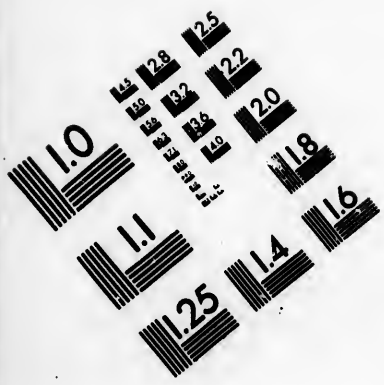

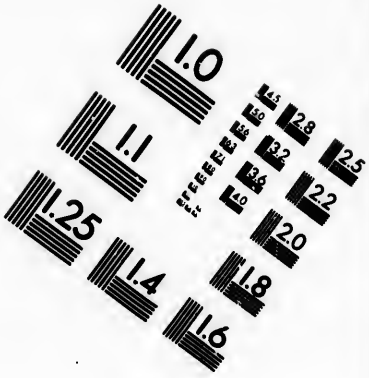

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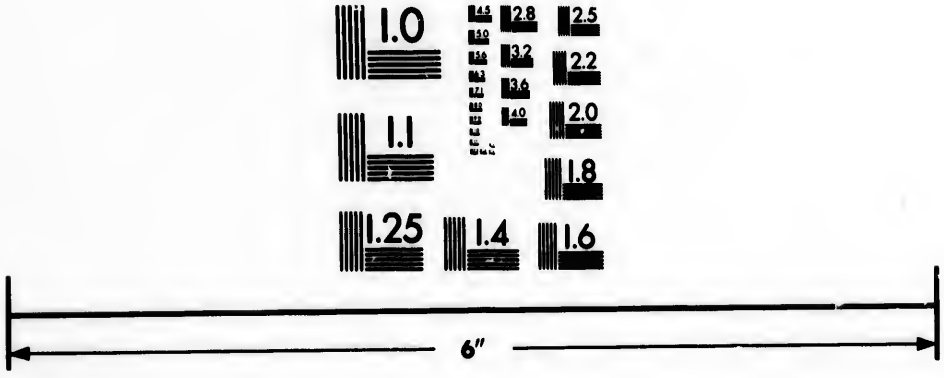

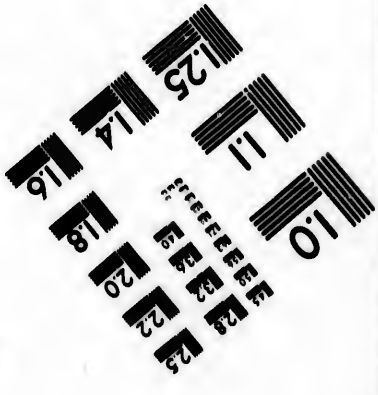

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ON

OZONE

AND ON THE

METEOROLOGY

OF THE

VICINITY OF MONTREAL.

BY CHARLES SMALLWOOD, M.D., L.L.D.,

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(Two Papers read at the Annual Meeting of the American Association for the Advancement of Science, Montreal August, 1857, and published in the November No. of the *Canadian Naturalist and Geologist.*)

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ON OZONE.

It would be unbecoming in me as forming a part of the deputation to Albany last year, for the purpose of inviting the Association to meet at this place, were I not to take advantage of the present moment, to greet you, gentlemen Members of the American Association, with a cordial and hearty welcome, and I need scarcely add, that the like sentiment inspires the whole of the inhabitants of this city.

Until the present time, these Annual Meetings have been confined to the United States alone, (although not exclusively American,) and separated only by an imaginary boundary, which has now been removed, for we here meet, united as one family, having one common object in view,—"the Advancement of Science," we are treading the same peaceful path of knowledge, we are assembled under the broad, the vast canopy of the American firmament, the gentle breeze that wafts the red cross banner of St. George and Merry England, alike unfurls, the stars and stripes, the emblem of your land of freedom. Long may these two flags entwine in peace, in kindred folds, and may that master-piece of scientific genius, the electric cable, which is at this moment being laid beneath the Atlantic sea, whose waves science has measured with a mighty span, be the peaceful band, that will cement more firmly the destinies of the two great nations of the earth, under the benign and able guidance of your worthy President, and our beloved Queen, and may science, which knows no country, no nation, no language, be rendered more subservient to the happiness and welfare of the whole human family.

A year has now passed since the deputation from this place enjoyed the hospitalities of one of your large cities, the familiar and friendly faces of many we met there, and now present, calls to mind many pleasant recollections, but like all things mundane, we have some cause for sadness, for in the few fleeting moons that

have waned since last we met, death has taken from our midst a Redfield, a Bailey, and a Mitchel, each pre-eminent in his department of scientific research, and to science and us, an irreparable loss, and the Association has done itself honor in paying a tribute to their memories; but the midnight lamp of the man of science must grow dim, the experimentalist must for ever quit the busy scenes of his laboratory, the eye of the astronomer must be closed, for the life of the philosopher is but mortal.

It is my intention to lay before the section the results of observations made on the amount of ozone present in the atmosphere. The place of observation is at St. Martin's, about 9 miles due west of Montreal, and is 118 feet above the mean level of the sea; it is situated in the centre nearly of the Isle Jesus, an island surrounded by the branches of the Ottawa, the place of observation is a little more than 3 miles from the river, thus being sufficiently inland, to be removed from any transient vapour or fog, which is often present in the proximity of rivers; it is a flat island, and the whole of the neighborhood is under cultivation.

It is not my purpose to enter into a lengthy detail of the chemical composition of ozone, enough for our present purpose to define it to be, a compound of oxygen, analogous to the per-oxide of hydrogen, or that it is oxygen in an allotropic state, that is with the capability of immediate and ready action impressed upon it. To Schonbien is awarded the discovery, who, in 1840, applied the term ozone to the peculiar smell which is perceptible during the action of the electrical machine, and also during the decomposition of water by the galvanic apparatus. It was subsequently ascertained that a similar smell is developed by the influence of Phosphorus on moist air, and also by a great many chemical changes, and for some time its existence was recognized by its smell, or odour, alone; but in April, 1848, Schonbien became possessed of another of its characters, viz: its oxidizing principle, and it is this property which it possesses more particularly, when we direct our attention to its presence in the atmosphere, although these oxidizing properties may be common to some other bodies, as nitrous acid, which is said to be generated in the atmosphere by atmospheric electricity.

When largely diffused in the atmosphere, it causes like chlorine (to which it is somewhat allied) very unpleasant sensations, such as difficult respiration, and it acts powerfully on the mucous membrane, it kills small animals very quickly; it is insoluble in water,

and oxydizes very quickly all metallic bodies, and it has the power in a large degree, of destroying *miasma* arising from the decomposition of animal and vegetable substances, and Schonbien came to the conclusion, that its formation depended upon the action or formation of atmospheric electricity, and he referred the beneficial effects of thunder storms, to the action of the ozone formed, neutralizing the miasma arising from the decomposition of animal and may be vegetable substances, and it possesses in a powerful degree bleaching properties, and in this it is again analogous to chlorine.

Since Schonbien brought its properties before the scientific world, it has received more or less attention both from the physi cian and the meteorologist.

It has been advanced, that during the presence of cholera and other epidemic disease, its absence was remarked, while on the other hand, when the atmosphere has indicated a great amount present, diseases of the lungs and mucous membrane have been more prevalent, it has been still further stated that its action on the vegetable kingdom is similar in its effects as in the animal economy ; the potatoe disease or rot especially, and other diseases in vegetables has, it is said, been caused by either its absence or presence, in too large quantities.

It would far exceed the limits of time alloted to me to enter fully into the progressive steps of the investigation or history of ozone, for it has engaged the attention of physicians in England, and on the continent of Europe, and I am happy to say, that some members of the American Association have devoted considerable attention to it, and I have deemed it of sufficient import, to lay before the section the result of some eight years of investigation, or nearly 6,000 observations. This includes observations during the visitation of the cholera in 1854, and I heartily trust that the Association may, by its influence, extend these observations through the whole of the United States territory, and, as far as practical, throw some light on its action in the animal and vegetable kingdom, and I am sure a subject of so much importance, and which must (if we are to believe the report of some investigators) exert an influence on both the health of animals and of plants, will be at once a sufficient ground for extending such observations, which should be as uniform as possible.

The method of estimating and detecting the amount of ozone, is by what is called the *Ozoneometer*, which is nothing more than

slips of paper, wetted with the solution of starch and iodide of potassium; these became blue on exposure, owing to the oxidization of the potassium by the ozone, and the setting free of the iodine, the formula I use, and the one generally adopted is ℥ i of starch boiled in ℨ i of distilled water, and when cold 10 grains of the iodide of potassium is mixed with it, it is quickly spread on paper and dried in the dark, and must be kept in a dry place, and free from light until required; when they are placed in a situation shaded from the sun and rain, these strips are one-half an inch wide, and from three to four inches long. Dr. Moffatt, an eminent English physician, and who has paid much attention to the subject, places his slips of paper in a box, without a bottom, so as to be *excluded* from the light; but so far as my observations go, I have found so little difference in the two methods, that I have continued that of Schonbien's, as I have before stated, and expose the slips of paper to light, but *excluded from the sun and rain.* The amount of ozone present is estimated, in 10ths the deep shade or saturation, being 10, and diminishing in depth of shade to 0.

It has also been asserted that slips of paper placed at high elevations, has exhibited a deeper shade. To test this fact, I exposed slips of prepared paper at an altitude of 80 feet, on the top of a pole or mast, which is used for collecting atmospheric electricity; and as far as my observations go, I could detect no appreciable difference from those exposed 5 feet from the ground, and if I might be permitted to suggest, that to insure uniformity, the elevation of 5 feet might be considered the standard height, and which is at once convenient and far enough removed from the effects of terrestrial radiation or deposit of dew, leaving it o course to observers to adopt at the same time, any other method which might suggest itself, during the observations on this phenomena.

So far I have, as concise as the subject would permit, traced its history, properties and method of observations, and the propriety of so doing may indeed be questionable, before so learned a body; but I have felt that the subject might be new to some present, and with a wish that uniform observations should be made, I deemed it well to state very briefly its prominent character, and in so doing I have thrown myself on your indulgence. I may just state that the colour of the test paper may be brought more fully out, by moistening it with water.

I shall now proceed to give the *section* the results of observations made by these means.

The questions for our investigation, and which naturally arise are these:—What is the effect of the presence of ozone on the meteorological conditions of the atmosphere, as indicated by the instruments most in use?

And, secondly, what influence does its presence or absence exert on the health of animals or vegetables? or does its presence or absence give rise to disease?

1st. What are the *barometric* indications?

The presence of ozone in the atmosphere is accompanied by a low reading of the barometer, which generally continues while the *ozonic* period lasts; this period is accompanied or terminated almost invariably by precipitation in the shape of rain or snow.

Therometer. I have observed the presence of ozone at all temperatures, when the therometer has indicated 20°, (below zero,) and as high as 80°, and in all the intermediate temperatures, and it is generally in larger quantities during a fall of snow than of rain. The *psychometer* is a certain indication of the presence of ozone, for it would appear that a moist state of the atmosphere was necessary for its production or development, for when the difference between the *dry* and *wet* bulb therometer is little, the presence of ozone in considerable quantity is invariably present but when the difference between the two therometers is considerable, no ozone is appreciable by the *ozoneometer*. This fact and the only one which (as far as my observations here go) is in connexion with the presence or absence of ozone, has led me to compare the presence of ozone with the presence of precipitation in the shape of snow or rain, which gives a remarkable co-incidence. For in and during the past seven years there were 918 days on which rain or snow fell, (this is regardless of the amount or duration,) and during the like period there were 816 days on which ozone was present in a quantity of five-tenths, any amount below that quantity in this estimation is not taken into consideration in the discussion. In the year

1850	there were	106	days of	precipitation,	and	110	days of ozone.
1851	"	123	"	"		135	" "
1852	"	136	"	"		152	" "
1853	"	136	"	"		114	" "
1854	"	133	"	"		73	" "
1855	"	140	"	"		110	" "
1856	"	144	"	"		126	" "

The small amount of ozone in 1854, which was the year of the last visitation of cholera, would tend to favour the opinion that

there was a deficiency of ozone in the atmosphere during the prevalence of that epidemic. A deficieney was, however, observed in almost every month of that year, although the number of days on which snow or rain fell were almost equal with the other years which see the following table, which shews the amount for each year, and for each respective month :—

YEARS.	1851.		1852.		1853.		1854.		1855.		1856.	
MONTHS.	DAYS OF Precipitation.	DAYS OF Ozone.	DAYS OF Precipitation.	DAYS OF Ozone.	DAYS OF Precipitation.	DAYS OF Ozone.	DAYS OF Precipitation.	DAYS OF Ozone.	DAYS OF Precipitation.	DAYS OF Ozone.	DAYS OF Precipitation.	DAYS OF Ozone.
January,	10	5	14	7	9	11	14	6	12	6	12	14
February,	6	7	11	8	11	9	16	6	8	9	9	16
March,	11	6	17	11	9	21	17	7	9	6	10	17
April,	12	8	10	11	7	12	10	6	14	8	11	20
May,	16	14	9	8	16	12	8	7	6	9	13	20
June,	12	12	17	18	15	11	10	8	15	12	10	17
July,	13	16	11	17	9	4	5	4	7	11	12	18
August,	8	15	9	16	13	7	7	3	11	12	15	11
Septcmber,	11	15	10	16	11	9	11	3	12	11	14	12
October,	12	11	17	18	14	5	11	8	18	11	10	8
November,	10	13	10	12	14	11	13	11	14	9	15	8
December,	11	13	18	14	8	8	12	7	14	6	11	5
Total.	123	135	136	152	136	110	133	73	140	110	144	126

Southerly and easterly *winds* being the point from which our rain or snow generally comes, are for the most part present, during the indications of ozone, while on the contrary northerly or westerly winds, very rarely accompany its development.

In reviewing these observations, there is no condition of the atmosphere appreciable by our instruments, that indicates the presence of ozone except the presence of vapour or humidity.

Schonbien has asserted that a high electrical state of the atmosphere was always present when ozone was developed, and that the amount depended essentially on the amount of atmospheric electricity. From the comparison of nearly 6,000 observations on the electrical state of the atmosphere, and the amount of ozone taken at the same hour, at this place, and carefully compared; I have not found that opinion sustained, neither have I found its amount or presence influenced by the appearance of the *aurora borealis* which has also been said to be the case.

From these observations it would appear that a moist and humid atmosphere was necessary for the development of ozone, and this may account in some measure for its more constant presence and its greater quantity, in proximity to the sea. So far as its effects on the production of disease in plants, especially the

potatoe, and to which it has been more especially referred; it is almost certain that one of two causes must have given rise to the lamentable failure in this useful vegetable, either that the soil must have furnished the medium of disease, or the action of the atmosphere upon the leaves and stem of the plant,—the causes which act upon the stem and leaves, involve the action alone of Atmospheric Influences, while those that act through the medium of the soil are more numerous.

In this neighbourhood the disease showed itself after rain followed by a hot Sun, the atmosphere being loaded with moisture or vapour—just the condition essentially proper for indicating the presence of Ozone—the disease was much more extensive on wet and clayey soils than on sandy or dry ones.

It cannot be doubted that an agent so active as ozone, if really present, must exert a great influence on the health of individuals as well as animals and plants, the manner of its production, whether by chemical action or electricity, or magnetism, demands from us further investigation, and these investigations should be carried out with uniformity for the sake of careful comparison—one point should not be overlooked, that is, to mark carefully the amount of vapour present in the atmosphere, as the intimate connexion between them is too prominent to escape observation.

I have, as you will perceive, offered no theoretical deductions, if, as our continental brethren assert, that it does possess such powerful and wonderful properties, it must be evident that the American Association should at once take up the subject, in a way that we may arrive at important conclusions. I should not be justified in expressing a doubt on the labours of others in this Department of Physical Science, neither do I think it fair to offer any conclusions until our observations are more extended, and it is with this intention that I have brought it before the Association, hoping that between now and our next meeting, we may be able to investigate and compare observations so as to give it a proper place in this department of physical investigation.

THE METEOROLOGY OF THE VICINITY OF MONTREAL.

Being well aware that many of you are here for the first time in this, our Northern city, and have scanned, and I have no doubt, admired the numerous edifices—those artificial structures erected by the human hand, guided by human skill, and well suited to our wants. I am also aware that many among you have bent your investigations beneath our alluvial and fruitful soil, to contemplate the geology of our rocky formations, and the deposits of bygone ages, the work of that Divine Architect at whose command those bright and countless orbs that spangle in our firmament were brought into existence, and which forms to the astronomer so many objects for his study;—and I felt it might be interesting to you to know something of our climatology, and it is for this purpose I intend laying before the section some remarks in illustration, reduced from observations taken at St. Martins, nine miles due west of this place, and I shall for this purpose confine my observations to the means reduced from the last septennial period, although the observations on record extend over a much longer period of time.

The geographical co-ordinates of the place are 45° 32′ north latitude, and 73° 36′ longitude west of Greenwich. The cisterns of the barometers are placed at 118 feet above the level of the sea. The instruments used are standard instruments; the barometric observations are all redueed to the freezing point, (32° F.) and the temperatures are all in Farenheit's scale. The hygrometric observations are reduced by the tables and formula adopted at the Greenwich observatory in England. The receiver of the rain guage is placed 20 feet above the soil. The direction and velocity of the wind is ascertained by a self-registering instrument which indicates its velocity by dots on a paper register in miles linear. The electrical apparatus is provided with a collecting lanthorn which is elevated 80 feet from the ground. The solar and terrestrial radiators are also read in terms of Farenheit's scale. The ozonometer is of Schonbien's construction. The whole of the means are reduced from three daily observations, taken at 6 a.m., 2 p.m., and 10 p.m.; extra hours are also set apart for any unusual phenomena.

Barometer.—The mean heighth of the barometer for this period (7 years) was 29.676 inches, the mean reading for the

same septennial period in January was 29.744 inches, February 29,744 inches, March 29,492 inches, April 29,679 inches, May 29,604 inches, June 29,718 inches, July 29,715, inches, August 29,754 inches, September 29,722 inches, October 29,619 inches, November 29,769 inches, December 29.565 inches. The highest reading observed and on record here was on the 8th January 1855, and at 4 p.m. it attained the unusual height of 30.876 inch.; the lowest reading on record was in December also in 1855, and was 28,689 inches, giving an absolute range of 2,187 inches. The mean yearly range for the 7 years was 1,032 inches, and for the months as follows:

	inches.		inches.		inches.
January,.....	1,550	May,.....	0,800	September,.....	0,815
February,.....	1,131	June,.....	0,752	October,.....	0,951
March,.....	1,145	July,.....	0,616	November,.....	1,295
April,.....	1,090	August,.....	0,701	December,.....	1,538

There are two maxima and two minima variations occurring in the barometer in the 24 hours; the maxima variations occur at between 9 and 10 o'clock a.m., and between 9 and 10 p.m., the minima variations occur at 3 a.m., and 3 p.m.

Thermometer.—The temperature of the air for the same period (7 years) exhibits a yearly mean of 41° 56'. The mean temperature of January was 13° 26', February 13° 31', March 25° 44', April 40° 12', May 55° 70', June 62° 11', July 74° 78', August 61° 21', September 58° 12', October 46° 04', November 31° 49', December 13° 80', the absolute mean range for the same period has been from 90° 9' + to 27 ° 4' — (below zero) the absolute monthly range was, in

January + 40° 7 to 25° 1—	July + 97° 1 to 47° 8+
February + 41° 1 to 25° 2—	August + 96° 7 to 40° 6+
March + 56° 0 to 6° 7—	September + 91° 2 to 30° 4+
April + 75° 6 to 10° 1+	October + 75° 7 to 23° 8+
May + 86° 6 to 25° 7—	November + 60° 4 to 5° 7+
June + 94° 5 to 40° 5+	December + 42° 1 to 26° 3—

The highest temperature in the shade on record here was 100° 1, and the lowest range was 36° 2' below zero, giving a climatic range of 136° 3' degrees; the hottest month is July, and the coldest month is February; the warmest part of the day in summer is at 3 p.m., and in the winter season at 2 p.m.; the coldest part of the day in winter is at a little before sunrise.

The mean yearly temperature of the *dew point* reduced for the same period was 35° 6, and for the different months as follows:—

January.....	9° 6	July,.....	65° 0
February.....	7° 4	August,.....	53° 1
March,.....	20° 2	September,.....	52° 2
April,.....	34° 6	October,.....	40° 8
May,.....	47° 2	November,.....	26° 1
June,.....	54° 1	December,.....	8° 1

The relative degree of humidity for that period saturation being 1·000 was 814, and for the months:—

January,.....	·869	July,.....	·744
February,.....	·808	August,.....	·765
March,.....	·835	September,.....	·809
April,.....	·812	October,.....	·821
May,.....	·774	November,.....	·824
June,.....	·770	December,.....	·832

The *Electric force of Vapour* exhibits a daily maximum at 3 a.m., and a minimum at between 3 and 4 p.m. The summer quarter, which embraces June, July and August, is the dryest quarter; next is the Spring quarter which embraces March, April and May, the Autumnal and Winter Quarters are the most humid. Complete saturation does not often occur, it has nevertheless taken place about four or five times in each year.

The mean number of days on which *rain* fell for the same period is 73 per year, and the number of days on which *snow* fell is 43, making a sum of 116 days on which precipitation took place, leaving 249 fair days as a yearly mean for the 7 years,—there is on an average of about 110 nights suitable for astronomica purposes in each year.

The yearly mean amount of rain for the same period was 43.004 inches in depth on the surface, and the depth of snow also on the surface, shows a yearly mean of 95.76 inches. The monthly mean for snow and rain are as follows:—

	Inches of Rain.	Snow.		Inches of Rain.	Snow.
January,.....	0·600	22·38	July,.....	3·003	.....
February,.....	0·167	25·00	August,.....	5·908	.....
March,.....	0·380	18·79	September,.....	5·831	.....
April,.....	4·624	2·46	October,.....	6·063	1·80
May,.....	4·386	.....	November,.....	5·055	4·34
June,.....	6·013	.....	December,.....	0·940	17·71

This gives a mean of 52,380 inches of rain and melted snow, this is reduced by the Smithsonian formula, which does not hold good or correct for low temperatures, and I think 1 to 8 would

e more accurate. The greatest amount of rain which fell in 24 hours, on record here, was in September 1853, and amounted to 5,142 inches, but this is unusual ; you will perceive that we are little more than five months without snow.

The difficulty in this climate of measuring the amount of evaporation from the surface of water, except for 7 months of the year, owing to frosty nights, has induced me to undertake the registration of the amount of evaporation from the surface of ice during the remainder of the year, (5 months) so as to compensate in some measure for the defect in the observations on the amount of evaporation from the watery surface. These combined observations give a mean of more than 30 inches as the amount of water evaporated. The evaporator is shaded from the sun and rain, but is exposed to the currents of wind, so is also the icy surface in winter.

I am led to believe this amount is tolerably correct. The mean amount of evaporation from the surface of water alone for the 7 months is nearly 21 inches, the remaining amount being furnished by the evaporation which takes place from the surface of ice during the remaining 5 months.

Winds.—The most prevailing wind of the year is the Westerly, and the mean direction for the 7 years in the different months is as follows :—

January,	N.E. by E.	July,	S.W. by W.
February,	W.S.W	August,	W.N.W.
March,	W.	September,	W.N.W.
April,	N.E. by E.	October,	W. by W.
May,	N.W. by N.	November,	W.N.W.
June,	S.W. by W.	December,	N.E. by E.

The greatest velocity on record here exceeds somewhat 60 miles per hour linear,—there seems a disposition for a change both in the direction and velocity, at 3 p.m. and at 3 a.m., which corresponds precisely with the diurnal barometric fluctuations. The whole amount of miles linear of wind during the past year (1856) was 53061,63 miles, which being resolved into the four cardinal points, gave, N. 6969,80 miles ; S. 5298,89 miles ; E. 10776,40 miles, and W. 30016,56 miles. The maximum velocity during the past year was 44,40 miles per hour. There were 2220 hours 15 minutes calm, and 6546 hours during which the atmosphere was in motion. Below is a table of the anemometric observation during the year 1856, showing the direction and amount of miles from each quarter of the compass, and also the amount of miles

run in each month, also the amount of calm in hours for each month :—

Course.	Velocity in Miles.	Course.	Velocity in Miles.	Course.	Velocity in Miles.
N.	310,50	S.E. by E.	403,00	W.S.W.	4679,66
N. by E.	211,50	S.E.	297,00	W. by S.	4542,50
N.N.E.	412,00	S.E. by S.	690,20	W.	3111,80
N.E. by W.	661,70	S.S.E.	374,00	W. by N.	3103,00
N.E.	1325,00	S. by E.	578,50	W.N.W.	4790,00
N.E. by E.	8092,60	S.	714,70	N.W. by W.	2112,80
E.N.E.	892,70	S. by W.	238,30	N.W.	2728,00
E. by N.	237,10	S.S.W.	497,57	N.W. by N.	1269,00
E.	86,30	S.W. by S.	608,10	N.N.W.	687,00
E. by S.	156,00	S.W.	2375,70	N. by W.	77,00
E.S.E.	240,00	S.W. by W.	3845,60	.....	.....

RESOLVED INTO THE FOUR CARDINAL POINTS.

Months.	Miles North.	Miles South.	Miles West.	Miles East.	Total Miles.	Hours and Min. calm
Jany.	395·40	95·77	4115·66	1744·10	6351·23	143·00
Feby.	71·90	280·00	4854·80	277·20	5463·90	166·00
March.	674·80	917·30	3706·60	567·70	5866·40	177·00
April.	234·00	116·00	1644·00	2585·10	4579·10	247·00
May.	1415·00	484·00	1323·00	1321·00	4540·00	179·10
June.	350·00	768·00	1450·00	582·00	3130·00	168·40
July.	776·00	345·00	1652·20	111·00	2884·00	174·20
August.	621·00	242·30	1018·20	569·30	2450·00	269·20
Sept.	471·00	589·50	1249·00	490·00	2799·50	243·14
Oct.	843·00	371·00	2270·00	248·00	3752·10	226·45
Nov.	653·00	650·00	2386·00	975·00	4644·00	149·00
Dec.	464·70	458·00	4387·00	1310·00	6628·20	78·30

The yearly mean intensity of the sun's rays for the same septennial period, is 102° 6, and for the months as follows :—

January, ...	79° 4	July, ...	121° 4
February, ...	87° 5	August, ...	118° 4
March, ...	119° 4	September, ...	103° 9
April, ...	107° 1	October, ...	99° 4
May, ...	110° 5	November, ...	89° 7
June, ...	110° 2	December, ...	84° 9

The yearly (septennial) mean of Terrestrial Radiation was 11° 6, and for the months as follows :—

January, ...	20° 9	July, ...	46° 7
February, ...	22° 6	August, ...	38° 1
March, ...	18° 2	September, ...	34° 2
April, ...	8° 0	October, ...	18° 9
May, ...	29° 6	November, ...	11° 6
June, ...	39° 1	December, ...	25° 1

The amount of dew is very variable, but bears a proportion to the degree of terrestrial radiation.

The mean of cloudless days were 57 days perfectly cloudless—the prevailing clouds are the Cumuli Stratus and Cirri Stratus.

The song Sparrow—(*Fringilla Melodia*)—The harbinger of the Canadian spring generally makes its first appearance the first week of April. Frogs, *Rana*, are first heard about the 23rd of April. Shad, *Alosa*, are caught the last week in May. Fire-flies, *Lampyrus corusca*, are first seen about the 24th of June, and the Snow-bird, *Plectrophanes nivalis*, generally makes its first appearance about the 20th of November; Swallows, *Hirudo rufa*, about the 18th of April. Our winter generally sets in about the latter week of November or the first week in December, and is ushered in by a fall of snow from the N.E. by E., and this is the point from which our winter storms come. Rain generally comes accompanied with a wind from the S. S.W. or S.E., and also from the N.E. by E.

We have generally a few days of that poetic season, the Indian Summer in November.

> "The years last lovliest smile,
> That comes to fill with hope the human heart;
> And strengthen it to bear the storms awhile,
> Till winter's days depart."

Our snow storms of winter are from the N.E. by E., and for some hours before they form, the Eastern horizon becomes gradually covered with heavy *strata* clouds of a deep leaden hue, the upper strata of clouds are generally a mixture of *Cirri Cumulus* and *Stratus*, moving from the South, but the surface wind is from the point I have stated N.E. by E., the wind during these storms often attain a velocity of some 30 or 40 miles per hour, the barometer is falling and the thermometer somewhere about zero, the Psychometer indicates an increasing amount of moisture, the Electrometers indicate a very high tension of *Negative* Electricity, often an amount of 300 deg. in terms of Volta's No 1. Electrometer, and sparks are constantly passing between the receiver and discharger for hours.

Minute but perfect crystalline forms of snow commence to fall, and may continue for some 48 hours, and I have seen some 12 or more inches of snow fall during this time. Precipitation then ceases; the wind veers *always* by the N. to the W., or W. N.W., with a velocity of some 30 miles per hour, (this is our cold term); and the wind carries the loose finely crystallized snow in clouds before it, this is in Canadian parlance a "Poudrerie."

The wind is intensely cold; the thermometer during this period attains a minimum of some 30° below zero. The sky is partly covered by *cumuli* clouds, with a few *strati*—the electrometers still indicate a high tension, but of an opposite or *Positive* character, this Westerly wind may last some 48 hours or more, and lulls down at sunset; may be of the second day into a calm. The blue tint of the sky is very deep, and the rays of the setting sun throws a red or orange shade on the snowy scene, and the atmosphere attains a greater dryness, the electrical action gradually ceases with the wind.

Our thunder storms of summer, which give a yearly mean of 14 (for the same period of 7 years) are of short duration, forming generally in the W. or N.W., and the electricity varies in kind.

The months of April, May and June bring returning summer; the nights of July and part of August are generally oppressive, the temperature often remains at 70° during the night: but the Canadian autumn is very pleasant. The woods with its leaves of a thousand varied tints, and the blue and cloudless sky, with frosty nights, reminds us that the good times of the merry sleigh bells are near.

Notwithstanding these vicissitudes and extremes of temperature, the soil is very productive and vegetation prolific and rapid; and it has again pleased an all-wise Providence, during the present year, to crown the labours of the Canadian husbandman with a bountiful and abundant harvest.