ.

PHACELIA HETEROPHYLLA PURSH. Near Vancouver, July.

HYDROPHYLLUM CAPITATUM DOUGL. Vancouver, July.

POLEMONIACEÆ.

GILIA ACHILLAEFOLIA BENTH. Vancouver, July.
GILIA CAPITATA DOUGL. Park, Victoria, June,
COLLOMIA LINEARIS NUTT. Regina, July.
COLLOMIA DEBILIS GREENE. Near Vancouver, July.
LINANTHUS BOLANDERI GREENE. Port Angeles, July.

ASCLEPIADACEÆ.

ASCLEPIAS OVALIFOLIA DECAISNE. Near Vancouver, July.

ACERATES.

ACERATES VIRIDIFLORA (PAF) EATON. Stonewall, July.

VINCA.

VINCA MAJOR L. Port Angeles, July.

GENTIANACEÆ.

GENTIANA AFFINIS GRISEB. Donald, July.

PRIMULACEÆ.

TRIENTALIS LATIFOLIA HOOK. Esquimault, June.
PRIMULA CUSICKIANA GRAY. Port Angeles, July.
DODECATHEON CUSICKII GREENE. Banff, July.
DODECATHEON TETRANDRUM SUKSDORF. Banff, July.

ARMERIACEÆ.

ARMERIA VULGARIS WILLD. Seashore at Victoria, June.

PYROLACEÆ.

Chimaphila Menziesii Spreng. Near border of Washington, July.

Pyrola rotundifolia incarnata DC. Near Vancouver, July.

ERICACEÆ.

Kalmia glauca microphylla Hook. Lake Louise, July.

Arctostaphylos tomentosa Dougl. Very common near coast, June.

Arbutus Menziesii Pursh. Abundant near Victoria, June.

GAULTHERIA.

Gaultheria Shallon Pursh. Vancouver and elsewhere, June.

EPHEDRA.

Ephedra trifida Torr. Port Angeles, near the shore, July.

VACCINIACEÆ.

Vaccinium Alaskaensis How. Olympia Mountains, July.

Vaccinium Ovalifolium Smith. Near Vancouver, July.

CAMPANULACEÆ.

Campanula betonicæfolia L. Olympia Mountains, July.

Campanula prenanthoides Durand. Olympia Mountains, July.

OPUNTIA.

Opuntia polyacantha Haw. Medicine Hat, July.

MENTZELIA.

Mentzelia albicaulis Dougl. Medicine Hat, August.

CIRCÆA.

Circæa Pacifica Asch. & Mag. Victoria, June.

GAURA.

GAURA PARVIFLORA DOUGL. Wolseley, July.

ANOGRA.

ANOGRA PALLIDA BRITTON. Calgary, June.

EPILOBIUM.

EPILOBIUM ANAGALLIDIFOLIUM LAM. Near Banff, July.

EPILOBIUM ALPINUM L. Banff, July.

CHAMÆNERION.

CHAMÆNERION LATIFOLIUM L. Field, July.

SEDUM.

SEDUM STENOPETALUM PURSH. Sulphur Mountain, July.

SEDUM SPATHULIFOLIUM HOOK. Victoria, June.

SEDUM RHODIOLA, DC. Esquimault, June.

RIBES.

RIBES DIVARICATUM DOUGL. Stanley Park, June.

RIBES SANGUINEUM PURSH. Vancouver, June.

PHILADELPHUS.

PHILADELPHUS LEWISII PURSH. Victoria and North Bend, June.

HEUCHERA.

HEUCHERA GLABELLA T. & G. Victoria, June.

HEUCHERA PARVIFLORA NUTT. Tunnel Mountain, July.

HEUCHERA MICRACANTHA DOUGL. Park, Victoria, June.

TELLIMA.

TELLIMA GRANDIFLORA R BR. Vancouver, July.

TIARELLA.

TIARELLA LACINIATA HOOK. Victoria, June.

TIARELLA TRIFOLIATA L. Esquimault, June.

SAXIFRAGA.

SAXIFRAGA NUTKANA MOCENGLER. Sulphur Mountain, July.

SAXIFRAGA INTEGRIFOLIA HOOK. Esquimault, July.

SAXIFRAGA BRONCHIALIS L. Vancouver, July.

ARUNCUS.

ARUNCUS ARUNCUS KARST. Very common, coast to Rockies, June.

SPIRÆA.

SPIRÆA DOUGLASII HOOK. North Vancouver, July.

RUBUS.

RUBUS URSINUS CHAM. Stanley Park, June.

RUBUS NIVALIS DOUGL. Stanley Park, June.

RUBUS SPECTABILIS PURSH. Vancouver and Victoria, June.

RUBUS PARVIFLORUS NUTT. Very common, June.

POTENTILLA.

POTENTILLA GLANDULOSA LINDL. Vancouver, July.

POTENTILLA GRACILIS DOUGL. Vancouver, July.

SIBBALDIA.

SIBBALDIA PROCUMBENS L. Esquimault, June.

PRAGARIA.

FRAGARIA CALIFORNICA CHAM. Common, June.

FRAGARIA CUNEIFOLIA NUTT. Common, June.

GEUM.

GEUM TRIFLORUM PURSH. Esquimault, June.

HOLODISCUS.

HOLODISCUS ARIÆFOLIA HOW. Vancouver, July.

ROSA.

ROSA WOODSII LINDL. Banff, July.

AMELANCHIER.

AMELANCHIER ALNIFOLIA NUTT. Vancouver, July.

MALUS.

MALUS RIVULARIS ROEM. Vancouver, July.

AMORPHA.

AMORPHA CANESCENS PURSH. Near Wolseley, July.

ROBINIA.

ROBINIA VISCOSA VENT. Stanley Park, June.

LATHYRUS.

LATHYRUS LITTORALIS ENDL. Victoria, June.

HEDYSARUM.

HEDYSARUM FLAVESCENS COULT. Near Washington Border, July.

HEDYSARUM MACKENZII RICHARD. Banff and westward, July.

OXYTROPIS.

OXYTROPIS MONTICOLA GRAY. Banff, July.

ASTRAGALUS.

ASTRAGALUS HYPOGLOTTIS L. Very common, July.

ASTRAGALUS ADSURGENS PALL. Very common, July.

PSORALEA.

PSORALEA ARGOPHYLLA PURSH. Wolseley, July.

PSORALEA PHYSODES DOUGL. Columbia River, July.

KUHNISTERA.

KUHNISTERA CANDIDA (WILLD). Kuntze, Stonewall, July.

TRIFOLIUM.

TRIFLOLIUM HETERODON T. & G. Victoria, June.

TRIFOLIUM CYATHIFERUM LINDL. Victoria Park, June

ULEX.

Ulex Europæus L. Vancouver and Victoria, June.

LUPINUS.

Lupinus pusillus Pursh. Victoria, June.

Lupinus argenteus Pursh. Near Columbia River, July.

Lupinus arcticus Watson. Victoria, June.

THERMOPSIS.

Thermopsis montana Nutt. Banff, July.

ACER.

Acer Schwedleri. Agassiz, July.

Acer circinatum Pursh. Mission Junction, June.

Acer glabrum Torr. Victoria, June.

Acer macrophyllum Pursh. Mission Junction, June.

Acer Campestre L. Stanley Park, Vancouver.

GERANIUM.

Geranium pusillum L. Victoria, June.

MONTIA.

Montia parviflora Greene. Vancouver, June.

Montia-minor Gmelin. Port Angeles, July.

Montia Sibirica How. Vancouver, Common, June.

CLAYTONIA.

Claytonia megarrhiza Parry. Columbia Mountains, July.

Claytonia umbellata Watson. Very common, June.

Claytonia lanceolata Pursh. Esquimault, June.

LEWISIA.

Lewisia rediviva Pursh. Cascade Mountains.

SILENE.

Silene Menziesii Hook. Very Common, June.

Silene Gallica L. Esquimault, June.

CARDAMINE.

CARDAMINE PARVIFLORA L. Vancouver, June.

BICUCULLA.

BICUCULLA FORMOSA DC. Port Angeles, July.

BERBERIS.

BERBERIS AQUIFOLIUM PURSH. Field, June.

AQUILEGIA.

AQUILEGIA FLAVESCENS WATSON. Banff, July.

RANUNCULUS.

RANUNCULUS CALIFORNICUS BENTH. Vancouver, July.
RANUNCULUS NIVALIS L. Glacier, June.

ANEMONE.

ANEMONE DRUMMONDII WATSON. Sulphur Mountains, Banff, July.

PLECTRITIS.

PLECTRITIS CONGESTA DC. Victoria Park, June.

VALERIANA.

VALERIANA SITCHENSIS BONG. Near Vancouver, July.

XYLOSTEON.

XYLOSTEON INVOLUCRATUM RICHARD. Stanley Park, Vancouver, July.

LINNÆA.

LINNÆA LONGIFLORA TORR. Near Vancouver, July.

SAMBUCUS.

SAMBUCUS MELANOCARPA GRAY. Glacier, July.

VIBURNUM.

VIBURNUM ELLIPTICUM HOOK. Vancouver, July.

CORNUS.

CORNUS NUTTALII AUDUBON. Hope, B.C., July.

ECHINOPANAX.

Echinopanax horridum Decaisne. North Vancouver, July.

SANICULA.

Sanicula bipinnata Hook. Victoria Park, June.

OSMORRHIZA.

Osmorrhiza nuda Torr. Victoria Park, June.

PIMPINELLA.

Pimpinella apiodora Gray. Victoria, June.

THASPIUM.

Thaspium aureum trifoliatum C. & R. Wolseley, July.

PHELLOPTERUS.

Phellopterus littoralis Schmidt. Shore, near Port Angeles, July.

PEUCEDANUM.

Peucedanum triternatum Nutt. Victoria, June.

Peucedanum macrocarpum Nutt. Victoria, June.

Peucedanum ambiguum Nutt. Banff, July.

COMPOSITÆ.

Agoseris laciniata Greene. Vancouver and Victoria, July.

Crepis virens L. Vancouver and Victoria, July.

Hypochæris radicata L. Vancouver and Victoria, July.

Cnicus benedictus L. Port Angeles, July.

Arnica foliosa Nutt. Near Vancouver, July.

Arnica amplexicaulis Nutt. North Vancouver, July.

Artemisia ludivicina Nutt. Near Victoria, July.

Hymenopappus filifolius Hook. Vancouver and Victoria, July.

Gærtneria bipinnatifida O. Ktz. Port Angeles, July.

Adenocaulon bicolor Hook. Very common, July.

GNAPHALIUM MICROCEPHALUM NUTT. Vancouver, July.

ANTENNARIA ALPINA (L.) GAERTN. Banff, July.

ASTER GEYERI GRAY. Vancouver, July.

ASTER INTEGRIFOLIUS NUTT. Sycamous, July.

ASTER FOLIACEUS FRONDENS GRAY. Banff, July.

BELLIS PERENNIS L. Common about Vancouver and Victoria, June.

EUTHAMIA OCCIDENTALIS NUTT. Banff, July.

SOLIDAGO CALIFORNICA NUTT. New Westminster, August.

SOLIDAGO ELONGATA NUTT. New Westminster, August.

SOLIDAGO MISSOURIENSIS NUTT. New Westminster, August.

SOLIDAGO TOLMIEANA GRAY. New Westminster, August.

SOLIDAGO CONFERTIFLORA DC. New Westminster, August.

SOLIDAGO MULTIRADIATA AIT. Banff, July.

GRINDELIA NANA NUTT. Wolseley and Winnepeg, July.

GRINDELIA SQUARROSA DUNAL. Shore at Victoria, June.

GRINDELIA INTEGRIFOLIA DC. Marshy shore, Vancouver, July.

The Pleistocene of Montreal and the Ottawa Valley from a Railway Carriage.[1]

By J. S. Buchan, K.C., B.C.L.

The purpose of this paper is to give an illustration of what may be seen and observed on even so commonplace an occasion as a Railway journey from one place to another.

In carrying out this purpose, I have endeavoured to avoid any reference to detail or anything but what can be seen and observed in the ordinary course of such a journey.

Setting out from Montreal from the Bonaventure Station of the Grand Trunk Railway, we see but little of the natural features of the country until we reach St. Henry Station, the line being shut in by buildings on both sides. From St. Henry we observe that the line passes through a valley which is bounded on the Western side by a steep bluff about one hundred (100) feet in height, the top of which is level and presents a straight line to the view, and which extends almost the whole distance to Lachine, where it rises in a more gradual ascent.

The Eastern side is bounded by a hill considerably lower, and except in some places less abrupt than the West, but its appearance has evidently been somewhat changed by the excavation of the Lachine Canal close to the foot of the hill and by the large banks of earth from the Canal piled on its Western side.

The width of the valley is about half a mile, and its floor, which is almost perfectly level, is composed of a deep black soil, on which are the famous celery fields of Montreal.

In this valley are a single and a double line of steam

1 Read before the Natural History Society of Montreal, February 29th, 1904.

and one dou ble track electric railway, the little River St. Pierre and the Lachine Canal. From the nature of the soil as well as the dead level of its surface, it is easy to conclude that at some period the land was covered with water; that, in course of time the water became a shallow lake gradually overgrown with water plants, and at length a swamp through which the small river carried all that remained of the water which formerly filled the valley.

Approaching Lachine the limit of the black soil is passed, and horizontal beds of limestone are seen reaching to the surface, which here becomes more uneven and is covered in places with loose stones interspersed with low swampy tracts; on the borders of the Town of Lachine the general surface being only slightly above the level of Lake St. Louis.

Retracing our steps we again begin our journey, this time by the Canadian Pacific Railway from the Windsor Station. Our route is now over the top of the bank which forms the Western side of the Valley, the level of which is reached at the Westmount Station.

A short distance beyond this point, at the Glen, where considerable excavations have been made, it is seen that the bank has been laid down by the agency of water, as it is composed of layers of sand and gravel with a covering of clay from which bricks are being manufactured.

To the West, a bank composed of the debris from the mountain extends to Montreal West, becoming gradually lower until it ends abruptly near the Station; this again showing the action of the currents of water which carried away the material planed off the top of the Mountain by ice-fields and strung it out in a tail several miles in length.

Looking towards the East we are surprised to find we cannot see the Valley through which we passed on the other Railway. Instead the surface of the land seems to extend without a break, and with a gentle slope to the St. Lawrence River, which can be seen in the distance, the appearance being continuous, as in Fig. 1.

Passing the Montreal West Station, we reach the point where the Valley comes into view, and here we observe that while the Easterly side is lower than the West, the slope of the surface towards the St. Lawrence is clearly produced on the Eastern side of the Valley as shown in Fig. 2.

From this we conclude that the bank, as laid down, extended to and beyond the present line of the St. Lawrence, and that the Valley was excavated by a stream of water which formed a channel or branch of the St. Lawrence, until, as the land continued to rise, the hard rock near Lachine remained firm while a break or fissure at the present Lachine rapids caused a lowering of the water which allowed it to drain off below the level of the Valley.

From Lachine to St. Anns, there are places where the limestone comes to the surface, and others where it is covered by the usual glacial drift. At Pointe Claire there is a mass of limestone, evidently in place from the markings of the stratification visible from the Railway, which rises abruptly from the plain to the height, apparently of about forty (40) feet, and through which a wide level road passes where the stone has been removed by quarrying operations.

This was doubtless left in place when the surrounding beds of limestone were removed by erosion, owing to the part where the denuding forces struck it being harder than the rest of the mass, possibly due to the presence of a trap dyke or merely a harder bed of limestone. From what remains some idea may be formed of the enormous mass of limestone which has disappeared from the surrounding country through the action of nature's forces

Near St. Anns some rounded hills of sand and gravel show where fierce currents, carrying with them the materials which formed the sides and beds of the channel through which they flowed, cast them into an eddy which washed and heaped them up in its circular course.

At St. Anns, at the head of the Island of Montreal, the shore rises steeply from the water. The limestone extends to the surface, and at the Station has been removed to form the bed of the Railway, showing the even and regular stratification; while for a considerable depth from the surface it is decomposed and turned into soil containing small rounded boulders of decomposition near the Station. Among other debris being removed by laborers, was a large block of conglomerate apparently identical with that on St. Helen's Island belonging to the Helderburg system.

Crossing the River by the fine steel bridge, we note the presence of a number of low, flat islands in the lake, indicating shallow water outside of the channel marked by a line of buoys.

Crossing Isle Perrot, which is alternately low, and swampy, and hilly, with small boulders, an outcrop of red sandstone belonging to the Potsdam formation may be observed; another of the same being found near Hudson.

Passing over the branch of the Ottawa separating the Island from the mainland, which is shallow with swift currents, we reach Vaudreuil, situated on a flat alluvial plain marked to the South by a high well-defined bench, at some time the shore of the then lake.

Approaching Como the plain becomes broken and irregular with gravelly hills covered in places with boulders, and at Hudson Heights the Railway runs close to the water's edge with a bank of sand and gravel rising steeply on the south side of the line to the height of apparently over a hundred feet.

Directly across the lake which seems to be about two miles in width, there rises the mass of Mont Calvaire; while the shore on the North is seen to be a great bank similar to that on the South, stretching along the lake for a distance difficult to estimate, but apparently about the same height as the southern bank with the straight, even line of surface at the top which shows that it was carried into its position by the action of water.

Passing close to the shore for a distance of about half a mile the limit of the bank is reached, and it is then seen to sweep away from the river in a curving line until it joins the high ridge formed by the tail or continuation of Rigaud Mountain.

As the train advances and both sides of the lake come into view together, it can now be seen that there is a similarity between the banks on both sides of the water, and that they present the appearance which is seen when a railway embankment or a dam has been broken; thus giving the impression that a great bank or dam extended across the whole width of the lake, which has been broken and cut away by the water, leaving only the two ends which now form the bank on each side of it.

As it is a well-established fact that the tendency of a steep bank is to become flattened by the constant action of the ordinary forces of nature, and these banks as well as those of the St. Pierre Valley, which were first noticed, are still steep and regular, it may further be inferred that these changes took place at a comparatively recent period of geological time.

Passing quickly over another alluvial plain flanked on the South by Rigaud Mountain and crossing a small river which flows past the western end of the mountain, the country becomes uneven with rounded gravelly hills and occasional outcrops of limestone, until the half-way point between Montreal and Ottawa is reached at Van Kleek Hill, beyond which great stretches of peat bogs, bounded by well-defined raised beaches, begin and extend over almost the whole of the distance to Ottawa.

If a journey is made in the Spring, these bogs are usually covered with water for a great distance, reproducing to some extent the former conditions when this region was a vast lake extending in places to the base of the Laurentians to the north and beyond the line of vision to the south; but if made during the dry season, covered with the smoke of numerous fires where the peat is burning from which it may be inferred that in these bogs there is an inexhaustable supply of material for fuel if a proper and sufficiently economical method of manufacturing it for use can be found.

In this sketch only a few salient points have been noticed. Many others might be referred to, and if the journey is repeated on each occasion new ones may be observed.

Apart from any scientific interest, or even in its absence, there may be a moral or quasi moral side to the question. The habit of observation is a most valuable one. It stimulates and calls into action faculties which in their turn exert a most powerful influence, both mentally and physically, producing quickness and certainty of thought and action, and doubtless in many cases replacing carelessness and indifference with those qualities which go far to make the differenec between failure and success in life.

THE CAMBRIC DICTYONEMA FAUNA OF THE SLATE BELT OF EASTERN NEW YORK.

By RUDOLF RUDEMANN.

[*N. York State Museum Bulletin 69, 1902 (1903)*].

This paper is of much interest to American and Canadian geologists as it contains a very full discussion of the relation of the Dictyonema Zone to the Cambrian and Ordovician systems.

The author gives an account of the position of this band in Scandinavia, and the elaborate studies Linnarsson, Tullt rg, Lundgren and Brögger upon its fossils, and its relation to the Cambrian types below and Ordovician above. "The northern European paleontologists, almost without exception, have agreed" to place this band as the "termination of the primordial [Cambrian] fauna."

On the other hand the English geologists, including Prof. Geikie, still include in the Cambrian the next group (Tremadoc) above this band, though Brögger and others show that the paleontological evidence is against such a decision. This use of the term Cambrian is based on historical usage, and the acceptance of the Areing fauna as the base of the Ordovician.

Dr. Rudemann, from the conditions at Navy Island, in the St. John basin, finds evidence (shown by Matthew) that the Dictyonema Zone should be included in the Cambrian; but he holds with the continental paleontologist that the divisional line for the summit of the Cambrian should be drawn at the top of this Zone. He alludes in terms of approval to the work of Ells and Ami on the rocks of the Quebec Group in the typical region, but he probably misunderstands Ells' table of the divisions in these rocks in attributing the two lower to Lower Cambrian on account of remains of *Olenellus Thompsoni.* Ells' meaning probably is that the fossils are contained in the pebbles of the conglomerate in division 2, in which case these divisions are not necessarily Lower Cambrian.

Rudemann's result would appear not to agree with C. D. Walcott's opinion of the limit of the Cambrian (see page 953, fourth paragraph), for he, Walcott, would include the Dictyonema Zone in the Lower Ordovician. Moberg has suggested a similar view of this Zone in Scandinavia, but, as Rudeman has shown, it does not apply in America.

Dr. Rudemann seems to think it will be possible to divide the Dictyonema Zone in America into two or three sub-zones,as has been done for that of Europe in Sweden.

Three plates are given to show the lithological aspect of the Dictyonema beds on the Hoosic R. in New York. The article is preliminary to a work on the Graptolites of New York by this author.

G. F. MATTHEW.

The Monteregian Hills—A Canadian Petrographical Province.[1]

GENERAL STATEMENT.

In the province of Quebec, between the enormous expanse of the Laurentian highlands to the northwest, constituting the "Canadian Shield," and the disturbed and folded tract of country to the southeast which marks the Appalachian uplift, there is a great plain underlain by nearly horizontal rocks of Lower Paleozoic age. This plain, while really showing slight differences of level from place to place, seems to the casual observer perfectly flat. Its surface is mantled with a fertile soil consisting of drift redistributed upon its surface by the sea which at the close of glacial times covered it. The uniform expanse of this plain, however, is broken by several isolated hills composed of igneous rocks, which arise abruptly from it and which constitute very striking features of the landscape. It was at the foot of one of these hills rising by the side of the river St. Lawrence, and which he named Mount Royal, that Jacques Cartier on his first visit found the Indian encampment of Hochelaga, whose site is now overspread by the city of Montreal, which has not only grown around the foot of the hill, but has extended up its sides and has reserved its summit as a park.

From the top of Mount Royal, the other hills referred to can all be seen rising from the plain to the east, while to the north the plain stretches away unbroken to the foot of the Laurentian country.

As has been remarked by Sir Archibald Geikie:[2]

[1] Read before the Natural History Society of Montreal, April 5th, 1904, and reprinted from the "*Journal of Geology*" by permission of the author.

[2] *Text-Book of Geology.*

The word "mountain" is properly speaking not a scientific term. It includes many forms of ground utterly different from each other in size, shape, structure, and origin. In a really mountainous country, the word would be restricted to the loftier masses of ground, while such a word as "hill" would be given to the lesser heights. But in a region of low or gently undulating land, where any conspicuous eminence becomes important, the term "mountain" is lavishly used. In eastern America this habit has been indulged in to such an extent that what are, so to speak, mere hummocks in the general landscape are dignified by the name of mountain.

The hills under consideration, while by no means "mere hummocks," being situated in such a country of low relief, seem to be higher than they really are and are always referred to locally as "mountains."

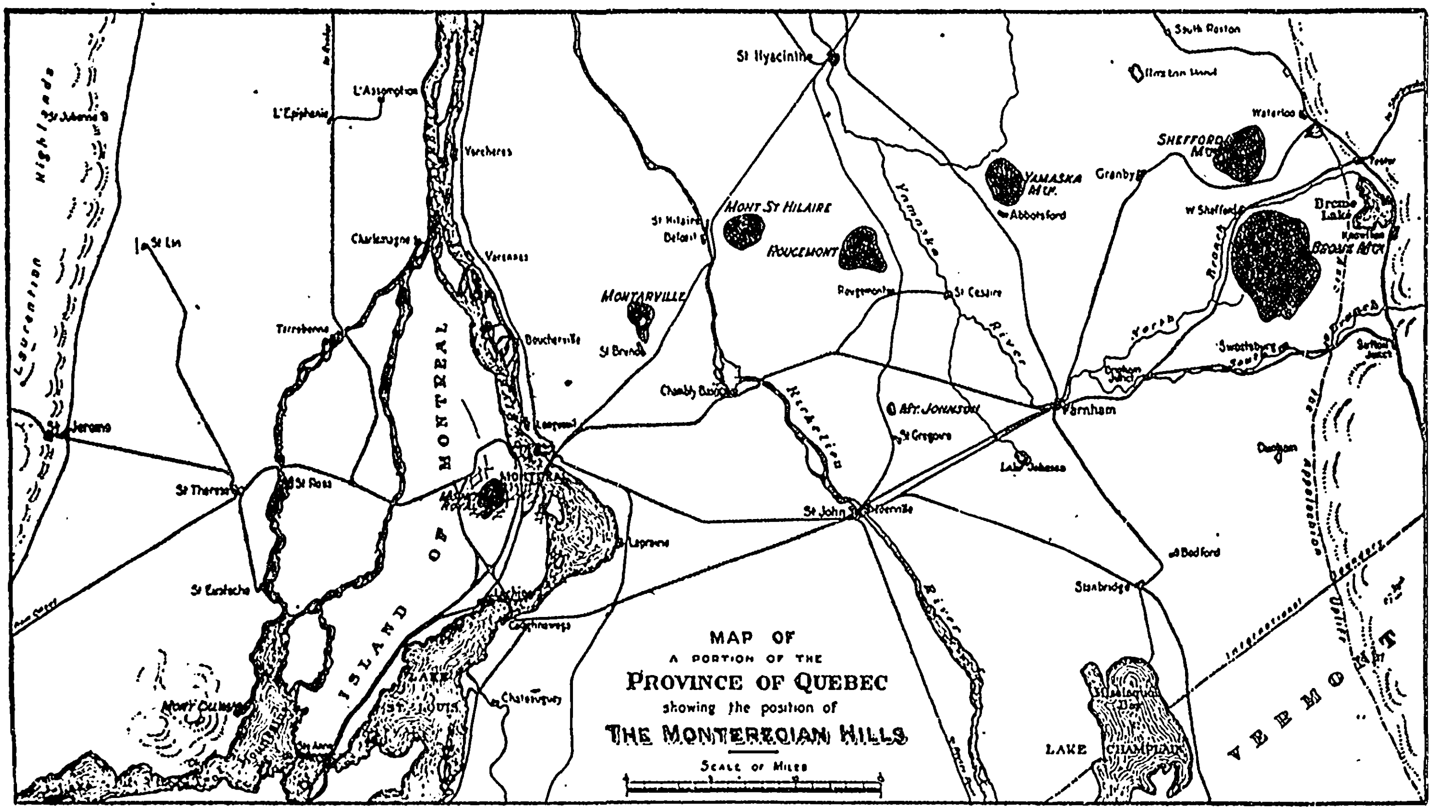
These mountains, whose positions are shown on the accompanying map (Fig 1), are eight in number, their names and their height above sea level being as follows;

Mount Royal	769.6 feet
Montarville or Boucherville mountain	Not yet accurately determined
Beloeil	1,437 feet (Leroy)
Rougemont	Not yet accurately determined
Yamaska	Not yet accurately determined
Shefford	1,600 feet (Dresser)
Brome	1,440 feet (Dresser)
Mount Johnson or Monnoir	875 feet

Brome mountain is by far the largest of the group, having an area of 30 square miles. Shefford comes next in size, having an area of rather less than nine square miles, while Mount Johnson, which is very much smaller than any of the others, has an area of only .422 of one square mile.

Of these eight, the first six, as Logan[1] notes, "stand pretty nearly in a straight line," running approximately east and west, Mount Royal being the most westerly, and the others following in the order in which they are enumerated above, until Shefford mountain is reached, which is the most easterly member of the series. The distance from Mount Royal to Shefford is fifty miles. Mount Johnson and Brome mountain lie on a line parallel to

1 *Geology of Canada*, p. 9.


MAP OF
A PORTION OF THE
PROVINCE OF QUEBEC
showing the position of
THE MONTEREGIAN HILLS
SCALE OF MILES
St Hyacinthe
MONT ST HILAIRE
ROUGEMONT
MONTARVILLE
YAMASKA MTN.
SHEFFORD MTN.
BROME MTN.
Granby
Waterloo
South Roston
Abbotsford
W Shefford
Brome Lake
Knowlton
Rougemont
St Cesaire
Yamaska River
St Hilaire Beloeil
St Bruno
Boucherville
Varennes
Varcheres
Charlemagne
L'Assomption
L'Epiphanie
St Lin
Terrebonne
St Rose
St Therese
St Jerome
St Eustache
Laurentian Highlands
ISLAND OF MONTREAL
Chambly Basin
Richelieu
St John
Iberville
St Gregoire
MT. JOHNSON
Farnham
Laprairie
Caughnawaga
Chateauguay
LAKE ST. LOUIS
Stanbridge
Bedford
LAKE CHAMPLAIN
Dunham
VERMONT
Appalachian Uplift
North Branch
Sutton Junct
MONT OKA
FIG. 1.

them, but a short distance to the south, Rougemont being the nearest neighbor to Mount Johnson and Brome mountain being immediately south of Shefford. It is highly probable, in view of this distribution, that these ancient volcanic mountains are, as is usual in such occurences, arranged along some line or lines of weakness or deep-seated fracture. The "pretty nearly straight line" referred to by Logan on which the first six mountains of the group are situated must be considered either as a single line with a rather sharp curve in the middle, or as made up of two shorter straight lines, each with three mountains, which diverge from one another at an angle of about 30°, Montarville being located at the point of intersection. Mount Johnson and Brome mountain might then be considered as situated on short subsidary fractures.

Brome and Shefford, however, which are the two largest mountains of the series and which are only separated by a distance of a little over two miles, are probably connected at no great depth below the surface, forming in reality one large mass, while Mount Johnson, like the similar volcanic necks of Fife and Würtumberg, may have no direct connection with any line of fracture. It must be noted, as mentioned by Dresser[1], that while six of these mountains rise from the horizontal strata of the plain, the two most easterly members of the group, named Shefford and Brome, while still to the west of the axis of the range, lie well within the folded belt of the Appalachians, though owing to the extensive denudation from which the region has suffered, this folding has had but little influence on the local topography.

No collective name has hitherto been proposed for this remarkable group of hills.[2] From their intimate geo-

1 "On the Petrography of Shefford Mountain," *Amer. Geol.*, October, 1901.

2 The only instances in which these hills have been referred to as a geographical unit are, so far as can be ascertained, in a paper by STERRY HUNT entitled "On Some Igneous Rocks of Canada." *Amer. Jour. Science*. March, 1860, where they are called the Montreal group; and by ELIE DE BEAUMONT, who in a late edition of his *Systemes de*

logical relationship, however, constituting as they do a distinct and remarkable petrographical province, such a name is required. I propose to call them the *Monteregian Hills,* deriving their name from Mount Royal ("Mons Regius"), which may be taken as their type, being as it is the best-known member of the group.

There are certain other hills which have been considered by former workers in the geology of this district to belong to this group. Thus Logan thought that Rigaud Mountain, situated near the margin of the plain, by the river Ottawa, about forty miles west of Mount Royal, was "probably connected with" the series.[1] Ells[2] also included Mount Calvaire, a large, low mass which rises from the plain immediately to the north of the Lake of Two Mountains, near the junction of the Ottawa and the St. Lawrence.

Ells also refers to "the hills on the west side of Memphremagog lake and to the northeast toward the Chaudière river and beyond" as bearing a marked resemblance to the rocks of Mount Royal, Yamaska, etc., and as probably being of the same age.[3]

In a careful study of Rigaud mountain, recently completed by Mr. Leroy,[4] of this university, it is shown that the rocks constituting this mountain are different in character from those of the Monteregian hills, being composed of a reddish hornblende syenite and a quartz-bearing porphyry. These rocks, however, were found to be identical in character and composition with a great area of syenite, cut by porphyry, mentioned by Logan as occupying some forty square miles in the townships of Chatham and Grenville on the margin of the Laurentian

Montagnes included these hills as one of his systems, under the name of the "Système de Montréal." See PRESTWICH, *Geology, Chemical, Physical and Statigraphical*, Vol I. p. 294.

1 *Geology of Canada*, 1863, p. 9.

2 "Report on a portion of the Province of Quebec," *Ann. Rept. Geol. Surv. of Canada*, Vol. VII, Part J, 1896.

3 Eastern Townships Map (Montreal Sheet), *Ann. Rept. Geol. Surv. of Canada*. Vol. VII, Part J.

4 *Bull. of the American Geological Society*, Vol, XII, 1901.

plateau, a few miles to the north of Rigaud mountain. Owing to the drift which mantles this district, the actual contact of the igneous rock of Rigaud mountain and the Paleozoic strata of the plain is nowhere visible, so that it is impossible to determine whether the mass of Rigaud mountain cuts through the strata in question, as in the Monteregian hills, or whether it is pre-Paleozoic in age. The same is true of the mass in Chatham and Grenville, the actual contact here also being found by Mr. Leroy to be banked up with drift. The narrow margin of gneiss shown on Logan's map[1] between the Chatham syenite and the Paleozoic is also conjectural, the area being likewise drift covered. Rigaud mountain is, furthermore, of a different shape from the mountains east of Montreal, being six miles in length and only two and one-half miles wide; at the eastern end of it, moreover, there is found an occurrence of ordinary Laurentian gneiss. The abrupt and straight southern boundary of the Laurentian plateau along this part of its course probably marks a fault. Ells has noted the existence of other faults in this district, one of which he believes to follow the north side of Rigaud mountain. It is thus highly probable that the ridge known as Rigaud mountain does not belong to the Monteregian hills, but that it is a portion of the Laurentian plateau separated from the main area by faulting and stripped of its original covers of Paleozoic strata by denudation. It is probable that Mount Calvaire, as regarded by Logan, is also an outlying portion of the Laurentian plateau.

The hills on the west side of Lake Memphremagog and to the northeast toward the Chaudière river, referred to by Dr. Ells, so far as is known, are quite different in petrographical character from Mount Royal and the other members of its group They constitute a chain of hills occupying a tract of country some four miles wide and

1 Atlas to accompany the *Geology of Canada*, 1863, Map No. 2.

thirty-five miles in length, in the heart of the Appalachian uplift and following the strike of the Appalachian folding. Many of them, as Owl's Head and Orford mountain, rise to a very considerable height, these peaks having a height of about 2,400 and 2,800 feet respectively; forming, in fact, the highest elevation in this part of Canada. So far as has been ascertained, these mountains are in all cases composed of highly altered rocks. Many of them are altered diabases.[1] In other cases the alteration is so far advanced that it is impossible to determine the character of the original rock. Many of them have been completely altered to masses of serpentine. Nepheline-syenites, essexites, and similar rocks have not as yet been found anywhere in this chain of hills. A series of dyke rocks from Lake Memphremagog, examined by Marsters,[2] were found to be chiefly granites and lamprophyres, with one typical camptonite. It would seem therefore, that while our knowledge of these hills is as yet very imperfect, the evidence at our command, so far as it goes, points to them as belonging to a group quite distinct from Mount Royal and its associates. The petrographical province of the Monteregian hills may, therefore, in the present state of our knowledge, be said to comprise only the eight mountains enumerated on p. 240, together with the consanguineous dykes which at many points are found cutting the rocks of the surrounding plains.

The first description of these hills was that given by Logan and Hunt in the early years of the Canadian Survey. To Hunt especially we owe a somewhat extended description of the petrography of the group and a number of chemical analyses, more especially of the constituent minerals of certain of the rocks. These descriptions are, however, very general and often very imperfect, as must necessarily have been the case before the introduction of modern petrographical methods. Nor were certain im-

1 F. D. Adams, *Ann. Rept. Geol. Surv. of Canada*, 1880-81-82, pp. 12-13 A.
2 *American Geologist*, July, 1895.

portant petrographical relationships observed which have in later times come to be recognized. This early work, however, is of great interest, and in case of three of the mountains almost all the information which we have even at the present time, is derived from those early studies. The results of this work were brought together in the *Geology of Canada*, published by the Geological Survey of Canada in 1863, and are to be found on pp. 655–70. During the thirty years following the appearance of this volume, only three papers containing additional information concerning these rocks appeared. These were by Harrington,[1] Lacroix,[2] and the present writer,[3] respectively, all dealing with Mount Royal. In 1896 the "Montreal Sheet" of the *Eastern Townships Map*, prepared by Ells, and embracing the district of the Monteregian hills, was published by the Geological Survey of Canada and accompanied by a geological report on this portion of the province of Quebec. Four years later Principal Dresser of St. Francis College, Richmond, aided by a small grant from the Geological Survey of Canada, made a careful study of Shefford mountain, and a preliminary paper embodying the chief results of his investigations appeared in 1901.[4] Mr. Dresser last summer extended his work to Brome mountain, and has since published a brief description of this occurrence.[5] Mr. O. E. Leroy, of McGill University, is now engaged in a study of Beloeil, and I am indebted to him for the facts concerning the geology of this mountain which are here presented. Montarville, Rougemont, and Yamaska mountains still await detailed study, but it is expected that they also will before long be put in commission.

1 "On Some of the Diorites of Montreal," *Ann. Rept. of the Geol. Surv. of Canada*, 1877-78, 42 G.

2 "Description des syénites néphélinitiques de Pousac et de Montréal (Canada) et de leurs phénomènes de contact," *Bull. Soc. Geol. de France*, 3e série, tome XVIII, 1890.

3 "On a Melilite-Bearing Rock [Alnoite] from St. Anne de Bellevue near Montreal, Canada," *Amer. Jour. of Science*, April, 1892.

4 "On the Petrography of Shefford Mountain," *Amer. Geol.*, October, 1901.

5 *Summary Report of the Geological Survey Department for* 1901, p. 183.

In the present paper it is proposed first to gather together the more important facts concerning the geology of the Monteregian hills which are scattered throughout these various publications, revising some of the earlier work and embodying the results of later personal studies, and then to describe in some detail one of these hills—Mount Johnson—of which hitherto but little has been known.

PETROGRAPHY OF THE MONTEREGIAN HILLS.

Hunt distinguished four types of igneous rocks as constituents of the Monteregian hills. These he classed as trachyte, phonolite, diorite, and dolerite, respectively. In this classification no distinction was made between rocks occurring as dykes and the great igneous intrusions which form the body of the hills; differences in structure resulting from mode of occurrence were not considered, the classification being based upon mineralogical composition alone.

Recent investigations have shown that Hunt's names do not convey an accurate idea of the petrography of these hills, nor do they set forth the interesting relationships of the various rocks composing them. It is necessary for this purpose to adopt a more modern nomenclature, for all the mountains of the group are composed of a family of consanguineous rocks, and taken together they present one of the finest examples of a petrographical province hitherto discovered. They consist, furthermore, of a rather rare class of rocks characterized by a high content of alumina and alkalies, especially soda.

The rocks forming the great intrusions which make up the mass of these mountains belong to two well-characterized types—one light in color, poor in iron-magnesia constituents, and comparatively high in silica; the other dark in color, rich in iron-magnesia constituents, and with a lower content of silica. They may be classed as follows, if Rosenbusch's nomenclature be followed:

1. Alkali-syenite, nepheline-syenite, or sodalite-syenite.
2. Essexite.

The first is an alkali-syenite, always containing a little nepheline, but this mineral in some cases becoming so abundant that the rock passes into a true nepheline-syenite, or, by the replacement of the nepheline by sodalite, into a sodalite-syenite. This in the case of Mount Johnson and Shefford mountain is represented by the variety known as pulaskite; in Brome mountain it is stated by Dresser to resemble Brögger's laurvikite,[1] while in Mount Royal and Beloeil it is a nepheline syenite. At the latter mountain a sodalite-syenite also occurs in association with the nepheline-syenite. Nepheline-syenite is also known to form part of Yamaska mountain. In addition to the syenite of the pulaskite variety, Dresser found in Shefford mountain a large development of a distinctly more acid type of the syenite magma, the rock showing occasionally a few grains of quartz. This rock he has classed as nordmarkite. These light colored syenites, together with certain dykes of bostonite having a general similarity in composition, were the rocks classed by Dr. Hunt as trachytes.

To the essexites belong the dolerites and diorites of Hunt, when he applied these terms to the great igneous intrusions of the mountains and not to mere dykes. They usually contain both hornblende and pyroxene, but the relative proportion of these two minerals varies considerably in the different occurrences. Olivine is sometimes present. Hunt did not recognize the presence of nepheline in these rocks, nor the highly alkaline character of the magma which they represent, and classified them as dolerite or diorite according to the preponderance of pyroxene or horneblende, noticing certain occurrences in which the former rock passed into a pyroxenite or peridotite.

The greater part of Mount Royal is composed of an essexite, usually very basic, the dark-colored constituents

1 *Summary Report of the Geological Survey of Canada*, 1901, p. 187.

forming a very large proportion of the whole rock. This was classed by Hunt as a dolerite, but is almost identical with the essexite of Mount Johnson, which Hunt classes as a diorite. This same rock is stated by Hunt to make up the greater part of Montarville and Rougemont and to form a portion of Yamaska mountain. An examination of thin sections of specimens of the Rougemont rock in the petrographical collection at McGill University shows it to be an essexite, rich in olivine. Dresser has found it to constitute approximately one-half of Shefford mountain and also to form large areas in Brome mountain. It makes up the greater part of Mount Johnson and forms the mass of Beloeil.

It is thus seen that the essexite magma is represented in every one of the eight mountains, and that in six of them at least it is associated with the syenite magma. The remaining two, Montarville and Rougemont, which have not been thoroughly examined as yet, while certainly composed chiefly of essexite, will probably be found, on further study, to present a development of the syenite in some portions of their mass also.

In addition to these bodies of intrusive rock which form the mass of the mountains, great numbers of dykes occur cutting both the surrounding sedimentary strata and the intrusions. These are, of course, especially numerous in and around the mountains themselves, but are also occasionally found far removed from the centers of activity. The relative abundance of these dykes in the vicinity of the several mountains varies greatly. They swarm through the Paleozoic strata about Mount Royal, cutting the limestones in all directions and also traversing, although less frequently, the igneous rock of the main intrusion as well. No less than twenty-nine dykes and flows, belonging to at least four and possibly five separate series, each cutting the preceding set, were mapped by Dr. Harrington some years ago in an excavation measuring 220 yards by 100 yards which was opened up in the

Trenton limestone on the flank of Mount Royal during the construction of the Montreal Reservoir extension. Dykes, in fact, abound wherever in the vicinity of Mount Royal the bed rock is exposed by the removal of the drift, as for instance, at the Mile End Quarries, St. Helen's Island, and in the bed of the St. Lawrence about Point St. Charles when it is exposed at low water. The whole district about the city would present a network of dykes, could the overlying drift be removed.

Dresser mentions dykes as occurring abundantly about Shefford mountain. In Mount Johnson, on the other hand, they are almost entirely absent. Only five dykes could be found after a careful exploration of the whole occurrence, and they were of insignificant dimensions. But very few dykes also occur at Beloeil mountain. A large number of the dyke rocks have been collected from the various occurrences and are now awaiting investigation in the geological department at McGill University. The work on the dykes of Mount Royal is now well advanced and, it is hoped, will be ready for publication shortly. They form a most remarkable series, comprising bostonites, tinguaites, sölvsbergites, camptonites, fourchites, monchiquites, and alnöites. Most, if not all, of the types of dyke rocks which have been described as occurring in association with the alkaline rich magmas of the theralite and nepheline-syenite groups in any part of the world are thus represented. To these dyke rocks belong Hunt's phonolite, which he considered to differ from the trachyte in that it contained a certain portion of natrolite. The two occurrences which he describes[1] are both from points near Montreal. They are nepheline bearing dykes in an advanced stage of alteration.

As has been mentioned, dyke rocks which from their composition are clearly connected with the intrusions of the Monteregian hills have been found cutting the rocks

[1] *Geology of Canada*, pp. 659-61

of the plain at very considerable distances from any of the main centers of activity. Thus, in addition to occurrences of Laprairie, Lachine, Rivière des Prairies, Ste Anne de Bellevue, St. Paul's Island in the vicinity of Montreal, several dykes and flows of "trachyte" (bostonite) are noted by Hunt and Logan as occurring about Chambly, which is six miles to the south of the line of the Monteregian hills,[1] while the occurrence of a "dolerite" dyke at St. Hyacinth, ten miles north of the line is mentioned.[2]

A sheet of trap evidently connected with these intrusions also occurs at St. Lin,[3] twenty-four miles north of this line, where it alters the Chazy limestone through which it cuts into a pink marble. It is very much decomposed, but evidently belongs to some variety of the nepheline or melilite dyke rocks above mentioned.[4]

Whether the camptonite and in some cases bostonite dykes, described by several authors from various points in the states of Maine, New Hampshire and Vermont, adjacent to the Canadian line, and still more distant occurrences of similar dyke rocks in the state of New York, are connected with the Monteregian hills, is not yet known. There seem to be no intrusions of nepheline-syenite or essexite hitherto discovered with which these southern dykes can be connected in the districts in which they occur. The umptekite intrusion of Red Hill, Moltonboro, N. H., is however, closely related to the Monteregian pulaskite in character and composition, and may prove to be such a center.

STRUCTURE AND ORIGIN OF THE MONTEREGIAN HILLS.

The question of the mutual relations and relative age of the several rock types constituting these hills presents many points of interest. In the case of Mount Royal the

1 *Geology of Canada*, pp. 209 and 657. 2 *Ibid.*, p. 210. 3 *Ibid.*, p. 133.

4 F. D. Adams, "Report of Geology of Laurentian Area to the North of Island of Montreal," *Ann. Rept. Geol. Surv. of Canada*, Vol. VIII, J., p. 139. 1896.

essexite which constitutes the greater part of the mountain was the earliest intrusion. When this had become solid the nepheline-syenite broke through it, sending arms into it and catching up detached fragments of the shattered essexite. The same sequence in time is, according to Dresser, to be seen in Shefford Mountain. The basic essexite here forms the earliest intrusion, and was succeeded by the pulaskite and more acid nordmarkite. Mount Johnson, however, presents the two rocks in an entirely different relation. Here, as will be shown later, there was but a single period of intrusion. For although both rocks are present in the mountain, the essexite forms the central portion of the mass and passes over into pulaskite about the periphery of the neck. The mountain thus consists of essexite in its center, surrounded by a zone of pulaskite, the two rocks passing imperceptibly into one another. Mr. Leroy considers it probable that a similar passage takes place in the case of Beloeil mountain, but it is there difficult accurately to determine the relations of the magmas to one another on account of the covering of drift which obscures the contact.

It is thus evident that the two rock types constituting the Monteregian hills are differentiation products of a single magma, the separated magmas, however, in the case of Mount Royal and Shefford having been erupted in succession instead of simultaneously. In connection with the question of differentiation, another noteworthy fact is that the more easterly mountains contain proportionately more syenite and the western hills a greater proportion of the essexite. The bearing of this fact on the character of the differentiation which took place in the subterranean magma basin can be more profitably discussed at a later date when the precise character and relative extent of the intrusions in Yamaska, Rougemont, and Montarville have been determined.

With regard to the structure of these mountains, it may be noted that Logan, who first examined them, refers to them as "intrusive masses breaking through the surrounding Paleozoic strata"[1] They are thus represented in the geological sections of this district contained in the atlas accompanying this report. Ells refers to them simply as "eruptive mountains."[2] The more detailed studies of Shefford and Brome mountains recently carried out by Dresser, however, have led him to consider these two occurrences as uncovered laccolites. Concerning Shefford mountain he says:

> The sedimentary strata which surround the mountain . . . . are found to wrap around the igneous mass of the mountain, mantling it with a hardened contact zone to a height of 300 to 1,000 feet above the surrounding country, according to the direction of glaciation. Above the latter height the mountain rises upward of 200 feet, the summit being capped by an outlier of Trenton slate about a quarter of a mile in extent. This preserves the cleavage, dip, and strike of the similar rock at either side of the mountain and is penetrated by dykes from the underlying igneous rocks. From these facts, together with the absence of tufaceous material and the general arching of the strata around the mountain, it is inferred that Shefford mountain is an uncovered laccolite rather than the denuded neck of a once active volcano.[3]

In Brome mountain also the presence of outlying masses of the surrounding sedimentary series at high levels lying upon the igneous rock of the intrusion "seem to indicate unmistakably that Brome mountain, like Shefford, is an uncovered laccolite and has never been an active volcano."[4]

Mount Johnson, on the contrary, as will be shown, is a typical neck or plug, representing a portion of the conduit through which the magma rose, to fill laccolites above in strata which have long since been swept away by erosion, or to be poured out at the surface at volcanic vents. This is seen by the fact that the flat-lying strata all about it are not arched up, but abut sharply against the igneous core of the mountain and are cut off by it. Being shales, they are of course baked to hornstones, but show no signs

1 *Geology of Canada*, p. 655.
2 *Ann. Rept. Gel. Surv. of Canada*, Vol. VII, J., p. 71.
3 *American Geologist*, October, 1901, p. 204.
4 *Geol. Surv. of Canada, Summary Rept. for* 1901, p. 187.

of upheaval or tilting. The small size and almost circular cross-section of the mountain are a further indication of this origin; and finally there is conclusive proof that there was a vertical or upward movement of molten rock through the pipe. The mountain has been figured by Professor Davis, in his *Physical Geography*, from one of the author's photographs, as a typical example of a volcanic neck

In a recent paper by Buchan[1] the view was put forward that Mount Royal represents the remnant of a denuded laccolite—on the ground that on one side of the mountain, toward the summit, there is an isolated mass of flat-lying, altered Paleozoic limestone, evidently a part of the sedimentary strata of the plain from which the mountain rises. This alone, however, is not sufficient to establish a laccolite origin, and opposed to such an explanation is the fact that where the strata of the plain are seen along their immediate contact with the intrusion in many places, especially on the eastern and northern side of the mountain, they abut against the intrusive rock and are cut off by it instead of being uplifted, the igneous core of the mountain rising up precipitously like a wall across the truncated edge of the beds. The occurrences of the flat-lying limestone on the side of the mountain referred to above appear to represent the remnant of certain beds, beneath which a portion of the intrusive mass penetrated, after the manner of a laccolite, on one side of the mass. Their existence does not by any means indicate a laccolite structure for the mountains as a whole, or that the igneous material did not find a vent at the surface, there developing a volcano. In fact, there is evidence in the existence of a remarkable deposit of a breccia-conglomerate in several places around the mountain that it did develop as a volcano and that the materials constituting the deposit in question were ejected from it. A study of this breccia was undertaken last autumn by one of the

[1] *Canadian Record of Science*, Vol. VIII, [1901], p. 331.

geological field parties of McGill University, and a description of it, with a discussion of its origin, is now in press and will appear in the *Canadian Record of Science* within the next few weeks. The other four hills have not as yet been studied in sufficient detail to enable any definite statement concerning their structure to be made.

In the Monteregian hills there are thus intrusions of the nature of laccolites, true necks, and probably also of stocks. The age of the intrusions cannot as yet be definitely determined. They are later than the lower Devonian, for some of the dykes connected with Mount Royal cut limestones which belong to the summit of the upper Silurian, while fragments of limestone which are shown by the fossils which they contain to be referable to the lowest beds of the Devonian; occur as inclusions in the volcanic breccia of agglomerate which is found about the flanks of the same mountain. The deeply eroded character of the mountains, however, shows that they are of early date, and it seems most probable that the intrusion took place somewhere in later Paleozoic time.

Having considered in a general way the character of the Monteregian hills as a whole, it may be of interest to look somewhat more closely into the structure and petrographical characters of one member of the group which has recently been studied in some detail, namely, Mount Johnson.

MOUNT JOHNSON.

Mount Johnson rises from the plain twenty-two miles east-southeast of the city of Montreal, and six miles northeast of the town of St. Johns on the Richelieu river, and twenty-five miles north of the international boundary. The little village of St. Grégoire is situated near its base. The surrounding country is perfectly flat, forming a fertile and well tilled agricultural district, the nearest mountain being Rougemont, which lies in a north-easterly direction some nine miles distant. In cross-section Mount Johnson is nearly circular. (Fig. 2.) The igneous

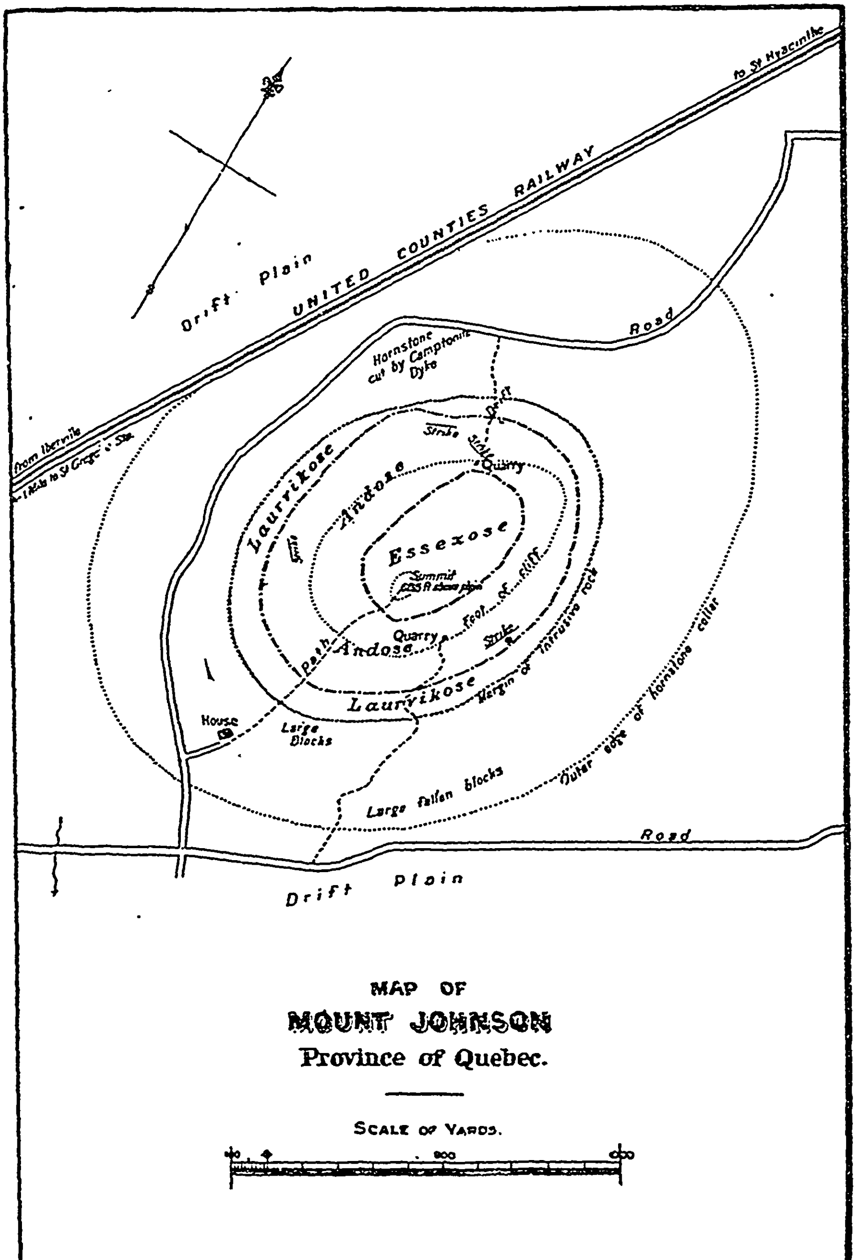

Drift Plain
UNITED COUNTIES RAILWAY
to St Hyacinthe
from Iberville
Road
Hornstone cut by Camptonite Dyke
Laurvikose
Andose
Essexose
Quarry
Summit
Foot of cliff
Strike
path
House
Large Blocks
Margin of intrusive rock
Outer edge of hornstone collar
Large fallen blocks
Road
Drift Plain
MAP OF
MOUNT JOHNSON
Province of Quebec.
SCALE OF YARDS.
800

FIG. 2.

plug itself has at the base, immediately above the hornstone collar, a somewhat elliptical outline, and measures 3,500 feet by 2,500 feet, the longer axis having a direction N. 20° E. This gives the igneous intrusion an area of .423 of a square mile. The mean of a series of closely concordant aneroid readings, corrected by comparison with barometers at the observatory at McGill University at Montreal, shows that the highest point of the mountain is 685 feet above the main street in the village of St. Grègoire opposite the church, that is, above the surrounding plain, or 875 feet above sea level, the plain here having an elevation above sea-level of 190 feet. It has a somewhat dome-like outline, and forms a very striking feature in the landscape. The slope on the southern side is steep, in places precipitous, while to the north it is more gentle. The accompanying photograph (Fig. 3), taken from the railway station near St. Grègoire, which is about a mile and a quarter distant from the mountain in a direction approximately southwest, shows this profile, as well as the little notch near the summit, caused by a ravine which passes down the side.

At the foot of the mountain, more especially on its southern, southeastern, and southwestern sides, are numbers of large blocks which have fallen from the steep upper slopes and extended out from the foot; on the southern is a gentle sloping, terraced platform of drift which in part buries these great blocks, forming a "tail" probably due to the drift accumulating here on the lee side of the mountain during the ice movements in the glacial age. This drift, however, has been in part at least reassorted by wave-action during the period of depression which in this region followed the glacial age and during which the sea covered the plain to a depth of several hundred feet at least, as shown by the high level terraces with shell banks on the slopes of Mount Royal. On the plain about the mountain no rock exposures are seen. A mantle of drift covers it, and numerous erratic blocks and bowlders are scattered about. These are largely gneisses from the Laurentian highlands, but some of them are plutonic rocks from other hills of the Monteregian group. The plain about Mount Johnson is, however, stated by Ells, who has examined this district, to be underlain "presumably" by rocks of the Utica-Lorraine division of the Lower Silurian.

On ascending the mountain the first rock which is exposed above the drift mantle is a very fine-grained dark hornstone, uniform in character and lying in undisturbed horizontal beds. It can be seen at intervals all around

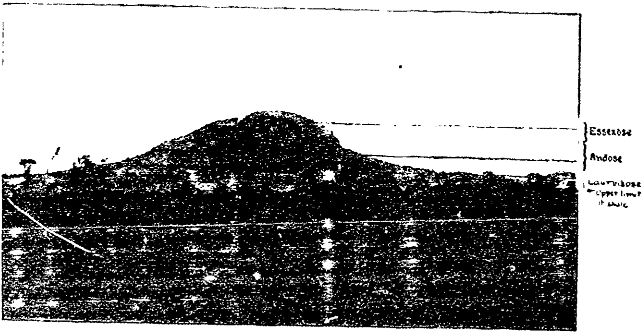


FIG. 3.—Mount Johnson, as seen from the southwest, showing limits of the several rock types composing the mountain.

the base of the mountain, forming a sort of collar, and is undoubtedly a shale such as that usually constituting the Utica formation, here however altered by its proximity to the intrusion. This shale wherever seen lies flat and abuts against the igneous rock of the intrusion, being cut sharply off by it, but not tilted or upturned. The upper limit of the shale is shown in the accompanying photograph of the mountain.

The mountain above this hornstone collar is made up exclusively of igneous material, which presents a most striking and beautiful instance of differentiation.

Immediately above the hornstone collar, and in contact with it, is a coarse-grained and highly feldspathic syenite, light buff in color, of the pulaskite type. This, as the mountain is scaled, passes rather abruptly into a dark-colored rock with large porphyritic white feldspars, which in its turn losses its porphyritic character and passes into a coarse-grained essexite which constitutes the mass of the hill, and which becomes at the summit finer in grain, richer in pyroxene and often holding a little olivine. No sharp lines can be drawn between these several rocks; one passes gradually into the other, the whole constituting one intrusive unit. The approximate limits of these several rock species are shown in the accompanying map (Fig. 2) and photograph (Fig. 3) of the mountain, it being impossible sharply to delimit the several species, seeing that they pass into one another. The mass therefore becomes progressively more basic as we pass from the margin of the intrusion to its center. The two chief rock types are the pulaskite and the essexite which will be separately considered. The essexite, being the more abundant rock and one presenting a greater complexity in mineralogical composition, may be first described.

ESSEXITE.—The rock is dark in colour and rather course in grain, and although holocrystalline usually presents a more or less marked fluidal arrangement of the constituents. This is especially marked in the zone of transition between the essexite and pulaskite, owing to the presence there of the large feldspar phenocysts which, being arranged with their longer axes parallel to the direction of flow, serve to accentuate this structure. The finer-grained variety forming the summit of the mountain is more massive in character and does not exhibit the fluidal arrangement of constituents. Under the microscope the rock is seen to be composed of the following minerals: hornblende, pyroxene, biotite, olivine, plagioclase, nepheline, sodalite, apatite, magnetite, sphene, and in some cases a very small amount of orthoclase.

There is a marked tendency on the part of all the constituents to assume an idiomorphic development. The long lath-shaped plagioclases and large hornblende individuals have an approximately parallel arrangement, and between these lie the other iron-magnesia constituents with the smaller plagioclase individuals, the nepheline and the other components of the rock. These interstitial constituents do not differ greatly in size from the others, and show the same tendency to a parallel arrangement.

Hornblende.—Although almost every thin section of the rock contains not only hornblende, but pyroxene and biotite also, their relative proportion varies considerably. The hornblende is distinctly the most abundant, except in the finer-grained variety forming the summit of the mountain in which it is distinctly subordinate in amount to both pyroxene and mica. It is deep brown in color and is sometimes hypidiomorphic in its development, but often occurs with perfect crystalline form, showing the prismatic and the orthopinacoidal faces. Its extinction is larger than is usual in brown horneblendes, judging from the recorded instances, reaching 20°. It possesses a strong pleochroism as follows:

$\mathfrak{a}$ = pale yellowish-brown.
$\mathfrak{b}$ = deep-brown.
$\mathfrak{c}$ = very deep-brown.
Absorption = $\mathfrak{c} \geqq \mathfrak{b} > \mathfrak{a}$.

It is often twinned parallel to $\infty P \bar{\infty}$ or to a steep orthodome, and sometimes presents a faint zonal structure, marked by a slight difference in extinction of the several zones indicating a slight change in composition as growth proceeded, and occasionally a greenish tint is noticeable about the margin of the individual. It sometimes holds inclusions of magnetite and is often intergrown with the pyroxene. In the essexite from one place on the south side of the mountain, the hornblende was found free from inclusions, and practically free from the pyroxene which is usually so intimately associated with it. From this locality a quantity of the hornblende was obtained in a state of perfect purity through repeated separations by means of Klein's solution, all grains of foreign mineral still remaining being finally removed by picking them out by hand with the aid of a powerful lens. The pure material thus obtained was analysed by Professor Norton Evans, of the McGill University, every precaution to secure accuracy being observed and especial care being taken to effect a complete separation of the magnesia from the alumina by the repeated precipitation of the latter. The water was estimated by a direct determination. The results of the analysis are given below, together with those of several other hornblendes of similar composition which have been added for purposes of comparison :

	No 1	No. 2	No. 3	No. 4	No. 5	No. 6
SiO_2........	38.633	39.75	40.15	40.14	41.35	39.16
TiO_4........	5.035	5.40	5.21	4.26	4.97	.....
Al_2O_3........	11.974	15.00	14 34	14.30	13.48	14.39
Fe_2O_3........	3.903	7.86	7.80	7.07	5.14	12.42
FeO........	11.523	2.89	4.53	6.27	10.33	5.85
MnO........	0.729	.....	....	0.21	.....	1.50
MgO........	10.200	14.16	13.14	11.62	11.44	10.52
CaO........	12.807	12.97	11.75	12.00	10.93	11.18
Na_2O........	3.139	1.92	2.31	2.22	2.10	2.48
K_2O........	1.489	1.61	1.14	1.35	0.62	2.01
H_2O........	0.330	.....	.....	.....	0.48	0.39
	99.762	101.56	100.37	99.44	100.84	99.90

No. 1. Hornblende. From the essexite of Mount Johnson, province of Quebec, Canada.

No. 2. Hornblende. From Bohemian Mittelgebirge.

No. 3. Hornblende. From tuff of hornblende basalt, Härtlingen, Nassau.

No. 4. Hornblende. Basalt tuff, Hoheberg, near Giessen.

No. 5. Hornblende. From "hornblende diabase," Gräveneck, near Weilburg.

No. 6. Hornblend. Syntagmatite. Jan Mayen.

Analyses Nos. 2 to 6 are taken from Schneider's paper referred to below.

The hornblende thus belongs to the class of basaltic hornblendes, and not to the barkevikites as might be expected. It contains, however, proportionately more of the iron in a ferrous condition, together with somewhat less alumina and a somewhat larger proportion of alkalies than most hornblendes. The unusually high extinction for a hornblend of this class which it possesses is probably connected with the high content in ferrous iron, since Schneider[1] has shown that the extinction increases with the increase of iron in this state of oxidation.

Pyroxene.—This mineral occurs intimately associated and often intergrown with the hornblende, both minerals frequently holding many inclusions of magnetite and apatite. It is very pale-greenish in color, with no perceptible pleochroism, but with a marked dispersion of the bisectrices. It is usually hypidiomorphic, but is frequently idiomorphic, showing a distinct cleavage parallel to the pinacoids, but usually none parallel to the prismatic faces. It belongs to the variety of diopside-like augites which occur in rocks of this class. The extinction is high, reaching 45°.

Biotite.—This is deep-brown and almost identical in color with the hornblende and is strongly pleochroic, **c** yellowish-brown, and **a** deep-brown. It occurs intimately associated with the hornblende and augite, and also frequently as a border around the iron ore. While usually present in comparatively small amount, in the finer-grained essexite forming the summit of the mountain it is much more abundant than the hornblende. In this variety of the essexite both the mica and the hornblende often possess a poikilitic structure owing to the presence of numerous inclusions of plagioclase, which mineral also often penetrates the individuals of biotite and hornblende in the form of well-developed crystals.

Olivine.—This species is found in the finer-grained variety of the essexite at the summit of the mountain,

1 "Zur Kenntniss basaltischer Hornblenden ... yst, 1891, p. 579

and was also observed in the thin sections from the essexite at one point on the east side of the mountain not far from the summit. It is very pale-green in color and occurs as little grains inclosed in the biotite and pyroxene.

Plagioclase.—The plagioclase in the rock has well-developed, lath-like forms and is, almost without exception, excellently twinned according to the albite law. Twinning according to the carlsbad and pericline laws is also very common, occurring in the same individuals which show the albite twinning. The laths of plagioclase can in a few cases be seen to be distinctly twisted, evidently owing to pressure exerted upon them by other crystals during the consolidation of the rock, since the rock was submitted to no dymamic action subsequent to its crystallization.

As before mentioned, all the plagioclase individuals are not of the same dimensions. There are larger laths associated with the large hornblende crystals, and between these are smaller laths. The two sets are not, however, sufficiently well marked to cause the resulting structure to be classed as porphyritic. The plagioclase in the rock is not all of the same composition, but varies somewhat, even in the same hand specimen, ranging from an extremely acid labradorite to an oligoclase. It, however, is chiefly andesine. Its character was determined by a large number of extinction measurements carried out on the albite twins, as well as by Michel-Lévy's method, which can readily be applied owing to the frequency of carlsbad twinning in association with albite twinning. These determinations were extended and checked by a number of specific-gravity determinations and separations by means of Thoulet's solution. The larger plagioclase individuals were found, in the case of the rock on the north-east side of the mountain 320 feet above the plain, to be somewhat more basic than the smaller crystals, having the composition of a basic andesine, while the latter ranged in character from andesine to oligoclase. In this case no feldspar having a specific gravity of over 2.65 was found to be present in the rock. Again, in the rock of one of the quarries on the south side of the mountain, the larger feldspars tested by Michel-Lévy's method were found to have the composition of a very acid labradorite, $Ab_1 An_1$. The results of a separation of the constituents of the rock by Thoulet's solution showed that the feldspar was almost all andesine, although it varied from $Ab_1 An_1$ to an oligoclase. A crystal examined by Mr. Wright in Professor Rosenbusch's laboratory gave on P an extinction of 5°-6° and on M about 11°, showing the feldspar to be on the line between andesine and labradorite. A very small amount of orthoclase was also present, forming a subordinate accessory constituent. That there is a variation in composition even in the same individual of plagioclase is indicated in many cases by marked growth rings with different extinctions in the different rings. The smaller plagioclases, although twinned in the same manner as the larger, usually have the twinning developed in a less striking manner. A certain proportion of the smaller grains are also untwinned, but most of these must be identical in character with the twinned feldspar, since the separations show that while orthoclase is often present it occurs in only extremely small amount. Dr. Sterry Hunt gives[1] an analysis of the feldspar from the essexite of Mount Johnson (called by him diorite). This is as follows:

SiO_2	62.05
Al_2O_3	22.60
Fe_2O_3	.75
CaO	3.96
Na_2O	7.95
K_2O	1.80
Volatile	.80
	99.91

Sp. G. = 2.659.

1 *Geology of Canada*, p. 477.

This feldspar has the specific gravity and general composition of an acid andesine, although the high content of K_2O may possibly indicate the presence of some potash feldspar as an intergrowth.

Nepheline.—This is quite subordinate to the feldspar in amount. It possesses the usual low index of refraction, with extinction parallel to the cleavages, which latter can usually be seen. It is sometimes quite fresh, but at other times is found more or less completely altered to a mineral which occurs as little fibrous bundles, showing strong double refraction and parallel extinction. The fibres usually have a more or less distinctly parallel arrangement. The mineral remains practically unaltered when treated with concentrated hydrochloric acid for twenty minutes, although the nepheline in which it is imbedded is destroyed. It is either muscovite or kaolin. The nepheline is allotriomorphic and occurs chiefly in the corners between the larger crystals of feldspar and other minerals, and is penetrated by them. It is especially abundant in those portions of the rock which are rich in the dark-colored constituents. When occurring in this manner it appears, with the sodalite, to have been the last constituent of the rock to crystallize out. It is usually much more abundant than the sodalite. The nepheline also occurs in places as irregular-shaped lath-like inclusions in the feldspar.

Sodalite is usually, although not invariably, present. It strongly resembles the nepheline in appearance and shows the same alteration product. It is, however, quite isotropic. Like the nepheline, it occurs either in the spaces between the other minerals, cementing them together, or as inclusions in the feldspars.

Apatite.—The abundance of apatite is a distinct feature in this, as in similar rocks occurring elsewhere. It is always present and was the first constituent to crystallize out, being found in the form of perfect hexagonal prisms with double pyramidal terminations imbedded in the iron ore. It also occurs in the sphene as well as in the iron-magnesia constituents, in the nepheline, and also, although much less frequently, in the feldspar. Its large amount is shown by the high percentage of phosphoric acid in the analysis of the rock, 1.23 per cent. Another specimen of the rock in which the phosphoric acid was determined by Dr. B. J. Harrington gave 1.01 per cent. These figures represent 2.79 per cent. and 2.35 per cent. of apatite, respectively. It is usually somewhat turbid from the presence of minute dust-like inclusions.

Magnetite occurs chiefly inclosed in the iron-magnesia constituents, but is occasionally found in the feldspar. It is black, opaque, and highly magnetic, and is usually allotriomorphic, but occasionally presents an approximation to definite crystalline outline. As shown by the calculation of the analysis of the rock, this iron ore contains a considerable percentage of titanic acid.

Sphene is not found in more than one-half of the specimens examined. When present it is not very abundant and usually occurs as well-defined wedge-shaped crystals, often of considerable size.

In the accompanying table analyses are given of the normal essexite which forms the greater part of Mount Johnson, and of the finer-grained olivine-bearing variety of the same rock found at the summit of the mountain. For purposes of comparison there is presented in the same table the analysis of the essexite from Shefford mountain, which belongs to the same Monteregian province, together with analyses of the original essexite from Salem, Mass., and of allied rocks from two other localities. A partial analysis of the transitional rock between the essexite and the pulaskite of Mount Johnson is also given. For the analysis of the Mount Johnson essexite (No. 1) as well as for that of the associated pulaskite, which is given below, I am indebted to Professor Norton-Evans, while the analysis of the olivine-bearing variety of the essexite (No. 2) was made for me by Mr. M. F. Connor. The methods recommended by Hillebrand and employed in the very accurate, analytical work carried out in the laboratory of the United States Geological Survey were followed by both analysts, and every precaution was taken to insure accuracy.

	I	II	III	IV	V	VI
SiO_2........	48.85	48.69	53.15	46.99	47.67	50.40
TiO_2	2.47	2.71	1.52	2.92	....	1.17
Al_2O_3	19.38	17.91	17.64	17.94	18.22	...
Fe_2O_3	4.29	3.09	3.10	2.56	3.65	5.58
FeO	4.94	6.41	4.65	7.56	3.85	
NiO + CoO ...	not det.	0.05	not det.	not det.	....	not det.
MnO.........	0.19	0.15	0.46	trace	0.28	0.77
MgO	2.00	3 06	2.94	3.22	6.35	...
CaO	7.98	7.30	5.66	7.85	8.03	6.77
BaO	....	0.08	0.13	none	....	....
Na_2O	5.44	5.95	5.00	6.35	4.93	6.24
K_2O...... ..	1.91	2.56	3.10	2.62	2.97	2.56
P_2O_5	1.23	1.11	0.65	0.94	....	0.09
Cl..	not det.	not det.	0.07	....	....	....
H_2O.........	0.68	0.95	1.10	0.65	3.82	....
Total	99.36	100.02	99.84	99.60	100.15	

I. Normal essexite (andose), Mount Johnson, Quebec.

II. Olivine-bearing essexite (essexose), Mount Johnson, Quebec.

III. Essexite (akerose), Shefford mountain, Quebec, (*American Geologist*, 1901, p. 201), (with $CO_2$0.39 and $SO_3$0.28).

IV. Essexite (essexose), Salem Neck, Salem, Mass. (Washington, Jour. Geol., 1899, p. 57).

V. Theralite, Elbow Creek, Crazy Mountains, Montana.

VI. Rock forming transition from essexite to pulaskite, Mount Johnson, Quebec. (Partial analysis. The iron present is all calculated as FeO.)

The analyses (Nos. 1 and 2) of the two varieties of the essexite from Mount Johnson can be readily calculated out so as to show the quantitative mineralogical composition of the rocks.

The calculation of the *mode*[1]—or relative proportion of the minerals actually present gives the following result:

[1] *Quantitative Classification of Igneous Rocks* (*C.I.P.W.*) (University of Chicago Press, 1903), p. 147.

	Essexite (Analysis 1) Mount Johnson		Olivine-Essexite (Analysis 2) Mount Johnson	
Albite	36.75	66.45	29.14	54.79
Anorthite	20.23		13.11	
Orthoclase	9.47		12.54	
Nepheline	3.99	4.77	11.12	11.90
Kaolin	.78		.78	
Pyroxene		6.29		12.22
Hornblende		7.05		2.30
Biotite		2.04		4.08
Olivine		none		2.84
Magnetite	5.68	9.53	3.94	8.41
Ilmenite	3.85		4.47	
Apatite		2.68		2.59
Water (hygr.)		.58		.85
		99.39		99.98

In the case of No. 1 the percentage mineralogical composition given expresses exactly the chemical composition of the rock, except that it requires 0.06 per cent. of FeO in excess of that shown in the analysis. In No. 2 the agreement is complete.

The calculation further demonstrates that the plagioclase in the case of No. 1 is a trifle more basic, and in the case of No. 2 a little more acid, than Ab_2 An_1, which as has been stated, is shown by the optical character and by the specific gravity of the feldspar to represent its average composition in these rocks. The amount of orthoclase recognized in thin sections also appears as mentioned in the description of the rock. The nepheline is in places somewhat altered to a mineral resembling kaolin. The small percentage of kaolin shown by the calculation has therefore been added to the nepheline in extending the table.

In order to fix the position of these rocks in the excellent system of classification recently elaborated by Messrs. Cross, Iddings, Pirsson, and Washington, and to determine the name which should be given to these rocks, if their precise character is to be designated, it is necessary to calculate their *norms*. These have been found to be as follows:—

	No. 1		No. 2	
Albite....	35.63		28.62	
Anorthite.	23.07	69.82	14.23	57.90
Orthoclase	11.12		15.05	
Nepheline.		5.40		11.83
Diopside..	34 $CaO.\ SiO_2$ — 3.94 7 $FeO.\ SiO_2$ — .92 27 $MgO.\ SiO_2$ — 2.70	7.56	53 $CaO.\ SiO_2$ — 6.15 18 $FeO.\ SiO_2$ — 2.38 35 $MgO.\ SiO_2$ — 3.50	12.03
Olivine...	6 $FeO.\ \frac{1}{2} SiO_2$ — .61 23 $MgO.\frac{1}{2} SiO_2$ — 1.61	2.22	21 $FeO.\ \frac{1}{2} SiO_2$ — 2.14 42 $MgO.\ \frac{1}{2} SiO_2$ — 2.94	5 08
Magnetite.		6 26		4.41
Ilmenite .		4 71		5.01
Apatite...		2.68		2.59
Water....		.68		.95
			BaO=.08, Excess FeO=.07	.15
		99.33		99.95

No. 1 thus takes the following position in the classification in question:

Class II, dosalane.
Order 5, germanare.
Rang 3, andase.
Subrang 4, andose (grad=polmitic.)

Its precise designation would be *nepheline-bearing grano-andose* or in some cases *nepheline-bearing tracho-andose*.

No. 2, however, belongs to the next order and is dom-alkalic. Its position is as follows:

Class II, dosalane.
Order 6, norgare.
Rang 2, essexase.
Subrang 4, essexose (grad=prepolic.

It would therefore be termed a *nepheline-bearing grano-essexose*. It is therefore seen that the essexite from the central portion of Mount Johnson (No. 2) is practically identical in character and composition with the essexite of the original locality of Salem, Mass. (Analysis IV), while the outer andose is poorer in nepheline and has a somewhat larger proportion of lime as compared with the alkalies.

The proportions of the several minerals present in thin sections of the specimens analyzed were then determined by the system of diametral measurements proposed by Rosiwal.[1] In each case over 500 average diameters were measured instead of 100, which latter number Rosiwal considers to be sufficient. The measurements were, however, confined to a small number of thin setions, namely two in the case of No. 1, and four in the case of No. 2, it being considered advisable to use only sections cut from the actual specimen from which the material for analysis was taken The results obtained were as follows:

	No. 1	No. 2
Feldspar	63.77 per cent.	64.06 per cent.
Nepheline	6.12 "	6.16 "
Pyroxene	9.26 "	13.60 "
Hornblende	8.06 "	1.29 "
Biotite	2 11 "	4.07 "
Olivine	....	1.40 "
Iron Ore	8.56 "	8.10 "
Apatite	2.12 "	1.29 "
	100.00 "	99.97 "

In the case of No. 1 the results are substanially the same as the calculated *mode* except that there is about 3 per cent. more pyroxene and a correspondingly smaller proportion of feldspar. This relatively high proportion of pyroxene is unusual, the examination of thin sections of the rock for various parts of the mountain showing that, as has been stated above, and as is shown also by the calculation of the *mode* of this specimen, there is usually a preponderance of hornblende over pyroxene. In the case of No. 2 the chief difference between the values measured and the calculated *mode* lies in the relatively higher proportion of feldspar and lower proportion

[1] *Verhd. K. K. Geol. Reichsanst.* (Wien, 1898), p. 143.

of nepheline in the former. In this rock, however, it is very difficult to distinguish the nepheline from the feldspar in every case. These discrepancies indicate that in applying Rosiwal's method to comparatively coarse-grained rocks such as these, especially if there be any tendency to irregularity in composition, a considerable number of thin sections should be employed in order to obtain a true average of the rock as a whole.

For purposes of comparison the analysis of the essexite from Shefford Mountain (No. III) has been reduced to its normative form and the position of the rock in the Quantitative classification determined. It is found to be as follows:

Class II, dosalane.
Order 5, germanare.
Rang 3, monzonase.
Subrang 4, akerose (grad = polmitic).

It thus, in composition, occupies, in a manner, a middle place between the essexose and andose of Mount Johnson.

THE PULASKITE.—This soda-syenite which, as above mentioned, forms the outer zone of the mountain, girdling the essexite, is less abundant than the latter, and differs greatly from it in appearance. This difference is due chiefly to the fact that it is much lighter in color, being pale-yellow or buff instead of dark-gray, the lighter color being due to the very small proportion of iron-magnesia constituents present and the marked preponderance of the feldspars. The rock also has a more massive structure, the fluidal arrangement of the constituents often met with in the essexite being absent, and it weathers in a somewhat different manner. It possesses, moreover, a species of porphyritic structure, owing to the development of the feldspar in two forms; first, as stout prisms, up to 10^{mm} in diameter, which are light-gray in color and very abundant; and, secondly, in the form of smaller laths of a yellow or buff color which, in association with the iron-magnesia and other constituents, form a sort of groundmass in the rock.

The constituent minerals of the rock are biotite, hornblende, (pyroxene), soda-orthoclase, nepheline, sodalile, apatite, magnetite, and sphene. The darker constituents are identical in character with those occurring in the essexite, and therefore do not require to be described again. Not only are they as a class much less abundant in this pulaskite, but the mica here preponderates, being the prevailing iron-magnesia constituent, while the hornblende is much less abundant and the pyroxene is entirely absent. It may be noted, however, that the hornblende sometimes possesses the greenish tint referred to as occasionally seen about the borders of the hornblende individuals in the essexite, indicating probably that, the pulaskite magma being richer in soda, the hornblende crystallizing out of it has a tendency to take up this element more abundantly.

The feldspar in the pulaskite, as has been mentioned, occurs in part as stout prisms and in part as smaller laths. The latter usually have a somewhat cloudy appearance under the microscope, probably owing to the incipient alteration. The larger feldspars are what is commonly described as soda-orthoclase. When examined under the microscope they are seen to be composed of very minute intergrowths of two, and in some cases perhaps even of three, different feldspars—causing them to present between crossed nicols a mottled appearance. These several feldspars have somewhat different indices of refraction, and frequently under a high power, where two are present, one of them can be seen to possess a very minute polysynthetic twinning, while the other is untwinned. The relative proportion of the several feldspars present differs in different grains. The individuals as a whole occasionally present the form of carlsbad twins, but usually have the appearance of simple crystals, and Professor Rosenbusch, to whom sections of the work were submitted, considers the feldspars composing them to be microcline, and in part microcline-microperthite, with probably some anorthoclase.

The specific gravity of these phenocrysts was determined in the case of two hand specimens of the pulaskite from different parts of the mountain. In the first of these three specimens of the feldspar were found to have specific gravities of 2.62, 2.609, and 2.603, respectively; while in the second, five specimens of the feldspar were selected and found to have specific gravities lying between orthoclase and albite, which bears out the results of their microscopic study.

The smaller lath-shaped feldspars, although more frequently composed of a single species, often show an intergrowth of two feldspars, as described in the case of the phenocrysts. Separations of the constituents of several species of the rock by means of Thoulet's solution show that these smaller feldspars have a somewhat lower specific gravity than the phenocsysts. Thus, while the specific gravity of the phenocrysts lies between 2.591, and 2.62, that of the smaller feldspars is between 2.591 and 2.56; that is to say, the smaller feldspars approach more nearly to pure orthoclase in composition. They consist chiefly of minute intergrowths of orthoclase with albite, or of either of these with microcline or anorthoclase. No lime-soda feldspar could be recognised in any specimen of the rock.

Nepheline and sodalite.—These minerals are quite subordinate in amount, although they are seen in nearly every thin section. Both minerals present the same characters and occur in the same way as the essexite, lying chiefly in the corners between the other constituents being penetrated by the latter, but also occurring as inclusions in the feldspar. They are, as a general rule much altered as to the same decomposition product seen in nepheline in the essexite and which is as has been mentioned, either kaolin or muscovite. Probably both are present.

Apatite is present in considerable amount and in the form of perfect crystals, occurring chiefly in the mica, hornblende, and sphene.

The *iron ore* and *sphene* present the same characters as in the case of the essexite, but the latter mineral is relatively more abundant than in that rock.

An analysis of this pulaskite is given in the accompanying table together with analysis of the pulaskite and the nordmarkite of Shefford mountain described by Dresser. Analysis of three allied rocks from other localities are added for purposes of comparison.

	VII	VIII	IX	X	XI	XII
SiO_2	57.44	59.96	65.43	56.45	59.01	60.03
TiO_2	1.97	0.66	0.16	0.29	0.81	.....
Al_2O_3	19.43	19.12	16.96	20.08	18.18	20.76
Fe_2O_3	1.69	1.85	1.55	1.31	1.63	4.01
FeO	2.70	1.73	1.53	4.39	3.65	0.75
MnO	0.25	0.49	0.40	0.09	0.03	trace
MgO	1.16	0.65	0.22	0.63	1.05	0.80
CaO	2.66	2.24	1.36	2.14	2.40	2.62
BaO	not det.	.12	none	.....	.08	.....
Na_2O	6.48	6.98	5.95	5.61	7.03	5.96
K_2O	4.28	4.91	5.36	7.13	5.34	5.48
P_2O_5	0.60	0.14	0.02	0.13	trace	0.07
SO_3	not det.	0.08	0.06	.....	.....	.....
Cl	trace	0.14	0.04	0.43	0.12	.....
H_2O	1.03	1.10	0.82	1.51	0.50	0.59
	99.69	100.17	99.86	100.19	99.98	101.07

VII. Pulaskite (laurvikose), Mount Johnson, Quebec.

VIII. Pulaskite (laurvikose), Shefford mountain, Quebec. (*American Geologist*, 1901, p. 211).

IX. Nordmarkite (nordmarkose), Shefford mountain, Quebec. (*Ibid.*, 1901, p. 209).

X. Sodalite syenite, Square Butte, Montana (differentiation product of shonkinite).

XI. Umptekite, Red Hill, Moltonboro, New Hampshire.

XII. Pulaskite, Fourche mountain, Arkansas (original locality).

The *mode* of the Mount Johnson pulaskite (No. VII), calculated from the analysis given above, is as follows:

Albite	48.73	
Anorthite	3.06	74.03
Orthoclase and microline	22 24	
Nepheline		2.56
Kaolin		4.96
Hornblende		5.08
Biotite		6.29
Magnetite	1.86	2.77
Ilmenite	0.91	
Sphene		2.35
Apatite		1.34
Water (hygroscopic)		0.30
		99.68

This proportion of the various minerals expresses exactly the chemical composition of the rock as presented by the analysis, except that a very small excess of silica, amounting to 0.06 per cent., is required.

The calculation shows clearly the fact, ascertained by the study of the thin sections of the rock, that a considerable percentage of sphene is present, a mineral which does not occur at all in the essexite.

The anorthite is probably in combination with the other feldspathic constituents in the form of anorthoclase. The calculation also brings out clearly a point already mentioned, namely, that in this rock the nepheline is much more highly altered than in the essexite, as shown by the amount of kaolin present. This kaolin, however, is not entirely derived from the alteration of the nepheline, but appears as a haze through all the smaller feldspars, and hence in the extension of the results should be assigned in part to the nepheline and in part to the feldspar. It is, of course, impossible to measure the amount of kaolin present by Rosiwal's method, occurring, as it does, distributed through the sections in the form of extremely minute individuals. If, however, the amount of nepheline given by the Rosiwal measurement be correct, namely 4.40 per cent.—and this, of course, includes both the unaltered mineral and that filled with decomposition products—then 1.84 per cent. of the kaolin has been derived from the alteration of the nepheline. There will thus remain 3.12 per cent. of the kaolin which has been derived from and measured up with the feldspar. If this amount be added to the feldspar found by calculation, it will increase the proportion present to 77.15 per cent., which is within 0.09 per cent. of the percentage of feldspar obtained by the Rosiwal measurement.

The *norm* of the pulaskite is found to be as follows:

Albite	50.30	85.61
Anorthite	9.73	
Orthoclase	25.58	
Nepheline		2.56
Olivine $2MgO.SiO_2$	2.03	2.54
Olivine $2FeO\text{-}SiO_2$	0.51	
Corundum		0.41
Magnetite		2.55
Ilmenite		3.80
Apatite		1.34
Water		1.03
		99.84

Its position is, therefore, as follows:

Class I, persalane.
Order 5, canadare.
Rang 2, pulaskase.
Subrang 4, laurvikose.

It should thus be termed a *grano-laurvikose*, or possibly, in view of its somewhat poryphyritic structure, a *granophyro-laurvikose*. The proportions of the several minerals present, or *mode*, as determined by Rosiwal's method were as follows:

Feldspar - - -	77.24	per cent.
Nepheline - - - -	4.40	"
Hornblende - - -	5.37	"
Biotite - - - -	7.08	"
Iron ore - - -	1.81	"
Sphene - - - -	3.29	"
Apatite - - - -	.81	"
	100.00	

For purposes of comparison the analysis of the pulaskite (No. VIII) and of the nordmarkite (No. IX) of Shefford mountain were calculated into their respective *norms* and the position of these rocks in the new system of classification determined. The pulaskite (No. VIII) is found to have the following position:

Class 1, persalane.
Order 5, canadare.
Rang 2, pulaskase.
Subrang 4, laurvikose.

The nordmarkite (No. IX), however, is peralkalic and must be classified as follows:

Class I, persalane.
Order 5, canadare.
Rang 1, nordmarkase.
Subrang 4, nordmarkose.

It, however, lies just on the line between nordmarkose and phlegrose, and might thus be best termed a nordmarkose-phlegrose.

It is thus seen that the rocks from Mount Johnson and from Shefford mountain which, following Rosenbusch's classification, have been called pulaskite, and which in this new scheme of classification are pulaskase, are almost identical in composition with one another and with the Norwegian laurvikite, and the nordmarkite of Shefford mountain is very close in composition to the nordmarkose of the original Scandinavian locality.

Diagrams showing the composition of these several rocks are presented in Fig. 4.

THE TRANSITION ROCK.—As has been metnioned, there intervenes in Mount Johnson between the pulaskite border and the central mass of essexite a transitional zone consisting of a rock which is dark in color and thus resembles the essexite, but which is characterized by the presence of large porphyritic feldspars sometimes as much as two inches in length, of peculiar form scattered through it and often arranged with their larger axes in the same direction, thus giving a fluidal appearance to the rock. This rock contains a large proportion of the same iron-magnesia minerals, more especially the hornblende, found in the essexite, and passes over gradually into this rock. Its passage into the pulaskite is rather more abrupt and is marked chiefly by the almost entire disappearance of the dark-coloured constituents above mentioned. There is, however, a continuous transition or passage from the pulaskite through this intermediate rock into the inner essexite of the mountain.

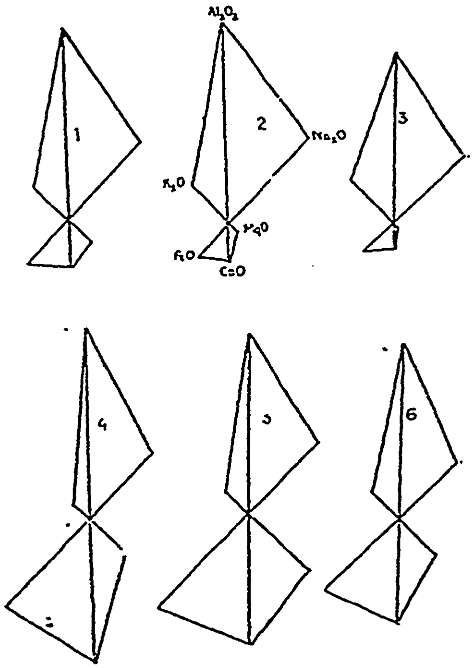


FIG. 4.—Diagrammatic representation of the chemical composition of the several rocks described.

No. 1. Laurvikose—Monnt Johnson.
No. 2. Laurvikose—Shefford mountain.
No. 3. Nordmarkose--Shefford mountain.
No. 4. Andose—Mount Johnson.
No. 5. Essexose—Mount Johnson.
No. 6. Andose—Shefford mountain.

This transitional rock is composed of the same minerals as the essexite with the exception of the feldspar, which consists in part of the soda-orthoclase characteristic of the pulaskite, and in part of the plagioclase (in this case oligoclase) which forms the feldspathic element of the essexite. It is thus in mineralogical composition intermediate between these two rocks, although, as above mentioned, being rich in the dark-coloured constituents, it more closely resembles the latter.

The large feldspars have frequently a peculiar crystalline form giving to the mineral, when broken across, a perfect hexagonal outline. The six faces represented in this form are apparently T, L, and M. The crystals hold many little inclusions of pyroxene, biotite, hornblende, magnetite, sphene, and nepheline, often regularly arranged so as to give a zonal structure to the feldspar individual. The specific gravity of twelve small fragments of the feldspar of these large crystals, collected from a locality on the southern side of the mountain and as free as possible from all inclusions, was determined. The specific gravity of nine of these lay between 2.59 and 2.607, while that of the other three was between 2.625 and 2.628. This shows the feldspar in the former case to be identical with that of the pulaskite, while in the latter three the specific gravity lies between that of albite and oligoclase. The somewhat greater specific gravity in this case may be due in part to inclusions of other minerals. A separation of the constituents of the rock shows, however, that, as above mentioned, a considerable amount of oligoclase is really present. The feldspar individuals, both great and small, usually show in thin sections the mottled character due to the intergrowth of different species, described in the pulaskite. A partial analysis of a specimen of this intermediate rock, from the south side of the mountain, is given in the accompanying table of analyses (No. VI), on page 220. As will be seen, in chemical composition as well as in mineralogical character, it occupies a position intermediate between the essexite and the pulaskite, occurring on either side of it, thus representing an intermediate zone in which the differentation was not quite completed. It is, however, much more nearly allied to the essexite, being alkalicalcic and dosodic, and although in the absence of a complete analysis or detailed measurements its position in the new classificatian cannot be determined with absolute certainty, there is very little doubt that it also, like the essexite adjacent to it, is an andose.

DYKES.—A feature in connection with Mount Johnson, and one possibly connected with its somewhat peculiar structure, is the almost entire absence of dykes. These were found only in two places, and in both cases the dykes were small in size. The first of these localities is on the northeastern margin of the intrusion, where the dyke occurs in association with and probably cutting the hornstone. It was found as large angular blocks in the heavy maple bush which here covers the slope of the mountain, but is undoubtedly in place in the immediate vicinity. The rock is very dark gray in color and very fine in grain, and belongs to the camptonites. It has a porphyritic structure, the very numerous phenocrysts consisting of hornblende and pyroxene. The hornblende phenocrysts are deep-brown in color and strongly pleochroic, the mineral being the same basaltic hornblende described in the essexite. The pyroxene of the phenocrysts is pale purplish in color and shows a marked dispersion of the bisectrices. Both minerals have very perfect crystalline forms. The plagioclase of the rock is very basic in character, as shown by its high extension. The rock resembles very closely certain occurrences found on Mount Royal. The size of this dyke is not known, but it probably has not a width of more than a foot or two. The other dykes occur on the southeastern slope of the mountain by the side of the road leading down from the quarries here. At this locality there are four small dykes, the largest only a foot in width, cutting the essexite. These are all very fine in grain and much decomposed, but represent two varieties of rock. Two of the smallest are composed of a camptonite consisting of a groundmass of brownish hornblende and plagioclase, with lath-shaped plagioclase phenocrysts. The other two dykes consist of a rusty weathering rock, made up of feldspar laths and a mass of pseudomorphs of limonite

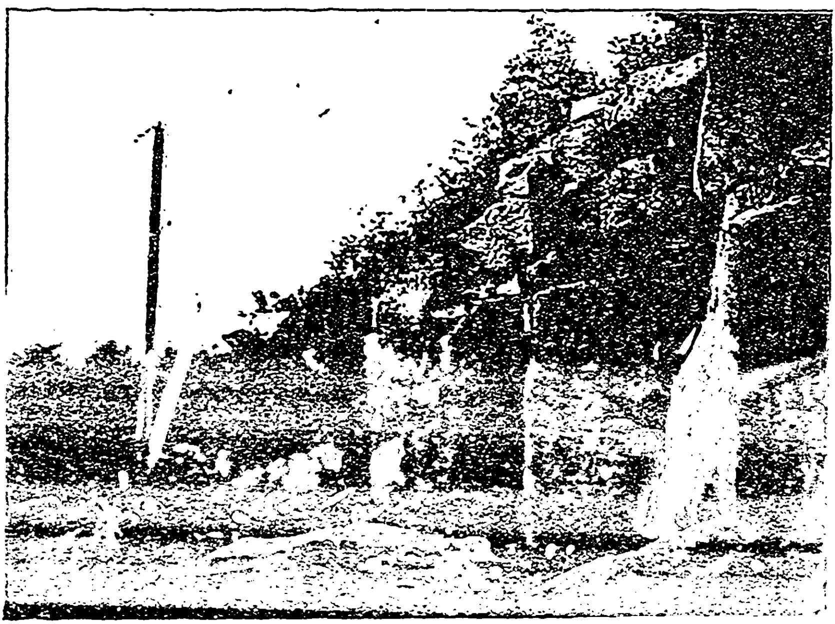


FIG. 5.—Quarry in andose, Mount Johnson, showing vertical flow structure on right.

after some prismatic mineral, probably either ægerin or arfvedsonite. Professor Rosenbusch considers it to be a highly altered tinguaite or sölvsbergite, probably the latter.

The several dykes, while small and unimportant in themselves, are of interest in that they present the petrographical types regularly associated with the alkaline rich intrusions of the class represented in Mount Johnson.

The Structure of Mount Johnson.—The structure of the mountain and the character of the rocks composing it also throw some light on the question as to where the differentiation took place. In course of conversation with the foreman of one of the quarries in the essexite on the flank of the mountain, the writer was informed by him that Mount Johnson consisted of three layers of horizontal rock; a fine-grained one on top, below which was the coarser-grained rock of the quarry, and beneath this a spotted variety. Each of these layers, he considered, went through the mountain horizontally and could be seen outcropping at their respective levels on every side. The three rocks referred to were, as will be recognized, the fine-grained essexose, the andose, and the transitional rock below the latter, respectively. The pulaskite zone he had not noticed, it being at the base of the mountain and in many places more or less covered with fallen blocks and talus. If this were the true interpretation of the structure, the mountain would have to be considered as the remnant of a laccolite which had been intruded between the horizontal Silurian strata and which had subsequently been almost entirely removed by peripheral denudation. This has been shown to be the true explanation of the origin of some of the occurrences, formerly supposed to be intrusive stocks, in the western portion of the United States, and it was at first considered as a possible explanation of the origin of Mount Johnson. A careful examination of the mountain, however, shows that such an explanation of its origin is untenable, and that it is a true neck, due to the filling up of a nearly circular perforation in the horizontal strata of the plane, by an upward moving magma.

The evidence of this is to be found in the direction of the banding or fluidal arrangement of the crystals in the essexite already referred to and shown in Fig. 5. This fluidal arrangement is seen in most large exposures of the essexite and with especial distinctness in the great faces, of this rock exposed in the quarries on the mountain side, and it is always vertical, showing that the movement of the rock was upward through the pipe, and not outward and horizontally over the pulaskite, as it would have been in the case of a laccolite. Furthermore, in several cases when the fluidal arrangement is very distinct and has a somewhat banded character, as shown in Fig. 6, due to the

Fig. 6.—Andose in quarry on Mount Johnson, showing vertical flow structure.

alteration of somewhat more feldspathic portions of the rock with others richer in iron-magnesia constituents, a strike can be made out on horizontal surfaces, and this strike curves around the mountain, following its marginal outline, as shown in the map, Fig. 2.

It is thus clear that Mount Johnson is a neck in its most typical form. A cross-section of the mountain is shown in Fig. 7. The opening occupied by the intrusion was in all probability formed by the perforation of the horizontal shales at this point by the explosive action of the steam and vapors preceding the eruption proper, as it presents exactly the features reproduced by Daubrée in his highly suggestive experiments on the penetrating action of exploding gases. It is, in fact, what he terms a *diatrème.*

Des perforations aussi remarkables, tant par leurs formes que par les communications qu'elles ont etablies avec les profondeurs du sol, constituent, parmi les cassures terrestres, un type assez nettement charactérisé pour mériter d'être distingué par une dénomination precise et cosmopolite. Le nom de diatrème rapelle l'origine probable de ces trouées naturelles, veritables *tunnels verticaux*, qui se rattachent souvent, comme un incident particulier, aux cassures linéaires, diaclases et paraclases [1]

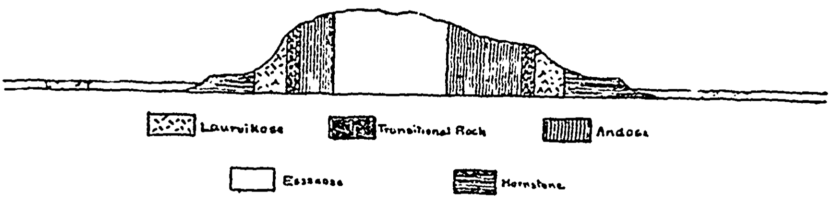


FIG. 7.—Diagrammatic cross-section of Mount Johnson, showing the relation of the several rock types.

The occurrence is one which presents a close resemblance to the remarkable volcanic necks recently described by Sir Archibald Geikie[2] in East Fife, and also to those described by Branco,[3] in Würtemberg. Mount Johnson, however, is a neck occurring in an area which has undergone much more extensive denudation since the time of the intrusion than in the cases above mentioned, and as a consequence of this the fragmental material

[1] "Recherches expérimentales sur le rôle possible des gaz à hautes températures doués de très fortes pressions, etc.," *Bull. de la Soc. Géol. de France*, 3e série, tome XIX (1891), p. 328.

[2] *The Volcanic Necks of East Fife.* Glasgow: Hedderwich & Sons.

[3] *Schwabens 125 Vulcan-Embryonen und deren tufferfüllte Ausbruchsröhren das grösste Gebiet ehemaliger Maare auf der Erde.* Tübingen, 1894.

which fills some, although not all of the necks referred to above, has been entirely swept away.

In view of the fact, then, that Mount Johnson is a neck or pipe of comparatively small sectional area, in which the differentiation is very complete, but in which the magma did not remain at rest, but was long prior to final consolidation, moving upward, it seems improbable that the marked differentiation of the magma into the several varieties described in this paper took place while the magma was in the pipe itself. The evidence points rather to the differentiation of the mass having already taken place in the reservoir of molten rock beneath, which was tapped by the pipe. If this be the case, it would seem that the upper and more acid portion of the magma, represented by the lighter pulaskite, had collected in the upper portion of the reservoir, and that the essexite formed a lower, more basic, and heavier stratum or part. When the passage to the surface was opened up, the pulaskite would first rise in it and, after a more or less long-continued flow, being followed by the essexite, would be pressed toward the circumference of the pipe, the more basic rock occupying the central portion of the passage, and the most basic variety, originally lower, would be found in the central axis of the neck. The fact that, while the essexite forms the mass of the intrusion, there is a zone of pulaskite about it, would seem to indicate that there had not been at this center of volcanic activity any very protracted outpouring of the essexite, since, had this been the case, it would seem probable that the pipe would have in time been cleared of the earlier pulaskite magma.

The interesting question of the succession of the eruption of the several magmas in this petrographical province, as well as the causes of their differentiation, can be more profitably discussed when the other centers of eruption have been more thoroughly studied. It is interesting to note the cumulative evidence in favor of differentiation as an explanation of the origin of these and similar groups of rocks, arising not only from the repeated association of the various members of the group at many centres in a single area like that described in the present paper, but also at centers widely separated from one another in different parts of the world. The occurrences described by Ramsay[1] in the Kola peninsula may be especially noted in this connection as closely allied to those of the Monteregion hills, a soda-syenite (umptekite) occurring about the margin of an intrusion of the nepheline-syenite which constitutes the *massive*, while theralite is also found as a differentiation product of the same intrusion.

The author desires to acknowledge his indebtedness in connection with this investigation to Miss Rosalind Watson, of Victoria, B. C., who, when a student at this university began the study of Mount Johnson; also to Professor Rosenbusch, Professor Iddings, and Professor C. H. McLeod for valuable aid during the course of the work.

FRANK D. ADAMS.

McGILL UNIVERSITY,
Montreal.

1 *Des Nephelinsyenitgebiet auf der Halbinsel Kola.* Fennia 11, No. 2. Helsingfors, 1894.

PROCEEDINGS OF THE NATURAL HISTORY SOCIETY.

MONTREAL, OCTOBER 26TH, 1903.

The First Monthly Meeting of the society was held this evening. Present, Dr. E. W. MacBride, President, in the chair. Messrs. J. A. N. Beaudry, A Holden, H. McLaren, C. E. H. Phillips, Jos. Fortiér, R. W. McLachlan, C. J. Stuart, Rev. R. Campbell, J. S. Buchan, F. Topp, W. O. Roy, A. Griffin, T. Craig, H. H. Lyman and about twenty visitors.

Minutes of last meeting, April 27th, were read and confirmed.

The Curator reported the following Donations to the Museum:—Remains of whale ploughed up at Little Metis, donor, J. S. Buchan, Neptune's Drinking Cup, C. T. Hart, specimen Slate, Quarries, Newfoundland, E. W. Roberts, specimen Graphite, Calumet (Field day), A. Griffin, view, specimen of Meteorite (?) by J. M. Aird. It was moved by Rev. Dr. Campbell, and agreed, that the Secretary convey the thanks of the Society to the Donors. Rev. H. J. S. Boyle and C. J. Hart were admitted o membership. Miss Martha Craig was admitted to associate membership. Rev. Dr. Campbell then gave an interesting talk on the Fungi of the Island of Montreal, exhibiting many specimens, also a specimen of the foliage and fruit of the Coffee tree, from the mountain and cemetery, also specimens of fruit of Bladder Pod.

Mr. Stuart then read his paper "Further observations of the Aurora Borealis." After discussions and questions, the President in closing expressed the hope that Mr. Stuart would continue his investigations and again address the society, when Dr. Rutherford would be invited to be present.

MONTREAL, NOVEMBER 30TH, 1903.

The Second Monthly Meeting of the society, for the season, was held this evening, Dr. E. W. MacBride in the chair.

There were also present, J. Harper, Rev. Dr. Campbell, Jos. Fortiér, C. S. J. Phillips, C. E. H. Phillips, A. Holden, J. S. Buchan, A. E. Norris, C. T. Williams, A. Robertson, Thos. Craig, Prof. Bemrose, H McLaren, and about twenty visitors.

In the absence of the Secretary, Mr. H. McLaren consented to act in that capacity. The Minutes of last meeting were read and confirmed. On motion, the rules were suspended, and J. W. Currie was duly elected an ordinary member of the Society. Mr. S. Cleveland Morgan then read his paper on "The Mollusca of the Island of Montreal," followed by the Rev. Dr. Campbell, who exhibited and explained some new specimens (12) of Fungi, also 25 specimens of plants, many of which were quite new to the vicinity of Montreal. A discussion followed, many interesting questions being asked and answered by the respective lecturers.

A vote of thanks moved by A. E. Norris, seconded by John Harper, was unanimously carried, and tendered the lecturers. The meeting then adjourned.

MONTREAL, FEBRUARY 1ST, 1904.

The Third Monthly Meeting of the society was held this evening. The chair was occupied by Dr. E. W. MacBride. The following were present. Rev. Dr. Campbell, J. S. Buchan, John Topp, A. Robertson, A. E. Norris, A. Holden, H. McLaren, C. J. Stuart, Dr. Wesley Mills, Oswald Duckett, C. S. J. Phillips, C. E. H. Phillips, A. Griffin and about thirteen visitors.

In the absence of the secretary, Mr. A. E. Norris consented to act. The minutes of last meeting were read and confirmed. Rev. Dr. Campbell then read the obituary notice he had drafted, to be sent to the families of the late Samuel Finley and Sir William Van Horne. The curator reported the following donations:—70 specimens British Birds' Eggs, donor, Gilbert McGibbon. A vote of thanks was tendered to to the donor on motion of J. S. Buchan, seconded by Rev. Dr. Campbell. The librarian reported the following gifts to the Library:—Oysters and all about them, donor, L. Philpot, (2 vols.), Fish, and Fisheries, (prize essay, 1 vol.), Paley's Natural Theology, donor, Mrs Alfred Griffin. A vote of thanks was accorded the donors on motion of A. Robertson, seconded by J. S. Buchan. On motion the rules were suspended, and S. Cleveland Morgan was duly elected an ordinary member of the society.

Dr. E. W. MacBride then gave his paper, "The Canadian Oyster," followed by Charles J. Stuart, who gave a paper *on* A Remarkable Display of *the* Aurora Borealis *on* October 31st last. Both these papers evoked a spirited discussion, and were very much enjoyed.

A vote of thanks proposed by Dr. Wesley Mills, seconded by H. McLaren, was unanimously accorded the lecturers for their interesting and valuable communications.

The meeting then adjourned.

MONTREAL, FEBRUARY 29TH, 1904.

The Fourth Monthly Meeting of the society was held this evening at 8-30 p.m. The chair was occupied by Dr. E. W. MacBride. The following were also present: Rev. Dr. Campbell, J. Harper, A. E. Norris, J. S. Buchan, C. S. J. Phillips, A. Griffin, J. A. W. Beaudry, Jos. Fortiér, A. F. Winn, P. S. Ross, C. E. H. Phillips, H. McLaren.

Mr. McLaren kindly consented to act as secretary in the absence of Mr. Richards who was unable to attend On motion, the rules were suspended, and Jas. Tasker was duly elected an ordinary member of the society. On motion, the minutes of last meeting were taken as read.

Mr. J. S. Buchan then read his paper on "The Pleistocene of Montreal and the Ottawa Valley as seen from the Windows of a Railway Carriage," followed by a paper from Mr. A. E. Norris, on "Insect Miners and their habits." Both of the papers were listened to with a great deal of interest, several members taking part in the discussion that followed. It was then moved by Rev. Dr. Campbell, seconded by J. Harper, that the thanks of the meeting be tendered to both of the above gentlemen for their interesting communications. Carried.

MONTREAL, APRIL 5TH, 1904.

The Fifth Monthly Meeting of the society was held this evening at 8-30. The chair was taken by George Sumner, and the following were also present. Rev. Dr. Campbell, Dr. F. D. Adams, J. S. Buchan, H. McLaren, J. Harper, C. E. H. Phillips, J. Topp, P. S. Ross, Dr. J. C. Cameron, Lachlan Gibb, Dr. J. Stafford, A. E. Norris, C. J. Stuart, A. Griffin, Jos. Fortiér, and a number of visitors.

In the absence of the secretary, Mr. H. McLaren consented to act. The minutes of last meeting were read and confirmed. The curator reported a donation to the Museum of a number of botanical specimens, collected in the vicinity of Montreal by Mrs. Marrotte. It was moved by Rev. R. Campbell, seconded by J. S. Buchan, that the thanks of the society be tendered to the donor. Carried.

The rules having been suspended, the following gentlemen were elected ordinary members of the society. J. H. Warren and Harry Bragg. Dr. Frank D. Adams then read his paper on "Mount Royal and the Monteregian Hills," followed by Rev. R. Campbell, who gave his paper on "Some characteristic Plants of British Columbia." Both of these papers were listened to with a great deal of attention, and elicited many questions, especially the former paper.

It was then moved by Mr. J. S. Buchan, seconded by Dr. J. C. Cameron, that the thanks of the society be tendered to the two gentlemen for their very interesting and instructive papers. Carried.

A communication was read from C. J. Stuart and A. Griffin, questioning the genuineness of the supposed meteorite loaned recently by J. M. Aird. The meeting then adjourned.

MONTREAL, APRIL 25TH, 1904.

The Sixth Monthly Meeting of the society was held this evening at 8-30. The minutes of last meeting were read and confirmed. The chair was occupied by the President, Prof. E. W. MacBride, and the following were also present: J. A. N. Beaudry, J. S. Buchan, R. W. McLachlan, Prof. Bemrose, Prof. D. P. Penhallow, Rev. R. Campbell, H. McLaren, C. S. J. Phillips, F. W. Richards, A. E. Norris, Jos. Fortiér, C. E. H. Phillips, A. Holden, J. Gardner, Miss O'Keeffe, Dr. Wesley Mills, Dr. J. Stafford, J. Walker, J. M. M. Duff, and a number of visitors, including several ladies.

The curator reported a donation of 130 plants from British Columbia, collected and presented to the Museum by the Rev. R. Campbell. On motion, a vote of thanks was tendered to the Rev. Dr. for his valuable donation. Carried. The report of Council was read and adopted on motion of C. S. J. Phillips, seconded by J. A. N. Beaudry. On motion, the following were requested to act on the Nomination Committee: Prof. E. W. MacBride, C. S. J. Phillips, F. W. Richards.

Prof. D. P. Penhallow then read his paper on "Some recent Developments in the Classification of the North American Coniferæ." This communication was very much appreciated by those present, and revealed a prodigious amount of research and study in its preparation. Dr. J. Stafford followed with his paper "The Fresh Water

Fishes brought to Montreal Markets," which was listened to with great attention.

On motion of C. S. J. Phillips, seconded by J. S. Buchan, a vote of thanks was tendered the above gentlemen for their valuable communications. The meeting then adjourned.

ANNUAL MEETING.

MAY 30TH, 1904.

The Annual Meeting was held this evening at 8-30 o'clock, Prof. E. W. McBride presiding. There were also present Prof. F. D. Adams, J. Beattie, J. A. U. Beaudry, J. S. Buchan, K.C., C. Cassils, T. Craig, Oswald Duckett, Jos. Fortier, F. C. Morgan, A. E. Norris, C. E. H. Phillips, F. W. Richards, W. O. Roy, C. T. Williams, John Fair, G. A. Greene, A. Holden, J. Harper, A. C. Lyman, Miss Luke, Dr. Wesley Mills, John M. Coxen, H. McLaren, C. S. J. Phillips, A. Griffin, P. S. Ross, C. J. Stuart, and about 150 visitors.

Minutes of last Meeting were read and confirmed. Reports of Council, Treasurer, House Committee, Librarian, Museum, Lecture, Editing and Exchange Committees, were received and adopted after discussion on motion by Jos. Fortier, seconded by J. A. U. Beaudry.

The election of officers resulted as follows :—

PATRON :
His Excellency the Governor General of Canada.

HON. PRESIDENT :
Lord Strathcona and Mount Royal.

PRESIDENT :
Prof. D. P. Penhallow.

VICE-PRESIDENTS :

Frank D. Adams, Ph.D., F.R.S.C.	J. H. Joseph.
Rev. Robt. Campbell, M.A., D.D.	E. W. MacBride, M.A., Sc.D.
B. J. Harrington, Ph.D., F.R.S.C.	Dr. Wesley Mills.
Albert Holden.	Hon. J. K. Ward.

HON. RECORDING SECRETARY
F. W. Richards.

HON. CORRESPONDING SECRETARY:
C. E. H. Phillips.

HON. TREASURER:
Chas. S. J. Phillips.

HON. CURATOR:
A. E. Norris.

MEMBERS OF COUNCIL:

J. A. U. Beaudry, C.E., Chairman.	Edgar Judge.
J. S. Buchan, K.C., B.C.L.	H. McLaren, B.A.
Joseph Fortier.	Alex. Robertson, B.A.
John Harper.	C. T. Williams.

Prof. E. W. MacBride then delivered the President's annual address on "The Origin of the Human Race." A very interesting discussion of the paper followed, and Dr. MacBride, together with the retiring officers, was tendered a hearty vote of thanks by the members for their untiring efforts in promoting the welfare of the society during the year.

REPORT OF COUNCIL.

To the Officers and Members of the Natural History Society of Montreal :—

LADIES and GENTLEMEN :—

Your Council beg to submit the following report of their work for the year ending May 30th, 1904.

The regular business meetings have been well attended, and on the whole it has been a year of increased usefulness, although we are still suffering from the same causes that have crippled the work in former years.

The attendance at the Museum has increased beyond all expectations, while the hall has proved too small to accommodate all who came to the Somerville course of lectures, as well as to the Saturday afternoon talks to the young people.

The membership remains at about the same figure as at our last report, but we are sorry to say the rentals are somewhat less.

The pressure for increased room is more intense from year to year, and we could add considerably to our income if we could offer better accommodation to our tenants, while our librarian knows not which way to turn for accommodation.

The question of sale is still unsettled, the option granted to certain parties having still some time to run.

The field day excursion to Calumet was well attended, although the rain marred the pleasure of the day. Our reception at Calumet was most hospitable.

It is with much regret that we have to report the removal by death of four of our members:

Mr. Samuel Finley.	Mr. S. Silverman.
Major L. A. H. Latour.	Hon. Justice Wurtele.

The following papers were presented at the monthly meetings of the Society:

Oct. 26.—"The Toadstools of Montreal, Edible and Poisonous." Rev. Robt. Campbell, M.A., D.D.

"Further Observations of the Aurora Borealis." Chas. J. Stuart, Esq.

Nov. 30.—"The Mollusca of Montreal." S. Cleveland Morgan, B.A.

"Some additional notes on the Flora of Montreal, including the Toadstools." Rev. Robt. Campbell, M.A., D.D.

Feb. 1.—"The Canadian Oyster." Prof. E. W. MacBride, Principal of the Zoological Laboratory, McGill University.

"The Great Aurora Borealis of October 31st, as seen at Montreal." Chas. J. Stuart, Esq.

Feb. 29.—"The Pleistocene of Montreal and the Ottawa Valley, as seen from the Windows of a Railway Carriage." J. S. Buchan, B.C.L., K.C.

"Insect Miners and Their Habits." (Illustrated by colored lantern slides from Nature.) A. E. Norris, Esq.

Apr. 5.—"Mount Royal and the Monteregian Hills." Prof. Frank D. Adams, Ph.D., F.R.S.

"Some Characteristic Plants of British Columbia." Rev. Robt. Campbell, D.D.

Apr. 25.—"Some Recent Developments in the Classification of the North American Coniferæ." Prof. D. P. Penhallow.

"The Fresh Water Fishes brought to Montreal Markets." J. Stafford, M.A., Ph.D.

May 30.—"The Origin of the Human Race." Prof. E. W. MacBride, M.A., D.Sc., of Zoological Laboratory of McGill University.

SOMERVILLE COURSE.

Feb. 26.—"Bermuda and its Coral Reefs." Prof. C. L. Bristol.

Mar. 3.—"The Yukon Country." Prof. John McCoun, M.A., Naturalist to the Geological Survey.

10.—"Canada's Great Inland Sea (Hudson Bay) and the Surrounding Country." Robt. Bell, M.D., D.Sc., F.R.S., Acting Director of the Geological Survey.

17.—"The Grand Canoñ of Arizona." H. Bragg, Esq.

24.—"Japan, its Geography and People." Shaw T Nishimura, Esq.

31.—"The Sandwich Islands." Edgar Judge, Esq.

YOUNG PEOPLE'S HALF-HOUR TALKS.

Feb. 27.—"A Piece of Maple Sugar." J. S. Buchan, B.C.L., K.C.

Mar. 5.—"Dick's Dive in a Duck Pond." C. T. Williams, Esq.

12.—"The Story of an Apple." Carrie M. Derick, M.A.

19.—"How Plants Look after their Children." Eleanor Tatley, B.A.

26.—"The Purpose and Value of Pain." Wesley Mills, M.D.

Apr. 2.—"Wild Flowers and how to Treat Them." Rev. G. Colborne Heine, B.A.

9.—"On Collecting, Drying, and Mounting Plants." Rev. Robt. Campbell, D.D.

REPORT OF THE LECTURE COMMITTEE.

The chairman of the Lecture Committee being out of the city, I have been asked to report in his stead:

The Somerville course for the season was unusually interesting, and attracted large and intelligent audiences. Dealing mainly with descriptive geography, all the subjects treated of were within the grasp of ordinary hearers, who showed their unmistakable appreciation of them by their eager attention and hearty applause. This was specially the case with reference to the Japanese gentleman who gave such a realistic description of his country and its people. The thanks of the entire community, as well as of the members of the Natural History Society are due to the several lecturers, including the two members of the Geological Staff from Ottawa.

The Saturday afternoon talks to children abated nothing of the interest of former years. They continued to be attended by crowds of bright-eyed, eager young people, to the close of the series; and there is every ground to believe that from among those keenly attentive little folk future men and women of science will arise. The seed sown in their young minds cannot all perish.

In name of the Lecture Committee,

ROBERT CAMPBELL, Acting Chairman.

REPORT OF THE EDITING AND EXCHANGE COMMITTEE.

Your Editing and Exchange Committee beg leave to report that two numbers of the "Record of Science" were issued since the last annual meeting, one in July, 1903, vol. ix, No. 1, and one in January, 1904, vol. ix., No. 2. There was serious delay occasioned by our printer, with regard to both issues. The contents consisted mainly of papers communicated to the Society, and pertained to many of the fields of Natural History, while they were of special interest to those engaged in local research; they were of greater or less intrinsic value as aiding in the extension of a knowledge of Natural Science generally.

The exchange list continues to be large and valuable.

Respectfully submitted in name of the Editing and Exchange Committee.

ROBERT CAMPBELL, Chairman.

REPORT OF THE HOUSE COMMITTEE.

Montreal, 30th May, 1904.

To the President of the Natural History Society:

SIR:—Your Committee begs to report that the lease of the present tenants has been renewed for one year to May, 1905. The many repairs to the building which have been reported and delayed for several years for want of funds have been carried over owing to the property being under offer for sale. The option is given to 1st November next. Should this sale be carried out, your Committee is ready to carry out a proposition that will (with the consent of the Society) place the Natural History Society in a position to make it independent in the future.

The thanks of the Society are due to the Superintendent and Mrs. Griffin for their many extra services during the past year.—Yours respectfully,

A. HOLDEN,
For the Committee.

MUSEUM REPORT.

Session 1903-1904.

Mr. President, Ladies and Gentlemen,

On behalf of the Museum Committee the following report is submitted.

The Museum continues to attract great numbers of children and others. The fact of so many young people coming is an encouragement in itself, because they are generally more impressionable to the facts of Natural History than the older people, who naturally are burdened with other pursuits, and the cares of business.

We had great hopes of being able to report something concerning the proposed new Museum, but that must be left to a later date.

The donations to the Museum have been very interesting, and having been examined by the society, thanks to the donors were accorded in the minutes. The Botanical department has been considerably enriched by the generosity of Mrs. Marotte and Dr. Robert Campbell.

The Museum on the Saturday half-holiday is "Crush Day," when as many as three hundred to four hundred people visit it. Respectfully submitted,

A. E. NORRIS.
Honorary Curator.

LIBRARY REPORT.

During the past year many valuable bound volumes and Atlases have been received from Scientific Societies, as well as the usual Exchanges for the Record of Science. Nine volumes have also been presented by private individuals.

There is no relief yet to the congestion of the shelves, which are much overloaded, and in many cases "Two-deep," so that access to the volumes is difficult. More shelving is very urgently required, and it is to be hoped that the finances of the society may permit of this being done at an early date.

H. McLAREN,
Chairman, Library Committee.

June 6th, 1904.

NATURAL HISTORY SOCIETY OF MONTREAL

In account with CHAS. S. J. PHILLIPS, Hon. Treasurer.

CASH SUMMARY FOR YEAR ENDING MAY 31st, 1904.

RECEIPTS.

To Rents	960.50	
" Members' subscriptions	475.00	
" Record of Science	18 61	
" Microscopical Society on affiliation	45.00	
		1499.11
" Bank overdraft		459.32
		$1,958.43

DISBURSEMENTS.

By Balance due Bank		352.16
" Superintendent's salary	650.00	
" " Commision	46.00	
" Mrs. Griffin	50.00	
" Sundry Expenses	167.02	
" Lighting account	169.23	
" Fuel "	250.16	
" Water "	34.92	
" Printing "	23.00	
" Lecture "	37.00	
" Museum "	12.00	
" Interest "	28.75	
" Record of Science	138.19	
		1,606.27
		$1,958.43

Audited and found correct, this 30th day of May, 1904.

(Signed) H. McLAREN,
ALEXANDER ROBERTSON.

ABSTRACT OF OBSERVATION OF AURORA BOREALIS SEEN FROM MONTREAL, 1903. By C. J. STUART.[1]

During the Autumn of 1903 I witnessed 5 displays of Aurora as follows :—

19th 20th Sept.—W. to E. drift indicated. Surface wind S.W. Cross winds above.

13th Oct.—Drift suggested not distinct. Wind W., and puffs from N.W. Cross winds above.

30th Oct.—1st Nov.—W. to E. drift pronounced. Surface wind W. and W.S.W. Cross winds.

Morning, 4th November.—W. to E. drift suggested (short observation). Surface wind S. of W. No clouds.

18th Nov.—Drift not observed, but not incompatible with conditions as seen. Surface wind W. Clouds from N.W.

The McGill monthly weather reports mention two Auroras for September, three for October, and evidently only one night in November—probably the early morning display of November 4th was missed—but it was undoubtedly Aurora, as indicated by the filling and fading of light. Dawn the same morning was high peaked, suggesting zodiacal light with which I am not familiar, however. As dates are not given in the weather reports, and as my observations do not pretend to be complete, it would appear that there were at least seven or eight displays during the year.

During the nights of September 19th and 20th, and again on October 13th and 14th, displays of Northern lights were noted from here.

On both occasions I had what I considered evidence of a West to East drift of the field or medium in which the luminous phenomona took place.

The display of September 19th was rather feeble and sluggish. I did not notice anything unusual until 8.35 p.m. and until 3 a.m.—when fog drifted in from the South—the overhead clouds were so thin and indistinct that no positive assurance could be obtained of high cross winds, but from the appearance and behavior of cloud banks on the horizon I inferred that there was both a high cirro mist and a W. to E. wind, the surface wind being South to North nearly.

On the 13th October, however, there was unequivocal evidence of several cross winds, the highest evidently from W. to E. This display, I understand, was observed as far South as Washington, D.C. In the early evening it was brilliant although sluggish in movement. The moon was in its last quarter, so the early morning appearance was chiefly interesting for the behavior of the clouds and winds. I watched

[1] Read before the Natural History Society of Montreal, February 1st, 1904.

at intervals and saw Aurora from 6.20 p.m. up to 5.05 a.m. (dawn) morning of the 20th. At 4.40 a.m. 20th I had the good fortune to observe, under very favourable circumstances, the formation of a field of cirrus clouds almost overhead. It showed the wind action I expected—high W. to E., under N. to S., with a probable stratum almost calm in between—but what is of exceptional interest, the coincident behaviour of the Aurora showed a decrease while the clouds grew, and an increase while the clouds again melted away. At the same time the high cirrus mist which makes the stars look dim, and which was evident as a large halo round the moon, diminished in density and decreased in size. These changes in the cloud formation, the halo, and the Aurora were coincident and apparently in reverse proportion.

A somewhat similar cloud phenomenon was seen between 8 and 9 a.m. Of course the Aurora was invisible, but certain heavy low-lying, cumulus clouds were distinctly exhibiting electrical influences, so I presume if the Aurora had been still visible we would have seen changes in it also. I consider the observation of these clouds important, so the running notes I kept will be transcribed and forwarded to the Society for anyone who may be interested. It may be remarked that the period between these two displays is twenty five days, roughly one revolution of the sun. On the 20th of September there was no sun spot visible, although a group observed two weeks later must have been forming on the reverse surface. On October 14th the old group of sun spots that had been exciting so much attention could be seen on the Western limb of the sun's disc, while a single new spot was just appearing on the Eastern side. The meredian field, however, was clear. In this respect, however, I may mention that the connection of sun spots and terrestial Aurora Borealis is not direct, but probably through the "protuberances" which accompany the outburst of spots, or at least the earlier stages of their development, the solar protuberances in high latitudes are said to synchronize with terrestrial magnetic disturbance, or magnetic storms (Lockyer), and the latter, according to weather conditions and other modifying circumstances, finds a consequent expression either in Aurora or thunderstorms, or simply the unsettled state of the magnetic needle, indicating disturbed earth currents.

A great magnetic storm with displays of Aurora took place on the two nights, October 30th and 31st and November 1st. It was supposed to have originated in the sun, or at least to have had some connection with two large groups of sun spots then attracting attention. Telegraphic communication was generally interrupted, but in some instances lines were worked without battery power, as was the case between Montreal and Fort William Friday night. James Kent, Esq., of the C.P.R. Telegraph Company, gives me the information that trouble was first experienced about midnight on the Winnipeg circuits, rapidly extended

Eastward and South, lasted for over twelve hours, and retreated from South and East to West. The greatest disturbances centered North of Lake Superior.

As to the Aurora visible from Montreal, it was probably the most resplendent and extensive seen in the last fifty years.

The repetition of details, remarks, compass bearings, and other items, as I have them in my notes, would make somewhat monotonous reading, so I will co fine my abstract to the principal points noticed; which seem to have . bearing on the peculiarities we have previously discussed. First, I had evidence to confirm the view that the body of the Aurora has a steady W. to E. "drift." During the early morning of October 31st I particularly observed patches of light exhibit a steady drift across the stars; also fields of red colored light and beams appeared in the W. and disappeared in the E., uniformly taking 15 minutes to pass from W. to E. The same drift was seen the following night in a less marked degree, the drift being a little slower and the opportunities to see it less frequent.

During the evening of the 31st the weather and clouds were changeable. These cloud changes came from the W., although the then cloud motion was from the N.W. by N. The suggestion is that the cloud changes were influenced by the electric conditions above passing W. to E. The Aurora light was not mixed up with the cloud at this time, but occurred in the intervals of clear weather.

Again on November 4th, at 20 minutes past five in the morning, I noticed a nebulous band lying from Orion's belt across to the Morning Star. It showed the filling and fading light of the Aurora, and one patch suggested the W. to E. " drift," but the exhibit was not long enough or distant enough to make sure.

On November 18th there was a bright display in rather peculiar weather, clearing up after rain and sleet. At the end of my notes that night I find this remark :—" Although bright and strong, the changes of light are quite rapid, and no distinct forms are retained; for this reason I cannot say that there is any proper drift from W. to E." A slow drift, however, was not incompatible with the appearances as observed.

Cloud motions at variance with the surface winds were noted on October 31st and November 1st and 18th. There were no clouds to mark motion by on the morning of November 4th.

Of the great display of October 31st, between four and five o'clock in the morning the colors were magnificent. All the colors of the spectrum were to be seen. The reds and orange-lilac and violet shades predominated, but scarlet, a little green, purples, and even light browns were noticed. The reds hung together in rather large masses, as did the violets, lilacs, and whites. The reds all drifted W. to E., but the whites and blues sometimes succeeded to a climax of red, or crept back in little spurts and rushes from the Eastern edge to meet reds advancing from the W.

Both the white and colored climaxes, or pulses of light, rose out of the West. The colors began with rose red, about 3.40 a.m., and continued until dawn. Flat, even tints were the rule, rays or beams of exceptional length were one shade throughout, and would change tint as different colors rippled together; but after 5 o'clock, when things got a little mixed, a few lilac tinted beams exhibited orange and red butts, but they were probably two sets of short rays in the same line.

The light at the early morning climax was more diffused, but as bright, if not brighter, than moonlight. I could read pencil notes—and read small lettering on a tombstone at about 10 ft. distance. The following night (Hallowe'en), at 4 o'clock, I could hardly read the same lettering 6 in. from my nose.

During the first night very active and long beams (some of them with a visual angle of quite 30 degrees) and broken arches were the pronounced feature, while after midnight of the second night the nervous, fuming, fluttering light was most prevalent, and but few short and ill-defined beams were seen.

During the first night the set of the arches centred W. of N.; while the second night arches centred well E. of N. The difference was very noticeable. The W. to E. drift, however, was not apparently influenced by this change.

On Friday night I remarked a peculiar thing. From Fletcher's Field I seemed to be looking up at the legs of the arches resting on the misty horizon; while later, from the top of the mountain, I got the distinct impression of looking down on the lower ends of beams resting in the horizon mist. Whether it was some illusion of the night, the ground mist or light, I do not know, but the effect was to place the legs of the arches more in the middle foreground than past the horizon. This impression was not repeated the second night.

The arches that formed were not of uniform span, and several times volute forms and serried arches with broken echelon steps appeared, but changes of form and changes of phase to rippling beams would only be a matter of a moment or two. As to other forms, the corona was in evidence more or less all night, and twice for a brief moment the serpentine form which figures so largely in illustrations of Aurora was seen. It was evidently an accidental appearance, resulting from the disposition of long and short beams in several parallel arched fragments.

The brilliance and beauty of the display between four and five o'clock in the morning of the 31st was surpassingly grand. Much the finest display within my experience.

Book Notices.

The Department of the Interior has recently published in book form a "Dictionary of Altitudes in Canada," by Jas. White, Esq., F.R.G.S. The data are substantially the same as in this author's well known "Altitudes in Canada," but in the present issue places in each Province are arranged alphabetically, and the work makes a most convenient volume for reference. In the several columns are given the name of the station, its location, the elevation, and the source of the information. There is to be a relief map of the Dominion that will give a synoptic view of the broad features of the country, and will issue from the Press presently as provision is made for it.

The book will fill a distinct want on many bookshelves, and there should be a considerable demand for it, from the general public as well as professional and scientific men, to whom altitudes are a matter of frequent concern.

Mr. White is to be congratulated on the style, finish, and accuracy of his work.

C. J. S.

ABSTRACT FOR THE MONTH OF NOVEMBER, 1903.

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

DAY	THERMOMETER. † Mean.	THERMOMETER. Max.	THERMOMETER. Min.	THERMOMETER. Range.	* BAROMETER. † Mean.	* BAROMETER. Max.	* BAROMETER. Min.	* BAROMETER. Range.	‡Mean relative humidity.	WIND. General direction.	WIND. Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY....... 1	47.4	54.4	40.1	14.3	30.06	30.09	30.01	.08	80	S.W.	24.1	93	.00	....	.00	1..........SUNDAY
2	47.8	53.0	41.3	11.7	30.06	30.10	30.02	.08	78	S.W.	16.6	75	....	....	....	2
3	50.2	56.6	43.5	13.1	30.00	30.05	29.95	.10	80	S.W.	24.7	92	....	....	....	3
4	50.2	55.2	45.5	9.7	29.84	29.95	29.62	.33	88	S.W.	21.6	50	....	....	....	4
5	39.9	55.0	31.8	23.2	29.62	29.79	29.48	.31	84	N.E.	21.6	....	.33	2.1	.54	5
6	30.4	34.8	26.2	8.6	30.01	30.17	29.79	.38	66	N.W.	16.8	05	....	....	....	6
7	31.9	37.2	25.0	12.2	30.12	30.17	30.08	.09	80	N.W.	16.4	24	...	....	....	7
SUNDAY....... 8	38.6	42.0	32.7	9.3	30.13	30.17	30.08	.09	85	S.W.	18.2	....	....	0.0	.00	8..........SUNDAY
9	48.3	55.0	40.5	14.5	30.02	30.15	29.91	.24	83	S.W.	23.8	67	....	....	....	9
10	45.4	56.1	39.0	17.1	29.82	29.94	29.70	.24	75	S.W.	24.0	15	....	....	....	10
11	43.1	48.7	38.1	10.6	29.90	30.00	29.66	.34	90	S.W.	13.9	56	....	....	....	11
12	43.4	47.7	39.7	8.0	29.80	29.88	29.63	.25	73	S.W.	22.4	82	.05	....	.05	12
13	42.6	49.8	37.5	12.3	29.85	30.02	29.76	.26	68	S.W.	20.3	39	.00	....	.00	13
14	36.7	44.0	32.2	11.8	29.98	30.05	29.90	.15	76	S.W.	18.3	30	.06	0.2	.08	14
SUNDAY.......15	31.2	34.8	28.0	6.8	30.11	30.20	29.96	.24	81	S.W.	16.2	12	....	0.2	.02	15..........SUNDAY
16	24.0	32.1	20.0	12.1	30.12	30.25	29.85	.40	83	N.E.	17.8	....	.01	0.4	.05	16
17	33.1	41.0	24.0	17.0	29.75	29.90	29.63	.27	84	N.W.	22.3	....	.37	0.1	.38	17
18	27.4	33.0	23.2	9.8	29.99	30.07	29.90	.17	83	N.W.	19.0	52	....	0.0	.00	18
19	24.2	27.6	19.1	8.5	30.25	30.40	30.07	.33	87	S.W.	13.1	77	....	0.3	.03	19
20	20.4	23.1	14.5	8.6	30.63	30.75	30.40	.35	87	W.	13.3	62	....	0.3	.03	20
21	20.7	28.0	12.0	16.0	30.64	30.76	30.44	.32	85	S.W.	11.2	58	....	0.0	.00	21
SUNDAY.......22	29.5	34.3	20.8	13.5	30.22	30.44	30.10	.34	86	S.W.	9.1	09	....	0.1	.00	22..........SUNDAY
23	33.0	35.8	29.0	6.8	29.77	30.10	29.46	.64	93	N.W.	13.5	....	.11	0.8	.19	23
24	27.6	36.1	19.0	17.1	29.57	29.78	29.42	.36	89	S.W.	28.8	....	....	0.3	.05	24
25	17.5	21.1	14.0	7.1	29.92	29.99	29.78	.21	84	S.W.	27.5	65	......	0.2	.02	25
26	11.0	17.4	4.3	13.1	30.07	30.10	29.99	.11	89	S.W.	19.9	60	....	0.1	.01	26
27	15.6	19.0	12.6	6.4	30.07	30.11	30.03	.08	87	S.W.	12.6	33	....	0.1	.01	27
28	16.2	18.1	11.9	6.2	29.88	30.03	29.78	.25	87	N.W.	5.9	30	....	0.2	.02	28
SUNDAY.......29	17.4	19.7	14.3	5.4	29.79	29.81	29.77	.04	89	N.W.	4.6	....	....	0.0	.00	29..........SUNDAY
30	17.9	22.0	13.7	8.3	29.94	30.11	29.81	.30	86	N.W.	7.1	...	....	0.0	.00	30
Means..........	32.09	37.75	26.45	11.30	29.999	30.11	29.86	.25	82.9	S. 62° W	17.6	37	0.93	5.4	1.46	.......Sums........
29 Years means for and including this month......	32.65	38.87	26.78	12.09	30.013	......	......	.27	80.5	......	‖ 14.1	¶ 29	2.28	13.33	3.64	29 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	416	908	111	55	465	7536	1995	2186	
Duration in hrs..	46	52	12	3	34	365	145	63	
Mean velocity....	9.0	17.5	9.3	18.3	13.7	20.7	13.8	18.8	

Greatest mileage in one hour was 45 on the 10th.
Greatest velocity in gusts was 60 on the 10th and 24th.
Resultant mileage, 8,356

Resultant direction, S. 62° W.
Total mileage, 12,672.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. ‖ 17 years only.

The greatest heat was 56.6 above zero on the 3rd. The greatest cold was 4.3 above zero on the 26th, giving a range of temperature of 52.3 degrees.

Warmest day was the 4th. Coldest day was the 26th.

Highest barometer reading was 30.76 on the 21st: lowest barometer was 29.42 on the 24th, giving a range of 1.34 inches.

Minimum relative humidity observed, was 61 on the 6th.

Rain fell on 8 days.

Snow fell on 19 days.

Rain and snow on 5 days.

Lunar halos observed on 2 nights

Aurora was observed on 1 night.

Snow on ground in patches.

‖ Wind direction taken from City Hall records for first 25 days.

ABSTRACT FOR THE MONTH OF DECEMBER, 1903.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	20.1	28.2	16.2	12.0	30.22	30.35	30.13	.22	87	S.W.	10.2	18	....	0.5	.05	1
2	17.7	22.6	14.2	8.4	30.36	30.41	30.28	.13	91	N.E.	11.8	34	....	....	....	2
3	20.9	25.7	15.9	9.8	30.24	30.28	30.18	.10	92	N.E.	18.5	50	....	....	....	3
4	25.0	27.0	22.1	4.9	30.11	30.18	30.07	.11	87	N.E.	9.5	....	....	....	....	4
5	27.7	32.2	25.5	6.7	29.98	30.07	29.92	.15	94	S.W.	13.5	....	....	1.6	.16	5
SUNDAY........ 6	25.3	28.8	23.0	5.8	29.94	30.00	29.87	.13	91	W.	15.3	04	....	0.1	.01	6..........SUNDAY
7	22.6	29.0	17.3	11.7	29.87	29.92	29.81	.11	93	N.E.	9.0	....	....	2.5	.25	7
8	16.2	20.9	10.0	10.9	30.05	30.16	29.87	.29	87	W.	9.0	33	....	0.2	.02	8
9	13.5	19.9	8.5	11.4	29.99	30.18	29.54	.64	88	N.E.	19.8	....	....	2.6	.26	9
10	20.4	24.0	16.2	7.8	29.35	29.60	29.20	.40	93	W.	26.1	....	....	12.6	1.26	10
11	18.2	26.8	8.2	18.6	29.82	29.93	29.60	.33	87	S.W.	21.8	40	....	0.6	.09	11
12	23.4	30.9	16.2	14.7	30.09	30.26	29.85	.41	95	S.W.	17.2	13	....	0.7	.07	12
SUNDAY....... 13	24.7	36.9	10.9	26.0	29.75	29.99	29.50	.49	70	S.W.	28.4	40	.04	0.0	.04	13..........SUNDAY
14	4.8	13.9	—1.7	15.6	30.20	30.32	29.99	.33	68	N.W.	23.5	68	....	....	....	14
15	3.2	14.2	—6.7	20.9	30.09	30.32	29.94	.38	77	N.W.	22.7	16	......	0.2	.02	15
16	8.2	16.6	—0.8	17.4	29.84	29.99	29.77	.22	83	N.W.	20.7	....	....	0.8	.05	16
17	3.9	9.0	—3.6	12.6	29.99	30.14	29.89	.25	82	N.W.	23.4	....	....	0.0	.00	17
18	3.4	9.2	—0.7	9.9	30.43	30.55	30.14	.41	67	N.W.	20.4	89	....	....	....	18
19	5.6	14.0	—2.2	16.2	30.43	30.60	30.12	.48	74	S.E.	15.5	....	....	....	....	19
SUNDAY.......20	22.9	35.9	5.3	30.6	29.59	30.12	29.12	1.00	96	S.E.	13.0	....	.50	1.3	.63	20..........SUNDAY
21	26.5	35.8	22.0	13.8	29.46	29.62	29.11	.51	87	S.W.	25.5	47	.02	0.3	.05	21
22	18.5	35.0	4.0	31.0	29.69	30.06	29.34	.72	78	N.W.	31.2	67	....	0.2	.02	22
23	21.8	32.0	5.8	26.2	29.95	30.07	29.88	.19	91	S.W.	24.8	....	....	2.7	.14	23
24	27.9	34.3	23.9	10.4	29.80	30.01	29.45	.56	94	S.W.	14.8	....	.05	5.9	.64	24
25	22.6	35.0	11.0	24.0	29.56	29.64	29.41	.23	80	N.W.	18.7	17	....	0.1	.01	25
26	—4.5	11.0	—13.6	24.6	29.78	29.94	29.63	.31	80	N.W.	19.7	21	....	....	....	26
SUNDAY.......27	—7.6	—0.6	—16.3	15.7	29.70	29.94	29.52	.42	71	N.E.	11.8	....	....	1.6	.19	27..........SUNDAY
28	—8.4	2.7	—14.6	17.3	30.03	30.28	29.54	.74	65	W.	26.4	47	....	0.9	.09	28
29	—4.9	3.4	—14.9	18.3	30.17	30.28	30.02	.26	78	N.E.	14.2	....	....	1.3	.13	29
30	4.6	7.7	—0.5	8.2	30.00	30.04	29.96	.08	79	N.W.	17.5	01	....	1.0	.09	30
31	10.0	17.2	0.5	16.7	29.86	29.98	29.78	.20	83	S.W.	18.5	....	....	1.0	.05	31
Means......	14.03	21.93	6.5	15.4	29.946	30.10	29.75	.35	83.5	N. 85° W	18.5	20	.61	38.7	4.32	.......Sums.........
29 Years means for and including this month......	18.93	26.0	11.8	14.1	30.028	......	......	.30	83.3	......	§ 16.1	¶ 26	1.35	24.0	3.69	29 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	758	1679	497	344	1262	1141	6712	1336	
Duration in hrs..	62	106	44	26	84	46	312	64	
Mean velocity....	12.2	15.8	11.3	13.2	15.0	24.8	21.1	20.9	

Greatest mileage in one hour was 47 on the 13th.
Greatest velocity in gusts was 72 on the 13th.
Resultant mileage, 6,561

Resultant direction, N. 85° W.
Total mileage, 13,729.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 22 years only. § 17 years only.

The greatest heat was 36.9 above zero on the 13th. The greatest cold was 16.3 below zero on the 27th, giving a range of temperature of 53.2 degrees.

Warmest day was the 24th. Coldest day was the 28th.

Highest barometer reading was 30.60 on the 19th; lowest barometer was 29.11 on the 21st, giving a range of 1.49 inches.

Minimum relative humidity observed, was 53 on the 13th and 28th.

Rain fell on 4 days.

Snow fell on 24 days.

Rain and snow on 4 days.

Lunar halos observed on 1 night.

No. of inches of snow on ground, 15.5.

Meteorological Abstract for the Year 1903.

Observations made at McGill College Observatory, Montreal, Canada.—Height above sea level 187 ft. Latitude N. 45° 30′ 17″. Longitude 4^h 54^m $18^s{\cdot}67^s$ W.

C. H. McLEOD, *Superintendent.*

Month.	Thermometer. † Mean.	Thermometer. ¶ Deviation from 29 years, means.	Thermometer. Max.	Thermometer. Min.	Thermometer. Mean daily range.	* Barometer. † Mean.	* Barometer. Max.	* Barometer. Min.	* Barometer. Mean daily range.	‡ Mean relative humidity.	Wind. Resultant direction.	Wind. Mean velocity in miles per hour.	Per cent. possible sunshine.	Precipitation. Inches of rain.	Precipitation. Number of days on which rain (or sleet) fell.	Precipitation. Inches of snow.	Precipitation. Number of days on which snow fell.	Precipitation. Inches of rain and melted snow.	Precipitation. No. of days on which rain *and* snow fell.	Precipitation. No. of days on which rain or snow fell.	Month.
January	14.61	+ 2.17	38.6	−20.0	16.2	29.898	30.59	29.11	.35	81.3	N. 77° W.	10.3	27.3	0.64	6	33.5	20	4.08	2	24	January
February	18.86	+ 3.13	46.5	−11.8	13.7	29.962	30.41	28.97	.39	81.2	S. 37° W.	18.4	32.7	2.16	4	26.2	12	5.28	1	15	February
March	34.15	+ 9.15	62.0	− 0.6	13.6	30.188	30.71	29.38	.28	80.7	S. 64° W.	16.7	34.0	3.19	13	3.1	7	3.49	1	19	March
April	44.06	+ 3.22	82.2	12.8	18.2	29.895	30.48	29.34	.21	63.8	N. 51° W.	15.8	43.0	1.61	6	4.3	3	2.22	1	8	April
May	57.79	+ 3.02	84.8	27.9	24.2	30.097	30.52	29.58	.20	59.7	S. 46° W.	14.4	63.5	0.11	9	....	..	0.11	..	9	May
June	62.90	− 1.83	84.2	46.5	16.8	29.931	30.38	29.58	.12	70.5	S. 1° E.	11.8	38.0	4.76	17	....	..	4.76	..	17	June
July	67.72	− 1.08	88.0	54.0	14.9	29.847	30.16	29.46	.14	73.1	N. 84° W.	12.6	56.0	2.87	17	...	..	2.87	..	17	July
August	62.00	− 4.55	80.2	48.3	14.9	29.969	30.43	29.45	.11	74.3	N. 87° W.	10.3	47.1	3.17	13	....	..	3.17	..	13	August
September	59.99	+ 1.36	83.0	39.6	15.3	30.062	30.43	29.48	.20	72.3	S. 32° E.	13.1	64.0	1.27	11	....	..	1.27	.	11	September
October	48.58	+ 2.59	66.8	25.2	14.7	29.995	30.41	29.42	.23	74.6	S. 8° W.	16.4	38.4	3.56	17	1.5	4	3.71	3	18	October
November	32.09	− 0.56	56.6	4.3	11.3	29.999	30.76	29.42	.25	82.9	S. 62° W.	17.6	36.6	0.93	8	5.4	19	1.46	5	22	November
December	14.03	− 4.90	36.9	−16.3	15.4	29.946	30.60	29.11	.35	83.5	N. 85° W.	18.5	19.8	0.61	4	38.7	24	4.32	4	24	December
Sums for 1903	516.78	....	....	....	....	....	....	....	....	....	....	....	....	24.88	125	112.7	89	36.74	17	197	Sums for 1903
Means for 1903	43.07	+ 0.98	....	....	15.9	29.982	....	....	.24	74.8	S. 62° W.	14.7	41.7	....	....	....	..	3.06	..	..	Means for 1903
Means for 29 years ending Dec. 31, 1903	42.09	....	....	....	....	29.979	....	....	....	75.5	....	a14.8	§45.3	28.93	....	120.3	..	40.96	..	..	Means for 29 years ending Dec. 31, 1903

* Barometer readings reduced to 32° Fah. and to sea level. † The monthly thermometer and barometer means are derived from bi-hourly readings taken from self-recording instruments, beginning 1 h. 0 m. Eastern Standard time. ¶ "+" indicates that the temperature has been *higher*: "—" that it has been *lower* than the average for 29 years inclusive of 1903. ‡ Humidity relative, saturation being 100; the humidity means are derived from observations made at 8 *h*, 15 *h* and 20 *h*. § For 22 years only. *a* For 17 years only. The anemometer and wind vane are on the summit of Mount Royal, 34 feet above the ground and 807 feet above sea level. *h* For 340½ days only.

The greatest heat was 88.6° (Fah.) above zero on July 9th; the greatest cold was 20.0 below zero on Jan. 19th. The extreme range of temperature was, therefore, 108.6°. Greatest thermometer range in one day was 41.7° on May 1; least range was 3.9° on March 5th. The warmest day was July 10th, when the mean temperature was 79.7° above zero. The coldest day was Jan. 19th, when the mean temperature was 10.2° below zero. The minimum relative humidity observed was 20 on June 4th. The greatest mileage of wind recorded in one hour was 55 on Feb. 28th, and the greatest velocity in gusts was at the rate of 72 miles per hour on Feb. 28, April 30, May 1 and Dec. 13. The total mileage of wind was 119,935 *h*. The resultant direction of the wind for the year was S. 62° W., and the resultant mileage 38268. Lunar halos were observed on 5 nights. Auroras were observed on 6 nights.

Fog on 9 days; thunderstorms on 12 days; total number of thunderstorms 14. First sleighing of winter in city was on Dec. 6th. The first appreciable snowfall of the autumn was on Oct. 26th. The first trace of snow was on Oct. 18th.

NOTE.—The yearly means of the above are the averages of the monthly means, except for the velocity of the wind.

ABSTRACT FOR THE MONTH OF JANUARY, 1904.

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

DAY	THERMOMETER. † Mean.	THERMOMETER. Max.	THERMOMETER. Min.	THERMOMETER. Range.	* BAROMETER. † Mean.	* BAROMETER. Max.	* BAROMETER. Min.	* BAROMETER. Range.	‡ Mean relative humidity.	WIND. General direction.	WIND. Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	6.3	22.0	—11.0	33.0	29.93	30.23	29.70	.53	82	N.W.	20.1	....	....	0.2	.05	1
2	—11.7	—6.3	—15.0	8.7	30.21	30.28	30.10	.18	56	N.E.	9.0	....	....	0.3	.03	2
SUNDAY........ 3	—9.5	—7.2	—11.8	4.6	30.11	30.17	30.05	.12	64	W.	20.2	63	....	0.0	.00	3..........SUNDAY
4	—14.6	—8.4	—20.7	12.3	30.41	30.54	30.11	.43	39	S.W.	32.0	63	....	....	....	4
5	—5.7	1.1	—14.7	15.8	30.51	30.59	30.38	.21	67	S.W.	24.1	44	....	....	....	5
6	9.6	17.9	—1.0	18.9	30.12	30.38	29.97	.41	88	S.W.	17.5	....	....	0.5	.03	6
7	18.9	23.0	12.2	10.8	29.94	29.97	29.89	.08	94	S.W.	8.0	....	....	0.1	.01	7
8	22.7	28.6	12.2	16.4	29.69	29.89	29.60	.29	92	S.E.	16.9	....	....	0.5	.03	8
9	23.3	28.0	19.0	9.0	29.61	29.65	29.56	.09	89	N.E.	16.5	....	....	2.4	.19	9
SUNDAY....... 10	21.7	27.0	16.0	11.0	29.75	29.89	29.63	.26	86	N.W.	20.6	01	....	0.8	.09	10..........SUNDAY
11	14.6	17.4	6.1	11.3	30.07	30.16	29.89	.27	91	W.	6.0	09	....	0.0	.00	11
12	10.7	21.0	3.6	17.4	30.21	30.26	30.16	.10	89	S.E.	9.3	17	....	....	....	12
13	27.2	30.4	15.8	14.6	29.95	30.16	29.61	.55	96	S.E.	16.8	....	....	5.9	.57	13
14	27.6	30.0	20.4	9.6	29.30	29.61	29.21	.40	93	W.	23.4	....	....	9.3	.93	14
15	7.2	23.8	2.3	21.5	29.89	30.12	29.51	.61	81	W.	29.7	51	......	....	....	15
16	7.5	15.5	—1.2	16.7	29.82	30.13	29.51	.62	88	N.W.	8.3	....	....	3.2	.27	16
SUNDAY.......17	8.8	12.7	—1.0	13.7	30.01	30.35	29.52	.83	68	N.W.	20.0	22	....	0.7	.06	17..........SUNDAY
18	—7.9	2.0	—13.9	15.9	30.65	30.86	30.35	.51	53	N.W.	11.7	64	....	....	....	18
19	—10.8	—5.0	—16.8	11.8	30.84	30.95	30.55	.41	62	N..E	8.8	03	....	....	....	19
20	6.7	14.8	—11.4	26.2	30.22	30.55	30.15	.40	90	N.W.	9.6	....	....	0.4	.05	20
21	5.5	14.4	—0.8	15.2	30.28	30.35	30.16	.19	72	N.E.	15.0	....	....	....	....	21
22	8.2	18.9	—2.0	20.9	29.90	30.29	29.56	.73	85	N.E.	17.9	....	....	3.7	.47	22
23	28.0	34.5	10.2	24.3	29.78	29.91	29.55	.36	87	S.W.	17.6	01	....	0.0	.00	23
SUNDAY.......24	19.2	29.0	5.6	23.4	29.88	29.96	29.84	.12	76	S.W.	26.1	54	....	1.0	.03	24..........SUNDAY
25	3.3	9.8	—1.0	10.8	30.26	30.41	29.96	.45	74	W.	25.5	88	....	....	....	25
26	—0.3	7.0	—6.5	13.5	30.27	30.47	29.92	.55	73	N.E.	15.8	....	....	4.6	.46	26
27	3.4	7.8	—2.2	10.0	30.11	30.43	29.82	.61	82	W.	24.5	51	....	1.5	.15	27
28	0.6	7.0	—7.7	14.7	30.48	30.55	30.43	.12	68	S.W.	13.4	28	....	....	....	28
29	0.4	7.0	—6.2	13.2	30.32	30.45	30.18	.27	72	N.E.	5.6	....	....	....	....	29
30	6.6	15.0	—2.3	17.3	30.09	30.18	29.98	.20	82	S.W.	9.6	....	....	0.2	.01	30
SUNDAY.......31	25.7	28.9	6.4	22.5	29.80	29.98	29.59	.39	91	N.W.	16.5	....	....	3.0	.22	31..........SUNDAY
Means............	8.17	15.08	—0.56	15.64	30.077	30.25	29.89	.36	78.4	West	16.66	27.8	....	38.3	3.65	.......Sums........
30 Years means for and including this month......	12.29	20,58	4.34	16.24	30.047	......	......	.34	82.3	......	§ 16.27	¶ 33.7	....	30.3	3.71	30 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	495	2030	303	859	614	2722	3677	1692	
Duration in hrs..	39	146	30	63	50	131	180	105	
Mean velocity....	12.7	13.9	10.1	13.7	12.3	20.8	20.4	16.1	

Greatest mileage in one hour was 41 on the 15th.
Greatest velocity in gusts was 60 on the 15th.
Resultant mileage, 4,452.

Resultant direction, West.
Total mileage, 12,392.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

The greatest heat was 34.5 above zero on the 23rd. The greatest cold was 20.7 below zero on the 4th, giving a range of temperature of 55.2 degrees.

Warmest day was the 23rd. Coldest day was the 4th.

Highest barometer reading was 30.96 on the 19th: lowest barometer was 29.21 on the 14th, giving a range of 1.75 inches.

Minimum relative humidity observed, was 30 on the 4th.

Snow fell on 21 days.

No. of inches of snow on ground at end of month, 23.5.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1904.

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

DAY	THERMOMETER. † Mean.	THERMOMETER. Max.	THERMOMETER. Min.	THERMOMETER. Range.	* BAROMETER. † Mean.	* BAROMETER. Max.	* BAROMETER. Min.	* BAROMETER. Range.	‡Mean relative humidity.	WIND. General direction.	WIND. Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	12.8	29.0	—9.2	38.2	29.60	29.88	29.46	.42	83	N.W.	18.1	....	....	.8	.08	1
2	—12.5	0.7	—18.7	19.4	30.00	30.16	29.–5	.40	50	N.E.	16.9	....	....	.3	.03	2
3	—4.0	2.6	—11.7	14.3	30.00	30.13	2–.73	.40	63	S.W.	20.4	61	....	.6	.06	3
4	3.2	6.0	—2.8	8.8	30.07	30.16	29.96	.20	65	S.W.	23.0	52	....	.3	.03	4
5	—1.4	6.0	—6.4	12.4	30.16	30.24	29.96	.28	61	N.W.	16.8	78	...	.0	.00	5
6	—1.0	7.0	—8.7	15.7	29.91	30.18	29.78	.40	76	N.E.	16.3	....	....	2.9	.29	6
SUNDAY........ 7	8.7	10.2	4.2	6.0	29.55	29.79	29.31	.48	91	N.E.	16.1	....	....	2.9	.65	7..........SUNDAY
8	—1.9	13.3	—9.4	22.7	30.06	30.40	29.48	.92	66	N.W.	28.0	76	....	1.5	.09	8
9	—10.1	—4.0	—18.7	14.7	30.47	30.51	30.40	.11	51	N.W.	23.5	76	....	....	....	9
10	—3.1	2.5	—12.1	14.6	30 52	30.58	30.48	.10	56	W.	31.2	70	....	....	....	10
11	2.6	5.5	—3.3	8.8	30.49	30.52	30.46	.06	71	S.W.	10.6	....	....	....	....	11
12	6.4	10.0	1.4	8.6	30.45	30.49	30.43	.06	79	S.E.	4.6	....	....	.0	.00	12
13	8.5	14.4	2.1	12.3	30.48	30.55	30.39	.16	80	N.E.	6.5	32	....	....	....	13
SUNDAY....... 14	12.7	24.0	0.3	23.7	30.06	30.39	29.73	.66	89	S.E.	15.0	....	....	3.0	.20	14..........SUNDAY
15	15.7	25.7	5.7	20.0	29.71	29.73	29.67	.06	80	S.W.	28.0	19	......	1.8	.11	15
16	—0.5	9.0	—2.9	11.9	29.81	29.97	29.73	.24	77	W.	39.1	14	....	.3	.03	16
17	—1.5	1.7	—6.7	8.4	30.19	30.37	29.97	.40	63	W.	33.6	83	....	.0	.00	17
18	2.5	7.0	—5.7	12.7	30.48	30.55	30.37	.18	70	S.W.	9.5	74	....	....	....	18
19	10.8	17.3	3.5	13.8	30.32	30.42	30.25	.17	83	N.W.	8.3	11	....	.3	.03	19
20	13.2	17.9	7.4	10.5	30.53	30.61	30.38	.23	80	N.W.	21.5	87	....	....	....	20
SUNDAY........21	20.3	34.6	4.3	30.3	30.31	30.61	29.85	76	90	S.W.	17.5	33	.04	.0	.04	21..........SUNDAY
22	32.5	38.0	24.0	14.0	29.55	29.85	29.41	.44	84	S.W.	30.8	....	.22	.0	.22	22
23	20.6	28.0	12.9	15.1	29.69	29.76	29.57	.19	89	S.W.	18.8	....	....	2 1	.21	23
24	10.9	19 6	2.4	17.2	29.72	29.80	29.66	.14	78	N.W.	17.4	....	....	.9	.07	24
25	9.6	15.8	2.7	13.1	29.88	30.23	29.64	.59	78	S.W.	24.9	15	....	.8	.08	25
26	5.8	10.2	0.5	9.7	30.36	30.41	30.23	.18	82	S.W.	11.0	87	....	....	....	26
27	5.5	14.3	—7.4	21.7	30.48	30 54	30.38	.16	83	N.E.	10.7	81	....	....	....	27
SUNDAY........28	26.8	31.8	8.6	23.2	30.05	30.38	29.92	.46	90	S.W.	19.7	....	.09	2.0	.29	28..........SUNDAY
29	16.5	32.0	10.0	22.0	30.39	30.51	30.15	.36	79	N.E.	20.3	21	....	....	....	29
Means.............	7.23	14.83	—1.16	15.99	30.114	30.27	29.95	.32	75.4	S 83° W.	19.26	24.8	.35	21.5	2.51	.......Sums.........
30 Years means for and including this month......	15.45	23.51	7.46	15.79	30.012	......	......	.31	80.6	......	§ 18.29	¶ 40.5	.80	23.5	3.14	30 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	693	1539	315	570	198	4176	4571	2342	
Duration in hrs..	52	85	36	50	16	200	188	68	1
Mean velocity....	13.3	18.1	8.8	11.4	12.4	20.9	24.3	19.7	

Greatest mileage in one hour was 56 on the 16th.
Greatest velocity in gusts was 72 on the 16th.
Resultant mileage, 6,718.

Resultant direction, S. 83° W.
Total mileage, 13,404.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶23 years only. §17 years only.

The greatest heat was 38.0 above zero on the 22nd. The greatest cold was 18.7 below zero on the 2nd and 9th, giving a range of temperature of 56.7°.

Warmest day was the 22nd. Coldest day was the 2nd.

Highest barometer reading was 30.61 on the 20th and 21st; lowest barometer was 29.31 on the 7th, giving a range of 1.30 inches.

Minimum relative humidity observed, was 33 on the 2nd.

Rain fell on 3 days. Snow fell on 20 days. Rain and snow on 3 days.

No. of inches of snow on ground at end of month, 31.5.

ABSTRACT FOR THE MONTH OF MARCH, 1904.

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

DAY	THERMOMETER.				* BAROMETER.				‡ Mean relative humidity.	WIND.		Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour.					
1	24.1	30.9	14.3	16.6	30.13	30.27	30.03	.24	93	S.W.	23.0	....	....	9.0	.86	1
2	32.3	38.8	25.0	13.8	30.10	30.17	29.91	.26	87	S.W.	16.8	10	....	.4	.04	2
3	29.5	39.1	5.0	34.1	29.50	29.91	29.14	.77	94	S.W.	32.3	....	.09	.1	.10	3
4	4.1	13.0	—2.9	15.9	30.38	30.73	29.77	.96	81	S.W.	22.0	87	....	....	....	4
5	8.4	18.9	—5.4	24.3	30.81	30.94	30.66	.28	86	N.E.	9.2	16	...	....	....	5
SUNDAY........ 6	26.3	32.4	12.8	19.6	30.51	30.66	30.35	.31	83	W.	15.5	18	....	.0	.00	6..........SUNDAY
7	35.3	38.5	30.0	8.5	29.94	30.35	29.53	.82	94	S.E.	16.2	....	1.16	2.0	1.36	7
8	35.5	39.1	32.9	6.2	29.52	29.56	29.48	.08	91	W.	26.8	....	.09	.2	.11	8
9	18.8	34.3	6.1	28.2	29.75	30.05	29.51	.54	77	S.W.	29.8	41	....	.0	.00	9
10	6.8	11.8	—0.4	12.2	30.15	30.24	30.05	.19	73	S.W.	19.5	77	....	.0	.00	10
11	11.2	15.6	5.4	10.2	29.96	30.08	29.85	.23	85	N.E.	10.4	33	....	....	....	11
12	11.0	15.0	3.5	11.5	29.83	29.90	29.77	.13	88	W.	20.2	57	....	.1	.01	12
SUNDAY....... 13	17.7	24.3	10.5	13.8	29.90	30.02	29.77	.25	83	N.W.	17.9	28	....	.2	.03	13..........SUNDAY
14	23.1	29.4	13.7	15.7	30.00	30.05	29.94	.11	87	N.W.	9.0	71	......	....	....	14
15	24.7	29.9	12.6	17.3	29.86	29.94	29.81	.13	85	N.E.	13.3	....	....	.4	.04	15
16	19.5	28.7	12.8	15.9	30.11	30.33	29.86	.47	85	N.W.	20.2	68	....	....	....	16
17	18.5	24.9	12.8	12.1	30.36	30.46	30.21	.25	69	N.W.	12.5	77	....	....	....	17
18	19.6	24.5	13.0	11.5	29.89	30.21	29.71	.50	93	N.W.	10.2	....	....	2.2	.27	18
19	30.5	36.2	23.0	13.2	29.78	29.86	29.55	.31	79	S.W.	18.3	42	....	1.3	.13	19
SUNDAY........20	33.1	36.2	24.1	12.1	29.83	30.28	29.51	.77	71	N.W.	28.3	25	....	....	....	20..........SUNDAY
21	22.2	30.0	16.0	14.0	30.46	30.54	30.28	.26	[illegible]	N.E.	10.7	79	....	....	....	21
22	32.8	36.7	21.1	15.6	29.97	30.41	29.74	.67	87	S.E.	19.5	....	.36	....	.36	22
23	36.8	39.8	33.7	6.1	30.04	30.28	29.74	.54	74	S.W.	26.2	83	.01	....	.01	23
24	34.4	40.5	28.1	12.4	30.47	30.59	30.28	.31	69	S.W.	15.4	83	....	....	....	24
25	39.8	42.9	34.6	8.3	29.99	30.36	29.70	.66	84	S.W.	22.6	14	.09	....	.09	25
26	37.2	44.2	25.3	18.9	29.64	29.99	29.44	.55	81	N.W.	24.7	....	.60	0.0	.60	26
SUNDAY........27	17.6	32.6	12.0	20.6	30.12	30.18	29.99	.19	80	N.E.	10.7	62	....	....	....	27..........SUNDAY
28	22.2	28.2	14.5	13.7	30.17	30.21	30.14	.07	84	S.W.	6.3	55	....	....	....	28
29	25.8	31.5	19.0	12.5	30.23	30.27	30.17	.10	82	S.W.	14.2	87	....	....	....	29
30	34.5	42.1	26.7	15.4	30.26	30.30	30.22	.08	73	S.	10.7	....	....	....	....	30
31	34.8	40.1	30.7	9.4	30.29	30.34	30.25	.09	82	N.E.	11.0	57	....	....	....	31
Means............	24.78	31.3	16.5	14.8	30.062	30.24	29.88	.36	82.9	S 69° W.	17.5	38.8	2.40	15.9	4.01	.......Sums.........
30 Years means for and including this month......	24.99	32.1	17.6	14.5	29.981	......	......	.28	77.5	......	§ 17.6	¶ 45.1	1.42	22.9	3.88	30 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	571	846	435	453	1619	4228	2696	2188	
Duration in hrs..	59	67	44	26	97	196	142	112	1
Mean velocity....	9.7	12.6	9.9	17.4	16.7	21.6	19.0	19.5	

Greatest mileage in one hour was 50 on the 3rd.
Greatest velocity in gusts was 72 on the 3rd.
Resultant mileage, 6,281.

Resultant direction, S. 69° W.
Total mileage, 13,036.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 17 years only.

The greatest heat was 44.2 above zero on the 26th. The greatest cold was 5.4 below zero on the 5th, giving a range of temperature of 49.6°

Warmest day was the 25th. Coldest day was the 4th.

Highest barometer reading was 30.94 on the 5th: lowest barometer was 29.14 on the 3rd, giving a range of 1.80 inches.

Minimum relative humidity observed, was 54 on the 10th.

Rain fell on 7 days. Snow fell on 14 days. Rain and snow on 4 days.

No. of inches of snow on ground at end of month, 9 inches.

The average temperature for the four months ending March 31st, was 13°.5, which is the coldest since the winter of 1884-85, and 10°.5 below normal.

ABSTRACT FOR THE MONTH OF APRIL, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	36.0	40.0	30.2	9.8	29.86	30.23	29.57	.66	85	S.E.	22.3	....	.88	....	.88	1
2	37.2	40.1	33.0	6.2	29.58	29.68	29.50	.18	88	S.W.	27.0	07	.00	....	.00	2
SUNDAY........ 3	28.6	32.8	23.6	9.2	30.07	30.29	29.68	.61	87	N.	19.3	82	....	.6	.04	3............SUNDAY
4	34.4	42.0	25.9	16.1	30.21	30.33	30.22	.21	61	S.W.	29.6	83	...	....	....	4
5	39.3	46.0	31.1	14.9	30.16	30.20	30.12	.08	64	W.	30.0	84	....	....	....	5
6	40.8	50.9	32.2	18.7	30.08	30.14	30.00	.14	65	S.W.	12.5	55	....	....	....	6
7	37.2	41.2	32.2	9.0	29.98	30.08	29.94	.14	86	N.W.	9.6	09	.06	....	.06	7
8	40.1	49 7	32.2	17.5	30.15	30.23	30.07	.16	83	N.E.	11.0	83	....	....	....	8
9	39.6	45.2	35.9	9.3	29.79	30.07	29.50	.57	92	N.E.	12.2	43	.55	....	.55	9
SUNDAY....... 10	43.3	51.4	36.5	14 9	29.50	29.59	29.43	.16	72	S.W.	23.0	....	.03	....	.03	10 ....SUNDAY
11	41.2	47.2	37.2	10.0	29.66	29.77	29.59	.18	69	S.W.	20.5	18	....	....	....	11
12	37.9	45.5	31.4	14.1	29.62	29.77	29.50	.27	85	S.W.	16.5	12	.18	....	.18	12
13	26 7	37.0	22.0	15.0	29.85	29.92	29.61	.31	87	W.	20.4	03	....	.6	.06	13
14	30.8	36.8	24.0	12.8	29 89	29.96	29.86	.10	81	W.	14.7	76	....	.0	.00	14
15	28.2	31.2	25.3	5.9	30.04	30.11	29.96	.15	87	N.W.	8.0	03	....	....	....	15
16	30.4	35.4	24.0	11.4	29.91	29.99	29.88	.11	69	N.W.	17 0	71	....	....	....	16
SUNDAY........17	36.5	45.4	27.0	18.4	29.98	30.02	29.92	.10	58	S.W.	26.6	85	....	....	....	17.......... SUNDAY
18	41.2	51.2	32.0	19.2	29.91	29.97	29.85	.12	55	W.	14.5	15	....	....	....	18
19	35.6	45.5	25.5	20.0	29.77	29.85	29.70	.15	77	S.W.	16.3	22	....	1.0	.06	19
20	29.6	35.9	19.5	16.4	29.84	30.03	29.73	.30	96	N.E.	20.2	87	....	4.3	.51	20
21	38.1	46.4	29.5	16.9	30.21	30.32	30.03	.29	59	N.W.	10.3	83	....	....	....	21
22	41.9	50.6	34.0	16.6	30.45	30.50	30.32	.18	69	S.W.	4.3	34	....	....	....	22
23	47.0	61.0	32.2	28.8	30.33	30.44	30.18	.26	50	S.	....	35	....	....	....	23
SUNDAY........24	52.1	61.8	41.8	20.0	29.99	30.18	29.70	.48	79	S.	....	....	.09	....	.09	24............SUNDAY
25	45.3	56.6	42.3	14.3	29.65	29.73	29.59	.14	84	S.W.	22.9	....	.31	....	.31	25
26	44.8	50.3	39.2	11.1	29.94	30.09	29.73	.36	75	N.E.	10.3	....	.02	....	.02	26
27	50.4	60.0	39.6	20.4	30.16	30.25	30.09	.16	53	N.E.	17.8	52	....	....	....	27
28	47.2	54.7	41.4	13.3	30.17	30.24	30.03	.21	85	N.E.	18.7	....	.60	....	.60	28
29	47.7	53.4	44.0	9.4	29.85	30.03	29.74	.29	80	N.E.	13.4	....	.35	....	.35	29
30	49.4	53.7	45.0	8.7	29.73	29.81	29.70	.11	98	N.W.	8.6	....	.07	....	.07	30
Means......	39.27	46.6	32.3	14.3	29.943	30.06	29.82	.24	76.0	West.	17.05	35.7	3.14	6.5	3.81	.......Sums ....
30 Years means for and including this month......	40.79	49.18	33.01	16.17	29.960	......	......	.20	67.0	......	§ 16.29	¶ 49.4	1.78	5.1	2.31	30 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	967	1893	511	375	300	3333	3237	843	
Duration in hrs..	78	122	45	24	21	148	166	65	3
Mean velocity....	12.4	15.5	11 4	15.6	14.3	22.5	19 5	13.0	

Greatest mileage in one hour was 45 on the 5th.
Greatest velocity in gusts was 72 on the 5th.
Resultant mileage, 4,075.

Resultant direction, West.
Total mileage, 11,459. ‖

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 17 years only.

‖ For 28 days only.

The greatest heat was 61.8 above zero on the 24th. The greatest cold was 19.5 above zero on the 20th, giving a range of temperature of 42.3°.

Warmest day was the 24th. Coldest day was the 13th.

Highest barometer reading was 30.50 on the 22nd: lowest barometer was 29.43 on the 10th, giving a range of 1.07 inches.

Minimum relative humidity observed, was 35 on the 23rd.

Rain fell on 12 days. Snow fell on 5 days. Rain or snow on 17 days.

No snow on ground at end of month.

ABSTRACT FOR THE MONTH OF MAY, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY........ 1	51.2	60.3	41.7	18.6	30.01	30.14	29.84	.30	50	N.E.	14.5	82	....	....	....	1..........SUNDAY
2	57.8	66.6	46.1	20.5	30.24	30.27	30.14	.13	43	N.E.	10.8	88	...	...	....	2
3	65.9	75.3	53.0	22.3	30.26	30.30	30.22	.08	46	S.W.	17.3	82	....	....	....	3
4	66.1	75.3	57.0	18.3	30.16	30.26	30.02	.24	52	S.W.	26.8	87	....	....	....	4
5	59.8	68.4	53.0	15.4	30.05	30.14	30.00	.14	55	S.W.	19.7	52	....	....	....	5
6	55.5	65.2	42.2	23.0	30.18	30.26	30.11	.15	40	N.E	9.8	94	....	....	....	6
7	65.7	78.9	48.9	30.0	29.96	30.11	29.81	.30	52	S.W.	9.5	67	....	....	....	7
SUNDAY....... 8	66.3	75.0	57.5	17.5	29.84	29.92	29.75	.17	63	S.W.	12.8	43	....	....	....	8..........SUNDAY
9	66.6	78.5	56.0	22.5	29.69	29.75	29.63	.12	61	S.E.	17.4	70	....	...	....	9
10	59.3	69.0	51.2	17.8	29.87	29.95	29.70	.25	52	S.W.	22.3	80	....	....	....	10
11	57.1	66.0	45.8	20.2	30.04	30.13	29.95	.18	60	S.W.	17.4	90	.. .	...	....	11
12	52.1	61.0	39.8	21.2	30.13	30.19	30.08	.11	58	S.W.	12.3	81	....	....	....	12
13	61.6	72.5	48.5	24.0	30.06	30.13	29.94	.19	54	N.E.	6.5	80	....	....	....	13
14	66.1	76.2	56.6	19.6	29.87	29.95	29.79	.16	53	S.E.	21.0	76	....	....	....	14
SUNDAY........15	58.4	65.8	48.8	17.0	29.77	29.83	29.72	.11	83	S.E.	13.5	69	.38	....	.38	15..... .....SUNDAY
16	50.9	57.7	46.8	10.9	29.72	29.77	29.70	.07	93	W.	16.8	....	.49	....	.49	16
17	53.7	63.5	44.1	19.4	29.89	29.99	29.77	.22	73	S.W.	16.8	....	.11	....	.11	17
18	61.9	73.6	48.0	25.6	29.97	30.01	29.90	.11	74	N.E.	12.5	73	.04	....	.04	18
19	49.9	64.8	46.8	18.0	29.82	29.92	29.73	.19	100	N.E.	15.6	....	1.05	....	1.05	19
20	49.9	53.4	45.5	7.9	29.67	29.74	29.64	.10	96	N.E.	5.6	....	.15	....	.15	20
21	61.5	73.9	46.9	27.0	29.78	29.81	29.74	.07	79	W.	18.5	91	....	....	....	21
SUNDAY........22	66.4	77.2	56.6	20.6	29.80	29.83	29.76	.07	62	S.W.	20.8	54	....	....	....	22..........SUNDAY
23	63.3	74.9	57.5	17.4	29.76	29.84	29.71	.13	86	S.W.	16.0	....	.20	....	.20	23
24	65.6	71.5	58.7	12.8	29.91	30.04	29.74	.30	55	S.W.	17.9	77	...	....	....	24
25	57.8	65.5	52.6	12.9	29.99	30.07	29.87	.20	90	N.E.	10.9	03	2.08	...	2.08	25
26	59.8	69.0	52.6	16.4	29.77	29.89	29.56	.33	98	S.W.	7.4	....	.22	....	.22	26
27	59.4	65.0	52.2	12.8	29.62	29.85	29.42	.43	78	S.W.	22.7	28	.08	....	.08	27
28	57.4	67.3	45.6	21.7	29.92	30.00	29.85	.15	62	S.W.	19.4	95	....	....	....	28
SUNDAY........29	64.6	75.0	53.0	22.0	29.93	30.03	29.80	.23	58	S.W.	21.0	93	.00	....	.00	29 .. ..SUNDAY
30	64.1	71.7	54.3	17.4	29.80	29.97	29.75	.22	67	S.W.	19.9	19	....	....	....	30
31	55.7	62.8	46.7	16.1	30.17	30.25	29.97	.28	69	F.E.	10.8	69	....	....	....	31
Means......	59.72	69.0	50.1	18.9	29.925	30.01	29.83	.18	66.5	......	15.62	56	4.80	....	4.80	......Sums........
30 Years means for and including this month......	54.93	64.3	46.0	18.4	29.935	......	......	.17	66.2	......	§ 14.35	¶ 51.5	2.90	....	2.91	30 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	274	1596	290	1046	491	4480	2796	650	
Duration in hrs..	24	133	29	80	41	240	155	40	2
Mean velocity....	11.4	12.0	10.0	13.1	12.0	18.7	18.0	16.3	

Greatest mileage in one hour was 40 on the 10th.
Greatest velocity in gusts was 60 on the 10th.
Resultant mileage, 4,962.

Resultant direction, S.59°W.
Total mileage, 11,623.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 17 years only.

The greatest heat was 78.9 above zero on the 7th. The greatest cold was 39.8 above zero on the 12th, giving a range of temperature of 39.1°.

Warmest day was the 9th. Coldest day was the 20th.

Highest barometer reading was 30.30 on the 3rd; lowest barometer was 29.42 on the 27th, giving a range of .88 inches.

Minimum relative humidity observed, was 30 on the 6th.

Rain fell on 11 days.

Thunder on the 15th and 25th.

ABSTRACT FOR THE MONTH OF JUNE, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	54.9	57.8	51.5	6.3	30.21	30.25	30.17	.08	97	N.E	11.0	....	.57	....	.57	1
2	63.4	66.5	50.4	16.1	30.09	30.17	29.98	.19	90	N.E.	6.7	17	.03	....	.03	2
3	60.8	64.3	57.0	7.3	29.97	30.05	29.94	.11	97	N.E.	9.0	04	.41	....	.41	3
4	59.5	66.0	51.1	14.9	30.15	30.21	30.05	.16	74	N.E.	12.6	52	.00	....	.00	4
SUNDAY........ 5	54.4	58.8	51.5	7.3	29.88	30.07	29.83	.24	95	N.E.	12.8	....	.28	....	.28	5..........SUNDAY
6	55.4	60.3	51.0	9.3	29.81	29.84	29.80	.04	97	N.E.	9.7	....	.04	....	.04	6
7	63.7	74.8	53.1	21.7	29.82	29.89	29.80	.09	90	S.W.	7.1	47	.62	....	.62	7
8	63.1	73.2	53.6	19.6	29.97	30.02	29.89	.13	82	N.E.	10.7	44	....	....	....	8
9	64.1	73.0	53.8	19.2	30.19	30.28	30.02	.26	85	N.E.	7.4	46	....	....	....	9
10	64.7	74.7	58.0	16.7	30.22	30.30	30.08	.22	81	S.W.	10 4	80	....	....	....	10
11	66.5	74.1	58.6	15.5	30.09	30.15	30.05	.10	70	N.E.	11.3	94	....	....	....	11
SUNDAY....... 12	60.2	67.4	51.0	16.4	30.17	30.20	30.10	.10	75	N.E.	6.0	93	....	....	....	12..........SUNDAY
13	59.9	70.8	46 6	24.2	30.20	30.25	30.13	.12	74	N.E.	5.2	94	....	....	....	13
14	65.0	74.3	54.0	20.3	30.06	30.13	29.94	.19	85	E.	8.2	88	....	....	....	14
15	65.9	74.6	59.4	15.2	29.91	29.95	29.85	.10	88	N.W.	10.5	28	.18	....	.18	15
16	62.7	69.7	56.7	13.0	30.02	30.10	29.88	.22	81	N.W.	6.9	95	....	....	....	16
17	64.3	73.5	51.0	22.5	30.06	30.14	29.95	.19	78	W.	5.9	87	....	....	....	17
18	66.0	75.5	58.8	16.7	29.93	30.03	29.90	.13	75	N.W.	13.4	83	....	....	....	18
SUNDAY........19	63.0	72.5	50.5	22.0	30.06	30.12	30.00	.12	77	N.W.	6.3	91	....	....	....	19..........SUNDAY
20	71.7	82.0	61.5	20.5	29.85	30.00	29.68	.32	79	W.	8.3	93	....	....	....	20
21	73.0	81.9	66.1	15.8	29.56	29.68	29.48	.20	89	W.	8.6	01	.00	....	.00	21
22	63.9	69.4	56.6	12.8	29.74	29.98	29.50	.48	88	N.	11.5	56	.30	....	.30	22
23	65.2	74.4	53.1	21.3	30.16	30.22	29.98	.24	84	W.	9.6	96	....	....	....	23
24	70.5	81.0	55.5	25.5	30.09	30.19	29.98	.21	83	W.	12.6	85	....	....	....	24
25	74.8	83.0	67.5	15.5	29.88	29.98	29.81	.17	93	W.	12.8	59	.10	....	.10	25
SUNDAY........26	76.4	83.8	66.8	17.0	29.80	29.90	29.77	.13	86	W.	20.3	88	....	....	....	26..........SUNDAY
27	65.5	72.6	60.5	12.1	30.06	30.12	29.90	.22	81	N.W.	10.9	89	....	....	....	27
28	67.7	75.9	57.3	18.6	30.07	30.16	29.95	.21	85	W.	8.7	96	...	....	....	28
29	62.3	66.1	58.1	8.0	29.83	29.95	29.77	.18	98	W.	8.0	41	.28	....	.28	29
30	69.6	79.7	61.0	18.7	29.73	29.78	29.69	.09	92	W.	9.7	....	.00	....	.00	30
Means............	64.60	72.39	56.05	16.33	29.985	30.07	29.90	.17	85.0	N. 51° W.	9.7	60.4	2.81	....	2.81	.......Sums........
30 Years means for and including this month......	64.73	73.43	56.19	17.24	29.905	......	......	.16	70.9	......	§ 12.73	¶ 54.0	3.62	....	3.62	30 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	961	1221	689	39	176	232	3253	440	
Duration in hrs..	85	140	90	6	19	29	286	57	8
Mean velocity....	11.3	8.7	7 7	6.5	9.3	8.0	11.4	7.7	

Greatest mileage in one hour was 25 on the 11th.
Greatest velocity in gusts was 36 on the 11th.
Resultant mileage, 2,554.

Resultant direction, N.51°W.
Total mileage, 7,011.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 17 years only.

The greatest heat was 83.8° above zero on the 26th. The greatest cold was 46.6 above zero on the 13th, giving a range of temperature of 37.2°.

Warmest day was the 26th. Coldest day was the 5th.

Highest barometer reading was 30.30 on the 10th; lowest barometer was 29.48 on the 21st, giving a range of .82 inches.

Minimum relative humidity observed, was 62 on the 11th.

Rain fell on 13 days.

Thunder on 4 days.

ABSTRACT FOR THE MONTH OF JULY, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	69.4	77.8	61.9	15.9	29.74	29.80	29.70	.10	89	S.E.	11.2	72	.02	....	.02	1
2	58.7	63.9	55.2	8.7	29.86	30.00	29.79	.21	92	N.W.	11.0	....	.59	....	.59	2
SUNDAY........ 3	60.3	70.5	49.5	21.0	30.14	30.17	30.00	.17	81	N.W.	12.3	94	....	....	....	3..........SUNDAY
4	66.1	75.0	54.0	21.0	29.98	30.18	29.78	.40	84	W.	13.1	36	.00	...	.00	4
5	70.8	76.8	65.4	11.4	29.86	29.95	29.79	.16	73	W.	17.7	46	.03	....	.08	5
6	73.9	68.7	61.0	7.7	30.04	30.07	29.95	.12	71	N.W.	10.3	40	.01	....	.01	6
7	68.9	78.1	58.1	20.0	30.07	30.11	30.05	.06	71	W.	12.5	98	....	....	....	7
8	63.9	83.3	61.0	22.3	30.07	30.12	30.05	.07	60	W.	3.3	97	....	....	....	8
9	74.1	83.9	62.0	21.9	30.00	30.07	29.92	.15	62	E.	6.6	78	...	....	....	9
SUNDAY....... 10	67.7	73.0	64.7	8.3	29.86	29.91	29.83	.08	95	W.	9.2	11	.13	....	.13	10..........SUNDAY
11	70.6	79.4	63.7	15.7	29.76	29.82	29.70	.12	87	N.W.	12.5	61	.00	....	.00	11
12	69.8	82.2	61.7	20.5	29.56	29.69	29.44	.25	90	N.W.	9.0	45	.50	....	.50	12
13	62.5	67.2	59.0	8.2	29.78	29.95	29.56	.39	71	N.W.	10.6	44	...	....	....	13
14	66.7	76.0	55.0	21.0	30.01	30.07	29.95	.12	72	W.	5.5	97	....	....	....	14
15	68.7	75.8	60.9	14.9	29.91	30.01	29.80	.21	84	W.	11.0	11	.02	....	.02	15
16	71.9	78.8	65.0	13.8	29.85	29.90	29.80	.10	77	N.W.	12.2	78	....	....	....	16
SUNDAY........17	70.0	77.0	63.2	13.8	29.92	29.97	29.88	.09	70	N.W.	4.9	68	....	....	....	17..........SUNDAY
18	76.2	85.9	67.9	18.0	29.85	29.88	29.82	.06	80	W.	7.0	77	....	....	....	18
19	78.3	90.1	69.1	21.0	29.78	29.86	29.69	.17	65	W.	16.8	73	.00	....	.00	19
20	70.9	78.7	62.7	16.0	29.78	29.82	29.69	.13	61	N.W.	13.4	82	.00	....	.00	20
21	62.8	68.6	56.4	12.2	29.87	29.90	29.82	.08	66	N.W.	5.7	63	....	....	....	21
22	64.8	72.2	56.8	15.4	29.98	30.03	29.90	.13	55	N.W.	3.8	95	....	....	....	22
23	63.0	68.5	59.1	9.4	30.07	30.10	30.02	.08	82	N.E.	4.4	02	.08	....	.08	23
SUNDAY........24	67.9	76.0	60.1	15.9	30.09	30.14	30.06	.08	77	N.E.	5.1	32	....	....	....	24..........SUNDAY
25	72.4	79.8	64.5	15.3	30.09	30.12	30.07	.05	76	N.E.	3.5	47	....	....	....	25
26	68.1	71.2	63.5	7.7	30.08	30.11	30.04	.07	87	N.W.	4.7	14	.09	....	.09	26
27	71.9	82.3	63.0	19.3	30.02	30.06	29.98	.08	83	W.	7.2	71	....	....	....	27
28	70.1	78.0	63.3	14.7	29.97	30.01	29.87	.14	85	W.	7.3	22	.36	....	.36	28
29	63.0	69.0	57.6	11.4	29.93	30.08	29.84	.24	90	N.W.	15.2	40	.57	....	.57	29
30	66.5	74.0	55.9	18.1	30.05	30.10	29.92	.18	73	W.	9.5	65	.00	....	.00	30
SUNDAY........31	70.0	80.4	63.6	16.8	29.81	29.92	29.74	.18	94	W.	15.5	16	.50	....	.50	31..........SUNDAY
Means......	68.38	76.2	60.8	15.4	29.929	30.00	29.88	.12	77.5	......	8.94	54	2.95	....	2.95	......Sums........
30 Years means for and including this month......	68.80	77.2	60.8	16.4	29.898	......	......	.14	72.0	......	§12.69	¶58.7	4.16	....	4.16	30 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	170	280	449	27	18	....	4233	1472	
Duration in hrs..	24	52	71	3	2	....	432	149	11
Mean velocity....	7.1	5.4	6.3	9.0	9.0	....	9.8	9.9	

Greatest mileage in one hour was 25 on the 31st.
Greatest velocity in gusts was 48 on the 31st.
Resultant mileage, 4,850.

Resultant direction, N.73°W.
Total mileage, 6,649.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

The greatest heat was 90.1° above zero on the 19th. The greatest cold was 49.5 above zero on the 3rd, giving a range of temperature of 40.6°.

Warmest day was the 19th. Coldest day was the 2nd.

Highest barometer reading was 30.18 on the 4th; lowest barometer was 29.44 on the 12th, giving a range of .74 inches.

Minimum relative humidity observed, was 43 on the 8th.

Rain fell on 17 days.

Thunder on 5 days.

ABSTRACT FOR THE MONTH OF AUGUST, 1904.

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

DAY	THERMOMETER.				* BAROMETER.				‡Mean relative humidity.	‖ WIND.		Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
	† Mean.	Max.	Min.	Range.	† Mean.	Max.	Min.	Range.		General direction.	Mean velocity in miles per hour.					
1	72.5	80.5	67.1	13.4	29.85	29.89	29.80	.09	79	S.W.	10.4	65	.04	....	.04	1
2	67.6	73.2	61.7	11.5	29.95	29.99	29.89	.10	69	N.E.	2.8	60	....	....	....	2
3	67.9	77.0	58.5	18.5	30.05	30.08	29.97	.11	60	N.E.	4.5	92	....	....	....	3
4	69.6	78.8	57.7	21.1	30.06	30.12	30.00	.12	69	S.W.	4.9	89	....	...	....	4
5	71.1	80.4	61.3	19.1	29.85	30.00	29.74	.26	80	S.W.	11.7	44	.12	....	.12	5
6	71.3	81.8	63.0	18.8	29.68	29.77	29.60	.17	77	S.W.	14.8	72	.00	....	.00	6
SUNDAY....... 7	63.6	74.0	51.1	22.9	29.85	29.93	29.69	.24	79	N.W.	11.8	..	....	....	....	7..........SUNDAY
8	62.5	69.8	57.0	12.8	30.01	30.21	29.91	.30	71	N.W.	10.8	69	.06	....	.06	8
9	63.3	73.4	50.0	23.4	30.34	30.38	30.21	.17	66	W.	8.3	85	....	....	....	9
10	64.3	71.8	54.6	17.2	30.18	30.33	29.99	.34	86	S.W.	12.9	02	...	....	....	10
11	65.0	72.3	60.1	12.2	29.96	30.10	29.91	.19	92	N.W.	12.6	28	.13	....	.13	11
12	65.2	74.7	56.0	18.7	30.21	30.28	30.10	.18	82	S.W.	5.1	79	.01	....	.01	12
13	63.0	65.9	59.0	6.9	30.00	30.17	29.81	.36	98	S.W.	12.8	..	.13	....	.13	13
SUNDAY....... 14	68.0	74.6	61.8	12.8	29.74	29.81	29.68	.13	85	S.W.	15.0	50	1.00	....	1.00	14..........SUNDAY
15	64.7	70.0	59.3	10.7	29.81	29.90	29.71	.19	75	N.W.	8.2	93	....	....	....	15
16	60.2	63.3	56.3	7.0	29.84	29.90	29.77	.13	97	N.E.	6.6	..	.35	....	.35	16
17	65.7	72.6	58.6	14.0	29.78	29.81	29.73	.08	91	W.	12.7	59	.52	....	.52	17
18	60.8	67.0	55.5	11.5	29.94	30.07	29.78	.29	73	N.W.	17.3	73	....	....	....	18
19	61.8	71.2	51.0	20.2	30.14	30.21	30.07	.14	72	W.	8.2	87	....	....	....	19
20	57.9	59.0	54.7	4.3	29.84	30.11	29.60	.51	99	S.W.	14.7	..	2.21	....	2.21	20
SUNDAY.......21	60.6	67.6	54.5	13.1	29.98	30.04	29.73	.31	86	S.W.	6.6	50	....	....	....	21..........SUNDAY
22	66.5	79.3	59.2	20.1	29.92	30.06	29.75	.31	85	S.W.	18.2	42	.61	....	.61	22
23	58.5	64.5	51.6	12.9	30.25	30.33	30.06	.27	66	N.W.	8.6	93	....	....	....	23
24	64.3	74.3	51.0	23.3	30.11	30.22	30.00	.22	71	S.W.	15.0	92	....	....	....	24
25	69.6	78.0	59.3	18.7	29.74	30.00	29.54	.46	83	S.W.	13.9	40	.08	....	.08	25
26	61.0	70.9	52.3	18.6	29.91	30.08	29.54	.54	68	N.W.	22.0	87	....	....	....	26
27	63.5	71.7	55.0	16.7	30.09	30.14	30.03	.11	76	S.W.	19.3	92	....	....	....	27
SUNDAY.......28	67.1	76.2	58.7	17.5	29.95	30.03	29.83	.20	74	S.W.	21.2	84	....	....	....	28..........SUNDAY
29	62.4	66.8	56.3	10.5	29.99	30.15	29.82	.33	63	N.W.	13.9	88	....	....	....	29
30	59.7	67.3	51.8	15.5	30.15	30.19	30.12	.07	67	S.W.	13.2	77	....	....	....	30
31	56.9	63.5	50.0	13.5	30.24	30.29	30.13	.16	63	N.W.	7.5	96	....	....	....	31
Means............	64.39	72.0	56.6	15.4	29.981	30.08	29.85	.23	77.5	S 74° W	11.69	60.6	5.26	....	5.26	.......Sums........
30 Years means for and including this month......	66.47	74.7	58.6	16.1	29.943	......	......	.14	73.7	......	§ 11.90	¶ 57.6	3.64	....	3.64	30 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	231	367	39	74	101	4778	1074	2034	
Duration in hrs..	36	60	8	11	14	359	101	142	13
Mean velocity....	6.4	6.1	4.9	6.7	7.2	13.3	10.6	14.3	

Greatest mileage in one hour was 32 on the 25th.
Greatest velocity in gusts was 60 on the 25th.
Resultant mileage, 5,767.

Resultant direction, S.74°W.
Total mileage, 8,698.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

Aurora on the 3rd. ‖ Direction for part of month taken from City Hall records.

The greatest heat was 81.8° above zero on the 6th. The greatest cold was 50.0 above zero on the 9th and 31st, giving a range of temperature of 31.8°.

Warmest day was the 1st. Coldest day was the 31st.

Highest barometer reading was 30.38 on the 9th; lowest barometer was 29.54 on the 25th, giving a range of .84 inches.

Minimum relative humidity observed, was 44 on the 3rd.

Rain fell on 13 days.

Thunder on 6 days.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	58.5	68.5	50.3	18.2	30.14	30.25	30.04	.21	86	S.E.	8.8	43	.08	....	.08	1
2	58.6	66.0	54.5	11.5	30.09	30.15	30.03	.12	95	N.E.	12.5	..	.53	....	.53	2
3	55.6	57.2	53.3	3.9	29.94	30.03	29.83	.20	100	N.E.	11.6	..	1.72	...	1.72	3
SUNDAY........ 4	61.1	65.7	54.1	11.6	29.89	29.97	29.81	.16	83	S.W.	18.7	79	....	....	....	4..........SUNDAY
5	56.1	62.8	47.3	15.5	30.04	30.23	29.95	.28	79	S.W.	14.3	35	.08	....	.08	5
6	52.8	59.8	44.0	15.8	30.28	30.35	30.23	.12	60	N.W.	8.9	96	....	....	....	6
7	56.9	64.8	47.0	17.8	30.13	30.24	30.00	.24	82	S.W.	12.1	57	.01	....	.01	7
8	55.2	58.8	47.7	11.1	30.09	30.20	29.98	.22	70	N.E.	11.0	56	.02	....	.02	8
9	52.1	60.8	41.1	19.7	30.17	30.20	30.11	.09	82	S.E.	10 2	47	....	....	....	9
10	60.3	69.8	51.1	18.7	30.08	30.12	30.02	.10	89	S	8.8	28	....	....	....	10
SUNDAY....... 11	65.0	72.9	57.0	15.9	29.96	30.06	29.86	.20	88	S	15.2	79	....	....	....	11..........SUNDAY
12	59.4	66.8	50.2	16.6	29.99	30.24	29.84	.40	84	N.W.	14.0	14	.17	....	.17	12
13	53.0	58.7	45.0	13.7	30.32	30.39	30.24	.15	73	N.E.	6.6	93	....	....	....	13
14	58.9	68.9	49.8	19.1	29.97	30.24	29.75	.49	93	S.E.	16.0	04	.86	....	.86	14
15	53.7	60.0	48.0	12.0	29.92	30.16	29.78	.38	80	N.W.	18.3	64	.05	....	.05	15
16	55.7	63.0	44.5	18.5	30.01	30.15	29.83	.32	80	S.W.	15.0	65	....	....	....	16
17	58.5	64.0	53.0	11.0	29.91	29.96	29.84	.12	76	S.W.	14.1	68	...	....	....	17
SUNDAY........18	62.9	74.1	53.5	20.6	29.84	29.99	29.78	.21	91	S W.	16.0	27	.41	....	.41	18..........SUNDAY
19	51.0	60.0	44.7	15.3	30.19	30.27	29.99	.28	72	N.E.	9.4	91	....	....	...	19
20	49.6	55.3	42.7	12.6	29.99	30.14	29.86	.28	94	N.W.	15.1	..	.15	....	.15	20
21	40.1	45.5	36.6	8.9	30.29	30.42	30.13	.29	70	N.W.	16.7	29	....	.00	.00	21
22	41.5	47.6	34.8	12.8	30.52	30.57	30.42	.15	67	N.W.	11.7	84	....	....	....	22
23	47.0	55.0	34.2	20.8	30.40	30.54	30.19	.35	77	S.W.	13.7	48	....	....	....	23
24	52.0	61.2	48.8	12.4	29.86	30.19	29.59	.60	100	S.W.	14.6	..	1.77	....	1.77	24
SUNDAY........25	52.1	58.5	49.9	8.6	29.88	29.93	29.71	.22	91	N.E.	8.9	..	....	....	....	25..........SUNDAY
26	53.5	58.9	49.8	9.1	29.82	29.91	29.73	.18	99	S.W.	10.0	91	.07	....	.07	26
27	46.3	52.2	39.8	12.4	30.06	30.13	29.88	.25	76	N.E.	8.6	90	....	....	....	27
28	49.2	56.7	40.2	16.5	30.17	30.24	30.13	.11	75	S.W.	5.8	..	....	....	....	28
29	53.7	63.2	45.7	17.5	29.80	30.14	29.53	.61	100	S.W.	17.3	..	.68	....	.68	29
30	56.2	63.9	49.3	14.6	29.43	29.56	29.34	.22	88	S.W.	26.7	24	.06	....	.06	30
Means..........	54.22	61.3	46.9	14.4	30.039	30.17	29.91	.25	83.3	S 66° W	13.0	43.8	6.66	....	6.66	......Sums........
30 Years means for and including this month......	58.49	66.5	50.8	15.6	30.017	......	......	.19	76.5	......	§12.6	¶53.7	3.33	....	3.33	30 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	353	1756	149	462	1465	2635	1098	1460	
Duration in hrs..	36	155	15	49	124	166	81	93	1
Mean velocity....	9.8	11.3	10.0	9.4	11.8	15.8	13.6	15.7	

Greatest mileage in one hour was 32 on the 30th.
Greatest velocity in gusts was 48 on the 30th.
Resultant mileage, 2,493.

Resultant direction, S.66°W.
Total mileage, 9,378.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

The greatest heat was 74.1° above zero on the 18th. The greatest cold was 34.2 above zero on the 23rd, giving a range of temperature of 39.9°.

Warmest day was the 11th. Coldest day was the 21st.

Highest barometer reading was 30.57 on the 22nd: lowest barometer was 29.31 on the 30th, giving a range of 1.23 inches.

Minimum relative humidity observed, was 47 on the 6th.

Rain fell on 15 days.

Trace of snow on the 21st.

Thunder on 5 days.

Earth quake on the 14th.

ABSTRACT FOR THE MONTH OF OCTOBER, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY
1	46.2	50.5	44.5	6.0	29.28	29 33	29.21	.12	82	S.W.	27.4	..	.00	...	.00	1
SUNDAY........ 2	44.6	47.8	39 2	8.6	29.40	29 55	29.31	.24	77	S.W.	19.9	41	....	....	....	2 ....SUNDAY
3	44.8	50.9	40.0	10.9	29.82	30.07	29.55	.52	82	S.W.	17.0	34	.01	...	.01	3
4	45.1	52.0	37.4	14.6	30.17	30.20	30.07	.13	83	S	9.2	68	....	....	....	4
5	48.9	53.0	44.6	8.4	29.92	30.20	29.73	.47	99	S.E.	6.2	..	.73	....	.23	5
6	41.4	46.0	36.0	10.0	30.20	30.33	29.82	.56	77	S.W.	18.9	85	....	....	....	6
7	36.7	43.0	28.1	14.9	30.47	30.57	30.38	.19	72	S.E.	5.3	69	....	....	...	7
8	43.6	50.0	35.2	14.8	30.24	30.39	30.17	.22	82	S.E.	5.7	..	.02	....	.02	8
SUNDAY....... 9	47.1	52.0	44.0	8.0	30.21	30.26	30.12	.14	91	N.W.	9.9	7	.00	....	.00	9 ....SUNDAY
10	57.5	63.0	44.6	23.4	29.69	30.12	29.46	.66	95	S.E.	20.7	..	.18	...	.18	10
11	48.5	53.2	39.2	14.0	29.92	30.23	29.52	.71	84	N.E.	16.5	19	.00	....	.00	11
12	37.3	44.0	30.8	13.2	30.40	30.45	30.23	.22	77	N.E.	18.0	..	....	....	....	12
13	38.8	44.0	34.7	9.3	30.37	30.46	30.26	.20	89	N.E.	7.1	..	....	....	....	13
14	41.6	48.6	34.0	14.4	30.22	30.28	30.17	.11	83	N.W.	17.9	11	.04	....	.04	14
15	39.9	48.0	31.6	16.4	30.30	30.37	30.24	.13	77	N.W.	12.7	91	....	....	....	15
SUNDAY........16	46.9	56.0	34.5	21.5	30.21	30.28	30.15	.13	75	S.E.	14.5	91	...	....	....	16.... .....SUNDAY
17	52.0	62.0	43.0	19.0	30.08	30.16	29.98	.18	79	S W.	21.5	53	.01	....	.01	17
18	50.7	56.0	40.6	15.4	29.96	30.07	29.87	.20	96	N.E.	11.0	72	.05	....	.05	18
19	48.1	58.7	40.1	18.6	30.06	30.14	29.98	.16	97	N.W.	6.3	24	....	....	....	19
20	58.3	67.0	50.2	16 8	29.85	29.98	29.74	.24	94	E.	19.1	40	...	....	....	20
21	54.0	63.0	47.0	16.0	29.55	29.74	29.33	.41	99	S.E.	13.1	..	2.29	....	2.29	21
22	47.9	54.2	43.0	11.2	29.59	29.65	29.55	.10	90	S.W.	19.0	27	....	...	....	22
SUNDAY........23	42.3	48.0	36.6	11.4	29.84	30.02	29 65	.37	89	S.W.	18.6	65	....	....	....	23 ....SUNDAY
24	36.8	42.0	33.0	9.0	30.19	30.25	30.02	.23	87	W.	11.1	87	....	....	....	24
25	42.5	48.0	35.5	12.5	30.08	30.22	30.02	.20	99	S.W.	18 2	..	.24	....	.24	25
26	39.0	43.0	35 0	8.0	29.96	30 08	29.87	.21	100	S.W.	12.6	..	.13	....	.13	26
27	32.7	38 0	28.7	9.3	30.08	30.21	29.88	.33	95	N.W.	15.6	38	... .	.00	.00	27
28	33.3	40.2	24.4	15.8	30.25	30.31	30.20	.11	89	S.W.	12.8	36	....	....	....	28
29	39.7	49.8	35.0	14.8	30.10	30.20	29.97	.21	97	S.W.	18.5	98	.01	....	.01	29
SUNDAY... 30	30.2	34.8	26.0	8.8	30.36	30.41	30.20	.21	88	N.W.	14.5	..	....	....	....	30..........SUNDAY
31	29.0	36.0	23.0	13.0	30.32	30.42	30.12	.30	97	W.	9.9	33	....	...	....	31
Means......	43.39	49.9	36.8	13.1	30.034	30.16	29.90	.26	87.8	S 43° W	14.64	35.1	3.21	.00	3.21	......Sums.........
30 Years means for and including this month......	45.91	52.9	39.0	13.9	30.014	......	......	.22	77.3	......	‖ 13.50	¶ 41.1	3.03	1.00	3.13	30 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	209	926	833	1512	923	3633	1323	1533	
Duration in hrs..	27	68	66	99	66	200	116	107	5
Mean velocity....	7.7	13.6	12.6	15.2	14.0	18.2	11.4	14.3	

Greatest mileage in one hour was 36 on the 10th.
Greatest velocity in gusts was 48 on the 10th.
Resultant mileage, 3,560.

Resultant direction, S.43°W.
Total mileage, 10,892.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. ‖ 18 years only.

ɪɪ Direction for part of month taken from City Hall records.

The greatest heat was 63.0° above zero on the 10th. The greatest cold was 23.0 above zero on the 31st, giving a range of temperature of 45.00.

Warmest day was the 20th. Coldest day was the 31st.

Highest barometer reading was 30.57 on the 7th, lowest barometer was 29.21 on the 1st, giving a range of 1.36 inches.

Minimum relative humidity observed, was 63 on the 7th.

Rain fell on 14 days.

Snow fell on 1 day.

Aurora on the 6th.

ABSTRACT FOR THE MONTH OF NOVEMBER, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY
1	35.6	40.7	30.8	9.9	30.23	30.42	30.07	.35	87	N.E.	11.0	..	....	...	....	1
2	33.8	42.8	26.2	16.6	30.35	30.46	30.17	.29	91	N.E.	9.6	76	....	....	....	2
3	42.9	51.8	35.4	16.4	30.01	30.17	29.94	.23	96	N.W.	14.4	35	.05	....	.05	3
4	36.6	47.5	32.5	15.0	30.01	30.07	29.94	.13	81	E.	10.3	14	....	....	....	4
5	27.7	33.0	24.0	9.0	29.85	29.97	29.80	.17	99	E.	15.0	36	....	....	....	5
SUNDAY........ 6	27.9	34.2	24.0	10.2	29.78	29.82	29.74	.08	99	N.W.	12.9	..	....	.00	.00	6 ....SUNDAY
7	30.9	38.7	26.3	12.4	29.71	29.74	29.66	.08	97	S.W.	21.6	19	....	....	....	7
8	29.9	38.0	25.0	13.0	29.87	29.94	29.74	.20	98	N.W.	11.6	56	....	....	....	8
9	24.4	32.0	20.6	11.4	30.06	30.17	29.94	.23	94	N.E.	9.3	28	....	....	....	9
10	25.0	30.0	19.7	10.3	30.22	30.29	30.17	.12	87	N.W.	9.3	65	....	....	....	10
11	23.2	26.0	18.9	7.1	30.03	30.18	29.96	.22	83	N.W.	8.6	..	....	....	....	11
12	37.6	48.0	21.0	27.0	29.61	29.96	29.44	.52	80	S.W.	22.0	49	...	....	....	12
SUNDAY....... 13	39.0	44.0	37.0	7.0	29.42	29.51	29.26	.25	80	S.W.	15.2	..	.03	....	.00	13 ....SUNDAY
14	35.9	41.0	31.2	9.8	29.58	29.91	29.24	.67	60	N.W.	28.9	38	....	....	....	14
15	36.4	41.0	29.5	11.5	30.00	30.03	29.91	.12	83	S.W.	17.4	..	.03	....	.03	15
16	32.0	38.0	19.5	18.5	30.26	30.57	30.03	.54	61	N.W.	13.9	49	...	.00	.00	16
17	17.8	24.0	10.3	13.7	30.65	30.72	30.56	.16	74	N.E.	9.3	39	....	....	....	17
18	21.2	30.0	12.7	17.3	30.39	30.56	30.26	.30	85	N.E.	12.4	36	....	....	....	18
19	25.5	32.0	20.0	12.0	30.18	30.26	30.04	.22	93	E.	3.1	..	....	....	....	19
SUNDAY........20	29.7	33.8	25.7	8.1	29.79	30.04	29.59	.45	98	N.E.	4.5	..	.14	....	.14	20.... .....SUNDAY
21	34.2	38.0	29.0	9.0	29.89	30.09	29.58	.51	91	S.W.	12.9	13	.11	....	.11	21
22	33.1	36.0	27.0	9.0	29.93	30.09	29.79	.30	86	S.W.	2.6	..	.06	...	.06	22
23	35.0	37.5	3[illegible]	4.6	29.88	29.96	29.79	.17	80	S.W.	10.6	..	...	....	....	23
24	33.1	35.8	31.0	4.8	29.69	29.81	29.64	.17	78	N.E.	16.4	..	....	.00	.00	24
25	31.0	33.2	29.5	3.7	29.70	29.82	29.64	.18	97	N.W.	16.6	..	....	.10	.01	25
26	23.1	29.0	20.0	9.0	29.96	30.02	29.82	.20	77	W.	18.1	..	....	.00	.00	26
SUNDAY........27	20.0	30.0	9.4	20.6	29.96	30.02	29.93	.09	93	N.E.	7.2	..	....	3.25	.09	27 ....SUNDAY
28	11.8	15.6	8.0	7.6	30.17	30.26	30.02	.24	83	S.W.	9.5	..	....	.00	.00	28
29	21.8	34.0	6.9	27.1	29.84	30.23	29.57	.66	91	S	7.1	..	....	5.75	5.7	29
30	34.0	37.6	31.0	6.6	29.68	29.75	29.58	17	99	S.W.	15.4	..	....	1.50	.16	30
Means......	29.64	35.7	23.8	11.9	29.959	30.10	29.83	.27	86.7	N 30° W	12.57	21.6	.39	10.6	1.22	.......Sums.........
30 Years means for and including this month......	32.55	38.8	26.7	12.1	30.012	......	.....	27	80.7	......	§ 15.6	¶ 28.7	2.22	13.2	3.56	30 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	1260	1997	833	5	250	2949	1073	681	
Duration in hrs..	95	175	80	1	37	185	82	51	14
Mean velocity....	13.3	11.4	10.4	5.0	6.8	16.3	13.1	13.3	

Greatest mileage in one hour was 46 on the 13th.
Greatest velocity in gusts was 60 on the 13th.
Resultant mileage, 1,612.

Resultant direction, N.30°W.
Total mileage, 9,048.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

‖ Velocity for part of month and direction taken from City Hall records.

The greatest heat was 51.8° above zero on the 3rd. The greatest cold was 6.9 above zero on the 29th, giving a range of temperature of 44.9°

Warmest day was the 3rd. Coldest day was the 28th.

Highest barometer reading was 30.72 on the 17th: lowest barometer was 29.24 on the 14th, giving a range of 1.48 inches.

Minimum relative humidity observed, was 48 on the 16th.

Rain fell on 6 days.

Snow fell on 9 days.

First sleighing in the City Nov. 27th.

ABSTRACT FOR THE MONTH OF DECEMBER, 1904.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	22.5	28.0	20.3	7.7	29.81	29.92	29.76	.16	88	S.W.	14.0	21	....	.3	.03	1
2	14.1	21.5	9.8	11.7	30.29	30.49	29.92	.57	88	S.W.	13.6	81	....	....	....	2
3	11.9	15.6	7.9	7.7	30.46	30.52	30.34	.18	68	W.	6.5	28	....	...	....	3
SUNDAY........ 4	11.4	16.6	5.9	10.7	30.28	30.34	30.23	.11	80	S.W.	10.9	09	....	.2	.02	4..........SUNDAY
5	21.7	25.7	13.0	12.7	30.05	30.24	29.85	.39	90	S.W.	6.1	..	....	2.6	.26	5
6	13.7	26.0	9.0	17.0	30.04	30.16	29.85	.31	74	S.W.	10.0	63	....	....	....	6
7	20.9	29.4	11.0	18.4	29.55	29.90	29.38	.52	90	S.W.	11.5	..	....	3.0	.30	7
8	7.8	11.8	5.2	6.6	29.56	29.71	29.47	.24	80	N.E.	8.2	37	....	....	....	8
9	4.2	7.5	−3.8	11.3	29.91	30.10	29.71	.39	72	N.W.	16.0	18	....	.0	.00	9
10	−2.3	3.2	−7.2	10.4	30.10	30.12	30.07	.05	63	W.	12.0	..	....	....	....	10
SUNDAY....... 11	−1.6	1.6	−6.5	8.1	30.17	30.22	30.10	.12	63	N.W.	14.6	80	....	....	....	11 ....SUNDAY
12	2.9	6.0	−3.6	6.6	30.13	30.21	30.05	.15	72	N.E.	13.8	..	...	.0	.00	12
13	4.7	8.5	−1.0	9.5	30.12	30.23	30.05	.18	66	N.E.	13.8	73	....	....	....	13
14	9.0	11.0	5.6	5.4	30.37	30.45	30.23	.22	75	N.W.	11.2	43	...	....	....	14
15	0.2	8.6	2.0	7.6	30.38	30.45	30.22	.23	79	N.E.	4.2	..	....	.0	.00	15
16	6.1	11.8	−1.6	13.4	30.18	30.24	30.13	.11	86	W.	9.0	03	....	....	....	16
17	7.7	12.6	0.6	12.0	30.14	30.20	30.04	.16	83	S.W.	8.4	04	....	....	....	17
SUNDAY........18	10.2	17.4	2.1	15.3	29.99	30.06	29.96	.10	74	N.E.	11.0	80	...	.0	.00	18.... ....SUNDAY
19	22.2	27.7	7.6	20.1	29.75	29.99	29.60	.39	90	S.	16.2	..	....	1.8	.18	19
20	11.8	30.0	6.2	23.8	29.75	29.86	29.60	.26	81	W.	15.5	56	....	.1	.01	20
21	0.4	6.0	−5.5	11.5	30.09	30.28	29.79	.49	70	W.	15.7	71	....	....	....	21
22	8.9	12.3	−5.3	17.6	30.19	30.24	30.14	10	86	N.W.	12.2	72	...	3.5	.35	22
23	8.4	10.0	6.4	3.6	29.90	30.15	29.75	.40	87	N.E.	13.4	67	....	5.3	.53	23
24	−1.7	6.0	−8.2	14.2	30.35	30.58	29.92	.66	71	N.E.	12.2	35	....	....	....	24
SUNDAY........25	−7.4	−1.4	−14.0	12.6	30.57	30.62	30.51	.11	58	E.	9.9	..	....	....	....	25 ....SUNDAY
26	1.6	10.4	−5.0	15.4	30.45	30.56	30.30	.26	71	N.E.	9.1	..	....	...	....	26
27	18.1	24.5	7.0	17.5	29.88	30.30	29.41	.89	94	N.E.	12.1	..	.00	6.2	.62	27
28	22.3	28.2	16.2	12.0	29.18	29.41	29.08	.33	94	E.	9.0	..	.41	5.0	.76	28
29	7.5	16.0	2.0	14.0	29.61	29.91	29.22	.69	84	N.W.	16.5	64	....	.3	.02	29
30	5.8	7.7	1.8	5.9	29.98	30.11	29.89	.22	84	N.E.	4.2	..	....	.9	.09	30
31	23.4	36.4	3.9	32.5	29.65	29.89	29.52	.37	94	S.W.	15.5	..	.07	1.1	.19	31
Means......	9.44	15.4	2.7	12.7	30.032	30.17	29.87	.30	79.2	N 80° W	11.65	28.8	.48	30.3	3.36	.. ....Sums ....
30 Years means for and including this month......	18.61	25.6	11.5	14.1	30.023	......	......	.30	83.2	......	§ 15.84	¶ 26.5	1.32	24.3	3.68	30 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	236	2258	530	52	488	1927	2559	621	
Duration in hrs..	33	183	68	7	48	145	206	48	6
Mean velocity....	7.2	12.3	7.8	7.4	10.2	13.3	12.4	12.9	

Greatest mileage in one hour was 30 on the 20th.
Greatest velocity in gusts was 40 on the 20th.
Resultant mileage, 2,230.

Resultant direction, N.80°W.
Total mileage, 8,671.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 23 years only. § 18 years only.

The greatest heat was 36.4° above zero on the 31st. The greatest cold was 14.0° below zero on the 25th, giving a range of temperature of 50.4 degrees.

Warmest day was the 31st. Coldest day was the 25th.

Highest barometer reading was 30.62 on the 25th: lowest barometer was 29.08 on the 28th, giving a range of 1.54 inches.

Minimum relative humidity observed, was 45 on the 25th.

Rain fell on 3 days.

Snow fell on 17 days.

Rain and Snow on 3 days.

Aurora on 1 night.

Meteorological Abstract for the Year 1904.

Observations made at McGill College Observatory, Montreal, Canada.—Height above sea level 187 ft. Latitude N. 45° 30′ 17″. Longitude $4^h\ 54^m\ 18^s{\cdot}67$ W.

C. H. McLEOD, *Superintendent.*

Month.	Thermometer.					* Barometer.				‡Mean relative humidity.	Wind.		Per cent. possible sunshine.	Precipitation.							Month.
	† Mean.	¶ Deviation from 30 years, means.	Max.	Min.	Mean daily range.	† Mean.	Max.	Min.	Mean daily range.		Resultant direction.	Mean velocity in miles per hour.		Inches of rain.	Number of days on which rain (or sleet) fell.	Inches of snow.	Number of days on which snow fell.	Inches of rain and melted snow.	No. of days on which rain and snow fell.	No. of days on which rain or snow fell.	
January	8.17	— 4.12	34.5	—20.7	15.6	30.077	30.96	29.21	.36	78.4	West	16.66	17.8	....	..	38.3	21	3.65	..	21	January
February	7.23	— 8.22	38.0	—18.7	16.0	30.114	30.61	29.31	.32	75.4	S. 83° W.	19.26	24.8	0.35	3	21.5	20	2.51	3	20	February
March	24.78	— .21	44.2	— 5.4	14.8	30.062	30.94	29.14	.36	82.9	S. 69° W.	17.50	38.8	2.40	7	15.9	14	4.01	4	17	March
April	39.27	— 1.52	61.8	19.5	14.3	29.943	30.50	29.43	.24	76.0	West	17.05	33.7	3.14	12	6.5	5	3.81	0	17	April
May	59.72	+ 4.79	78.9	39.8	18.9	29.925	30.30	29.42	.18	66.5	S. 59° W.	15.62	56.0	4.80	11	....	..	4.80	.	11	May
June	64.60	— .13	83.8	46.6	16.3	29.985	30.30	29.48	.17	85.0	N. 51° W.	9.70	60.4	2.81	13	....	..	2.81	..	13	June
July	68.38	— .42	90.1	49.5	15.4	29.929	30.18	29.44	.12	77.5	N. 73° W.	8.94	54.0	2.95	17	...		2.95	..	17	July
August	64.39	— 2.08	81.8	50.0	15.4	29.981	30.38	29.54	.23	77.5	S. 74° W.	11.69	60.6	5.26	13	....		5.26	..	13	August
September	54.22	— 4.27	74.1	34.2	14.4	30.039	30.57	29.34	.25	83.3	S. 66° W.	13.00	43.8	6.66	15	0.0	1	6.66	0	16	September
October	43.39	— 2.52	68.0	23.0	13.1	30.034	30.57	29.21	.26	87.8	S. 43° W.	14.64	35.1	3.21	14	0.0	1	3.21	0	15	October
November	29.61	— 2.91	51.8	6.9	11.9	29.959	30.72	29.24	.27	86.7	N. 30° W.	12.57	21.6	0.39	6	10.6	9	1.22	0	15	November
December	9.44	— 9.17	36.4	—14.0	12.7	30.032	30.62	29.08	.30	79.2	N. 80° W.	11.65	28.8	0.48	3	30.3	17	3.36	3	17	December
Sums for 1904	....	....	....	....	....	....	....	....	....	....	....	....	....	32.45	114	123.1	88	44.25	10	192	Sums for 1904
Means for 1904	30.44	— 2.56	....	....	14.9	30.007	....	....	.26	79.7	S. 82° W.	14.0	39.6	....	....	....	.	....	.	..	Means for 1904
Means for 30 years ending Dec. 31, 1904	42.00	....	....	....	....	29.980	....	....	....	75.7	....	14.75	§45.1	29.05	....	120.4	..	41.08	..	..	Means for 30 years ending Dec. 31, 1904

* Barometer readings reduced to 32° Fah. and to sea level. † The monthly thermometer and barometer means are derived from bi-hourly readings taken from self recording instruments, beginning 1 h. 0 m. Eastern Standard time. ¶ "+" indicates that the temperature has been *higher*: "—" that it has been *lower* than the average for 30 years inclusive of 1904. ‡ Humidity relative, saturation being 100, the humidity means are derived from observations made at 8 *h*, 15 *h* and 20 *h*. § For 23 years only. *a* For 18 years only. The anemometer and wind vane are on the summit of Mount Royal, [illegible] feet above the ground and 897 feet above sea level.

The greatest heat was 90.1° (Fah.) above zero on July 19th: the greatest cold was 20.7 below zero on Jan. 4th. The extreme range of temperature was, therefore, [illegible]. Greatest thermometer range in one day was 33.2° on Feb. 1st; least range was 3.6° on Dec. 23rd. The warmest day was July 19th, when the mean temperature was 78 3° above zero. The coldest day was Jan 4th, when the mean temperature was 14.6° below zero. The minimum relative humidity observed was 30 on Jan. 4th and May 6th. The greatest mileage of wind recorded in one hour was 56 on Feb. 16th, and the greatest velocity in gusts was at the rate of 72 miles per hour on Feb. 16, March 3rd and April 5th. The total mileage of wind was 122,261 The resultant direction of the wind for the year was S. 82° W., and the resultant mileage [illegible]. Lunar halo was observed on 1 night. Lunar coronas on 2 nights. Auroras on 3 nights.

Earthquakes on March 21st and Sept. 14th.

Fog on 2 days; thunderstorms on 21 days; total number of thunderstorms 24. First sleighing of winter in city was on Nov. 27th. The first appreciable snowfall of the autumn was on Nov. 25th. The first trace of snow was on Sept. 21st.

Note.—The yearly means of the above are the averages of the monthly means, except for the velocity of the wind.

ABSTRACT FOR THE MONTH OF JANUARY, 1905.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY....... 1	35.9	37.0	34.8	2.2	29.71	29.79	29.53	.26	96	S.W.	15.9	..	....	....	....	1..........SUNDAY
2	28.3	35.8	10.5	25.3	29.80	29.95	29.76	.19	97	N.E.	9.6	..	.08	...	.08	2
3	1.2	9.4	−3.5	12.9	30.03	30.09	29.95	.14	60	N.E.	11.2	..	....	....	....	3
4	−2.4	1.0	−7.7	8.7	30.03	30.18	29.96	.22	62	N.W.	12.8	61	....	....	....	4
5	−6.8	−4.0	−10.4	6.4	30.46	30.64	30.18	.46	51	N.W.	3.2	78	....	....	....	5
6	−3.3	5.5	−11.3	16.8	30.50	30.65	30.21	.44	69	N.E.	14.6	..	....	6.7	.60	6
7	21.6	32.5	4.8	27.7	29.51	30.21	29.15	1.06	92	N.E.	25.0	03	....	6.2	.64	7
SUNDAY....... 8	16.9	24.4	10.2	14.2	29.68	30.10	29.38	.72	87	S.W.	22.9	44	....	2.2	.14	8..........SUNDAY
9	18.0	28.0	8.0	20.0	30.33	30.44	30.10	.34	89	S.W.	15.8	..	....	....	....	9
10	18.5	24.0	12.4	11.6	30.28	30.51	30.15	.36	79	S.W.	26.4	75	....	2.3	.20	10
11	3.1	12.4	−3.6	16.0	30.69	30.79	30.51	.28	75	N.W.	14.4	42	....	....	....	11
12	9.7	18.3	2.0	16.3	29.99	30.59	29.71	.88	89	N.E.	9.1	..	.00	8.5	.85	12
13	4.3	14.3	−1.0	15.3	30.26	30.35	29.91	.44	74	N.W.	15.5	86	....	....	....	13
14	−4.1	3.9	−8.0	11.9	30.33	30.38	30.30	.08	68	N.W.	10.9	53	....	....	....	14
SUNDAY.......15	6.7	15.2	−8.4	23.6	30.04	30.31	29.86	.45	81	S.W.	22.7	09	....	.6	.05	15..........SUNDAY
16	17.4	21.8	12.0	9.8	29.82	29.90	29.72	.18	85	S.W.	21.9	44	...	4.1	.38	16
17	16.6	20.0	11.6	8.4	29.91	30.00	29.72	.28	87	N.W.	13.8	48	....	1.3	.12	17
18	4.4	11.5	−0.9	12.4	30.14	30.26	29.87	.39	79	N.E.	8.8	27	...	.8	.07	18
19	26.0	36.3	0.5	35.8	29.52	29.87	29.35	.52	90	S.W.	23.9	22	....	5.9	.63	19
20	13.9	19.3	9.0	10.3	29.97	30.10	29.67	.43	78	S.W.	11.4	77	...	....	....	20
21	5.5	7.4	−2.5	9.9	30.16	30.22	30.10	.12	79	N.E.	8.0	..	....	.7	.07	21
SUNDAY.......22	10.6	14.2	5.7	8.5	30.16	30.22	30.09	.13	83	S.W.	8.3	14	....	1.0	.10	22..........SUNDAY
23	2.4	8.2	−3.3	11.5	30.31	30.35	30.22	.13	63	S.W.	10.7	81	....	....	....	23
24	−2.8	1.9	−11.0	12.9	30.23	30.31	30.16	.15	65	N.E.	11.7	05	....	...	....	24
25	1.2	6.2	−3.0	9.2	30.13	30.17	30.10	.07	67	N.E.	24.7	37	....	....	....	25
26	−2.1	2.5	−8.5	11.0	30.14	30.17	30.09	.08	75	S.W.	22.1	61	....	....	....	26
27	9.5	18.0	−2.0	20.0	29.99	30.17	29.84	.33	90	S.W.	15.0	..	....	3.3	.30	27
28	15.7	22.0	9.7	12.3	29.91	30.14	29.80	.34	88	S.W.	8.5	..	....	2.0	.20	28
SUNDAY.......29	3.8	13.8	−3.5	17.3	30.33	30.38	30.14	.24	72	S.W.	11.5	69	....	.0	.00	29..........SUNDAY
30	6.6	12.0	−1.0	13.0	30.49	30.60	30.35	.25	76	W.	8.0	81	....	....	....	30
31	−0.5	5.2	−8.5	13.7	30.53	30.61	30.43	.18	70	N.E.	8.2	03	....	....	....	31
Means............	8.96	15.4	1.1	14.3	30.109	30.27	29.95	.33	78.1	N 77° W	14.41	.33	.08	45.6	4.43	.......Sums.........
31 Years means for and including this month......	12.18	20.4	4.2	16.2	30.049	......	......	.34	82.3	......	‡ 16.15	§ 33.7	.80	30.8	3.74	31 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	157	2723	83	231	339	2424	3272	1493	
Duration in hrs..	18	211	12	22	24	130	191	113	13
Mean velocity....	8.7	12.9	6.9	10.9	10.0	18.6	17.1	13.2	

Greatest mileage in one hour was 44 on the 19th.
Greatest velocity in gusts was 60 on the 19th.
Resultant mileage, 3,980.

Resultant direction, N.77°W.
Total mileage, 10,722.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

§ 24 years only. ‡ 19 years only.

The greatest heat was 37.0° above zero on the 1st. The greatest cold was 11.3° below zero on the 6th, giving a range of temperature of 48.3 degrees.

Warmest day was the 1st. Coldest day was the 5th.

Highest barometer reading was 30.79 on the 11th: lowest barometer was 29.15 on the 7th, giving a range of 1.64 inches.

Minimum relative humidity observed, was 48 on the 5th.

Rain fell on 2 days.

Snow fell on 15 days.

Rain and Snow on 1 day.

Slight aurora on the 14th inst.

Depth of snow on ground at end of month 30 inches.

ABSTRACT FOR THE MONTH OF FEBRUARY, 1905.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	3.8	7.9	—3.0	10.9	30.24	30.40	30.01	.39	75	S W.	7.3	29	....	....	....	1
2	4.9	7.3	—0.6	7.9	29.94	30.01	29.90	.11	81	S.W.	25.1	34	....	1.4	.14	2
3	—2.7	3.8	—8.0	11.8	30.22	30.43	29.98	.45	68	S.W.	28.6	84	....	.3	.03	3
4	0.8	3.5	—2.5	6.0	30.50	30.54	30.43	.11	68	W.	14.6	76	....	....	....	4
SUNDAY........ 5	3.2	8.4	—6.2	14.6	30.58	30.67	30.40	.27	71	N.W.	5.0	68	....	....	....	5 ....SUNDAY
6	11.4	18.2	3.4	14.8	30.12	30.45	29.91	.54	89	N.E.	8.6	.	....	7.6	.80	6
7	13.4	17.7	9.0	8.7	30.13	30.44	29.92	.52	81	N.W.	13.1	60	....	1.5	.15	7
8	4.2	12.0	—3.8	15.8	30.48	30.57	30.30	.27	74	N.W.	6.2	79	....	....	....	8
9	19.7	31.2	—1.7	32.9	29.94	30.30	29.75	.55	89	S.E.	17.3	..	....	5.5	.56	9
10	26.8	30.9	20.4	10.5	29.74	29.91	29.65	.26	90	N.W.	17.9	08	....	6.5	.66	10
11	2.1	18.3	—2.2	20.5	30.36	30.54	29.91	.63	68	N.W.	24.5	98	....	...	....	11
SUNDAY....... 12	0.4	5.4	—7.5	12.9	30.15	30.53	29.60	.93	75	N.E.	8.7	48	....	4.5	.46	12............SUNDAY
13	9.9	21.0	2.8	18.2	29.44	29.61	29.32	.29	81	S.W.	22.0	..	....	4.5	.46	13
14	2.7	8.9	—6.0	14.9	29.89	29.98	29.61	.37	73	N.W.	22.6	54	....	....	....	14
15	7.5	10.0	4.5	5.5	30.06	30.19	29.97	.22	77	N.W.	7.5	68	....	.5	.06	15
16	3.0	10.0	—9.2	19.2	30.20	30.32	29.99	.33	77	W.	15.7	68	...	.6	.04	16
17	18.5	24.5	7.2	17.3	29.79	29.99	29.65	.34	93	S.W.	15.0	..	....	3.4	.34	17
18	8.6	24.6	—0.2	24.8	30.05	30.39	29.65	.74	73	N.W.	27.3	64	...	1.2	.12	18
SUNDAY........19	2.7	7.9	—5.7	13.6	30.52	30.59	30.39	.20	75	N.W.	18.8	90	...	....	....	19...........SUNDAY
20	24.5	34.9	3.3	31.6	30.18	30.49	30.06	.43	92	S.W.	25.9	..	...	....	....	20
21	17.7	34.8	7.5	27.3	30.40	30.50	30.10	.40	78	N.E.	15.7	56	....	....	....	21
22	10.8	16.2	4.2	12.0	30.42	30.50	30.36	.14	80	N.E.	13.3	..	....	....	....	22
23	17.5	22.0	11.6	10.4	30.30	30.36	30.24	.12	69	N.E.	6.6	50	....	....	....	23
24	20.1	27.0	10.1	16.9	30.18	30.26	30.06	.20	89	N.W.	3.3	46	...	...	....	24
25	16.6	24.6	8.4	16.2	29.87	30.06	29.72	.34	84	N.E.	6.1	37	....	....	....	25
SUNDAY........26	18.2	28.9	8.5	20.4	29.69	29.74	29.65	.09	80	S.W.	13.5	15	....	0.0	.00	26 ....SUNDAY
27	13.6	22.2	3.5	18.7	29.83	29.91	29.74	.17	81	N.W.	23.6	97	....	0.0	.00	27
28	20.6	25.5	16.4	9.1	29.77	29.92	29.68	.24	86	N.W,	12.0	20	....	1.4	.15	28
Means......	10.74	18.1	2.3	15.8	30.107	30.27	29.93	.34	79.2	N 78° W	15.21	44.5	....	38.9	3.97	.......Sums.........
31 Years means for and including this month	15.30	23.3	7.3	15.8	30.015	......	......	.31	80.5	......	§ 18.12	¶ 40.8	0.74	24.0	3.76	31 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	238	1337	153	244	792	2027	2287	3144	
Duration in hrs..	32	133	17	24	55	101	125	168	17
Mean velocity....	7.4	10.1	9.0	10.2	14.4	20.1	18.2	18.7	

Greatest mileage in one hour was 41 on the 18th.
Greatest velocity in gusts was 60 on the 18th.
Resultant mileage, 4,781.

Resultant direction, N.78°W.
Total mileage, 10,222.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 24 years only. § 19 years only.

The greatest heat was 34.9° above zero on the 20th. The greatest cold was 9.2° below zero on the 16th, giving a range of temperature of 44.1 degrees.

Warmest day was the 10th. Coldest day was the 3rd.

Highest barometer reading was 30.67 on the 5th; lowest barometer was 29.32 on the 13th, giving a range of 1.35 inches.

Minimum relative humidity observed, was 53 on the 23rd.

Snow fell on 15 days.

Lunar halos on the 14th and 24th.

Aurora observed on the night of the 4th. Dark cloud bank with luminous upper edge. After midnight a faint arch. Luminous clouds on the 22nd and 23rd.

Depth of snow on ground at end of month 36 inches.

ABSTRACT FOR THE MONTH OF MARCH, 1905.

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 relative humidity.	WIND. General direction.	Mean velocity in miles per hour.	Per cent. possible Sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	11.6	20.0	3.2	16.8	29.99	30.03	29.93	.10	79	N.W.	13.5	75	....	....	....	1
2	12.9	18.4	6.1	12.3	29.97	30.02	29.92	.10	80	N.W.	23.3	97	....	....	....	2
3	21.3	28.0	11.6	16.4	29.83	29.92	29.76	.16	93	S W.	21.8	..	....	0 0	.00	3
4	13.5	21.5	9.6	11.9	29.99	30.20	29.76	.44	69	N.W.	12.7	81	....	0 0	.00	4
SUNDAY........ 5	11.2	17.4	1.0	16.4	30.15	30.25	30.02	.23	86	S. N.W.	10.4	41	....	.9	.09	5 ....SUNDAY
6	12.8	16.5	8.0	8.5	30.38	30.55	30.11	.44	74	S.E.	18.3	93	....	0.0	.00	6
7	15.7	24.8	3.2	21.6	30.34	30.55	30.10	.45	80		15.3	44	....	....	....	7
8	23.8	30.3	18.0	12.3	29.92	30.10	29.86	.24	91	S.W.	10.1	..	....	1.8	.18	8
9	20.6	25.2	17.3	7.9	29.90	30.01	29.76	.25	85	S.W.	11.8	13	....	...	....	9
10	23.1	33.0	17.2	15.8	29.75	29.90	29.68	.22	90	S.W.	22.0	42	....	...	....	10
11	14.2	20.0	6.3	13.7	30.17	30.31	29.90	.41	66	S.W.	22.9	93	....	....	....	11
SUNDAY....... 12	13.1	19.0	3.8	15.2	30.34	30.37	30.29	.08	71	S.W.	22.8	94	....	....	....	12...........SUNDAY
13	7.2	16.5	—1.0	17.5	30.47	30.56	30.33	.23	70	S.W.	13.2	82	....	....	....	13
14	10.8	20.2	—0.7	20.9	30.46	30.49	30.43	.06	77	S.W.	16.0	57	....	....	....	14
15	18.9	26.8	10.3	16.5	30.48	30.56	30.41	.15	79	S.W.	24.7	95	....	....	....	15
16	24.3	31.8	16.2	15.6	30.33	30.41	30.29	.12	81	S.W.	19.3	33	...	....	....	16
17	27.0	32.4	15.8	16.6	30.16	30.30	29.96	.34	82	S.W.	13.4	84	....	....	....	17
18	37.5	44.0	29.0	15.0	29.69	29.96	29.54	.42	88	S.W.	23.7	1	.44	....	.44	18
SUNDAY........19	30.4	42.0	23.2	18.8	29.90	30.16	29.52	.64	83	N.E.	15.2	31	.31	....	.31	19 ....SUNDAY
20	20.6	26.8	13.[illegible]	13.7	30.22	30.26	30.16	.10	80	N.E.	14.9	76	...	....	....	20
21	23.4	31.5	11.0	20.5	30.19	30.27	30.10	.17	79	N.E.	14.0	17	....	....	....	21
22	28.3	37.4	19.3	18.1	30.20	30.27	30.11	.16	77	N.E.	9.5	93	....	....	....	22
23	34.1	41.8	31.0	10.8	30.28	30.34	30.22	.12	70	S.	10.3	30	....	....	....	23
24	37.5	41.5	34.0	7.5	30.03	30.22	29.94	.28	81	S.E.	21.3	38	.11	...	.11	24
25	37.9	41.0	34.7	6.3	29.96	30.01	29.94	.07	92	W.	9.0	07	.45	....	.45	25
SUNDAY........26	34.8	40.5	30.4	10.1	29.91	30.00	29.79	.21	88	N.E.	6.3	44	.00	....	.00	26...........SUNDAY
27	36.9	42.3	33.7	8.6	29.74	29.86	29.68	.18	92	S.W.	19.3	..	.46	....	.46	27
28	40.0	45.6	35.8	9.8	30.01	30.07	29.86	.21	79	N.W.	15.[illegible]	05	.00	....	.00	28
29	42.2	48.5	35.9	12.6	30.04	30.09	30.00	.09	73	N.	9.3	86	...	....	....	29
30	46.2	60.5	38.7	21.8	29 94	30.00	29.87	.13	80	S.W.	23.3	22	.11	....	.11	30
31	38.5	44.8	34.0	10.8	30.13	30.20	30.00	.20	68	W.	21.7	74	. ..	....	....	31
Means...... . ..	24.85	31.9	17.7	14.2	30.093	30.20	29.97	.23	80.3	S 73° W	16.28	50	1.88	2.7	2.15	.......Sums ....
31 Years means for and including this month	24.99	32.1	17.6	14.5	29.984	......	......	.28	77.6	......	§ 17.57	¶ 45.3	1.44	22.3	3.82	31 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	668	1560	146	312	1276	3501	3717	935	
Duration in hrs..	65	116	18	25	91	180	188	61	
Mean velocity....	10.3	13.5	8.1	12.9	14.0	19.5	19 7	15.3	

Greatest mileage in one hour was 36 on the 15th.
Greatest velocity in gusts was 48 on the 15th
Resultant mileage 5,799

Resultant direction, S.73°W.
Total mileage, 12,115.

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

† Mean of bi-hourly readings taken from self-recording instruments.

‡ Humidity relative, saturation being 100. Mean of observations at 8, 15 and 20 hours.

¶ 24 years only. § 19 years only.

The greatest heat was 60.5° above zero on the 30th. The greatest cold was 1.0° below zero on the 13th, giving a range of temperature of 61.5 degrees.

Warmest day was the 30th. Coldest day was the 13th.

Highest barometer reading was 30.56 on the 13th and 15th: lowest barometer was 29.52 on the 19th, giving a range of 1.04 inches.

Minimum relative humidity observed, was 54 on the 11th.

Rain fell on 8 days.

Snow fell on 5 days.

Auroras on the 6th, 14th and 31st.

Fog on 1 day.

Snow on ground at end of month in patches.