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THE QUEBEC GROUP OF LOGAN.

BY SIR WILLIAM DAWSON, F.R.S.

The discussion of questions of names in Geology is usually unprofitable and often invidious, and is useful only where justice to the claims of original discovery or the right understanding of natural facts is affected by such questions. I have, as a rule, avoided controversies of this kind, and in my geological work, extended over fifty years, I have refrained as far as possible from any reclamations as to my own rights, being disposed rather to allow others to take what I might have regarded as my own, than to make any objection, except where some important truth was endangered. I have, however, been less reticent as to the claims of my friends, and especially of those who have passed away.

In the Presidential address delivered before this Society in 1879, I entered at considerable length into the questions then raised as to the validity and importance of those great and important discoveries of the late Sir William Logan, which led to the establishment of the Quebec Group; and in a later address to the Royal Society of Canada,[1] I took

[1] Presidential address in Section IV. Points on which American Geology is indebted to Canada. 1886.

occasion to return to this subject, and to remark also on the attempts which had been made to depreciate Logan's great work in the Laurentian and Huronian systems. In a still more recent paper on the "Older Rocks of Eastern Canada in comparison with those of Modern Europe,"[1] I have incidentally referred to the same questions, and in the new edition of my "Handbook of Canadian Geology" (1889), have upheld the Laurentian and Huron[illegible]n and the Quebec Group in all their integrity.

It would seem, however, from some recent discussions, especially on the other side of the international boundary, that there is still need to vindicate, not so much the reputation of our great Canadian geologist as some important facts of Canadian geology connected with his work, and which are not appreciated by some as they deserve.[2] I shall here refer mainly to the reasons which seem to me good and sufficient for retaining the term "Quebec Group" for that peculiar and important development of the lower member of the Siluro-Cambrian, Cambro-Silurian or Ordovician, which is so widely distributed in the eastern part of the Province of Quebec, constituting indeed the dominant feature, as the name itself would import, in the palæozoic geology of this portion of Canada.

The "Quebec Group" of the great Canadian geologist should be understood in the sense in which he proposed it thirty years ago,[3] viz., as designating *"a great development of strata about the horizon of the Chazy and Calciferous,"*

[1] Journal Geological Society of London, Nov. 1888.

[2] American Journal of Science and American Geologist, April 1890.

[3] The first publication of Logan's name known to me was in 1861; and it is true that before this time Amos Eaton had designated similar rocks as "First Graywacke," and Emmons had called them "Upper Taconic," but there were good reasons why Logan, while frankly admitting the credit due to Emmons for maintaining the true age of these rocks, should not think it expedient to adopt either of the above names, one of which had been discredited by the progress of science, and the other by errors and controversies, the evil effects of which continue even until now.

as these exist further to the west; but to this should be added his expositions in the Geology of Canada, 1863, and in his note appended to Murray's Report on Newfoundland in 1865, in which he explains the peculiar character of the series as a sub-marginal or marginal group, distinct in structure because of its special conditions of deposit from the equivalent formations of the interior plateau. This distinction has been subsequently elaborated and enforced by the writer,[1] and lies at the foundation of any scientific conception of the general geology of Eastern America and Western Europe. Hence one important element in the value of the name as well as of the thing designated.

As Logan's summary of this subject in the Newfoundland Report is comparatively little known, it may be useful to quote a few sentences of it here, bearing in mind that it was written twenty-five years ago, when many of our present geologists were in their school-boy days.

"The sediments, which in the first part of the Silurian period were deposited in the ocean surrounding the Laurentian and Huronian nucleus of the present American continent, appear to have differed considerably in different areas. Oscillations in this ancient land permitted to be spread over its surface, when at times submerged, that series of apparently conformable deposits which constitute the New York system, ranging from the Potsdam to the Hudson River formation. But between the Potsdam and Chazy periods, a sudden continental elevation, and subsequent gradual subsidenee, allowed the accumulation of a great series of intermediate deposits, which are displayed in the Green Mountains, on one side of the ancient nucleus, and in the metalliferous rocks of Lake Superior on the other, but which are necessarily absent in the intermediate region of New York and central Canada.

"At an early date in the Silurian period, a great disloca-

[1] The Quebec Group, Canad. Naturalist, 1879. Address to British Association, 1886. Palæozoic Rocks of Eastern America, Journ. Geol. Soc., 1888.

tion commenced along the south-eastern line of the ancient gneissic continent, which gave rise to the division that now forms the western and eastern basins. The western basin includes those strata which extended over the surface of the submerged continent, together with the Pre-chazy rocks of Lake Superior, while the Lower Silurian rocks of the eastern basin present only the Pre-chazy formations, unconformably overlaid in parts by Upper Silurian and Devonian rocks. In the western basin the measures are comparatively flat and undisturbed, while in the eastern they are thrown into innumerable undulations, a vast majority of which present anticlinal forms overturned on the north-western side. The general sinuous north-east and south-west axis of these undulations is parallel with the great dislocation of the St. Lawrence, and the undulations themselves are a part of those belonging to the Apalachian chain of mountains. It is in the western basin that we must look for the more regular succession of the Silurian rocks, from the time of the Chazy, and in the eastern, including Newfoundland, for that of those anterior to it."

The last sentence may, in the light of recent discoveries, be regarded as little less than a prophetic anticipation of the work of Hartt, Matthew, Walcott and others.

It may be asked, however, why, if these rocks are of Chazy-calciferous age, give them a distinct name. The answer is that there is in such cases a real value in local names. They designate the special development of particular groups *in distinct localities; and it would be well if* geologists, instead of wrangling about these names, would recognize each in its several sphere. Old Red, Devonian, Esfelian and Erian, may all be names for one set of rocks, but they designate entirely distinct developments, and are therefore useful, though it is no doubt more desirable to have uniform names for *systems* of formations than for *series* under these. More especially names of this kind, which distinguish the older rocks of the Atlantic basin from their contemporaries on the submerged continental plateaus, are eminently useful in the present state of science. Let it be borne in mind here, that the sediments which were deposited and the animals which lived in the comparatively cold and deep waters of the Atlantic basin, were always different from those which existed on the submerged portions of the continental plateaus, and that while in some cases, as in the Siluro-Cambrian and Silurian, we know both kinds of deposit and life, in others, as in the lower and middle Cambrian, we know only the oceanic forms, and in others again, as the Devonian and Carboniferous, we are as yet entirely ignorant of these latter conditions. I have not space here to illustrate this significant fact, but may refer to my British Association Address of 1886.

It has been further objected to the name Quebec Group, that it has been used to designate other rocks, both older and newer than those included in it by Logan. As to newer rocks, I can testify that neither Logan nor Billings ever knowingly included any rocks or fossils newer than Chazy in this group; and in the case of certain beds at Quebec, to which reference has been made, they knew of the existence of these, but supposed them to be there faulted against the Quebec series, or as Hunt has suggested, resting unconformably on it, a view which I have myself been inclined to adopt.

With respect to Cambrian and other rocks, said to be included in the Quebec Group, I can state from my own observations, that fossils older than the Quebec Group are imbedded in large boulders in the lime conglomerates, in such a manner, that unless where the exposures are very good it is difficult to separate them. I have seen such travelled slabs, as much as nine feet in length, full of fossils, and lying flat in the conglomerate. In point of fact, the Quebec Group is in part, as I have on many occasions affirmed, a great palæozoic boulder formation, and in this respect as well as others, very distinct from its equivalents further to the west.

Again, in districts so disturbed as many of those in Eastern Canada, it is inevitable that rocks of different ages must be folded up together, and may be difficult to separate.

We all know how the Silurian in similar disturbed districts was originally made to include the Cambrian, and the latter the rocks since separated as Pebidian, and how Logan's Huronian has been made to include great masses of rock he would not have admitted as members of it. Such mistakes are inevitable, and shou d not invalidate good names.

With reference to the proposal to substitute the term "Levis" for Quebec, all the objections to the latter name would apply to the former. Besides this, the rocks exposed at Levis are known by all who have studied the geology of the Lower St. Lawrence, to be only a part of the Quebec Group. The latter name is also the more appropriate to a series so eminently characteristic of a large portion of the Province of Quebec, and so well exposed and easily studied in the vicinity of that city. It is besides to be observed, that the Quebec Group represents that development of the lower member of the Cambro-Silurian or Ordovician system, which is characteristic of all the Eastern part of Canada, and which connects this best, both as to rocks and fossils, with the development in Western Europe, as for instance, the Arenig and Skiddaw groups of England.

I may say here also, that this is entirely independent of the questions which have been raised as to the relative position of the Sillery sandstone and Levis shales. Admitting with Hunt and Ells, that the Sillery sandstone near Quebec is older than the Levis, this Sillery is only one group of sandstones out of several, which elsewhere underlie and overlie the Levis, and the Levis itself is only one of at least three (possibly four) bands of shale holding different groups of fossils, which belong to the great Calciferous-chazy formation of the Quebec group. This is established by Lapworth's studies of the Graptolites, and I well know the facts, from my own observations in the Lower St. Lawrenee, where I have passed the summer vacations of many years, and have occupied some of my leisure in studying these puzzling deposits; mainly, however, as a lesson in the intricacies of disturbed and originally irregular strata for the benefit of my students.

In this connection it may be proper to adduce even the commonplace consideration of personal convenience in favour of the use of the term Quebec series. In collecting fossils or observing physical phenomena on the Lower St. Lawrence, it may often be impossible to assign a particular band of shale or boulder conglomerate to any special horizon in the chazy or calciferous, yet it can be referred safely to Logan's series. For example, the shale at Metis, containing the remarkable sponges lately described,[1] may be an equivalent of the Levis shale, or a little lower, and may be contemporaneous with Upper Calciferous or Lower Chazy; but all that can be positively affirmed at present is, that it is in the Quebec series.

For such reasons as the above, I have retained the name "Quebec Series," in my recently published handbook, as the name for *the Atlantic type of the lower member of the Ordovician*, and as equivalent to Upper Calciferous and Chazy of the interior region of America. I would commend this view of the matter to other geologists, in connection with the principle stated above, of the utility of local names for local developments of particular series, while the great systems of formations should have general names.

It may be said that the same arguments would necessitate the retention of the Taconic system of Emmons. To this I have not the slightest objection, provided that the same rule be applied to it; namely, that it be taken on Emmons' own definition, and without including rocks or fossils referred by mistake, either by him or by others, to the horizon so defined.

In his American Geology, 1855, Emmons says (part II. p. 6) that in 1836 he had regarded the Potsdam sandstone as "the base of the Silurian system," but that he had since found "the same base resting on sediments still older." These he called the Taconic system, and defines this as a fossiliferous group under the Potsdam, and itself "found to

[1] Trans. Royal Soc. of Canada, 1889.

rest upon primary (that is crystalline) rocks." Thus his Taconic of 1855 is clearly the Middle and Lower Cambrian of modern geologists, and the fossils which he attributes to the Taconic, are in great part of this age. That in the subsequent pages of his book, in tracing the Taconic through the complex structure of the districts in which it occurs, and enumerating its fossils, he mixes other formations with it is most true. But fair critics of Emmons would do well to eliminate these errors, and leave him the credit of his discoveries in those pre-Potsdam rocks, which, though different in age from the Quebec group, are like it, in the main a marginal Atlantic series, not represented in the central plateau.

I do not wish, however, to enter into the "Taconic controversy," or to discuss the utility of now reviving Emmons' name, but merely to mention the points in which it resembles and differs from that of Logan, which belongs to a different series, and to which it has in many respects inferior claims.

I may sum up the matter by quoting a few sentences from one of the papers above referred to:—"The researches of Sir William, with those of Dr. Sterry Hunt and Professor Hall and Mr. Billings, have sufficed to demonstrate—1. The general diversity of mineral character in the Palæozoic sediments on the Atlantic slope as compared with the internal plateau of Canada. In these results Bailey, Matthew and Hartt in New Brunswick, and the writer in Nova Scotia, have also borne some part. 2. The establishment of the Quebec group of rocks as a series equivalent in age to the Calciferous-chazy of America, west of the Apalachian mountains, and to the Arenig and Skiddaw of England, and the elucidation of its special fauna. 3. The tracing out and definition of the peculiar faulted junction of the coastal series with that of the interior plateau, extending from Quebec to Lake Champlain. 4. The definition in connection with the rocks of the Quebec group, by fossils and stratigraphy, of formations extending in age from the Potsdam sandstone to the Upper Silurian, as in contact with this group, in various relations, along its range from the United States frontier to Gaspé; but the complexities in connection with these various points of contact, and the doubts attending the ages of the several formations, have never yet been fully solved in their details. 5. The identification of the members of the Quebec group and associated formations with their geological equivalents in districts where these had assumed different mineral conditions, either from the association of contemporaneous igneous beds and masses, or from subsequent alteration, or both. It is with reference to the results under this head the most difficult of all, that the greater part of the objections to Sir William's views, taken by Hunt, Selwyn and others, have arisen, and that recent discussions and observations have somewhat modified his conclusions."

Into the question of the age or ages of the crystalline rocks identified by Logan with those of the Quebec group, I do not now propose to enter. Facts in my possession with reference to the fossils contained in some of these rocks, cause me to hesitate as to the more pronounced views on the subject. This question is, however, independent of those relating to the position and character of the unaltered fossiliferous sediments, though very interesting in itself.[1]

I had intended to refer here to what can scarcely be characterized as other than a very injudicious attempt of a recent writer in the "American Geologist," to revive Desor's name "Laurencian" for the Pleistocene beds of the St. Lawrence valley, to the exclusion of Logan's name Laurentian for the rocks of the old Laurentide hills. This attempt has, however, been so ably and temperately rebuked by Professor Hitchcock, in the last number of the same journal, that any further argument is quite unnecessary, especially in Canada, where it is probable that no one would countenance such a heresy. Hitchcock says:

"It does not concern us now whether it was judicious for

[1] See a paper by Dr. Sterry Hunt, American Geologist, April, 1890, p. 212.

Logan to suggest a name of (nearly) the same sound (with Desor's) for the fundamental group, but it is clear that he took pains to derive the name from the Laurentide mountains."

"He says (Report of Progress, 1852–53, p. 8) 'it has been considered expedient to apply to them for the future, the more distinctive appellation of the Laurentian series, a name founded upon that given by Mr. Garneau to the chain of hills which they compose.' From his standpoint Laurentian was the proper term for the great system, and any use of a homophonous word for an insignificant terrane should not stand in its way. The geological public has thoroughly endorsed him."

It is fortunate that when the more aggressive spirits of the great Republic try to wrest from us the few geological laurels which we can fairly claim, we find friends and allies among the more just and liberally minded of their compatriots.

Note.

Since writing the above, I have seen the interesting paper by Dr. Ells on the Stratigraphy of the Quebec Group, in the Bulletin of the Geological Society of America for 1889. This, when read in the light of general geology and palæogeography, I think completely bears out the views above stated.

Dr. Ells, in his concluding summary, divides the Quebec group, as previously held, into five portions. The first of these includes older crystalline rocks, and the second contains beds which may in part be considerably older than the Calciferous. The third includes the lower part of the Quebec group proper, representing the Calciferous of the interior region. The fourth is the central part of the Quebec group, approximatly equivalent to Chazy. The fifth is, in part at least, Upper Quebec group, though I have doubts as to its being all of one age. Under the head of "Palæontological Succession," the same facts appear. The Cape Rosier or Matane (*Dictyonema sociale*) zone of Lapworth, as I had previously pointed out in 1883,[1] is palæontologically Calciferous or Tremadoc. The *Phyllograptus* zone of the same author is the typical Levis, and the *Cænogroptus* zone is the same with Dr. Ells' fifth group above. Besides these, however, there is on the lower St. Lawrence, probably between the *Dictymema* and *Phyllograptus* zones, another fossiliferous band of black shales which may be called the *Retiolites* or *Protospongia* zone, referred to in my paper on Fossil Sponges from the Quebec group (Trans R. S. C., 1889), and probably also another between the *Phyllograptus* and *Cænograptus* zones. Palæontologically as well as stratigraphically, all these zones are very distinct from their chronological equivalents on the American plateau to the west, and more or less akin to those of western Europe. Thus the whole Quebec group is a peculiar Atlantic development of the Calciferous-chazy horizons, as originally defined by Logan.

[1] Report of Peter Redpath Museum.

Our Winter Birds.

By F. B Caulfield.

In the second volume of the *Canadian Naturalist* (1857, p. 138) there is a paper by W. S. D'Urban on "Some Land Birds Wintering in the Neighbourhood of Montreal," and in the fifth volume of the same journal (1860, p. 425) there is a paper by H. G. Vennor on "Birds Observed at Montreal During the Winters of 1856-57-58-59-60." These contributions are of great value, being records of observations made at a season when field work has to be prosecuted under many disadvantages, as by the time the snow is drifting through the leafless trees, very few birds remain to represent the multitude that find a home with us during the summer months. As a number of years have elapsed since the publication of these papers, it may, perhaps, be well to give some additional notes, as a few species have been added to the list, and our knowledge respecting some others has been slightly increased. Our winter birds may be classed under three heads—loiterers, stragglers and residents; although in some instances it is difficult to draw the line sharply. Under the first may be placed a few species that linger with us until late in November, or the beginning of December. The second includes the gulls and hawks that occasionally visit us during the winter, while to the third belong the majority of our winter birds, consisting of species that are resident throughout the year, with the addition of those that come to us from regions still farther to the north at the setting in of cold weather.

The insectivorous species that stay with us during the winter, such as the nuthatches and titmice, generally keep in the woods, being fond of sheltered hollows with a thick growth of evergreens, finding in such localities an abundant supply of food and protection from the bitter winds that sweep across the open country. During mild weather they occasionally venture out, and may sometimes be seen passing through the trees in our streets and gardens, generally in small companies, each individual seemingly entirely occupied with its own affairs, yet taking good care to keep within call of its companions.

Our winter visitants, the grosbeaks and waxwings, which at this season live almost altogether upon berries and seeds, do not appear to be very much affected by cold, and may be seen in exposed situations during the most severe weather.

* *Rissa tridactyla*—Kittiwake.
* *Larus glaucus*—Glaucous gull.
* *Larus marinus*—Great black-backed gull.
* *Larus Delawarensis*—Ring-billed gull.
* *Larus atricilla*—Laughing gull.

All these gulls are rare in the vicinity of Montreal, but occasionally visit the open water at Lachine.

Larus atricilla may possibly be merely a loiterer, the latest date of its occurrence, known to me, being October 22nd, 1885, when an immature specimen was shot at Lachine by Mr. Charles Ralph.

* Denotes birds not given in D'Urban's or Vennor's lists.

Bonasa umbellus togata—Canadian ruffed grouse. Recorded by D'Urban as common; is now very rare in the vicinity of Montreal. A few pairs nest on the western mountain, and in the wooded parts of Mount Royal cemetery.

* *Accipiter velox*—Sharp-shinned hawk. I only know two winter records for this species. In February, 1880, a male was shot in a garden on Berthelet street, while eating a sparrow that it had captured. The second specimen, also a male, was shot on the western mountain, December 29th, 1889.

Accipiter atricapillus—American goshawk. Occasional during the autumn and winter months. The earliest date upon which I received it is October 27th, 1887, an immature specimen shot at the Back River.

Archibuteo lagopus sancti-johannis—American roughlegged hawk. This can hardly be called a winter bird with us. The latest date of its occurrence known to me is November 1st, 1889, when a specimen was shot at Cote des Neiges. Chamberlain states that it occurs in the Maritime Provinces in winter only. With us it is an autumn visitant, occaionally sloitering until November.

Asio Wilsonianus—American long-eared owl. A few specimens during November. I do not think it remains during the winter.

Asio acciptrinus—Short-eared owl. Same record as last species.

* *Syrnium Nebulosum*—Barred owl. Occasional during winter.

Ulula cinerea—Great gray owl. This fine owl, generally exceedingly rare with us, has been quite common along our southern border during the past winter. At least fifty specimens have been mounted in Montreal, and it is also reported in unusual numbers from Quebec and Toronto. I have received examples from Three Rivers, Sorel, Sherbrooke, Valleyfield and other places—the earliest on October 28th, 1889, from Grenville, P.Q.; the latest on March 28th, 1890, from Lachine. A specimen shot on the western mountain, on the 27th of November, had a freshly killed field mouse in its stomach, but they do not always confine themselves to such small game. Mr. P. W. Redpath told me that in January last, while crossing Lac Pisagouke, St. Maurice County, he saw a large gray owl attacking some animal on the ice, which, on closer investigation, proved to be a mink. Vennor, in his work on "The Hawks and Owls of Canada," states that in 1876 the unusual number of six specimens were exposed in the markets, all of which were obtained on, or in, the immediate proximity of the island of Montreal. It is worthy of notice that the winter of 1876 was mild and open.

* *Nyctala tengmalmi Richardsoni*—Richardson's owl. Occasional during the winter months. November 9th, 1888, Mount Royal Vale, one example. February, 1890, Lachine, one example. Petite Cote, March 2nd, 1890, two specimens. I have also seen it exposed in the market.

Nyctala Acadica—Saw-whet owl. Resident throughout the year.

Bubo Virginianus—Great horned owl. Apparently not common in the neighborhood of Montreal, but this may be owing to its wariness, and to its habit of keeping within the cover of the woods.

Nyctea nyctea—Snowy owl. Common during some winters; some years very scarce. Quite common during the past winter.

Surnia ulula caparoch—American hawk owl. Generally rare; some winters rather common, usually occurring in November, after which it is, I think, seldom observed in the vicinity of Montreal. D'Urban gives the following dates of its occurrence: November 19th, December, February 27th.

Dryobates villosus leucomelas—Northern hairy woodpecker. Occasional during the winter; more abundant during the migrations. In 1879 a balsam poplar on Cadieux street, badly infested by the larvæ of *Xyleutes robinia* and *Saperra moesta*, was frequently visited by one of these birds, who would hammer away busily for quite a length of time, the scattered chips and fragments of bark at the foot of the tree bearing witness to the energy with which he worked.

Dryobates pubescens—Downy woodpecker. Resident throughout the year; generally keeps in the shelter of the woods in winter.

* *Picoides Arcticus*—Arctic three-toed woodpecker.

* *Picoides Americanus*—American three-toed woodpecker. A few examples of both these species occur here in November, but, I think, do not remain during the winter.

* *Otocoris alpestris*—Horned lark. This species arrives from the north in the fall, and examples may perhaps winter with us, as it is found very late in autumn and early in spring, but the greater number pass farther to the south. Their breeding grounds are about the shores of Hudson's Bay, Labrador and Newfoundland. The horned lark that breeds here is the prairie form (*Otocoris alpestris praticola*), a western race that has extended its range eastward, occurring now from the western edge of the plains to Montreal. McIllwraith believes that it first appeared at Hamilton about the year 1868. I cannot ascertain the date of its first appearance at Montreal, but it appears not to have been noticed until recent years. It loiters with us until late in the fall, and individuals may winter, as it occurs in February, nesting as soon as the ground is bare of snow.

Cyanocitta cristata—Blue jay. Common until late in the fall, and a few remain during the winter. Mr. Gordon, of St. Jerome, told me that a small flock of these birds frequented his farmyard during the winter of 1887-88, and, not being disturbed, became quite tame, feeding along with the poultry.

* *Perisoreus Canadensis*—Canada jay. A specimen shot at Lachine, November, 1889.

* *Corvus corax sinuatus*—American raven. Occasionally visits the river dump.

Corvus Americanus—American crow. Specimens remain during the winter, generally keeping in the shelter of woods near farm houses; becomes numerous in March, when large flocks assemble on the river dump.

* *Coccothraustes vespertina*—Evening grosbeak. An accidental straggler in winter from the west. Not recorded from the Province of Quebec previous to 1890. Since my former note on this species,[1] I have received a pair shot at Lachine on March 9th, 1889, by Mr. J. H. Harris, who told me that he saw a flock of about thirty individuals upon that occasion.

Pinacola enucleator—Pine grosbeak. A regular winter visitant, arriving from the north by the end of October or the beginning of November; leaving at end of March or early in April.

* *Loxia curvirostra minor*—American crossbill. An irregular visitant, sometimes appearing in large flocks.

* *Loxia leucoptera*—White-winged crossbill. Also of very erratic habits, sometimes appearing unexpectedly in considerable numbers. Both species may at times be seen feeding in company, and are generally very tame and unsuspicious.

Ecanthus linaria—Redpoll. Generally common, sometimes appearing in immense flocks. They are busy little birds, ever on the move, roving about from place to place, and appear to be of a most affectionate disposition. In former years numbers of these birds were captured and exposed for sale at the Bonsecours market. On one occasion I saw a specimen escape from a cage where a number were confined, and upon its taking flight, its companions com-

[1] Record of Science, Vol. IV, p. 109.

menced calling loudly, when it at once returned and alighted near the cage. This was repeated until it was again captured and recaged. While anxious to escape, it appeared to be quite unable to resist the calls of its companions.

Spinus pinus—Pine siskin. An irregular visitant, generally appearing in November. I do not think it remains during the winter.

Passer domesticus—European house sparrow. Now thoroughly naturalized. Withdraws in winter into the towns and villages.

Plectrophenax nivalis—Snow bunting. A regular winter visitant, not so abundant as in former years. Some linger until May or beginning of June.

* *Calcarius laponicus*—Lapland longspur. A rare winter visitant. I have obtained specimens in the market.

Ampelis garrulus—Bohemian waxwing. An irregular winter visitant—some winters rather common, other years entirely absent.

* *Ampelis cedrorum*—Cedar waxwing. Occasional during winter. Abundant summer resident.

Lanius borealis—Northern shrike. Regular winter visitant, arriving from the north in October or beginning of November, leaving us in March or beginning of April. The earliest arrival known to me is October 12th, 1889, on which date a young male was shot on the western mountain. The latest date of its occurrence in spring that I can be certain of is April 11th, 1890, when an adult male was shot at St. Armands. Both D'Urban and Vennor considered it to be a loiterer, but I am satisfied that many remain with us during the winter, as I have received it at different times between October and March. The specimen on the table was shot at Lachine on the 20th of January, 1890. D'Urban gives the date of its spring arrival from the south as April 13th, but neither he nor Vennor appear to have been aware of the fact that we have along our southern border two shrikes, one a winter, the other a summer resident, the latter being the white-rumped shrike (*Lanius ludovicianus excubitorides*). This species arrives from the south just as the other is leaving for the north, so that they sometimes overlap, and as many of the northern form winter far south of Canada, both species no doubt sometimes arrive at the same time, but *L. borealis* passes on to its breeding grounds in the fur countries, while *L. excubitorides* stops with us and nests, having reached the northern limit of its range. It may be possible that the white-rumped shrike did not occur here during D'Urban's or Vennor's time, as it has come to us from the west, having been first noticed in Ontario about 1860, according to McIllwraith.

Certhia familiaris Americana—Brown creeper. D'Urban records it as common on Nun's Island in winter. I have seen it in Phillips' square in February, 1885.

Sitta Carolinensis—White-breasted nuthatch.

Sitta Canadensis—Red-breasted nuthatch. Both of these species are recorded by D'Urban as common on Nun's Island in winter. Specimens may occasionally be seen on the mountain

Parus atricapillus—Chickadee. Abundant winter resident.

* *Parus Hudsonicus*—Hudsonian chickadee. Rare winter visitant; generally seen in November.

Regulus satrapa—Golden crowned kinglet. Occasional during winter.

Vennor gives the following winter records for the American robin (*Merula migratoria*), January 1857, and February 19th, 1869, but they can only be regarded as accidental. He also states that a specimen of the pileated woodpecker (*Ceophlœus pileatus*) was shot below the city. This, too, must be considered accidental, as it is a bird that is at home only amidst the solitude of the deep woods.

These are all the birds, so far as known to me, that have been observed in the neighbourhood of Montreal during the winter months. Continued research may add a few species to the list, and will enable us to speak more definitely with regard to the time of arrival and departure of several whose winter history has not yet been clearly worked out.

SUNSPOTS OBSERVED AT McGILL COLLEGE OBSERVATORY DURING THE YEARS 1888-89.

By C. H. McLeod.

The accompanying table gives a summary of the observations of Sunspots made at McGill College Observatory during the years 1888 and 1889. The spots were observed by projection on a screen attached to a telescope of 6 in. aperture; the diameter of the sun's image being enlarged to 8 inches. The heliographic latitude and longitude of each spot at the time of observation, have been determined with approximate accuracy. The dates given in the first column, except January 1st, 1888, correspond with the coincidence of the assumed prime meridian of the sun, with the central meridian as defined in the "Observatory" ephemeris. The numbers in the sixth column are obtained by dividing the total number of single spot observations in a rotation, by the number of days on which observations were made during the rotation.

A large spot, which was first observed near the eastern limb on June 17th, 1889, (whole area about $\frac{450}{1000000}$ and umbra $\frac{60}{1000000}$ of the sun's hemisphere) made one complete revolution and was observed on its second rotation until it disappeared beyond the western limb on July 24th. It did not greatly alter in form or area while visible. A large group, first seen on August 2nd, 1889, was observed in the two following rotations and disappeared about the end of September, having been last seen in longitude E 12° on September 28th. On their re-appearance these groups have been *counted* as "new." A small spot (area about 5 units) was observed in the very high latitude S 40° on June 30th. The observations were for the greater part made by Mr. E. H. Hamilton, B.A.Sc., and the remainder by myself.

Date of Commencement of period.	No. of days on which observations were made.	Total number of spots observed.	No of. Groups.	Average distance from the Equator.	Average No. spots per day.	Spots North of the Equator.		Spots South of the Equator.	
						No.	Average heliographic Latitude.	No.	Average heliographic Latitude.
1888.				°			°		°
January 1 to Jan. 22.6.	10	5	4	5.3	1.9	0	—	5	5.0
January 22.6	13	11	5	4.7	1.0	0	—	11	4.7
February 18.9	9	20	7	3.4	5.9	5	3.6	15	4.0
March 17.3	9	7	4	5.0	1.3	5	4.2	2	6.6
April 13.6	12	9	6	7.7	1.4	1	0.6	8	8.7
May 10.8	11	15	7	4.5	2.7	1	3.2	14	4.6
June 7.0	12	22	5	6.0	3.5	14	7.6	8	3.7
July 4.2	17	20	8	8.8	1.5	1	6.2	19	9.0
August 0.4	13	11	6	8.4	0.8	6	8.6	5	8.1
August 27.7	11	16	11	3.9	4.6	3	3.4	13	4.0
September 23.9	9	4	3	5.8	0.5	1	12.4	3	3.6
October 21.2	10	20	14	4.0	2.1	4	5.4	16	3.6
November 17.5	8	4	3	8.0	0.5	0	—	4	8.0
December 14.8	6	5	3	5.0	1.6	0	—	5	5.0
1889.									
January 11.2	11	14	4	4.3	2.2	14	4.3	0	—
February 7.5.	16	10	2	11.1	2.1	0	—	10	11.1
March 6.8	11	15	5	4.3	2.5	5	3.5	10	5.5
April 3.1.	18	7	3	3.4	0.8	3	3.5	4	3.0
May 0.4.	11	10	1	4.7	1.4	0	—	10	4.7
May 27.6	12	20	2	4.0	5.7	0	—	20	4.0
June 23.8	15	19	3	7.2	4.8	0	—	19	7.4
July 21.0	19	67	8	12.8	10.0	14	3 5	53	13.6
August 17.2	23	2	1	18.9	0.6	0	—	2	18.9
September 13.5	8	10	2	21.0	2.4	0	—	10	21.0
October 10 8	15	10	1	19.6	0.6	10	19.6	0	—
November 7.1	11	0	0	—	0.0	0	0.0	0	—
Dec. 4.4	9	23	5	21.2	3.3	9	20.0	14	22.0
Year 1888	150	157	79	5.9	2.1	37	6.7	120	5.5
Year 1889	179	207	37	11.2	2.9	55	9.3	152	11.3

MILK.

A LECTURE DELIVERED BEFORE THE MONTREAL NATURAL HISTORY SOCIETY.

BY W. HODGSON ELLIS, M.A., M.D.

Milk is the food which Nature has provided for the nourishment of the young of all the higher animals in the first helpless days of their life, before they have learned to forage for themselves. It is to this wonderful fluid—the meat and drink of infancy, a draught of which will satisfy the cravings of the already imperious appetite and still it to a sweet satiety, which a few years later it will seek in vain in a dinner of a dozen courses—to this true *elixir vitae* by means of which all higher forms of life are perpetuated from generation to generation, that I have the honour of inviting your attention this evening.

Average cow's milk has a composition about as follows:—

Fat	3·8
Albuminoids	4·0
Milk sugar	4·0
Salts	0·7
Water	87·5
	100·0

The fat constitutes butter.

The greater part of the albuminoids are separated from the milk by the addition of a little acid, either purposely added or formed in the milk itself when it "curdles." The curd carries the fat with it and a portion of the salts. The sugar and the rest of the albuminoids and salts remain in solution in the "whey." On boiling the whey, dissolved albuminoids are coagulated and may be filtered off, and on evaporating the filtrate the sugar crystallizes out.

That portion of the albuminoids which is coagulated by acid is usually known as casein. The portion not so coagulated is called albumen, and is held by some to be identical with serum albumen.

If a drop of milk be examined under the microscope it is seen to consist of a clear colourless fluid, in which float innumerable minute globules which refract light strongly. Those are the globules of fat, which is not dissolved in the milk, but held in suspension in it, forming what is known as an *emulsion*. The nature of these globules and the cause of their remaining suspended in the milk have given rise to much controversy, and have been very carefully studied. Fat is soluble in ether. But you may shake milk with ether and the globules will not dissolve in it, unless you add some potash or some acetic acid, and then shake with ether, when they readily dissolve. So, too, if you mix acetic acid with a drop of milk under the microscope, you may watch the globules melt together and form larger globules and irregular masses of fat.

These globules of fat are lighter than the rest of the milk, and hence on standing they rise to the surface and form a layer of cream. This separation is never complete. That is, the cream contains some of the other constituents of the milk, and the skim milk still retains a little fat—about 0·5 per cent. By violently agitating the cream, as in churning, the fat separates in the form of butter. This separation takes place more readily if the milk has become just faintly acid.

Now all these things go to show that there is some kind of envelope surrounding the fat globules which protects them from the action of solvents until it is itself either dissolved by acid or alkali, or broken up as in the violent agitation of churning.

If the milk is heated for several hours in a little dish of metal or porcelain or glass, at the temperature of boiling water, the water is all driven off and the solids—the fat, casein, albumen, sugar and salts—are left behind as a solid residue. From this solid residue ether and other solvents will readily extract the fat, so that the envelope must be broken up by this process of drying also.

Formerly it was thought that this envelope was a solid skin of casein, and this idea was supported by the fact that casein is soluble in acid and in alkalies. The circumstances that after breaking up the globules no traces of this membrane can be detected under the microscope, and that milk dried in thin layers at low temperatures leaves a residue from which ether readily dissolves the fat, have thrown the gravest doubt on this hypothesis. One recent French writer, indeed, M. Béchamp, has endeavoured to show that the milk globules are true physiological individuals, like blood corpuscles. By appropriate treatment he has succeeded in separating them by filtration from the rest of the milk. He states that when thus isolated and dried they dissolve in ether, leaving about 1·3 per cent. of a residue insoluble in ether, which he asserts is not casein, but of the nature of a cell-wall. These views of the French savant are, I think, opposed to the general current of modern opinion on this matter, and his facts can probably be explained without accepting his hypothesis. It seems most likely that each globule of fat is surrounded by a thin pellicle of *fluid* casein. It is a fact well known to chemists, that when a complex organic fluid is shaken with ether or chloroform for the purpose of separating some constituent soluble in these liquids, it is not uncommon for each globule of ether or chloroform to become encased in just such a liquid pellicle, which most obstinately resists our efforts to break it up and bring about the union of the globules. Milk itself very easily causes this condition of things when shaken with ether. I have had, to my great annoyance, frequent experience of this phenomenon, and have had samples of this emulsion which remained intact for weeks and even months, the ether refusing to separate as I wished it to do.

As to the chemical composition of butter fat a few words will suffice. Fats are combination of certain organic acids —"fatty acids" as they are called—with glycerine. Besides stearic, palmitic and oleic acids, which are present in most animal fats, butter is peculiar in containing more than 6 per cent. of butyric acid, which differs from those just named by being soluble in water and volatile. This fact is of great importance in enabling us to detect adulteration of butter by admixture with foreign oils and fats.

The quantity of fat in healthy cow's milk varies from 2·5 per cent. to 5·5 per cent., the average being a little under 4 per cent. The milk of the ass only contains a little over 1 per cent. of fat. That of the porpoise contains 45·8 per cent. fat.

The casein and albumen belong to the class of organic bodies called albuminoids. They differ from the other constituents of the milk in containing nitrogen, and are of great nutritive value.

In composition they very closely resemble one another, but they differ in some of their properties. The casein is coagulated by the addition of acetic acid. The albumen is not. The casein may also be separated from the albumen by filtration through porous earthenware. If a porous earthenware cell, such as is used in many forms of galvanic batteries, be closed by an indiarubber cork, perforated to admit of a glass tube which is connected with an apparatus for exhausting the air, and then plunged into a vessel of milk, the water, the sugar and the albumen will pass into the cell, while the casein and the fat will remain outside. A portion of the salts will pass into the cylinder; another and larger portion will remain in combination with the casein.

The casein can be freed from the fat by treatment with ether, which dissolves the fat and leaves the case in behind.

Magnesium sulphate also precipitates casein from cow's milk.[1] The albumen can be precipitated from the filtrate by the addition of acetic acid and boiling.

Our knowledge of the albuminoids of milk is not very exact. Some authors think that the different forms are only modifications of casein; others believe that there are several albuminous substances, and that casein itself is not a simple body. For our purposes it will be sufficient to class them under the common name of albuminoids, including in this term both casein and albumen.

The quantity of albuminoids contained in the average

[1] Not from human milk. Biedert & Schröter, *Jahresber f. Thier-Chem,* 1888, p. 103.

cow's milk is about 4 per cent. The albumen is usually about 7 per cent.

The milk sugar is a body similar in composition to cane sugar, but differing in many of its properties. It is not so soluble as cane sugar, and consequently not so sweet. It may be obtained from whey by evaporating it to a thin syrup, and allowing it to stand for a long time in a cool place, when it crystallizes out. It forms hard colourless transparent four-sided prisms. When milk is kept, after a variable time depending on temperature and other conditions, the milk sugar begins to undergo a change, by which it is converted into a peculiar acid—lactic acid. One molecule of milk sugar and one molecule of water form four molecules of lactic acid.

$$[C_{12}H_{22}O_{11} + H_2O = 4\ C_3H_6O_3.]$$

The lactic acid so formed causes the coagulation of the casein ("curdling"), and is the cause of the sour taste of spoiled milk. This change is caused by a peculiar ferment present in the milk. The activity of this ferment is destroyed for a time by boiling. Hence the peculiar effect of boiling milk.

Milk sugar, like cane sugar, belongs to that class of saccharine bodies which are not directly susceptible of alcoholic fermentation. When a solution of cane sugar is mixed with yeast, it takes up a molecule of water and is converted into a fermentable sugar or glucose, which in its turn splits up into alcohol and carbon dioxide.

$$[C_{12}H_{22}O_{11} + H_2O = 2\ C_6H_{12}O_6$$
$$C_6H_{12}O_6 = 2\ C_2H_6O + 2\ CO_2.]$$

Similarly milk sugar, under the influence of yeast, is changed first into a fermentable sugar galactose and then into alcohol and carbon dioxide. These changes are utilized in the preparation of koumiss, an aerated alcoholic beverage obtained by fermenting milk. The alcohol which koumiss contains and the carbon dioxide which gives it its sparkling effervescent character are both derived from the sugar of milk.

This drink has from time immemorial been prepared by the wandering tribes of the Steppes of Russia and Central Asia. These people live in tents for nine months in the year. During the winter they bury themselves in pits dug in the ground and covered by a rounded roof of thick felt. Their only wealth consists of herds of small hardy horses. From the milk of their mares they prepare a drink by fermenting it in bags made of smoked horse-hide, the hair being turned outwards. In spring they use as a ferment either the dried casein from strong koumiss, prepared during the preceding autumn and preserved through the winter for the purpose, or a mixture of flour and honey, or a piece of fresh horse skin, or even an old copper coin covered with verdigris.

During fermentation the milk is frequently agitated, and this agitation is absolutely necessary to the process however carried on. After once a supply of koumiss has been obtained. a fresh supply can be got by adding some of it to fresh milk, in which it at once sets up the alcoholic fermentation.

William de Rubruquis, who wrote a book of travels in Tartary as long ago as 1253, describes this beverage, and tells us that he found it very savoury. "It biteth," says he, "like wine of raspes when it is drunk. After a man has taken a draught thereof it leaveth behind it a taste like that of almond milk and maketh one's inside feel very comfortable; and it also intoxicateth weak heads."

Marco Polo also tells us that the Tartars drink "mare's milk prepared in such a way that you would take it for a white wine; and a right good drink it is."

The first to employ koumiss as a therapeutical agent was Dr. John Greive, a Scotch surgeon in the Russian army, who gave an account of it in a communication to the Royal Society of Edinburgh in 1784, and who employed it with success in wasting diseases. There are now in the Steppes several koumiss establishments where a large number of patients are treated annually. [1]

[1] *Koumiss*, G. L. Carrick, M.D.

The natives of the highest part of the Caucasian Mountains prepare a similar drink from the milk of cows and goats which they call "kephir." They make it by adding to fresh milk in goatskin bottles a peculiar ferment which is also called kephir. This substance is described as consisting of white or yellow balls of different sizes with an irregularly furrowed surface. They look like little cauliflowers and are often as big as waluuts. As to the origin of this ferment we know nothing. The mountaineers themselves have only various legends concerning it.

The balls after setting up fermentation in fresh milk grow and are removed, when the preparation of the kephir is complete, dried in the sun and used again for a fresh lot. The method of preparation and character of kephir are entirely similar to those of koumiss.[1]

ANALYSIS OF KOUMISS AND KEPHIR.

Wencki & Fabian (Polish Chemists.)

	Koumiss.			Kephir.		
DAYS OLD.	1.	2.	3.	1.	2.	3.
Specific gravity	1·041	1·037	....	1·032	1.026	....
Albuminoids	2·31	2·62	2·79	3·93	4·15	3·70
Alcohol	0·56	1·42	2·11	0·41	0·81	1·20
Lactic acid	0·45	0·56	0·78	0·51	0·43	0·83
Carbon dioxide	0·10	0·12	0·35	0·03	0·03	0.16
Sugar	4·02	2·45	1·25	2·04	1·82	1·37
Ash	0·52	0·50	0·48	0·61	0·68	0·68

The salts of milk are chiefly phosphates, chlorides and sulphates of potash, soda, lime and magnesia with a trace of iron. Lactic acid is generally present in milk, though it is doubtful whether it is contained in perfectly fresh milk. The quantity increases quickly on keeping from the fermentation of the sugar. It is an interesting discovery of quite recent date that cow's milk contains about 1 gramme per litre of citric acid, the acid of lemons. A good milk cow will afford daily as much citric acid as is contained in two or three lemons.

[1] Kaunhals, *Jahrsber, f. Thier Chem.*, 1884, p. 191.

When the residue left by evaporation of milk is burnt at a low red heat, the inorganic constituents of the milk remain behind as ash. The quantity of ash contained in cow's milk usually amounts to about ·7 per cent.

MEAN COMPOSITION OF THE ASH OF COW'S MILK.
(Schrodt and Hansen.)

Potassium Oxide	25·98
Sodium Oxide	10·75
Calcium Oxide	20·87
Magnesium Oxide	2·76
Iron Oxide	·13
Sulphuric Anhydride	3·99
Phosphoric Anhydride	23·63
Chlorine	15·08

The following Table compiled from various sources will enable us to compare the milk of different animals:—

ANALYSIS OF THE MILK OF DIFFERENT ANIMALS.

	Water.	Solids.	Fat.	Albu-min-oids.	Sugar.	Salts.
Human Milk	87·8	12·2	3·9	2·5	5·5	0·3
Cow	87·5	12·5	3·8	4·0	4·0	0·7
Sheep	78·7	21·3	8·9	6·3	5·1	1·0
Buffalo	81.7	18·3	9·0	4·0	4·5	0·8
Goat	86·4	13·6	4·4	4·5	4·0	0·7
Camel	86·9	13·1	2·9	3·8	5·7	0·7
Mare	90·1	9·9	1·1	1·9	6·6	0·3
Ass	90·5	9.5	1·3	2·0	5·7	0·7
Sow	82·4	17·6	6·4	6·1	4·0	1·1
Hippopotamus	91·0	9·0	4·5	4·4	...	0·1
Bitch	76·6	23·4	9·6	9·9	3·2	0·7
Cat	81·6	18·4	3·3	9·6	4·9	0·6
Porpoise	41·1	58·9	45·8	11·2	1·3	0·6

In order to form a judgment of the value of milk as a food, a few words as to the composition of the various substances which constitute the food of man and animals will be useful.

Nutritive substances may be classed as follows:—

1. Albuminoids.
2. Fats.
3. Carbohydrates.

Under this name are included sugar, starch and similar bodies.

4. Salts, chiefly phosphates, sulphates and chlorides of potassium, sodium, calcium, magnesium and iron.

5. Water.

The following table gives the average composition of the principal kinds of food :—

	Water.	Solids.	Albuminoids.	Fat.	Carbohydrates.	Salts.
Meat	75	25	18	6	..	1
Fowl	75	25	21	3	..	1
Fish	78	22	18	3	..	1
Bread	40	60	8	3	48	1
Potatoes	75	25	2	..	22	1
Milk	87	13	4	4	4	1

Meat is rich in albuminoids, poor in carbohydrates. Bread and potatoes are rich in carbohydrates and poor in albuminoids. It follows from the table given above that a pint and a half of milk is about equal in nutritive value to half a pound of meat and half a pound of potatoes—not quite so rich in albuminoids, but a good deal richer in fat. In milk, too, the food constituents are in a liquid form, which renders them particularly easy of digestion and assimilation, a point of vital importance in the case of the infant and the invalid

This brings us to the subject of milk adulteration. There is no article of food which it is more essential to the public welfare to obtain pure than milk; none which is more easily adulterated, none which has been adulterated more extensively and more shamelessly.

When the public analysts of Canada published their first report in 1876, two-thirds of the samples analysed were reported as adulterated. In 1882, this number was reduced to less than one-fifth. This is gratifying, but it is bad enough still.

Strange stories used to be told of the substances employed to adulterate milk. It was popularly believed, for example, that calves' brains were largely used for this purpose: Chalk, also, was popularly credited with being a common adulterant. All these stories are fables. Milk is adulterated in two ways: by the addition of water and by the abstraction of cream.

The detection of adulteration depends upon our ability to determine whether cream has been abstracted or water added. Pure milk contains 87 per cent. water, and unless the added water introduces some impurity which we can detect by analysis, there is no way of distinguishing it qualitatively from that of the natural milk. Certain tests have been proposed for this purpose. Thus it has been suggested that added water may be detected by the nitrates it contains, but our public supplies from the great lakes and river are practically free from nitrates. The presence of sulphates has also been regarded as proving the addition of water, the old analysis of milk ash showing either the merest traces of sulphates or none at all. But the recent analyses of Schrodt and Hansen, already quoted, demonstrate that milk ash contains nearly 4 per cent. of its weight of sulphuric acid as sulphates, so that in nearly every case we are obliged to form an estimate of the purity of the milk by determining the amount of solids and fat it contains, and comparing our results with the composition of genuine milk.

The methods used for milk analysis have had much attention bestowed upon them. We owe a deep debt of gratitude to Mr. Wanklyn for shewing us how a milk analysis can be simply and accurately effected. His book was published in 1873, and his method was to dry the milk on a water bath in a little flat-bottomed platinum dish and weigh the residue, and to extract the fat from such a residue with ether, evaporate the ether and weigh the residual fat. In this way he obtained the total solids and the fat. By subtracting the fat from the total solids he obtained the *solids not fat*, and he was the first to show the great value of this determination. He pointed out that of all the constituents of the milk, the fat was the only one which varied very much in quantity, the percentage of the other solids only differing within comparatively narrow limits in genuine milk, whether rich or poor.

Wanklyn maintained that the solids not fat in genuine milk never fell below 9·3 per cent., and that the fat never falls below 3 per cent. The English Society of Public Analysts adopted limits rather more favorable to the milkman, namely, 9 for the solids not fat and 2·5 for the fat. If a milk contained less than 9 per cent. solids not fat, it was considered watered, and if less than 2·5 per cent. fat without a corresponding decrease of solids not fat, skimmed.

The English Public Analysts almost universally adopted Wanklyn's method of milk analysis. The German chemists, on the other hand, usually mixed the milk with some insoluble powder, like sand or plaster of Paris, during the drying, for the purpose of obtaining the residue in a fine state of division, in which condition the fat is more easily removed by ether. Of late years, too, various appliances for continuous extraction, such as Soxhlet's, came into use. These methods are found to extract the fat from a milk residue more completely than Wanklyn's process; for milk drying up in a dish forms a horny mass, only penetrated with difficulty by solvents. Chemists using these processes got higher percentages of fat than those who used Wanklyn's. He, for example, gave 3·2 as the average percentage of fat, but Vieth, as the average of 1,300 analyses made in 1887, gives 3·82 as the average, and we found in Canada the average 3·86 per cent. of fat. Now this increase in fat lowers the solids not fat, and it gradually became evident that 9 per cent. of solids not fat was too high a limit.

In 1883, there was a famous milk case tried in Manchester, in which a milkman appealed from a conviction of selling adulterated milk. The public analyst found 8·62 per cent. solids not fat by Wanklyn's method. and reported the milk adulterated. A great number of analysts were called on both sides, and a good deal of evidence of a very conflicting character was given, the result being that the conviction was dismissed.

This contradiction of testimony drew great attention to the subject of milk analysis and milk limits. A committee of the Society of Public Analysts was appointed to investigate the matter, and the result of their labours and discussions was to show clearly that Wanklyn's method did not extract all the fat, and therefore should be discarded for one of those processes which did so, but that in that case the limit of 9 per cent. solids not fat was too high. While the committee were deliberating, one of their number, Mr. Adams, brought forward a new process which commended itself to them as the best hitherto proposed, and which they accordingly adopted.

It consisted in absorbing the milk in a paper coil, drying it and extracting the fat from the dried coil with ether in a Soxhlet's extraction apparatus. The very fine division of the milk solids enables the other to get at every particle of fat and remove it completely from them. The Society adopted the process and reduced their limit to 8·5 per cent. solids not fat.

Our chief analyst, Mr. Thos. Macfarlane, has introduced a method in which he absorbs the milk by asbestos in a special apparatus, dries and extracts with ether. This method is beautifully simple and extremely accurate, and enables a great number of samples to be analysed with a very little expenditure of time.

The public analysts of Canada had followed with deep interest this discussion, and they felt that before they could intelligently adopt this or any other limit, they ought to make a thorough trial of the new methods upon the milk of Canadian cattle. Upon representing these views to the Department of Inland Revenue, they were favourably received, and the plan was put into execution during the summer of 1887. One hundred and sixty-two samples of milk were taken by the collectors of Halifax, St. John, Quebec, Montreal and Toronto. Each sample represented the whole mixed milk of a herd of cows milked in the presence of the collector and the public analyst of the district. Altogether the samples represented the milk of about 1,600 cows. The samples were analysed in duplicate by the public analyst and (also in duplicate) by the chief analyst at Ottawa. The chief analyst used the asbestos method, and the average of this large number of analyses was as follows:—

Total Solids	12·48
Fat	3·86
Solids not fat	8·62

Those of us who used the method of the Society of Public Analysts obtained results almost identical with those of the chief analyst.

The following table summarises our results in the various districts:—

	Fat.			Total Solids.	Solids not Fat.
	Highest.	Lowest.	Average.	Average.	Average.
Halifax	5·40	3·00	4·24	12·72	8·48
St. John	4·62	3·43	3·91	12·45	8·54
Quebec	4·18	3·02	3·54	12·39	8·85
Montreal	5·17	2·80	3·82	12·29	8·47
Ottawa	5·29	3·62	4·26	12·93	8·67
Toronto	4·50	2·52	3·38	12·08	8·70
All Canada	5·40	2·52	3·86	12·48	8·67

These results demand the most serious consideration. It will be seen that in two out of the six districts the average of the solids not fat is less than 8·5. As a matter of fact, in 55 samples out of the 162 they fell below this number. In two samples from Halifax they even fell below 8 per cent., and in one sample from Toronto, which I took myself from the mixed milk of a herd of ten cows, the solids not fat were only just barely 8 per cent.

Nor are these results by any means unique. So long ago as 1863, Professor Voelcker published an analysis of the milk of a herd of fifteen cows, which gave 7·5 per cent. of solids not fat. Only the other day Mr. Lloyd read a paper before the Chemical Society of London, giving the analysis of the milk of two cows, in which the solids not fat varied for two months between, in one case, 8·63 and 7·5, and in the other case between 8·52 and 8·1.

Looking these facts fairly in the face, I do not see how we can come to any other conclusion than this: that if the solids not fat of a milk are over 8 per cent., we cannot certify that the milk is not genuine. Indeed in the case of the milk of individual cows the solids not fat may be even lower than this. But the average of the milk of our 1,600 cows was 8·62 per cent. solids not fat, and many of the samples gave over 9 per cent. of solids not fat. If, then, we pass all milks in which the non-fatty solids are over 8 per cent., we give dishonest dealers the opportunity to let their milks down to this standard. Indeed we invite adulteration if done with judgment and in moderation.

With good rich milk a gallon of water may be added to every nine gallons of milk, and still analysis will not prove, except as a matter of probability, that the milk is not genuine. Similarly half the cream may be removed from a milk like some of the Halifax samples without lowering the percentage of fat below that found in some of the samples of mixed cow's milk that we obtained ourselves.

Except then in very flagrant cases, the penalties of the Adulteration Act, as it stands at present, are but empty threats. What then, I repeat, can we do? I answer, there are two ways in which we can check this evil.

The first is publicity. If A is only judicious in his *adulteration and not too much of a glutton in his use of* the tap, we cannot certify that his milk is not genuine, but we *can* say that it is wretched stuff, and very much inferior to the average, and in particular to that of his rival B. And A doesn't like this. He fears, and with good reason, that his customers will forsake him for the man who gives better milk, and the chances are he will mend his ways.

This is what we have been doing. So far there has been very little prosecution under the Act, and what there has has not been very successful. The influence we have exerted has been almost exclusively that which comes from publishing our results. In 1876, when the Act came into operation, we found two-thirds of the samples of milk which we analyzed adulterated. In 1882 there were only one-fifth. Is it too much to ascribe this improvement to the moral effect of the publicity given to the work of the public analysts?

The other method which might be adopted is to fix by legislation a standard—a reasonable, fair standard—for milk, which must be reached by all milk offered for sale. The chief analyst has proposed such a standard as follows:—

Total Solid	12·0	per cent.
Butter Fat	3·5	" "
Solids other than fat	8·5	" "

Milk falling below these limits should not be permitted to be sold.

If this scheme were adopted and vigorously carried out, I think we should soon see a marked improvement. Not only would the addition of water and the removal of cream be checked, but the quality of the cows used for milk purposes would be improved. For if a cow did not give milk up to the standard she would be better fed and better housed; aud if she still did not give standard milk she would be sold to the butcher and replaced by a good milker. Quality as well as quantity would be sought for in dairy cows; and we know enough of what can be done by cattle-breeders to be quite sure that within reasonable limits we can get what we want.

Hitherto we have been considering milk as a food, and as the most perfect food imaginable for the purpose for which nature provides it. We have now to see how, under certain circumstances, it may become a poison, or may become the vehicle of a poison, as deadly as that of the rattlesnake.

It has long been known that every now and then severe illness has been caused by eating cheese. Now, in its normal state cheese is a most wholesome and nutritive article of diet; but from time to time cases of poisoning have occurred, and often cases of wholesale poisoning, which have been traced without any shadow of a doubt to cheese. It was formerly supposed that these cases were due to some mineral matter introduced into the cheese. But in many cases the poisonous cheese has been submitted to analysis and no trace of any mineral matter found. These cases of cheese poisoning, indeed, were a puzzle to both physicians and chemists. About six years ago, however, Dr. Victor C. Vaughan, of the University of Michigan, succeeded in isolating from some cheese of this character a poison which he called tyrotoxicon. This cheese had produced most alarming symptoms somewhat resembling cholera in more than 300 persons in the State of Michigan. This poison he referred to a very remarkable class of bodies, the so-called *ptomaines*, which have come greatly into notice of late years. These ptomaines are substances similar in constitution and properties to the alkaloids which are found in plants, and, like these, while many of them are quite harmless others are as deadly poisons as strychnine itself. They are found in decomposing animal matter of all kinds. It is from this circumstance that they have received the names of ptomaines, from πτωμα, a corpse. From their resemblance to vegetable alkaloids they are also called cadaveric alkaloids, or the alkaloids of putrefaction.. They are many of them crystalline bodies which form definite salts with acids and give well marked reactions with various chemical reagents. They appear to arise under certain conditions as products of the decomposition of albumen and allied bodies. This tyrotoxicon is derived from a peculiar decomposition of the casein of cheese.

Tyrotoxicon is a crystalline body which, when eaten in very minute quantities, produces in an aggravated form symptoms precisely similar to those of cheese poisoning. Since it is produced in cheese by the decomposition of casein, it would appear *a priori* probable that it might sometimes be formed in decomposing milk. This turned out to be the case. Soon after his discovery of this poison in cheese, Dr. Vaughan was able to detect it in a sample of milk which had been kept in a stoppered bottle for about six months, and subsequently in other samples of milk allowed to stand for three months in closed bottles.

In June, 1886, in the village of Lawton, Michigan, eighteen people were seized with most alarming symptoms after eating ice cream flavored with vanilla. A sample of the cream was sent to Dr. Vaughan, together with some of the vanilla which had been used in flavoring, which it was supposed contained the poison, since some lemon ice cream, from the same maker, had not affected those who ate it. To decide if the vanilla was poisonous or not Dr. Vaughan and his assistant applied a very practical test by swallowing three drops each of it. No ill effects following, the assistant took two teaspoonfuls more. As he remained unaffected, Dr. Vaughan decided that the poison was not in the vanilla, and proceeded to analyse the ice cream. From it he isolated tyrotoxicon, with which he next experimented. This time he did not use his assistant, but a cat. The cat was affected exactly like the Lawton patients.

Dr. Vaughan then found that by taking a small portion of the poisonous ice cream, he could, as it were, sow the infection in perfectly fresh milk, and cause the development of tyrotoxicon in it. To a quart of perfectly fresh milk he added a small piece of the Lawton ice cream and set it in his cellar. Next morning he added another quart of milk and then mixed with eggs and sugar, so as to make a custard. On the following morning Dr. Vaughan tasted the custard and was taken very ill; not so ill, however, as to prevent him isolating tyrotoxicon and poisoning a kitten with it. At 2 p.m. he took a teaspoonful himself, and was seized with violent vomiting and purging and intense headache. Delighted with the success of his experiment, and feeling a little better at 3 p.m., he took another teaspoonful, with equally satisfactory results.

Since then other workers have confirmed Dr. Vaughan's conclusions, and there is no doubt that under certain circumstances a very dangerous poison is formed in milk. It is not a product of the ordinary decomposition of milk, but is evidently caused by a peculiar ferment, which fortunately is only rarely present. In all probability it will be found that this peculiar fermentation is due to some micro-organism. It is very unstable: standing in an open vessel will often cause all trace of it to disappear from a milk in which its presence had previously been shown. It appears to be developed most readily in bottles closely stoppered. And these facts are not without their practical bearing.

Milk is sometimes supplied to dealers in glass bottles. Now unless these bottles are most scrupulously cleaned after using, before being refilled, we have all the conditions, so far as we know them, most favorable to the development of this poison.

From what has been said already it will be evident that the decomposition of milk may take place in several different ways. The usual way is what is called the "lactic fermentation." In this form the decomposition appears to start in the milk sugar, part of which becomes converted into lactic acid and the milk turns sour. The formation of this lactic acid, coagulates the casein and the milk curdles. Then the casein and albumen molecules break up into simpler molecules. Carbon dioxide, ammonia and other bodies are formed. Carbon dioxide is continuously evolved from milk during decomposition, but only in a very moderate quantity.

This form of decomposition has been shown to be due to a micro-organism—the *Bacterium lactis*—minute bodies in the form of beads strung together or in that of threads. They grow and increase in number by a process of *fission*—that is one of the minute cells, divides, so as to form two individuals, and these in their turn divide again. The bacteria feed upon the sugar and albuminoids of the milk, and thus in some way bring about that peculiar form of decomposition which is known as the lactic fermentation.

The presence of acid checks the lactic fermentation, so that under natural conditions only part of the sugar is converted into lactic acid. But if chalk is added to neutralize the acid as it is formed, the whole of the sugar may be changed into lactic acid.

The alcoholic fermentation which takes place in koumiss and kephir is also due to minute fungus, the *Saccharomyces cerevisiæ*, or ordinary beer yeast—the same plant which causes the fermentation of beer, wine and the wort from which spirits are distilled. It is a plant similar somewhat in appearance to the *B. lactis*, but much larger.

Sometimes another kind of fermentation occurs—the butyric. The product in this case is butyric acid, and it is attended by a most abominable stench. This kind of decomposition is due to another microbe—the *Bacillus subtilis*, or, according to others, an allied form, *Clostridium butyricum*.

There is no doubt that the peculiar fermentation which leads to the formation of tyrotoxicon is due to another of these microbes, but the particular microbe is not known.

Nature as an Educator.[1]

By Sir William Dawson.

In the winter of 1856-7 I had the honor of delivering the introductory lecture of our Sommerville course, and took as my subject "Natural History in its Educational Aspects." Now, after the lapse of thirty-three years, and after the great changes which have occurred since that time, I desire to recur to the subject, and to ask what is the present aspect of nature as an educator relatively to education in general and to a society like this.

Let us consider in the first place how early, continuous and persistent are the operations of nature as an educator, regarding nature as a general name for all those objects which come under the cognizance of our senses, and from which we derive sensations and perceptions. It is scarcely necessary here to make any exception in regard to things artificial, for in reality these are all merely adaptations and imitations of nature. Nor need we inquire as to the reality or the origin of these objects, but may take them as the environment surrounding us on every side, and at all times more or less presenting itself to us.

From the moment when we first open our eyes on the outer world we are receiving impressions from external nature, which go on extending and multiplying at least until our attention is called away by pursuits and studies relating to the artificial life of man, and even then we recur when we can to nature as our most grateful teacher, nay, the friend and companion whose teaching has no hard tasks but is all pleasure. The weary schoolboy gladly turns

[1] Annual Presidential Address before the Natural History Society of Montreal.

away from dry text-books to ramble in the fields and woods. The child whose worldly horizon is limited by a dirty street or dull backyard rejoiçes to see grass and flowers and trees, and drinks in inspiration from them. Sitting one Sunday afternoon at the open window looking out on the college grounds, I saw a working-man walk past with a little girl at his side. Coming opposite the bit of old-fashioned, poorly kept garden, which thirty years ago I had managed to carve out of the unwholesome swamp which then lay in front of our college terrace, the child stopped to look at it, and said, "Papa, is that the Garden of Eden?" The poor little thing, who had perhaps never seen anything of a garden but the outside of its fence, had heard that once there had been a garden of the Lord—a free and happy abode of man. Some years ago I knew of a boy dying of consumption in a poor home, to whom a kind lady sent a bunch of rich purple grapes. He gazed at them, fondled them, could scarcely be persuaded to taste them, and said, "How pretty! I have heard of grapes, but I never had any before." Coming home some time ago from a little excursion in which I had secured some deer's antlers, I happened to drive up from the station at the early morning hour when our streets are swarming with factory hands going to their work, and I noticed how everyone turned and stopped to look at my prize, and how the faces of many lighted up as they saw in imagination a view of wild woods and bounding deer, which perhaps remained with them as a pleasant thought through the day. How is it that our boasted civilization shuts out so many from contact with nature? The God who long ago led Israel out of bondage provided that every Hebrew family should have for its very own some strip or patch of the green sward of the promised land, and the Great Teacher who came long after, drew His favorite texts from the trees, the flowers, the grass, the birds and the beasts. It is not the will of God that we should imprison ourselves between four dingy walls in the midst of His beautiful world.

But it may be said that the rustic who dwells in field and forest has as little of the real companionship of nature as the dweller in towns. I doubt this, except in cases where mental or moral degradation has reduced the countryman to a mere machine. I have found much genuine love of nature and appreciation of natural things in the country, especially in those parts in which good education has been provided for the young. Even in city life this love requires but to be ever so little encouraged and it will come to the front with a bound.

If we ask how this is to be done, why should we not have teaching as to nature in homes and schools: little museums in schools, greater and really popular ones for our cities, botanical gardens open to all, zoological gardens where means permit? Why should not excursions into parks or the country, or visits to museums be made a necessary part of school instruction? The answer is simply because we are not sufficiently civilized to understand these things. Unfortunately also we make mistakes in our mode of introducing them. The mistakes in education here as in most other subjects are portentous. Mere book-learning or cramming of hard names for an examination is not study of nature, nor is mere laboratory work. Educators and the public are apt in these matters to rush from one extreme to the other. Seeing the folly of mere book tasks, it was decreed that there should be practical teaching. Teachers must dissect frogs and other creatures and teach their pupils to do the same. The result has been failure and damage to the knowledge of nature. It is one thing to see an animal alive and carrying out its natural instincts; quite another to cut up its dead carcase and learn hard names for its parts. A boy learns ten times more of nature by watching the frogs swimming and diving in a pond than by cutting them up ever so cleverly. I do not say that the laboratory teaching is useless when managed by a skilful and sympathetic teacher who can point out the meaning and uses of structures and their homologies with those of other animals. It has a real scientific use, but ordinarily it degenerates into a mere task and cram, and has as much relation to true science as the trade of a butcher has to that of an artist. A curious illustration of this was presented some years ago, when it was decreed in England that Hygiene should be taught in the schools. The subject was a popular one, and would have been taken up with enthusiasm. But unfortunately it had been represented to the Committee of the Privy Council that it was necessary that the pupils should have learned Physiology before entering on Hygiene. Here was a difficulty which the teachers at once felt. Physiology was an unpopular subject. The trained teacher had learned to take his pupils through the anatomy of a few common animals; but to him a frog or a crayfish was no more than a sum in arithmetic, something to be learned as a matter of dissection and dry anatomy. The subject consequently was repulsive both to pupils and parents, and if this ordeal had to be first gone through there was an end of hygiene. Thus by a strange inversion of education and science, one of the most attractive and useful subjects had become a bugbear. It is to be hoped that just as English educators have got over many other follies they have also surmounted this.

One would fancy, however, that there is still need for reform, from the following terse and pungent summary of the matter in a recent address before the Royal Microscopical Society by its president, Dr. Hudson :—

"Which, then, is the more scientific treatment of a group of animals—that which classifies, catalogues, measures, weighs, counts and dissects, or that which simply observes and relates; or, to put it in another way, which is the better thing to do, to treat the animal as a dead specimen or a living one?—

"Merely to state the question is to answer it. It is the living animal that is so intensely interesting, and the main use of the indexing, classifying, measuring and counting is to enable us to recognize it when alive and to help us to understand its actions."

He goes on to contrast the position of the mere learner of structures and hard names with that of the country lad who has studied nature in her own haunts :—

"He has watched the cunning flycatcher leaving her obvious, and yet invisible young, in a hole in an old wall, while it carried off the pellets that might have betrayed their presence; and has stood so still to see the male redstart that a field mouse has curled itself up on his warm foot and gone to sleep. He gathers the delicate buds of the wild rose, happily ignorant of the forty odd names under which that luckless plant has been smothered; and if, perchance, his last birthday has been made memorable by the gift of a microscope, before long he will be glorying in the transparent beauties of *Asplanchna*, unaware that he ought to crush his living prize in order to find out which of some half-dozen equally barbarous names he ought to give it."

Practically, to give young people in cities the benefit of all this, it is necessary to have museums and public gardens. A very small collection, representing any definite series of objects, properly named and associated with those relations that give them interest, is of the greatest value. Larger public museums have wider uses. I have been struck with this in visiting the Liverpool Free Museum, where every object is so labelled as to tell something of its story, and where crowds of learners are constantly receiving instruction from well-prepared specimens.

Our little museum is capable of similar uses, but it requires much better display and labelling of its treasures, and funds to enable the Society from time to time to add to its attractions by introducing new objects. Public gardens, whether botanical or zoological, are also of the greatest use. I know of nothing which any of our patriotic citizens could do of greater utility than the opening of such a place where the useful and ornamental plants and the various animals of our own Dominion and of other countries could be seen and studied. Lastly, means should be provided for taking children under competent guidance on field excursions and to visit places of note and interest.

All this may be said to be desultory and unscientific, but it will lead to more precise knowledge, and will serve to develope the tastes and powers of those who are capable of doing better and higher work.

My own early training in this matter was when there were in most parts of this country neither public museums nor laboratories nor systematic teaching, and it had for stimulus and guidance merely the encouragement given at home by parents who saw that the pursuit of natural history was an elevating one, and of one or two teachers who themselves cultivated some branches of natural science. As a boy I collected indiscriminately fossils, minerals, plants, insects, and later added to these birds, which I had learned to prepare, and the shells and other organisms of the sea. When I became the happy possessor of a microscope, such as could be had in those early days, I went largely into the minute forms of aquatic life and sketched their structures and noted their habits, becoming familiar thus with some curious animals and embryonic forms, which only long afterwards were rediscovered as described by naturalists, though most of those I met with *were already known and described, but not in works* then accessible to me. I had no idea of studying merely the forms and structures of these creatures and knowing their names. To me they were living things, having strange ways and modes of thinking and acting of their own. They were truly acquaintances and friends, with whom I communed in private and who were my most pleasant teachers. It was for this reason that eventually I gave up all the others for the fossil relics of former life, because these, in addition to the living interest of the modern forms, possessed that fascination which arises from antiquity and from the stimulus to imagination given by their varied and often obscure relations to the past and present.

Judging from such experiences, I believe that it is best for young people to expatiate over a wide field of natural learning and afterwards to select any special field. On the other hand young people destitute of any developed taste for general knowledge, and introduced to special studies at first, will very likely beeome the crudest and narrowest of thinkers and at once the readiest recipients of fanciful hypotheses and the most stubborn sticklers for mere details and names.

In order to bring these desultory thoughts to some more practical issue, let us think for a little on the uses of the study of nature, whether we regard these in relation to the forming of the character and promoting the happiness of the student or to business utilities to which knowledge of nature may be applied. At present we hear much of applied and technical science, and these are daily showing their inestimable value, but it must be borne in mind that the science that enables us to smelt an ore, to construct a machine or a bridge is useful only in so far as it promotes the welfare and happiness of humanity. Apart from these it would be wholly unpractical and useless. That teaching of science, on the other hand, which exalts and ennobles the man and developes his higher nature, even if it have no technical applications, is that which is directly practical in the highest sense. I do not say that these are necessarily two distinct kinds of teaching. They may be and should be combined, and while we seek principally to promote by the study of nature the well-being of the man himself, we must never forget the multiform uses of science in promoting human welfare through technical applications. We may return to this thought, but in the meantime I desire to speak of nature as an educator of the man himself, and especially of those powess which make him distinctively a man and the very image of God.

The president then referred in detail to the educational uses of nature in training the observing powers and those of comparison and causation, to its bearing on the culture of true and high art, and to the large views to which it leads of the universe as an ordered and regulated cosmos. He then proceeded as follows :—

I may be pardoned here for directing your attention for a few minutes to the testimony of a writer eminent as an authority in art and full of true feeling for nature, both in reference to its direct ability to the thinking mind and its indirect utility as a means of furthering material interest. Ruskin thus discourses on these points :—

"That is to everything created, something pre-eminently useful, which enables it rightly and fully to perform the functions appointed to it by its Creator. Therefore, that we may determine what is chiefly useful to man, it is necessary first to determine the use of man himself. Man's use and functions (and let him who will not grant me this follow me no farther, for this I purpose always to assume) is to be the witness of the glory of God, and to advance that glory by his reasonable obedience and resultant happiness.

"Whatever enables us to fulfil this function, is in the pure and first sense of the word useful to us. Pre-eminently, therefore, whatever sets the glory of God more brightly before us. But things that only help us to exist are, in a secondary and mean sense, useful, or rather, if they be looked for alone, they are useless and worse, for it would be better that we should not exist than that we should guiltily disappoint the purposes of existence.

"And yet people speak in this working age, when they speak from their hearts, as if houses and lands and food and raiment were alone useful, and as if Light, Thought and Admiration were all profitless, so that men insolently call themselves Utilitarians, who would turn, if they had their way, themselves and their race into vegetables; men who think, as far as such can be said to think, that the meat is more than the life, and the raiment than the body, who look to the earth as a stable, and to its fruit as fodder; vine-dressers and husbandmen who love the corn they grind, and the grapes they crush, better than the gardens of the angels upon the slopes of Eden; hewers of wood and drawers of water, who think that the wood they hew and the water they draw are better than the pine-forests that cover the mountains like the shadow of God, and than the great rivers that move like His eternity. And so comes upon us that woe of the preacher, that though God "hath made everything beautiful in his time, also He hath set the world in their heart so that no man can find out the work that God maketh from the beginning to the end."

"But the common consent of men proves and accepts the proposition, that whatever part of any pursuit ministers to the bodily comforts and admits of material uses is ignoble, and whatsoever part is addressed to the mind only is noble; and that Geology does better in re-clothing dry bones and revealing lost creations than in tracing veins of lead and beds of iron; Astronomy better in opening to us the houses of heaven than in teaching navigation; Botany better in displaying structure than in expressing juices; Surgery better in investigating organization than in setting limbs; only that it is ordained that, for our encouragement, every step we make in the more exalted range of science adds something also to its practical applicabilities: that all the great phenomena of nature, the knowledge of which is desired by the angels only, by us partly, as it reveals to farther vision the being and the glory of Him in whom they rejoice and we live, dispense yet such kind influences and so much of material blessing as to be joyfully felt by all inferior creatures, and to be desired by them with such single desire as the imperfection of their nature may admit; that the strong torrents which, in their own gladness, fill the hills with hollow thunder and the vales with winding light, have yet their bounden charge of field to feed and barge to bear; that the fierce flames to which the Alp owes its upheaval and the volcano its terror temper for us the metal vein and quickening spring, and that for our incitement—I say not our reward, for knowledge is its own reward—herbs have their healing, stones their preciousness, and stars their times."

But in that time of confused and bewildering philosophies in which we live it may be asked, Is this really the case? Does not the study of nature rather lead to positivism and agnosticism. That it may do so is, I fear, too obvious. That this is its legitimate tendency may be emphatically denied. The case stands thus. Nature is to any rational man of science an exhibition of superhuman force, energy, power. It is in like manner an exhibition of regulated and determined power, of power under law and working to definite ends, and this with so complete and intricate machinery that it is beyond human comprehension. That this should be a result of mere chance without will or design is infinitely improbable. That it results from the operation of an all-powerful will and intellect is a conclusion based on all we know of ourselves.

The matter has been well summarized by a former pupil of my own, now a missionary in India, Rev. A. R. MacDuff, B.A. He says in effect :—

1. The apparent universe is phenomenal. A reality must be behind it, The things which are seen (the phenomenal) are necessarily temporal, the unseen is the eternal.

2. This reality must be persistent, not temporary. God only hath immortality.

3. This Divine reality must be incomprehensible in its essence and in the extent of its working. "Canst thou by searching find out God ?"

4. But this incomprehensible reality is everywhere present in the most minute as well as in the grandest phenomena, in the fall of a sparrow as in the creation of a planetary system. "Whither shall I go from thy presence ? In Him we live and move and have our being."

5. This infinite reality is more nearly akin to the spiritual nature of man himself than to any other energy known to us. It is, therefore, living, personal and free. "He that made the eye shall He not see ?"

So far the teaching of nature may carry any man willing to be guided by his own senses and reason. Beyond this lies the sphere of revelation, or that of direct communication of the Divinity with man. With revelation nature has nothing directly to do, except that it can see its possibility —for just as the Divine mind can reveal itself in the instincts of an animal, so it must be able to influence and inform the higher nature of man.

Here, however, we can reach an easy and plain possible solution of all the difficulties which half-informed men heap up around the relations of science and revelation. Given the admission that the phenomena of nature are not merely imaginary but based on a reality, and given the admission that the Divine reality has revealed Himself to inspired men or through a Divine Man, and supposing that scientific study on the one hand and Divine revelation on the other may deal with the same phenomena, certain conclusions as to their relations at once become obvious. (1) Scientific inquiry being inductive must proceed from individual facts by slow and gradual steps to general laws, while revelation may state the laws at once without descending to particulars. (2) It follows that these two lines of thought approach phenomena from different sides. One takes them in detail and then generalizes. The other regards them as emanations of a Divine mind. (3) At first the results reached may be far apart and may seem contradictory, but as they become more perfect they must approach and eventually coalesce.

The case is as if we imagine some great mill or machine-shop to be studied by two different persons in different ways. The first may be a skilful machinist and may enter the factory, note-book in hand, and examine each machine and process, and so arrive at last at a knowledge of the whole which may enable him accurately to describe all its machinery, and to form conclusions as to its uses and relations. The second may be no machinist, but an educated and intelligent man. He is introduced to the superintendent of the factory as his guest, and learns from him its general nature and uses, the history of its inception and growth and his plans for its future improvement and development. All this he may learn without any study of the machinery; and he also may write an account of what he has seen and heard. But how different will be the two productions, and how difficult might it be for a third person to combine the two accounts, so as to make plain their mutual coherence. This could only be done by some one enjoying the double advantage of the friendship of the superintendent and the technical knowledge of the machinery. So it must ever be with science and revelation; and until men equally appreciate both, we cannot have the best results either in Science or in Theology.

Revelation itself has been defined on the best authority as relating on its practical side to three great graces, Faith, Hope and Love, the greatest and most enduring of which is the last, for God Himself is Love. In regard to love or kindly affection as a motive and practice, science cannot doubt that however little of this may be seen in the lower strata of nature, it is and must be the soul of its higher forms. Hope as to this is apparent in all even of the speculations of rational science, for pessimism is not scientific. With reference to faith as a scientific grace there may be more doubt, but this is dispelled by the consideration already referred to, that nature itself teaches of the unseen, and that the foundation of science is a belief in our own intuitions, in the evidence of our senses and in the reality underlying phenomena. Without faith, therefore, science could not exist any more than religion. This being the case, it becomes plain that however faith or religion may for a time be dissociated from experiment, observation and induction, they must ultimately be resolved into a rational unity. Science must admit that she is the handmaid of religion, and religion must say to science that she is no more a servant but a friend. If we are true students of nature we shall all more and more approach to this conclusion as we rise from one step of knowledge to another, and obtain broader views of nature and a better comprehension of the superlative littleness and infinite greatness of man himself as a part of nature and as the image of God.

In conclusion, the address referred to the work of the Society in the past sessions. It appeared from the records that fifteen original papers were read at the monthly meetings, the greater part of which have been published in the journal of the Society — *The Canadian Record of Science.* Of these papers seven were on Geological and Mineralogical subjects, and contained many new and important facts in Canadian Geology and with reference to the mineral resources of our country. The authors were Dr. Harrington, Prof. Donald, Mr. Deeks and the President. The remainder were on new facts in Biological Science, both Zoological and Botanical. The authors were Prof. Penhallow, Prof. Wesley Mills, Rev. Dr. Campbell, Mr. Caulfield and Mr. Stevenson. Two papers of great interest in Canadian Science, as well as in relation to eminent Canadians, were that in the career of the late Prof. C. F. Hartt by Mr. G. F. Matthew and the Biographical Sketch of the late Mr. Charles Gibb by Prof. Penhallow.

Charles Gibb, B. A.

Mr. Charles Gibb, son of the late James Duncan Gibb, was born in Montreal on the 29th of July, 1845. His early education was received at the Bishop's College Grammar School, from which he proceeded to McGill University, where he graduated in 1865. The hard work of a college course told somewhat severely upon a not very rugged constitution, with the result of impaired eyesight. For the purpose of recovering his health he then visited Europe, where he spent six months, returning very much benefited by the change. Natural weakness of the lungs, however, induced him to seek some active occupation which would give the benefit of open-air employment. This led to his spending several years with some of the more prominent fruit culturists of New York and New Jersey, from whom he gained a practical insight into the most approved methods of fruit culture. It was this experience which soon aroused a decided taste for horticulture, and eventually led to his adoption of that pursuit into which he threw so much energy and enthusiasm. Fortunately for himself and for the country whose good he sought to promote, Mr. Gibb was possessed of means sufficient to enable him to execute his plans withont undue restriction, and future generations will have reason to hold in respect the name of one who, in so unselfish a spirit, endeavored to promote the welfare of his country in one of the most useful directions possible.

On his return from the States in 1872, he sought for a locality where he might pursue special studies in fruit culture and arboriculture, and eventually selected the warm, western slope of Yamaska mountain at Abbotsford, as fully meeting his requirements. In 1873 he purchased a large tract of land there, planted extensive orchards, established testing grounds for exotic trees and shrubs which might prove of value in Canada, and stimulated a local interest in his chosen pursuit, hitherto unknown in that part of Quebec. Here he established a delightful home, the door of which was constantly open to his many friends, all of whom have, on more than one occasion, experienced the full measure of his most generous hospitality. This Society has special reason for holding Mr. Gibb's charming retreat and his warm hospitality in remembrance. Two of their most profitable and enjoyable Field Days were those held at Abbotsford.

Of a somewhat retiring disposition, strangers were not drawn to him as quickly as they might be to many others, but even a brief acquaintance was sufficient to reveal qualities which were certain to cement a warm and enduring friendship, while to those who knew him best, his greatest fault lay in a modesty which permitted him to sacrifice a just appreciation of his own merits. Possessed of a warm heart, it was his first desire to see others about him happy, and had this idea not been carried out rather too unselfishly, doubtless his home would have known the blessing of a partner in his useful work. Though not a man of large means, he conscientiously endeavored to make the best use of what he possessed, and while his modesty forbade any ostentatious display, he accomplished a large amount of good in many directions. He was an active supporter of the Art Association of Montreal, a contributor to most of our public charitable institutions, and a warm supporter of those societies whose work lay in the promotion of science and horticulture. He contributed in many ways to the work undertaken by McGill College in promoting the study of science, his various donations at different times being most judiciously applied. Among other gifts of a similar nature, he, on more than one occasion, made valuable donations of trees and shrubs, which are now growing in the College grounds, and constitute an important element in the foundation of the Botanic Garden now in process of development.

As a pomologist Mr. Gibb was justly accorded a high position, and his writings on this subject will have a lasting value. Whatever he undertook to do was executed with a degree of intelligent interest and thoroughness which left little to be desired, and it was his most conscientious scrutiny of facts which has given character to his various writings, as being thoroughly reliable statements. The same thoughtful care and attention to details was evident in the expressions contained in his last letter, indited only two days before his death, of the near approach of which he was conscious.

Mr. Gibb died of pneumonia at Cairo, Egypt, on the 8th March, 1890. To all who knew him his death is a personal loss; to his more intimate friends, it is the loss of a brother; to his country, for whose walfare he nobly and generously toiled, and in whose interest he was making a prolonged tour of foreign lands when death overtook him, it is the removal of one who filled an important place in our material progress, one who could not well be spared.

Although not a scientific man, he had given such close and accurate attention to fruit culture as to make him eminent among the pomologists of this continent, while his name was well and favorably known throughout Europe. It is therefore desirable that his work in the interests of improved horticulture should receive consideration.

Mr. Gibb was a life member, and in 1879-81, vice-president for Quebec of the American Pomological Society; corresponding member of the Mississippi Valley Horticultural Society; corresponding member of the Massachusetts Horticultural Society; honorary member of the Nova Scotia Fruit Growers' Association; member of the Natural History Society of Montreal, and a member and, at the time of his death and for several years previous, vice-president of the Montreal Horticultural Society and Fruit Growers' Association of the Province of Quebec. He founded the Abbotsford Fruit Growers' Association, was its leading spirit to the day of his death, and at various times held most of its leading offices. He took a most active part in the recent efforts to establish a Botanic Garden in the city of Montreal, and was at all times one of the leading and most useful members of the Montreal Horticultural Society, to whom his loss comes as a most serious one. At the time of the Indian and Colonial Exhibition at London, he was one of the principal promoters of the important fruit exhibit then made.

In 1882, acting upon a suggestion made by Prof. Wm. Saunders, while president of the Ontario Fruit Growers' Association, and impressed with the need of a better acquaintance with the fruits of the old world, in order to determine how far improvements in our own fruits could be made through the importation of and crossing with those from similar and colder climates, Mr. Gibb, in company with Prof. J. L. Budd of Ames, Iowa, visited various parts of Russia and Northern Europe, and brought back information of great value. The expenses of this journey were wholly met by the private means of these two gentlemen The knowledge gained was subsequently embodied in several valuable articles published in the reports of the Montreal Horticultural Society and elsewhere. In 1888, Mr. Gibb visited California in the interests of fruit culture, and in June, 1889, he started on a journey through the east, for the purpose of more closely examining their various fruit products. Proceeding to Japan by way of Vancouver, he traversed the "Island Empire" from one end to the other, and was particularly interested in examining the resources of the northern Island of Yeso, which, on account of its high latitude, he felt sure was likely to yield many plants which would prove of great value in Canada. There he met with every attention from various officials to whom he had letters of introduction, and through whose courtesy he was enabled to carefully examine many localities of interest. The notes he took during this part of his travels undoubtedly contain a large amount of material of special value, and it is to be hoped that it may be possible to publish them at some future time. From Japan he proceeded to Hong Kong, Ceylon, Calcutta, Bombay, and thence to Cairo, where his fatal illness overtook him.

The work undertaken by Mr. Gibb, in the line of practical horticulture, was of the greatest importance to Canada, and more especially to Quebec, where the kinds of fruit which can be successfully grown are necessarily limited. At Abbotsford he had established extensive orchards of Russian fruits, which he was testing not only for quality, but for climatic adaptation and their value for purposes of hybridizing with native and less hardy kinds. Most of these trees are yet very young, but some of them have attained that age at which they are in a condition to yield important results. An extensive plantation of fruit and ornamental trees was also an important feature of his work, and had he been spared for another decade, valuable results would have been secured from a work wisely conceived and intelligently prosecuted. Though not known as an originator, one fruit will serve to transmit his name to future generations of pomologists. The Gibb Crab, a most delightful fruit of its class, was discovered by Mr. Gibb in the orchard of Mr. Peffer of Pewaukee, Wisconsin, by whom it had been overlooked, but who promptly named it in honor of him who had rescued it from oblivion.

Mr. Gibb's writings upon horticulture are somewhat numerous and of very considerable value. Almost his first contribution was the publication of "A Fruit List for the Province of Quebec." This little pamphlet was published in 1875, by the newly organized Fruit-Growers' Association of Abbotsford, and led to the issue, in the following year, of a "Report of the Fruit Committee of the Montreal Horticultural Society for 1876." The publication of this report was secured by Mr. Gibb in the face of great obstacles, but its importance demonstrated the need of an annual publication of the work of the Society. It thus came to be the first of a series of annual reports to which Mr. Gibb contributed largely, and which, through the valuable character of the material they contain, have gained a high reputation both at home and abroad. Perhaps Mr. Gibb's most important publication is his contribution to "The Nomenclature of our Russian Fruits." This paper was prepared at the request of the American Pomological Society, and offers at once a most careful, exact and authoritative revision of the names of Russian fruits imported into America, extant. It is a monument to the zealous and painstaking care of one who verified his statements in every possible way before giving utterance to them. The following list of publications will best serve to express the character and extent of his work:

1. "Report on Quebec Fruits," Rept. Amer. Pom. Soc., 1874, p. 33.

2. "A Fruit List for the Province of Quebec," published by the Abbotsford Fruit Growers' Association, 1875.

3. "Report of the Fruit Committee of the Montreal Horticultural Society," first An. Rept. M. Hort. Soc., 1876.

4. "Propagated Seedlings and Other Undescribed Fruits," Rept. Mont. Hort. Soc., 1876, p. 19.

5. "Report on the Fruit Growers' Association of Abbotsford," Rept. Mont. Hort. Soc., 1876, p. 67.

6. "Notes on Outdoor Grapes," Rept. Mont. Hort. Soc., 1879, p. 54.

7. "Ornamental and Timber Trees," Rept. Mont. Hort. Soc., 1881, p. 58.

8. "The Work of the State Agricultural College at Ames, Iowa," Rept. Mont. Hort. Soc., 1881, p. 151.

9. "Russian Fruits," Rept. Mont. Hort. Soc., 1882, p. 17.

10. "Hasty Notes on Trees and Shrubs of Northern Europe and Asia," Rept. Mont. Hort. Soc., 1882, p. 99; Rept. Ont. Fruit Growers' Association, 1883, p. 302.

11. "Catalogue of Russian Fruits Imported by the U.S. Department of Agriculture in 1870," Rept. Mont. Hort. Soc., 1883, p. 52.

12. "Report on Russian Apples Imported by the U.S. Department of Agriculture in 1870," Rept. Mont. Hort. Soc., 1883, p. 58.

13. "Report on Russian Fruits with Notes on Russian Apples Imported in 1870 by the U.S. Department of Agriculture," Rept. Ont. Fruit Growers' Association, 1883, p. 192.

14. "Siberian Apples and Their Hybrids," Rept. Mont. Hort. Soc., 1884, p. 33.

15. "Hardy Fruits in Wurtemburg," Rept. Mont. Hort. Soc., 1884, p. 19.

16. "Ornamental Trees," Rept. Mont. Hort. Soc., 1884, p. 50.

Proceedings of the Society.

The regular monthly meeting was held on Monday the 21st of April, Sir Wm. Dawson presiding.

Mr. Shearer, on behalf of the Excursion Committee, reported that Lachute had been selected for the annual field day, and that Saturday the 7th of June had been decided upon.

The following donation to the museum was reported by the Curator:—

Prairie horned lark, by Mr. F. B. Caulfield, for which the thanks of the Society were tendered the donor.

It was moved by Mr. Sumner, seconded by Mr. Beaudry, "that proposals for membership may be submitted to the Council at their monthly meetings and balloted for at the first meeting of the Society following." Carried. Balloting for new members resulted in the election of James Paton, Dr. F. J. Shepherd and George Boulter.

The Corresponding Secretary was instructed to invite the Ottawa Field Naturalists' Club and other societies from that city to participate in the field day excursion of this Society.

Sir William Dawson offered a paper "On the name Quebec Group as applied to certain Canadian Rocks."

Mr. H. T. Martin submitted a few notes on the beaver, and Mr. F. B. Caulfield read a contribution on the subject of "Our Winter Birds."

The annual meeting of the Society was held on Monday the 26th of May, when the following reports were read and adopted[1] and ordered to be printed in the *Record of Science.*

Mr. President, Gentlemen,

On behalf of your Council I have the honor to report.

The work of the Society for the year has been successful and attended with much interest.

The Society has had six general meetings, the Council ten meetings, three of which were special ones.

[1] The Presidential address will be found printed in full on p. 171.

Twenty-three new members were added to the list, five less than last year against twelve the year previous.

It is my painful duty to record the removal by death of the following of our members:—Chas. Gibb, Andrew Robertson, Jas. Hutton, Thos. Workman, Hon. Thos. Ryan and Dr. Barnes.

All the departments have received due care. The library has received more attention than any other year, and special thanks are due to the honorary librarian, who has attended regularly every week arranging the books and the catalogue.

Thanks are also due to the honorary curator for the time he has devoted to the museum. An important change has been made by the appointment of a Museum Committee, with the object of dividing the work, which had become very onerous.

We are also indebted to the Editing Committee and its chairman for the success of our journal.

The Sommerville course of lectures—seven in number—attracted more interest than previously. They were as follows:—

February 20—Food without and within the body, Dr. Wesley Mills, M.A.

February 27—Tea and coffee, Dr. J.P. Girdwood, F.R.S.C.

March 6—Flour, Prof. J. T. Donald, M.A.

March 13—Drinking water, Dr. R. F. Ruttan, B.A.

March 20—Food diseases, Dr. W. G. Johnston.

March 27—Jewish dietary law, Rev. Meldola de Sola.

April 3—Milk, Prof. W. H. Ellis, M.A., M.D.

Mr. P. S. Ross, our late treasurer, is entitled to our gratitude for a donation of $25 for the special purpose of illustrating *The Record.*

But Messrs. J. S. Brown and J. S. Shearer deserve more than a passing notice of the successful efforts and zeal displayed in finding the funds and improving the interior of the building.

The members and friends who have contributed to present to the Society the portrait of our worthy and respected president are also deserving your thanks.

The Government grant of $400 has been received and used for the publication of our journal.

The Council has passed a new by-law, so that proposals for membership to the Society are submitted to the Council and balloted for at the following general meeting, thus avoiding delays and yet leaving the names of candidates posted a sufficient length of time.

Our delegate to the Royal Society of Canada has been instructed to ask that Society to hold its meeting of 1891 in Montreal. It is to be hoped that there will be no serious objection to that project.

The field day was held on the 8th of June, at St. Eustache, and was enjoyed by a large number of members and their friends. There was only one collection entered for prizes —a collection of 34 specimens of named plants by Dr. Blackader.

In closing I may mention the attentive assistance your superintendent cheerfully renders to all the officers of the Society.

The whole respectfully submitted,

J. A. U. BEAUDRY,
Pres. of Council.

CURATOR'S REPORT, 1889-90.

The past year has been one of marked activity in the museum, owing chiefly to the extra work required in carrying out the alterations and reforms referred to in the last annual report.

It was found necessary to repaint the wall-cases on the main floor, and in consequence the animals and birds had all to be removed while that was being done. Specimens could not be displayed to advantage in the upper portions of these cases; it was, therefore, deemed advisable to frost the top row of glass and shelve off that part, thus affording space for duplicate specimens.

New cases have been ordered for the centre of this floor. They are now being made, and within the next month it is expected they will be placed in position, and the objects intended to occupy them arranged.

An important change has been made in regard to the management of the museum. It was generally acknowledged that a better arrangement and more scientific classification of specimens were necessary; and, as the carrying out of such a scheme would occupy more time than was at the disposal of your curator, at his suggestion a committee was formed and the museum divided into different departments, each member taking charge of one, according to natural inclination, as follows:—

Mammalogy—Mr. Horace T. Martin.

Ornithology—Mr. F. B. Caulfield.

Ichthyology— ———

Conchology—Mr. E. T. Chambers.

Geology and Mineralogy—Dr. Harrington and Mr. E. H. Hamilton.

Anthropology— ———

Should a botanical department be formed, Prof. Penhallow has signified his willingness to take charge of it.

At the first meeting of this committee a general plan of conformation was adopted, whereby all zoological specimens will occupy the main floor, the gallery being reserved for geological, anthropological and other specimens.

For obvious reasons the work of re-arranging could not be commenced simultaneously, but as one department is finished another is begun, and unnecessary confusion thus avoided.

Considering the late season at which these measures were introduced, it is pleasing to note the splendid progress made amongst the mammals and birds by Messrs. Martin and Caulfield respectively, whilst the re classification and labelling of the entomological collection by Mr. Winn and his friend Mr. Dawson have been almost completed.

There were 2,094 visitors admitted to the museum during this year, as against 1,192 last year. Considering that we had no carnival this year and that the museum was practically closed for two months during repairs, this result is very gratifying.

The admission fees for the year amount to $50.15, or about $20 less than last year, which may be accounted for in admitting the schools and colleges free, and which concession has been largely taken advantage of by the scholars and students attending the various schools and colleges of the city.

The thanks of the Society are due to the gentlemen of the Museum Committee, whose names have already been mentioned, for their valuable assistance in re-arranging specimens, as well as to the superintendent, Mr. Griffin, for his attention to visitors, and for the admirable manner in which the museum has been kept clean and free from dust.

The oil painting of our worthy president, Sir William Dawson (by Harris), which was presented to the Society by a number of members and friends, has been hung in an appropriate part of the museum.

The following specimens have been added to the museum during the year :—

DONATIONS.

A various collection of birds.

Small ant-eating bear.

Specimen of sponge.

Beaver wood and chips.

A collection of game birds.

Specimen of quartz rich from Mount Stephen.

Piece of (Norway?) pine taken from foot of St. Francois Xavier street, supposed to be part of Maisonneuve's fort.

Ulster County *Gazette*, N.Y., of January 4th, 1800, containing account of death and entombment of General Washington.

Chinese Testament.

Olive-sided fly-catcher, "Contopus borealis."

Black-crowned night heron (spring) "Nycticorax nævius."

Head of Maskinonge.

Great blue heron.

Evening grosbeak.

Brown rat (young male).

Pine grosbeak (young male).

Alligator.
Peregrine falcon or duck hawk.
Indian war club found at Guelph, Ont

PURCHASED.

Evening grosbeak (female).

BY EXCHANGE.

Northern shrike.

Respectfully submitted,
J. STEVENSON BROWN,
Hon. Curator.

To the President and Council of the Natural History Society.

GENTLEMEN,

The Library Committee beg to report that during the past year the work of sorting and arranging the parts and numbers of exchanges and periodicals belonging to the Society has been completed. One hundred and eleven volumes are now ready for the binder, and efforts are being made to obtain the parts required to complete about twenty other volumes, of which parts are missing.

Progress has been made in locating and noting in the catalogue the books on the south side of the library, but this work cannot well be finished till the books waiting to be bound be returned from the binder.

It was arranged at the special meeting of the Council, held on May 27th, 1889, that the periodicals and other works received in exchange for the *Record of Science* should be received and acknowledged by the Librarian. This has been done, and the works received immediately placed in the case for the use of members.

The Committee beg to acknowledge the following donations, for which, in the name of the Society, they desire to thank the donors:—

"Winchell's Pre-Adomites," from Mrs. E. P. Hannaford.
"New Species of Fossil Sponges," from Sir J. W. Dawson.
"Cretaceous Rocks of the North west," from Dr. G. M. Dawson.

"On the Ore Deposits of Treadwell Mine," from Dr. G. M. Dawson.

"Glaciation of British Columbia," from Dr. G.M. Dawson.

Seven papers on mathematical subjects, from Professor Hennesey.

"Tertiary Deposits of Manitoba," from J. B. Tyrrel.

"Stratigraphy of the Quebec Group," from Dr. Ells.

"Catalogue of Canadian Minerals at Philadelphia," from F. Emberson.

"Report on North Shore of Lake Huron Exhibition," from F. Emberson.

"Report on Geology of Newfoundland," from F. Emberson.

"Report of Geological Survey for 1844 and 1849-50, from F. Emberson.

Bulletins of the Agricultural Departmer t, Washington.

Bulletins of Inland Revenue Department, Ottawa.

Bulletins of Smithsonian Museum.

"Catalogue of Sponges in Australian Museum," from the Trustees of the Australian Museum.

Geology, Zoology, etc., of Lord Howe Island.

Your Committee are glad to report that more use has been made of the library by members during the past year, and believe that its usefulness will be greatly enhanced when a more simple catalogue is made out. This, it is hoped, will be taken in hand at once, now that the whole library has been looked over and in a great measure arranged.

Respectfully submitted on behalf of the Library Committee.

E. T. CHAMBERS,
Chairman.

MEMBERSHIP COMMITTEE—REPORT 1889-90.

A meeting of this Committee was held on March 17th, 1889, when the treasurer, Mr. Gardner, reported that there were only 181 ordinary members, and as these from time to time were dropping out, it was highly important that the list of life members should be increased.

A list of those who had lately resigned was read over, those present noting such as they wished to call upon with the view to having them continue their subscriptions.

It is the opinion of this Committee that, by the individual efforts of the members of the Society, the membership roll could be greatly increased, and the members are, therefore, specially appealed to to assist in this matter.

Respectfully submitted.

J. STEVENSON BROWN,
Chairman.

The Treasurer's statement for the year shows the following gratifying position of the Society:—

NATURAL HISTORY SOCIETY OF MONTREAL IN ACCOUNT WITH JAS. GARDNER, TREASURER.

RECEIPTS.

To Balance from last year	$ 16.80
" Rents	1202.00
" Annual Subscriptions	645.00
" Government Grant	400.00
" Entrance Fees, Museum	50.15
" Field Day Surplus	8.72
" Interest	4.36
" Special Donation P. S. Ross, Esq., towards illustrating Record	25.00
" Special Subscriptions collected by Messrs. J. S. Shearer and J. S. Brown for Improvements and Alterations	588.75
	$2940.78

DISBURSEMENTS.

By Salary Superintendent and Commissions.........	$ 453.80
" Sundry Expenses..	306.98
" Light...	207.95
" Fuel..	136.70
" Insurance..	69.60
" Taxes	32.64
" Lectures..	114.86
" Museum..	48.50
" Soil Temperatures.....................................	13.75
" Record of Science......................................	766.40
" Improvements and Alterations in Building.......	101.50
" " " from Special Fund Expended by Messrs. J. S. Shearer and J. S. Brown......................................	586.74
" Balance on hand..	101.53
	$2940.78

Examined and found correct.

GEO. SUMNER,
JOHN S. SHEARER.

MONTREAL, 26th May, 1890.

Sir Wm. Dawson having signified his desire to be relieved from the presidential office, he was, on motion of Hon. Senator Murphy, seconded by Mr. J. S. Shearer, elected to the position of Honorary President.

The following officers were then elected for the ensuing year :—

Honorary President—Sir J. Wm. Dawson.

President—Dr. B. J. Harrington.

Vice-Presidents—J. S. Shearer, Hon. E. Murphy, Prof. D. P. Penhallow, Rev. Robt. Campbell, Sir Donald A. Smith, J. H. R. Molson, George Sumner, H. J. Joseph, Very Rev. Dean Carmichael.

Recording Secretary—Albert Holden.

Corresponding Secretary—Horace T. Martin.

Curator—J. Stevenson Brown.

Members of Council—J. S. Shearer (Chairman), J. A. U. Beaudry, Dr. R. F. Ruttan, S. Finley, Dr. J. W. Stirling, R. W. McLachlan, Dr. J. C. Cameron, Major Latour, Rev. Canon Empson.

Editing Committee—Prof. D. P. Penhallow, Dr. B. J. Harrington, Dr. T. Wesley Mills, G. F. Matthew, J. F. Whiteaves.

Library Committee—E. T. Chambers (Chairman), J. A. U. Beaudry, F. B. Caulfield, R. W. McLachlan, Joseph Fortier.

Lecture Committee—Dr. Harrington (Chairman), Rev. Robt. Campbell, P. S. Ross.

House Committee—J. S. Shearer (Chairman), J. Stevenson Brown, Albert Holden.

Membership Committee—J. S. Brown (Chairman), S. Finley, P. S. Ross, Dr. Stirling, Geo. Sumner, Dr. Birkett, J. A. U. Beaudry, R. W. McLachlan, Henry Hamilton, A. F. Winn, Dr. J. C. Cameron.

Taxidermist—F. B. Caulfield.

NOTE.

The Duck Hawk at Abbotsford, P.Q.—A pair of this species (*Falco peregrinus anatum*) were recently presented to the Society by Mr. N. E. Fisk. They were shot at Abbotsford, P.Q., on May 7th, 1890, by his son Charles Albert Fisk. Mr. Fisk states that they had a nest in a recess in the western side of the mountain (Yamaska) and that one or two pairs of these birds have been observed there for the past forty-five years. This information is very interesting as this species although occurring throughout the entire Dominion is one of our rarest hawks and the records of its nesting in the southern parts of its range are very few indeed.

F. B. CAULFIELD.

FIELD DAY.

The annual field day of the Society was held on Saturday, June 7th. At ten o'clock about one hundred and fifty ladies and gentlemen assembled at the Windsor street station, where, through the courtesy of the Canadian Pacific Railway, four fine drawing-room cars were placed at their disposal. In addition to members of the Natural History Society, there were strong representations of the Camera Club, the Entomological Society and the Agassiz Association. On arriving at their destination the party met a delegation from Ottawa, consisting of the Ottawa Field Naturalists' Club and their friends, in all about fifty.

The objective point, Lachute, was reached in season for an early lunch. On disembarking, the excursionists were cordially welcomed by the mayor, Dr. Smith. In the absence of the president, Dr. Harrington, and of the honorary president, Sir Wm. Dawson, Prof. Penhallow, as vice-president, replied to the mayor on behalf of the Society, welcomed the Ottawa delegation and announced the programme for the day. Immediately after lunch the various parties dispersed in different directions under their respective leaders. Many visited the Lachute paper mills, to which an invitation had been extended by Mr. J. C. Wilson. Another large party visited the cartridge factory, where they received many courtesies at the hands of the manager, Capt. Howard. The entomologists under Mr. Jas. Fletcher and Mr. Caulfield; the geologists under Dr. Ells, Mr. Whitman and Mr. McOuat; the botanists under Prof. Penhallow, and the Camera Club under Mr. Henderson, all found, in their respective fields, opportunities for profitable employment.

At four o'clock the party assembled at the Post Office, where the various collections were examined and prizes announced. Mr. Whitman made some remarks upon the geology of the district, pointing out that in the immediate vicinity were localities which had gained great repute among geologists on account of the special work of Sir Wm. Logan in connection with them. Remarks on the insects of the region by Mr. Caulfield and on the plants by Mr. Jas. Fletcher were also made. The Very Rev. Dean Carmichael moved a vote of thanks to the mayor and citizens of Lachute for their hospitality, a sentiment most cordially supported by the assembled guests. The proceedings of the day were then clo ed by a few appropriate remarks from Prof. Penhallow ter which all adjourned to the cars, where they were provided with an elegant repast by the Canadian Pacific Railway. The excursionists reached Montreal at nine o'clock, feeling that one of Nature's most perfect days had been spent with great pleasure and profit.

The prizes awarded are as follows:

Miss Abbott........	1st prize	for	named	geological	specimens
Mr. F. S. Jackson....	2nd	"	"	"	"
Mr. John G. Saxe.. } Mr. J.Martin Black. }	Equal		unnamed	"	"
Mr. A. F. Winn.....	1st prize		named	entomological	"
Mr. W. C. Adams....	2nd	"	"	"	"
Miss F. Mills........	1st	"	unnamed	"	"
Miss Shearer........	1st	"	named	botanical	"
Miss E. Baylis.......	1st	"	unnamed	"	"
Mas. D. P. Penhallow..	2nd	"	"	"	"

ABSTRACT FOR THE MONTH OF APRIL, 1890.

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

DAY.	THERMOMETER.				*BAROMETER.				† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND.		SKY CLOUDED IN TENTHS.			Per cent of 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 perhour	Mean.	Max.	Min.					
1	27.90	32.5	23.8	8.7	30.3103	30.398	30.194	.204	.0902	59.7	15.8	S.W.	22.1	1.8	10	0	89	....	....	....	1
2	30.97	37.0	21.1	15.9	30.3263	30.454	30.214	.240	.1167	67.2	21.3	S.W.	32.0	6.7	10	0	43	....	....	....	2
3	40.50	48.1	32.5	15.6	30.0885	30.211	29.905	.306	.1480	58.7	27.2	S.W.	25.0	4.2	10	0	94	....	....	....	3
4	40.40	48.0	32.6	15.4	29.6580	29.781	29.507	.274	.2297	89.5	37 5	S.W.	21.3	10.0	10	10	00	0.65	.	0.65	4
5	29.88	36.0	24.8	11.2	30.1103	30.243	29.923	.320	.0928	56.0	16.7	W.	21.3	2.2	10	0	83	....	Inapp.	0.00	5
SUNDAY........ 6	....	45.5	27 8	17.7	....	......	......	....	.. .	....	....	S.W.	20.9	....	..	.	37	0.02	....	0 02	6 ....SUNDAY
7	40.95	47.0	35.2	11.8	29.8825	29.934	29.836	.098	.1693	67.0	29.7	W.	13.0	5.0	10	0	56	....	....	....	7
8	33.80	41.3	28.8	12.5	29.9108	30.047	29.729	.318	.1265	64.7	23.0	N.E.	15.1	6.7	10	0	50	0.03	0.2	0.06	8
9	40.52	44.9	35 7	8.2	29.4505	29.665	29 220	.445	.2145	84.8	36.5	S.E.	19.9	10.0	10	10	00	0.15	....	0.15	9
10	36.02	43.7	31.7	12.0	29.5372	29.833	29.249	.584	.1573	73.5	28.5	S.W.	25.6	10.0	10	3	06	....	Inapp.	0.00	10
11	32.87	40.8	25.8	15.0	30.0502	30.120	29 957	.163	.1173	62.8	21.7	W.	12.1	4.0	10	0	71	....	....	....	11
12	46.17	58.2	30.8	27.4	30.0792	30.191	30.003	.188	.1723	55.0	30.2	S.	18.6	1.0	4	0	91	....	....	....	12
SUNDAY. 13	.....	62.8	40.5	22.3	....	......	......	....	... .	....	....	N. W.	7.0	....	..	..	77	....	....	....	13 ....SUNDAY
14	46.05	57.0	37.6	19.4	29 9110	30.055	29.773	.282	.2080	66.3	35 0	N.	12.4	8.2	10	0	40	0.05	....	0.05	14
15	39.20	47.4	31.7	15.7	30.2778	30.375	30.165	.210	.0858	37.7	13.8	N.W.	19.2	0.0	0	0	99	....	....	...	15
16	40.87	52.0	30.7	21.3	30.2328	30.367	30.103	.264	.1363	53 8	25.2	S. W	17.4	2.0	10	0	82	....	....	....	16
17	37.30	46.8	30.7	16.1	29 9652	30.009	29.929	.080	.1138	51.3	20.7	N.W	17.0	7.2	10	0	61	....	....	....	17
18	27.27	31.6	21.6	10.0	29.9883	30.067	29.945	.122	.0738	49.3	11.3	N.W.	16.7	6 7	10	0	36	....	Inapp.	0.00	18
19	39.05	49.1	27.7	21.4	30 2027	30.301	30.120	.181	.1208	50.7	22.3	W.	12.3	1.8	10	0	87	....	....	....	19
SUNDAY........20	.....	54.4	33.7	20.7	....	......	.....	...	.....	....	....	N.W.	14.8	....	..	..	95	....	....	....	20 ....SUNDAY
21	44.47	53.8	36.6	17.2	30.2615	30.333	30 227	.106	.1855	62.7	32.0	S.W.	23.8	3.2	10	0	45	0.12	....	0.12	21
22	48.77	58.3	36.2	22.1	30.3020	30.409	30.178	.231	.1538	44.2	27.5	S.	12.2	3.8	10	0	46	Inapp.	....	....	22
23	55.57	66.9	44.6	22.3	29.9813	30.203	29.874	.329	.2683	61.3	41.5	S.W.	24.2	6.0	10	0	34	Inapp.	....	....	23
24	40.80	54.1	33.8	20.3	30.2552	30.294	30.158	.136	.1258	48.7	22.7	N.	15.5	2 5	8	0	95	....	......	....	24
25	38.02	49.9	29.7	20.2	30.3513	30.422	30.284	.138	.1065	47.0	19.3	N	17.9	1.7	10	0	76	....	....	...	25
26	41.75	53.0	29.6	23 4	30.3073	30.456	30.123	.333	.1277	49.8	23.0	S.E.	13.8	6.5	10	0	73	0.02	....	0.02	26
SUNDAY........27	.....	40.5	32.7	7.8	....	......	......	....	....	....	....	N.E.	12.3		..	..	00	0.13	2.8 (?)	0 41	27 ....SUNDAY
28	45.58	54.0	35.7	18.3	30.0542	30.116	29.994	.122	.1548	52.0	28.2	W.	15.3	0.5	2	0	98	....	....	....	28
29	49.27	59.6	38.6	21.0	29.8660	30 055	29.698	.357	.2325	66.8	37 3	S.	16.8	7.8	10	0	41	0.31	....	0.31	29
30	46.43	49.7	41.7	8.0	29.7198	29.777	29 660	.117	.2595	82.0	41.0	S W.	21.8	10.0	10	10	00	0.32	....	0.32	30
....Means	40.01	48.80	32 13	16.66	38.0415	......	......	0.236	.1534	60.1	26 5	....	17.9	4.98	..	..	56.8	1.80	3.0	2.11	Sums ....
16 yrs. means for & including this mo.	39.60	47.68	31.73	15.94	29.9425	......	......	0 201	.1683	66.7	....	... .	....	5.84	..	..	¶53.2	1.59	6.5	2.24	16 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............	1277	664	287	1122	872	5517	1628	1534	—
Duration in hrs..	89	50	25	68	52	236	95	99	6
Mean velocity...	14.4	13.3	11.5	16.5	16.8	23.4	17.1	15.5	

Greatest mileage in one hour was 41 on the 10th.
Greatest velocity in gusts 49 miles per hour on the 10th.
Resultant mileage, 5,760.

Resultant direction, S. 61°5 W.
Total mileage, 12,901.
Average mileage per hour 16.94.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 66.9 on the 23rd; the greatest cold was 21.1 on the 2nd, giving a range of temperature of 45.8 degrees. Warmest day was the 23rd. Coldest day was the 18th. Highest barometer reading was 34.456 on the 26th: lowest barometer was 29.220 on the 9th, giving a range of 236 inches. Maximum relative humidity was 96 on the 4th. Minimum relative humidity was 15 on the 15th.

Rain fell on 12 days.
Snow fell on 5 days.
Rain or snow fell on 13 days.
Auroras were observed on 3 nights.
Lunar halo on 1 night.
Fogs on 2 days.

ABSTRACT FOR THE MONTH OF MAY, 1890.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	§Max.	§Min.	§Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	41.30	48.4	32.5	15.9	29.8543	30.089	29.668	.421	.1778	65.3	29.8	W.	17.5	6.5	10	0	20	Inapp.	....	0.00	1
2	41.32	50.9	28.3	22.6	30.0842	30.143	30.014	.129	.1235	46.8	22.8	S.W.	14.5	4.5	10	0	71	....	....	....	2
3	53.53	71.5	39.7	31.8	29.8427	29.925	29.739	.186	.2533	63.2	40.0	S.	21.0	5.2	10	0	57	0.46	.. .	0 46	3
SUNDAY........ 4	.... .	47.0	36.2	10.8	....	......	......	....	... .	....	....	N.E.	25.0	....	..	..	00	0.38	... .	0.38	4 ....SUNDAY
5	42.78	47.3	38.1	9.2	29.6063	29.707	29.558	.149	.2665	96.3	41.8	N.E.	18.6	10.0	10	10	00	0.13	....	0.13	5
6	45.88	49.0	42.1	6.9	29.6558	29.739	29.585	.154	.2775	90.0	42.8	S.W.	16 5	9.8	10	9	00	0.98	....	0.98	6
7	44.27	49.4	37.8	11.6	30.0070	30.234	29.828	.406	.1777	61.0	31.5	S.W.	15 2	4.8	10	0	45	....	....	....	7
8	44.53	53.0	35.7	17.3	30.1140	30.191	30.042	.149	.1560	54.0	28.3	....	9 8	1.8	4	0	88	....	....	....	8
9	46.03	58.0	38.4	19.6	29.8825	30.015	29.763	.252	.2472	77.7	39.2	S.W.	19.6	8.3	10	c	06	0.18	....	0.18	9
10	45.77	51.8	39.6	12.2	29.9253	29.961	29 876	.085	.1862	60.5	32.5	W.	7.8	7.2	10	0	32	0.09	....	0.09	10
SUNDAY........11	.....	59.0	35.8	23.2	....	......	......	....	.....	....	....	N.W.	13.3	....	..	..	100	....	....	....	11 ....SUNDAY
12	48.70	57.5	35.7	21.8	30.0107	30.220	29.862	.358	.1802	52.5	31.5	S.W.	10.4	9.2	10	5	06	....	....	....	12
13	50.55	54.8	44.5	10.3	29.7057	29.851	29.605	.246	.3120	84.3	45 7	S.W.	7.6	9.8	10	9	00	0.13	....	0.13	13
14	54.83	62.0	50.3	11.7	29.6742	29.718	29.610	.108	.3147	74.2	46.2	S.W.	12.4	8.3	10	0	16	0.09	....	0.09	14
15	57 67	67.0	46.4	20.6	29.7558	29.808	29.720	.088	.3182	67.8	46.5	S.W.	14.3	8.2	10	0	51	Inapp.	....	0.00	15
16	51 07	60.5	45.6	14.9	29 8980	29.962	29.800	.162	.2348	63.2	38.7	S.W.	17.4	7.5	10	0	60	...	....	....	16
17	47.30	55.5	39.6	15.9	29.7943	30.022	29.635	.387	.2218	69.3	37.0	S.W.	24.1	6.0	10	0	28	0.21	....	0.21	17
SUNDAY........18	.....	55.5	37.6	17.9	....	......	.....	....	.....	....	....	W.	15.1	....	..	..	66	Inapp.	....	0.00	18 ....SUNDAY
19	57.48	64 0	51.3	12.7	29.7930	29.811	29.768	.043	.3737	78.2	50.7	S.	16.2	9.2	10	5	00	0.18	....	0.18	19
20	46.40	55.9	40.7	15.2	29.6952	29.930	29.562	.368	.2890	89.8	43.7	W.	18.8	8.7	10	2	00	1.31	......	1.31	20
21	49.72	59 0	38 3	20.7	30.1855	30.283	29.971	.312	.1962	56.0	34.0	S.W.	10.3	4.7	10	0	91	....	....	...	21
22	57.32	67.9	48.2	19.7	30.2680	30.311	30.212	.099	.2912	62.0	44.0	S.E.	8.1	5.0	10	0	22	....	....	....	22
23	56.25	63.2	46.5	16.7	30.0082	30.178	29.890	.288	.2823	62.8	42.2	S.E.	14.2	7.8	10	0	45	0.02	....	0.02	23
24	58.62	65.7	51.4	14.3	30.0413	30.083	30.012	.071	.3550	72.8	48.2	N.E.	8.0	7.3	10	2	47	....	....	....	24
SUNDAY........25	.....	73.0	53.4	19.6	....	......	......	....	... .	....	....	S.E.	20.2	....	..	..	56	....	....	....	25 ....SUNDAY
26	58.65	65.0	55.3	9.7	29.9808	30.062	29.890	.172	.3943	80.2	52.2	S.E.	16.2	10.0	10	10	16	0.05	....	0.05	26
27	56.23	66.6	50.9	15.7	29.8517	29.890	29.811	.079	.3608	81.0	50.0	....	9.5	8.5	10	2	49	0.44	....	0.44	27
28	57.33	67.9	50.5	17.4	29.9053	30 022	29.840	.182	.3252	71.7	47.2	N.	10.5	5.8	10	0	54	0.20	....	0.20	28
29	56.78	66.0	45 5	20.5	30.0390	30.112	29.972	.140	3138	68.3	46.2	N.E.	4.9	1 5	3	0	97	..	....	....	29
30	59.63	68.6	49.5	19.1	29.9033	29.999	29.804	.195	.3043	61.5	45.3	N.E.	6.6	0.8	4	0	89	....	....	....	30
31	62.88	74.1	48.4	25.7	29.7927	29.814	29.768	.046	.2588	45.7	41.0	....	9.5	0.2	1	0	100	....	....	....	31
....Means	51.59	59.84	43 03	16.81	29.8991	......	......	.195	.2664	68.7	40 7	....	14.0	6.54	..	..	42.3	4.85	....	4 85	Sums ....
16 yrs. means for & including this mo.	54.58	63.70	45.61	18.09	29.9342	......	......	.163	.2851	65.4	....	....	....	6.30	..	..	¶51.3	2.98	....	2 99	16 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..............	1099	1486	238	1352	1140	3560	1155	454	....
Duration in hrs..	81	108	24	92	92	222	82	41	2
Mean velocity...	12.5	13.8	9.9	14.7	12.4	16.0	14.1	11.1	

Greatest mileage in one hour was 42 on the 17th. Greatest velocity in gusts 66 miles per hour on the 17th.

Resultant mileage, 2,842.
Resultant direction, S. 38° W.
Total mileage, 10,394.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 74.1 on the 31st; the greatest cold was 28.3 on the 2nd, giving a range of temperature of 45.8 degrees. Warmest day was the 25th. Coldest day was the 1st. Highest barometer reading was 30.311 on the 22nd; lowest barometer was 29.558 on the 5th, giving a range of 0.753 inches. Maximum relative humidity was 100 on the 5th and 6th. Minimum relative humidity was 27 on the 11th.

Rain fell on 18 days.

Solar halos on 2 days.

Lunar halo on 1 night.

Fog on 3 days.

Thunder on 2 days.

The month was characterized by being unusually wet and cold.

ABSTRACT FOR THE MONTH OF JUNE, 1890.

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

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	§Max.	§Min.	§Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
SUNDAY........ 1	....	77.0	58.3	18.7	....	......	......	...	....	....	....	N.W.	19.9	....	..	..	100	....	....	....	1 .... SUNDAY
2	57.18	67.0	49.4	17.6	30.0358	30.092	29.974	.118	.2172	46.2	36.3	N.W.	17.8	3.2	8	0	84	....	....	....	2
3	58.93	65.9	47.4	18.5	30.0973	30.172	30.026	.146	.2155	43.5	36.3	E.	4.0	6.7	10	0	56	....	..	....	3
4	55.77	60.0	52.4	7.6	29.9068	29.991	29.870	.121	.4293	96.0	54.5	E.	7.2	10.0	10	10	00	0.89	..	....	4
5	60.38	66.7	55.1	11.6	29.9060	29.931	29.869	.062	.4988	94.7	58.8	N.E.	5.0	10.0	10	10	00	0.22	....	....	5
6	64.95	72.5	61.2	11.3	29.7878	29.916	29.640	.276	.5540	90.2	61.8	S.E.	4.4	10.0	10	10	07	0.05	....	....	6
7	58.65	67.8	46.8	21.0	29.7685	30.070	29.632	.438	.3640	71.5	49.2	S.W.	20.2	9.5	10	0	28	0.05	....	...	7
SUNDAY...... 8	....	59.4	40.8	18.6	....	......	......	....	....	....	....	W.	18.6	....	..	..	67	Inapp.	.. .	..	8 .... SUNDAY
9	58.78	66.2	54.4	11.8	30.1885	30.257	30.033	.224	.2415	48.8	39.2	W.	18.3	4.8	10	0	74	....	....	....	9
10	62.47	71.0	50.3	20.7	30.1182	30.270	29.951	.319	.3518	60.3	48.2	S.W.	8.4	8.0	10	0	60	....	....	....	10
11	69.98	81.0	57.3	23.7	29.8353	29.924	29.767	.157	.5305	72.8	60.7	S.W.	13.4	6.3	10	0	76	Inapp.	....	....	11
12	57.93	64.2	52.4	11.8	29.8472	29.880	29.818	.062	.4175	86.7	53.7	E.	14.0	9.2	10	5	00	0.25	....	....	12
13	55.02	60.2	50.3	9.9	29.8632	29.874	29.850	.024	.4018	92.3	53.0	E.	7.7	10.0	10	10	00	0.25	.. .	....	13
14	56.80	63.0	52.4	10.6	29.9502	30.040	29.881	.159	.3963	86.2	52.5	N.E.	16.2	9.8	10	9	02	0.08	....	....	14
SUNDAY. 15	.....	74.0	53.7	20.3	....	......	......	....	....	....	....	N.E.	5.0	....	..	..	63	....	....	....	15 .... SUNDAY
16	68.35	79.0	55.1	23.9	30.1245	30.196	30.060	.136	.5053	73.7	59.2	S.W.	6.5	5.2	10	0	55	....	....	....	16
17	71.32	79.9	64.8	15.1	29.9087	30.081	29.741	.340	.5897	77.7	63.3	S.W.	15.4	8.2	10	4	69	0.11	......	....	17
18	70.58	80.0	65.0	15.0	29.7290	29.779	29.692	.087	.5178	69.8	59.7	S.W.	20.6	4.2	10	0	82	....	....	....	18
19	61.35	69.0	53.4	15.6	29.9598	30.105	29.802	.303	.3323	61.7	47.7	N.	12.8	4.7	10	0	48	....	....	....	19
20	63.68	72.5	48.6	23.9	30.0880	30.165	30.010	.155	.3242	56.5	47.2	S.W.	11.7	1.8	9	0	100	....	....	....	20
21	68.03	79.4	57.6	21.8	29.8910	30.002	29.824	.178	.4177	61.5	53.5	S.W.	15.2	1.8	6	0	97	....	....	....	21
SUNDAY. 22	.....	70.0	58.7	11.3	....	......	......	....	....	....	....	N.E.	11.2	....	..	..	13	Inapp.	....	....	22 .... SUNDAY
23	69.35	82.3	58.3	24.0	29.9108	29.943	29.868	.075	.5485	77.2	61.5	S.W.	7.9	6.3	10	1	74	0.32	....	....	23
24	69.22	80.4	62.3	18.1	29.8297	29.917	29.686	.231	.5842	82.3	63.5	S.W.	13.5	8.0	10	2	33	0.49	....	....	24
25	72.65	82.0	62.8	19.2	29.7120	29.757	29.683	.074	.5323	63.2	60.8	W.	21.2	3.2	8	0	97	0.01	....	....	25
26	68.92	79.0	59.2	19.8	29.7928	29.838	29.750	.088	.3838	55.7	51.8	N.W.	16.7	2.5	9	0	88	....	.. .	....	26
27	66.60	75.7	58.3	17.4	29.8532	29.919	29.815	.104	.4058	62.3	53.0	N.W.	11.0	7.3	10	2	56	....	....	....	27
28	68.75	77.8	60.1	17.7	29.7912	29.830	29.746	.084	.3940	57.2	52.3	N.E.	6.2	0.5	3	0	100	....	....	....	28
SUNDAY........29	.....	78.5	56.3	22.0	....	......	......	...	....	...	....	E.	6.5	....	..	..	88	....	....	....	29 .... SUNDAY
30	75.63	85.3	66.2	19.1	29.8697	29.898	29.855	.043	.4757	54.5	57.5	S.W.	9.0	0.5	2	0	100	....	....	....	30
............Means.	64.45	72.88	55.63	17.25	29.9106	......	......	.160	.4252	69.7	53.4	....	12.2	6.07	..	..	57.2	2.72	....	....	Sums ....
16 yrs. means for & including this mo.	64.46	73.10	55.92	17.17	29.8978	. ....	......	.155	.4225	68.9	...	... .	....	5.70	..	..	¶55.2	3.16	....	....	16 yrs. 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............	410	1121	337	404	413	2689	1417	1779	....
Duration in hrs..	49	126	49	49	44	194	81	111	17
Mean velocity ...	8.4	8.9	6.9	8.2	9.4	14.9	17.5	16.0	

Greatest mileage in one hour was 29 on the 9th.
Resultant mileage, 3,315
Resultant direction, S. 85° W.
Total mileage, 8,770.

NOTE.—The mileage for the first 11 days of the month is for the greatest part taken from the City Hall record, which has been multiplied by 1.25 to reduce it to the mountain anemometer record.

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

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 85.3 on the 30th; the greatest cold was 40.8 on the 8th, giving a range of temperature of 44.5 degrees. Warmest day was the 30th. Coldest day was the 8th. Highest barometer reading was 30.270 on the 10th; lowest barometer was 29.632 on the 7th, giving a range of 0.638 inches. Maximum relative humidity was 100 on the the 4th. Minimum relative humidity was 29 on the 1st.

Rain fell on 14 days.

Lunar halo on 1 night.

Fog on 3 days.

Thunder on 6 days.