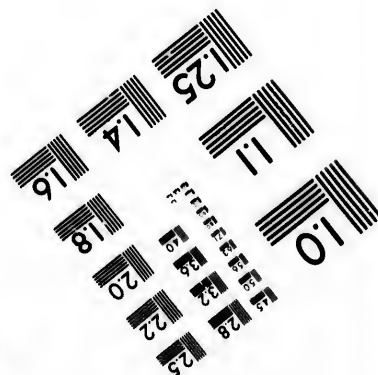
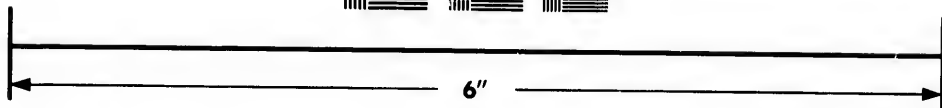
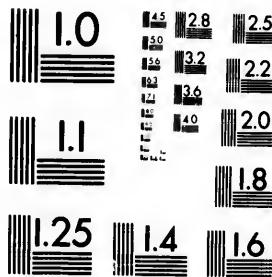


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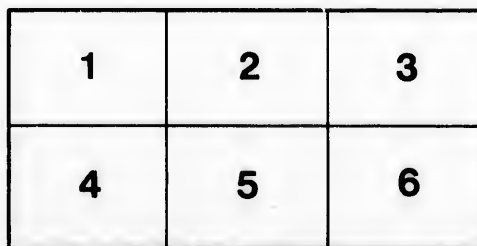
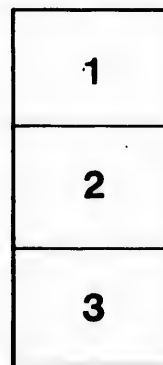
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METEOROLOGICAL SERVICE DOMINION OF CANADA.

THE RAIN AND SNOW FALL

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OF THE

PROVINCE OF ONTARIO "

BY

HUGH V. PAYNE.



PUBLISHED UNDER THE DIRECTION OF
CHARLES CARPMAEL, Esq., M. A., F. R. A. S.,
DIRECTOR OF THE METEOROLOGICAL SERVICE.

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PREFACE.

The accompanying map, chart and tables, were produced from a collection and tabulation of the rain and snow fall records of Ontario for the six years 1883 to 1888 inclusive.

All the records, when complete, of the volunteer and paid observers of the Dominion Meteorological Service, also of the volunteer observers of the Ontario Bureau of Statistics have been used, and are 135 in number.

Whenever it was found that the records of a station were not complete for one year at least, or there was doubt as to their reliability, they were not made use of.

The above years have been selected as they give a larger number of completed records than any other years.

The accompanying chart has been prepared with the object of showing the effect the westerly wind has in increasing the precipitation on the western slope of the high lands of Ontario.

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THE
RAIN AND SNOW FALL OF THE PROVINCE OF ONTARIO
WITH
MAP, TABLES, &c.,
BY
HUGH V. PAYNE.

The necessity for accurate knowledge of the rain and snow fall of different localities must be evident to every one, especially to the agriculturist, to whom such knowledge is of the greatest importance.

The effect of the rain and snow fall upon our crops is considerable and is a prime factor in regulating the price of produce. It also plays a very important part in the state of our health and the rate of mortality, and its study furnishes most important knowledge of the inland water supply, dependent on rainfall entirely.

Apart from the practical value these data have for the present inhabitant, they must prove of much use to the intending settler in the selection of the locality most suitable to his wants, and will dispel erroneous impressions which have prevailed in different districts.

In dealing with the rainfall of the province it is necessary to treat with three distinct causes. First, the movement of cyclones over the province; secondly, the effect of locality; and thirdly, the most prevalent winds.

The cyclones which give the more general, and as a rule, the heaviest rain or snow falls are those which come from the warmer regions of Texas or the Gulf of Mexico, and as they move towards Ontario are continually receiving a supply of warm and moist south and south-west winds. At the same time it is noticeable that higher pressure, from which a colder current of air is flowing, generally prevails to the north or north-east of these cyclones.

The co-mingling of these two currents, and the upward tendency of the warmer air into the higher and colder atmosphere, often causes a general downpour over Ontario.

Cyclones also pass over Ontario which come from the west and north-west, but these do not as a rule produce heavy rains in the Province and are sometimes unaccompanied by any precipitation until they reach the lakes, and even then may pass over the province without causing any precipitation. The reason is that before reaching the province they travel over a comparatively dry tract of country where there is little chance of absorbing moisture. When passing over the lakes they have a greater chance of doing so on their south-eastern or southern and warmer sides, where the incoming air rising into a colder altitude is deprived of its moisture and a fall of rain or snow sometimes occurs over the province. It is within the boundaries of these cyclones from the west, in the eastern and southern quadrants, that the summer thunderstorms usually occur. These same cyclones on moving further eastward and drawing in the humid air from the Atlantic Ocean may give heavy precipitation in eastern Canada.

Occasionally a cyclone may back in from the Atlantic causing a cold rain or fall of snow in Ontario. There is also a type met with more generally in summer, a small barometric depression, which is of small extent and occurs after a heated period during which great absorption has been going on. On the southern quadrant of this depression is higher pressure and an inflowing current of warm air; on the north side we also have higher pressure and an inflowing current of air of lower temperature. Condensation takes place and excessive local rains occur, which are frequently accompanied by thunderstorms and hail. On July 17th, 1886, there was an extreme type of this when a severe rainstorm accompanied by heavy hail and thunderstorms occurred in parts of southern Ontario.

Besides these general causes there are local directing causes which tend to increase the rainfall. These are the positions of the great lakes in connection with the land, the high and low lands, and the prevailing direction of the wind.

In Ontario the prevailing direction of the wind is westerly and where this wind passes over and collects the humid air of the lakes, the air will, if striking the high lands, have a tendency to

be driven up into the higher and colder atmosphere when rain or snow will be deposited on the western slope (see diagram and map), and the air will then pass over to the eastern side as a less humid wind, often depositing no further moisture:

The precipitation in Ontario is greatest on the western slope of the highest lands, which, starting from 582 feet, the level of Lake Huron above mean sea level, rise gradually to a height of 1750 feet, this being attained in the south-eastern portion of Grey County and south-western portion of Dufferin County.

The effect of the westerly wind in increasing the rainfall at the eastern extremity of Lake Ontario is also noticeable; and there is a marked increase in rainfall at the western extremity of this lake, which seems to be attributable to the length of water over which the easterly winds flow. These winds on reaching this locality, strike high lands and are driven up into a colder atmosphere. Care has been taken to check the rainfall returns from this locality, and the volunteer observer at Stony Creek states that he has every reason to believe that higher up the elevated lands the precipitation is much greater, his station being situated on the lower lands.

In the north-western portion of Peel County the land quickly rises until it reaches a small apex 1,377 feet above the sea. The western winds sweeping round the southern portion of the higher land immediately to the west of this apex, seems to be the cause of a marked increase of precipitation immediately to the south-west of this point.

Midway along the shore of Lake Ontario an increase in rainfall is shown, owing most likely to the humid winds off the lake striking the southern slope of the high lands there, which rise in Ontario County, just to the west of Lake Scugog, to a height of 659 feet above Lake Ontario.

On the high lands to the north of Lake Scugog, where the land rises 700 feet above Lake Ontario, an increase in rainfall is also noticeable. In the Muskoka high lands a similar increase is shown.

In the extreme eastern portion of the province there is a marked increase in precipitation, but as there is no very marked increase in elevation here, except further to the eastward, it is probably attributable to other causes, perhaps the confluence of the two great rivers, the St. Lawrence and Ottawa.

Enough has been stated, I think, to prove the intimate connection between the elevations, the prevailing winds, and the precipitation, of the province, and a study of the accompanying map and chart will show many other points of interest.

It would not be advisable to draw conclusions from the scant data obtainable from northern and north-eastern Ontario, but it is to be hoped that as time goes on this may be done.

The effect of forests as a factor in the increase of rainfall is more or less questioned, but evidence seems to point to the fact that they do slightly increase the rainfall. One thing seems certain, they retard evaporation and drainage, and by pumping up the superfluous moisture from the soil retain in the air that which otherwise would run off the ground. In denuding the land of this growth there is a far greater tendency for quick drainage after a rainfall. Not only does the land lose the full benefit of the rain, but a demand is placed on the water courses to carry off the amount in a far shorter time than formerly, whence may be traced the cause of many destructive floods that have occurred from time to time of late years; and if, as there is no reason to believe that the heavy downpours which caused these floods have decreased of late years, as the country becomes more and more denuded of its forests, they are more likely to increase than decrease in severity.

It has been demonstrated in studying the upper tributaries of the Hudson river that the summer flow of the Adirondack rivers has decreased 30 to 50 per cent within the memory of men now living. Many of the small streams which a quarter of a century ago were abundantly supplied with water during the entire summer are now dry during many months.

The question as to whether the rain or snow fall increases or decreases in the province as time goes on is one that has often been discussed, and is of great interest, giving rise to many statements as to excessive rain or snow falls, also as to whether our summers are now wetter or dryer than formerly.

There are not many continuous records obtainable in Ontario covering a sufficient number of years which can be relied upon and which have been recorded by reliable instruments, but a selection has been made from those obtainable for a summary of rain and snow fall, viz.: the meteorological stations at Barrie, Stratford,

Peterborough and Toronto, from which have been compiled the following table of ten year periods as near as possible.

In combining rain and snow 1 inch of snow has been taken as equivalent to .10 inches of rain.

GARRIE, ONT.

RAIN.			SNOW.			RAIN AND SNOW.	
Periods.	Mean rain.	No. of days.	Periods.	Mean Snow.	No. of days.	Periods.	Mean.
*1867-76 inc.	18.05 in.	86.3	1867-76 inc.	116.7 in.	73.0	*1867-76 inc	29.7 in.
1877-86 "	20.26 "	80.1	1877-86 "	83.8 "	58.9	1877-86 "	18.6 "

*1868 not complete, not used.

STRATFORD, ONT.

RAIN.			SNOW.			RAIN AND SNOW.	
Periods.	Mean rain.	No. of days.	Periods.	Mean snow.	No. of days.	Periods.	Mean.
1861-70 inc.	29.70 in.	97.6	1861-70 inc.	106.35 in.	63.5	1861-70 inc	40.34 in.
*1871-80 "	27.07 "	85.9	*1871-80 "	102.32 "	62.5	*1871-80 "	37.30 "
1881-87 "	29.77 "	91.8	1881-87 "	98.41 "	59.7	1881-87 "	39.61 "

*1876 and 1879 not complete, not used.

PETERBOROUGH, ONT.

RAIN.			SNOW.			RAIN AND SNOW.	
Periods.	Mean rain.	No. of days.	Periods.	Mean snow.	No. of days.	Periods.	Mean.
1867-76 inc.	20.89 in.	85.4	1867-76 inc.	82.48 in.	62.6	1867-76 inc	28.63 in.
1877-86 "	22.21 "	74.2	1877-86 "	64.93 "	*35.6	1877-86 "	28.70 "

*No. of days doubtful.

TORONTO, ONT.

RAIN.			SNOW.			RAIN AND SNOW.	
Periods.	Mean rain.	No. of days.	Periods.	Mean snow.	No. of days.	Periods.	Mean.
1841-50 inc.	33.38 in.	96.1	*1841-50 inc.	59.5 in.	46.5	*1841-50 inc	39.33 in.
1851-60 "	28.07 "	113.4	1851-60 "	63.0 "	65.5	1851-60 "	34.37 "
1861-70 "	27.98 "	119.7	1861-70 "	80.9 "	75.3	1861-70 "	36.07 "
1871-80 "	23.79 "	115.3	1871-80 "	77.0 "	72.8	1871-80 "	31.49 "
1881-90 "	24.48 "	120.6	1881-90 "	55.5 "	71.0	1781-90 "	30.03 "

*1841 not complete, not used.

With the Toronto summary we are able to make use of 50 years observations and it would appear from the record that as regards rainfall, the annual amount is apparently decreasing and the number of days of rain increasing. As regards snowfall there seems to be no reason to assume that there has been either an increase or decrease in the amount or number of days of fall, but the mean total precipitation seems to point to a decrease.

The records from the other stations given above may be of interest to many, but it is questionable whether the time during which observations were taken is long enough to draw conclusions from.

An abstract has also been made, from the Toronto records, of the highest and lowest annual number of days of rain and snow in each ten-year period :

Periods.	RAIN.		SNOW.	
	Lowest.	Highest.	Lowest.	Highest.
1841-50 inclusive.....	80	106	33	73
1851-60 "	87	134	50	87
1861-70 "	111	136	68	84
1871-80 "	103	140	54	84
1881-90 "	103	145	62	83

From this table it would also appear that the number of days of rainfall is increasing, but the same is not noticeable with the snowfall.

The question as to how much rain may fall in Ontario in a given time is often asked. An abstract has therefore been made of all falls that have occurred in Toronto in 24 hours during the last 50 years of 2 inches and over :

RAINFALL IN 24 HOURS.

Date.	Inches.	Date.	Inches.
Jan. 31, 1843.....	2.500	Sep. 14, 1843.....	3.455
April 5, 1850.....	2.350	“ 8, 1847.....	2.500
May 17, 1856.....	2.135	“ 17, 1855.....	2.535
“ 17, 1865.....	2.220	“ 7, 1869.....	2.350
“ 13, 1868.....	2.220	“ 15, 1870.....	2.285
June 11, 1870.....	2.360	“ 13, 1878.....	3.085
July 24, 1841.....	2.000	Oct. 17, 1842.....	2.150
“ 17, 1850.....	2.750	“ 6, 1849.....	3.160
“ 17, 1866.....	2.345	Nov. 8, 1842.....	2.000
Aug. 11, 1841.....	2.340	“ 17, 1843.....	2.020
“ 27, 1843.....	3.250	“ 20, 1851.....	2.770
“ 13, 1850.....	2.100	“ 2, 1861.....	3.132
“ 12, 1866.....	2.145	“ 17, 1868.....	2.230
“ 4, 1878.....	3.450	“ 14, 1871.....	2.310
Sep. 11, 1842.....	2.930		

It may be noted that the year 1878 was the most remarkable in Toronto when on August 4th 3.450 inches fell, and on September 13th 3.085 inches.

There was a remarkable fall of rain and hail at Toronto on July 17th, 1886, at about 5 p.m., accompanied by a heavy thunderstorm, when .82 inches fell in 30 minutes, this being at the rate of 39.36 inches in 24 hours.

By the rainfall of August 4th, 1878, great damage was done owing to the flooding of houses and bursting of drains. By that of September 13th, in the same year, immense damage was done to property in Toronto, and heavy floods occurred at many places in the province. By that of July 17th, 1886, the culverts being unable to carry the water away, many parts of Toronto were flooded.

With regard to excessive snowfalls, the Toronto records are again taken for the last 40 years, and the following is an abstract of falls exceeding 1 foot in 24 hours.

SNOWFALL IN 24 HOURS.

Date.	Feet.	Date.	Feet.
Dec. 29, 1855.....	1 ft. 3 in.	Feb. 17, 1871.....	1 ft. 0 in.
Feb. 5, 1863.....	1 " 4 "	Dec. 25, 1872.....	1 " 3 "
Jan. 20, 1867.....	1 " 3 "	Jan. 24, 1873.....	1 " 3 "
Mar. 21, 1867.....	1 " 3 "	Mar. 2, 1876.....	1 " 4 "
Mar. 27, 1870.....	1 " 4 "	Jan. 24, 1886..	1 " 8 "

The possibility of predicting rain for a short time ahead is one of the achievements of the present day, but as to the possibility of predicting wet or dry seasons the late Mr. G. M. Whipple, of Kew Observatory, who has carefully discussed 978 years of rainfall observations which he has divided into cycles of 5, 6, 7, 8, 9, 10, 11, 12 years, says "There is no marked indication of the presence of a short cycle to be found," and "I think it may now be stated with certainty that all predictions as to rainy or dry years based upon existing materials must in future be considered as utterly valueless."

A comparison of the rainfall of Ontario with that of other parts of the world is very favourable to this province. Excessive or insufficient rain, by which the crops are so often ruined, have seldom been recorded, and nowhere is the annual fall less than 20 inches, this being a limit generally accepted as determining the quantity required to fit a country for pastoral and agricultural purposes.

ONTARIO—RAIN AND SNOW.

Feet.	YEARS.						Means.
	1883.	1884.	1885.	1886.	1887.	1888.	
ft. 0 in.							In.
" 3 "							
" 3 "							
" 4 "							
" 8 "							
	Essex—						
	Stoney Point.....	35·25					35·25
	Windsor.....	27·26	26·62	38·18	29·58	29·90	30·31
	Cottam.....	32·41	32·24	37·91	34·22	37·41	34·50
	Maidstone.....	32·51	25·47	39·49	25·02	24·65	28·97
	Wheatley.....					34·38	33·70
	Amherstburg.....	32·41					32·41
	Wanstead.....					26·56	26·56
	Lambton—						
	Sarnia.....	30·95		30·10	27·06	22·69	27·27
	Birnam.....	27·67	31·27	36·16	37·29	33·06	32·88
	Watford.....		24·06	26·73	26·64		25·42
	Theford.....		28·86	30·01	33·39	30·82	31·01
	Petrolia.....		24·05		20·88	28·14	24·36
	Oil Springs.....		29·04	33·53	30·61	26·44	29·64
	Middlesex—						
	Granton.....	44·54	33·89	39·54	33·93		37·98
	Ailsa Craig.....	42·59	29·84	34·05	30·07	30·56	33·42
	Delaware.....	40·18	32·88	37·66			36·91
	London.....		42·86	40·62	39·89	28·12	36·51
	Strathroy.....	34·43	33·99				34·21
	Milton Grove.....	39·01	31·15	34·42	33·47	24·74	32·28
	Putman.....		32·73	38·29			35·51
	Lucan.....	40·90					40·90
	Florence.....		30·32				30·32
	Elgin—						
	Port Stanley.....	36·27	27·02	35·43	37·88	27·53	32·49
	St. Thomas.....	38·01	33·03	30·02			33·69
	Cowal.....		32·56	32·05	33·75	30·48	30·90
	Lyons.....		32·79	36·99	40·79	28·03	33·23
	Aylmer.....		33·66	42·28	39·32	32·43	36·92
	Grey—						
	Owen Sound.....	50·50	39·95	37·58		34·12	38·56
	Presqu'Isle.....		41·70	40·55	36·81	33·55	37·05
	Egremont.....	46·11	31·03	33·54	30·21	31·92	33·56
	Durham.....	47·26	44·19	50·57	39·86	41·84	43·08
	Bognor.....		46·26	30·69	36·29	32·43	34·97
	Kent—						
	Chatham.....		28·35	33·88	29·89	32·62	29·17
	Blenheim.....		36·29	4·47	37·97	34·40	36·53
	Dealtown.....		29·62	34·89	37·05	31·47	32·73
	Ridgetown.....		31·34	37·30	33·37	32·15	32·67
	Waterloo—						
	Galt.....				35·05	24·87	29·42
	Conestoga.....	43·71		36·02	39·07	29·03	34·69
	Brant—						
	Brantford.....		25·58	23·08		21·06	23·17
	St. George.....		29·26	40·74	39·48	30·11	32·68
	Paris.....			36·21	34·11	23·43	31·54

ONTARIO—RAIN AND SNOW.

Means.	In.	YEARS.						Means.
		1883.	1884.	1885.	1886.	1887.	1888.	
		Muskoka—Concluded.						
		54·81	48·11	44·11	44·01	44·10	47·03	
		41·63	35·39	33·80	35·21	31·39	34·27	
		43·17	30·72				36·94	
			37·98	36·55	33·83	33·34	34·54	
			39·61	45·69	43·77		43·02	
			32·43				32·43	
						38·72	44·01	
		Parry Sound—						
		43·01				32·69	37·49	
					35·10	29·47	29·46	
			34·44	40·40	39·14	34·05	36·13	
				35·23	33·63	31·13	32·70	
					39·95	34·00	35·41	
		Peel—						
		29·25					29·25	
							27·32	
		York—						
						27·59	26·78	
							22·57	
		38·21	30·16	28·11	29·75	25·76	29·76	
		34·13	28·55	32·91	35·07	26·28	30·45	
				27·28	28·57	22·06	25·18	
			28·61	30·69	33·46	27·21	29·27	
		Welland—						
			29·57		33·63		31·60	
					33·83		32·29	
						30·75		
		Lincoln—						
		34·07	28·59				31·33	
		Victoria—						
		40·16	34·93	29·86	34·64	32·77	33·24	
			32·92	32·42	32·91	22·55	29·25	
		Ontario—						
		35·15	33·71	29·03	33·51	27·05	31·69	
		Durham—						
		36·40	31·57	35·56		29·78	32·43	
		Peterborough—						
		20·19	33·04	31·51	32·48	23·67	28·18	
		34·42	28·70	29·94		24·07	27·70	
		38·94	32·75	35·53	35·85	30·67	33·48	
				18·70	23·35		21·02	
				29·35	41·11	31·27	31·81	
		Frontenac—						
		38·39	36·73	42·04	41·73	28·87	36·74	
		Hastings—						
		35·92	36·88	35·40	26·76	20·95	29·95	

ONTARIO—RAIN AND SNOW.

	YEARS.						Means
	1883.	1884.	1885.	1886.	1887.	1888.	
<i>Hastings—Concluded.</i>							In.
Bancroft.....	33·27	32·21	32·15				32·54
Belleville.....							
L'Amable.....		31·88	34·10	34·57			33·52
Sterling.....		33·95					33·95
Trenton.....		30·28	34·32				32·30
Shannonville.....			35·00	27·33	25·65	26·87	28·71
<i>Renfrew—</i>							
Clontarf.....	34·06		32·95	35·74	27·31	29·87	31·99
Pembroke.....	36·60	30·85	36·89	31·13	19·71		31·04
Rockliffe.....	33·92	33·97	29·00	34·64	22·10	24·71	29·72
Northcote.....	29·22		24·71	24·96	22·49		25·34
Renfrew.....	27·16	22·14	28·04	26·38	21·12	17·54	23·73
<i>Dufferin—</i>							
Orangeville.....		28·31	36·33	34·94	33·22		33·20
<i>Grenville—</i>							
Merrickville.....	29·45	30·58					30·01
Edwardsburg.....	34·95	36·72	40·87	41·93			38·62
<i>Carlton—</i>							
Ottawa.....	28·83	32·42	34·51	36·82	37·68	31·67	33·66
<i>Haliburton—</i>							
Minden.....					34·82	34·20	34·51
Haliburton.....		29·85	30·48	29·96	25·46	30·57	29·26
<i>Addington—</i>							
Glastonbury.....		32·29					32·29
Harrowsmith.....		33·66	35·24	35·69		26·38	32·74
Denbigh.....		28·96	38·37	38·39	26·11	33·46	33·06
<i>Stormont--</i>							
Cornwall.....	31·41	34·15	35·73	31·91	25·47		31·73
<i>Prescott—</i>							
L'Orignal.....		39·69					39·69
<i>Lanark—</i>							
Oliver's Ferry.....		35·34	39·74	29·84	22·49	24·30	30·34
<i>Nipissing—</i>							
Sturgeon Falls.....		29·99					29·99
<i>Haldimand—</i>							
Warkworth.....					23·03		23·03

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925.1
.2347

SLOPES

Means
In.
32'54
33'52
33'95
32'30
28'71

31'99
31'04
29'72
25'34
23'73

33'20

30'01
38'62

33'66

34'51
29'26

32'29
32'74
33'06

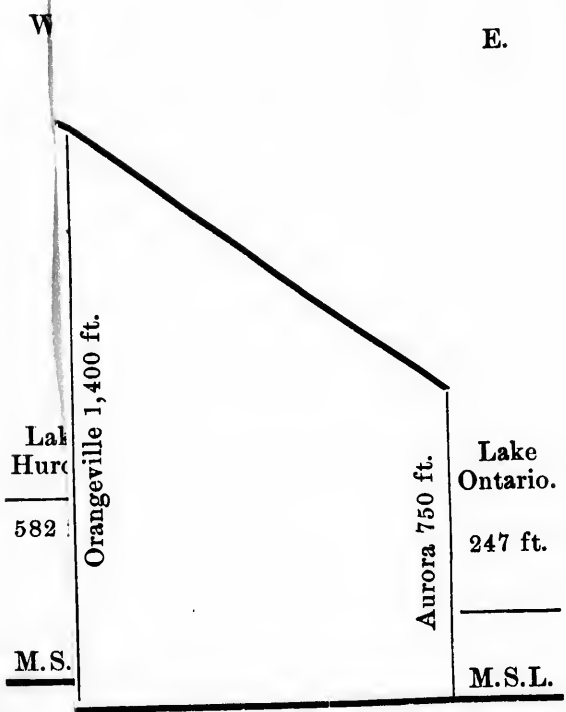
31'73

39'69

30'34

29'99

23'03



	Snow.	Rain.	Snow.
N.	7.50 in.	.00 in.	.00 in.
	7.00 "	3.24 "	9.62 "
S.	17.75 "	5.50 "	13.57 "
	.00 "	1.39 "	.00 "
S.V.	5.75 "	1.82 "	3.00 "
V.	4.46 "	1.85 "	4.60 "
N.V.	13.51 "	1.80 "	.90 "
	7.00 "	1.54 "	3.35 "

RAIN AND SNOW FALL ON THE WEST

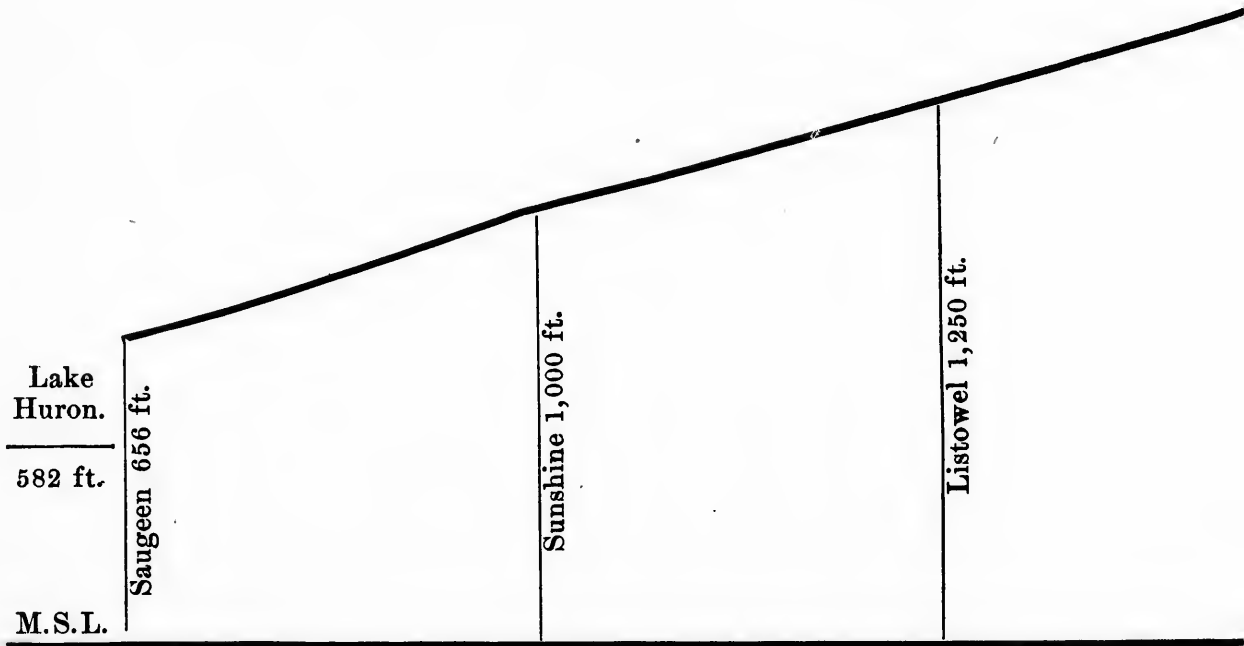
OF

WESTERN ONT

WITH DIRECTION OF WIND A

1886.

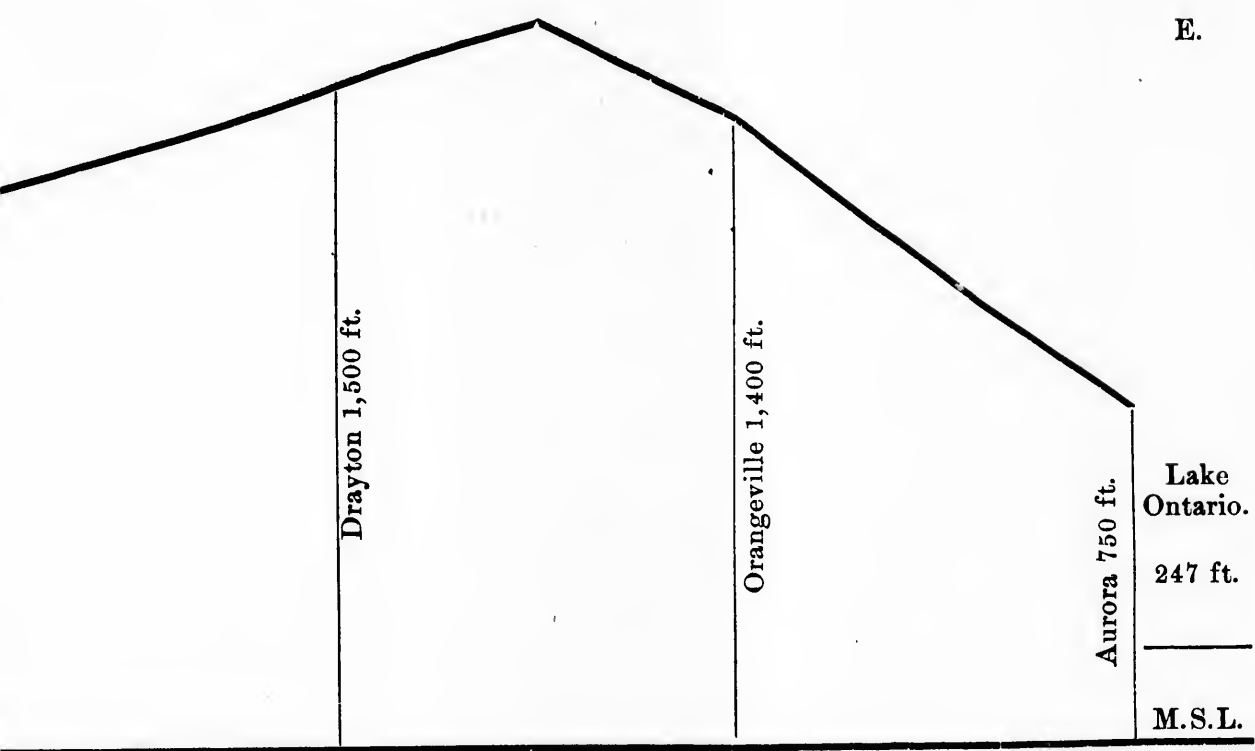
W.



	Rain.	Snow.	Rain.	Snow.	Rain.	Snow.
N.	1.53 in.	20.9 in.	1.30 in.	6.25 in.	.31 in.	.00 in.
N.E.	1.81 "	15.5 "	4.41 "	2.87 "	1.14 "	7.00 "
E.	3.14 "	13.5 "	5.47 "	7.10 "	4.82 "	6.00 "
S.E.	1.48 "	9.6 "	3.83 "	.75 "	7.81 "	17.50 "
S.	4.30 "	2.1 "	5.63 "	10.50 "	2.71 "	10.50 "
S.W.	2.74 "	10.7 "	3.02 "	11.50 "	9.62 "	52.15 "
W.	2.74 "	16.0 "	3.11 "	14.75 "	1.27 "	6.00 "
N.W.	1.17 in.	19.0 "	.48 "	16.52 "	.81 "	10.50 "

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THE WESTERN AND EASTERN SLOPES
OF
ERN ONTARIO,
OF WIND AT TIME OF FALL,
1886.



Snow.	Rain.	Snow.	Rain.	Snow.	Rain.	Snow.
.00 in.	.30 in.	.00 in.	1.42 in.	7.50 in.	.00 in.	.00 in.
7.00 "	.00 "	7.00 "	4.11 "	7.00 "	3.24 "	9.62 "
6.00 "	2.64 "	10.50 "	7.29 "	17.75 "	5.50 "	13.57 "
17.50 "	1.64 "	3.00 "	1.63 "	.00 "	1.39 "	.00 "
10.50 "	1.71 "	1.00 "	2.33 "	5.75 "	1.82 "	3.00 "
52.15 "	2.30 "	16.00 "	4.02 "	4.46 "	1.85 "	4.60 "
6.00 "	5.75 "	10.50 "	4.24 "	13.51 "	1.80 "	.90 "
10.50 "	.45 "	6.00 "	2.40 "	7.00 "	1.54 "	3.35 "

