The Frost and Drought of 1905.—By F. W. W. Doane, M. Can. Soc. C. E., City Engineer, Halifax, N. S.

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Frost.

The severity of the winter of 1904-5 is still fresh in the memory of the members of the Institute, and the record and effect of the heavy snowfall may be found in detail in the *Transactions* of last year. While the snowfall was extraordinary in itself the extreme severity of the winter was caused by the almost unbroken season of steady penetrating frost.

In ordinary soil in Nova Scotia a depth of two feet limits the penetration of frost; and in designing foundations for structures, footings three feet below the surface are considered safe and will rarely, if ever, be disturbed. In some other formations and under different conditions the penetration is much greater.

In Manitoba frost penetrates at times to a depth of nine feet, and in some towns water pipes are placed at a depth of eleven feet to prevent them from freezing.

In Nova Scotia the lowest temperature reported is about 30° below zero, while in Halifax the lowest record during the last forty years is 21° below in January, 1873, the next being 16° below in January, 1866.

The winter of 1903-4 was much colder than the average, the lowest temperature reached being 9° below in January and 11° below in February. The penetration was almost as great as in 1904-5, but the cold was not so continuous. The settling pond in front of the gate house at Spruce Hill lake froze, so that a man could walk over it—the first time since it was constructed, probably more than forty years ago.

In 1904-5 cold weather set in early and continued with almost unbroken severity for nearly three months. The temperature dropped in January to 7° below zero and in February to 6° below.

The penetration of frost reached a depth in some of the streets of Halifax of six feet. The unprecedented severity of the winter caused water pipes to freeze where frost had never been known before, and the usual waste was largely increased, causing a falling off in pressure on the summits and a water famine in the higher parts of the service.

Many service pipes were frozen, and after spending days and money in cutting down to the pipes and thawing them the greatest care was needed to prevent the frost from closing them again. Hydrants and mains were not immune, and the thawing operations overtaxed the staff of the water department all through the long winter. The frost penetrates more readily and to a greater depth where it can follow the water down a wall, curb-stone or pipe, consequently the pipes are sometimes frozen where the ground around them is unfrozen. The frost works down near the building and follows the pipe out under the street. When a trench or hole has been opened during the winter and refilled with frozen material, it is a difficult problem to prevent the pipes from freezing again. Frost also penetrates more readily in trenches made in rock than in closer filling. Apparatus has been provided for thawing frozen pipes in future by electricity, so that it will not be necessary to open trenches in winter and much delay, expense, annoyance and inconvenience will be avoided.

During the winter (1904-5) Barrington passage was closed by ice for about four weeks. This is a strait through which the tide rushes with a velocity of six to eight miles an hour. It has been closed twice only within the memory of the oldest inhabitant. About forty years ago this passage was frozen over so that men crossed on the ice, and about sixty years ago a load of hay drawn by oxen was taken across on the solid ice.

The writer witnessed a similar incident at Annapolis in 1888. The tide runs very swiftly opposite the town, but ice jammed in the river on the night of January 21st, and during the next thirty days steamers moored some distance down the river were loaded with apples hauled over the ice.

Governor Murray, of Rockhead prison, has kept a record for years of the date on which Bedford Basin froze over and the date on which the ice went out. February 6th was the earliest date for the closing and April 6th the latest day for the opening of this sheet of water. In 1905 it was shut up for the winter on January 24th, and remained frozen down to the Narrows until the ice broke up on April 16th.

There were ice races in the Dartmouth rink on April 3rd, and open-air skating on Milton pond, near Yarmouth, on April 5th.

The severity of the winter and the heavy snowfall chilled the water to such an extent that the lobster fishery along our shores was commenced much later than usual, and it was feared that the prosecution of this industry would be attended with but small results. Fortunately, the worst fears were not realized. The fishermen who followed this pursuit received higher prices in consequence of the conditions, and the results were even more satisfactory than in ordinary years.

Notwithstanding the lateness of the cold season, hedges were opening their leaves on May 8th, and the trees one week later.

The following table shows the lowest temperature for January and February in each year since 1864:—

1864—	January	9 below.	Febuary	4 below.
1865—	"	3 above.	"	2 above.
1866—	"	16 below.	"	12 below.
1867—	"	8 below.	"	5 below.
1868—	"	4 below.	"	7 below.
1869—	"	1 above.	"	6 above.

1870—	January	3 below.	February	4 below.	
1871—	"	15 below.			
1873—	"	21 below.	"	5 above.	
1874—	"	5 below.	"	zero.	
1875—	"	7 below.	"	14 below.	
1876—	"	1 below.	"	16 below.	
1877—	"	12 below.	"	6 above.	
1878—	"	3 below.	"	3 below.	
1879—	"	3 below.	"	1 below.	
1880—	"	9 below.	"	6 below.	
1881—	"	2 below.	"	3 below.	
1882—	"	12 below.	"	6 below.	
1884—	"	11 below.	"	6 below.	
1885—	"	9 below.	"	2 below.	
1887—	"	7 below.	"	7 below.	
1889—	"	6 below.	"	6 below.	
1890—	"	13 below.	"	4 below.	
1891—	"	2 below.	"	5 below.	
1892—	"	2 above.	"	7 above.	
1893—	"	2 above.	"	3 below.	
1894—	"	3 below.	"	10 below.	
1995—	"	2 below.	"	1 above.	
1896—	"	8 below.	"	3 below.	
1897—	"	5 below.	"	1 above.	
1898—	"	10 below.	"	zero.	
1899—	"	5 below.	"	9 below.	
1900—	"	1 above.	"	2 below.	
1901—	"	13 below.	"	18 above.	
1902—	"	zero.	"	4 below.	
1903—	"	5 below.	"	4 below.	
1904—	"	9 below.	"	11 below.	
1905—	"	7 below.	"	6 below.	
1906—	"	2 below.	"	1 above.	

Rainfall.

The amount of rainfall of any country is dependent upon the situation of the country, its position, the elevation of its hills and mountain ranges, and the prevailing direction of the winds. The influence of trees also has some effect.

The average annual rainfall in Halifax as deduced from long-continued observations covering a period of thirty-seven years, is 55.927 inches. The rainfall of 1905 was 47.795 inches—a deficiency of 8.132 inches, or 85 per cent. of the mean. There was an excess of rainfall in January, February, June, November and December, varying from 11 to 46 per cent. and a deficiency during the remaining seven months. When looked at in the dry light of statistics, the year recently ended seems to have been not unprecedented, still it was an exceptionally dry year. The number of days on which precipitation was recorded, 182, was about the average, but the total precipitation for the year was very near the minimum.

In the year 1894 the total precipitation was 45.808 inches, about two inches less than in 1905. A comparison of the two years shows, however, that at the end of November the rainfall of 1905 was slightly less than that of 1894, the difference of two inches being made in December. In fact, a study of the accompanying tables shows that the year from November 1st, 1904, to October 31st, 1905, is the driest on record, the total precipitation being only 41.685 inches or 74.5 per cent. of the mean. This minimum approaches within about two inches of the rainfall 39.51 inches reported for the year 1860, before the meteorological observatory was established. The accuracy of the latter will be accepted with less reluctance in future.

Long Lake, our great low service reservoir, was raised to overflow level by the melting of the great snows of 1904-5, and water began to run over the waste weir on the 30th of March. The lake continued to overflow until the 19th of May after which the water began to fall. It reached its lowest level on

November 4th—8 feet 4¾ inches below the waste weir. On the 16th November Spruce Hill lake was 7 feet 9 inches below the waste weir. The fall rains usually begin in September, but in 1905 the September rainfall was only 74 per cent. of the mean and October 28 per cent. Steps were taken by the city to prevent a water famine, but it was not until November 17th that fears for the efficiency of the supply were relieved. Although the rains came at last the lakes did not recover rapidly as the ground was parched, and to-day Long lake is eight inches below the waste weir, while Spruce Hill lake must rise 46 inches before it will overflow.

The season of 1905 was the driest for over ten years in the eastern States, and reports from England state that it was much below the average there.

The dryness caused much inconvenience in Halifax and was a greater strain on the water system than in 1894, because the consumption of water has increased considerably during the eleven years since the last drought. There is no danger of the low service supply running short, however, as over 1,000,000,000 gallons of water were allowed to run over the waste weir during April and May. The high service lakes were equal to the demand, although they fill up again more slowly in consequence of the comparative difference in water-sheds.

Not every engineer has the time or the opportunity to investigate in detail many points concerned in the observation of rainfall; that work appeals more to the meteorologist. It is sufficient for the engineer that he be able to obtain a trustworthy record. The writer is indebted to the meteorological agent of the Dominion government for the use of his records and valuable assistance in the compilation of the occompanying tables. The means placed at his disposal for making precipitation observations are not what they should be. He should be provided with all necessary self-recording instruments, so that a more complete record could be made and the greatest assistance given to the engineer.

The importance of possessing a reliable and complete record of rainfall appeals more strongly to the municipal engineer than to any other, because drainage and water-systems and water-power construction require for their fundamental basis a reliable record of rainfall upon which the calculations for his design may be based. In the design of drainage works the mean fall is not the conclusive fundamental datum of the engineer, not even the maximum yearly fall, but the heaviest daily fall, and, more particularly, the greatest heavy fall in a short period. The value of having such records from self-recording instruments is two-fold. First, they give an exact indication of the carrying powers of existing sewers; second, they show the demands likely to be made upon sewers and form a valuable basis upon which calculations for the improvement of existing or the design of new sewers can be based. A single gauge is not always reliable for the measurement of the rainfall in any gathering ground as instances are reported of a variation of 50 per cent. in one year where gauges were only one-quarter of a mile apart.

The following form of record would be most valuable to the municipal engineer:—

Date.	Duration of storm.		Total precipitation in inches.	Rate per hour in inches.	20 minutes of maximum precipitation	Period of greatest precipitation.		Rate per hour. In.
	Hours	From				Hours.	From.	

The rain gauge used by the city of Halifax is of brass, cylindrical in form, with a knife-edge rim. The diameter is

3½ inches. This may seem a very small size for the purpose, but this question was investigated many years ago. After a long series of experiments it was found that the size of gauge or funnel made practically no difference, as gauges varying from 1 to 24 inches in diameter were used with the following results. The 24-inch gauge, being the largest, the rainfall collected therein was taken as 100, and the others were found to read as follows:—

Diameter of gauge..	1	2	4	5	6	8	12	24 in.
Reading	93	96	100	99	102	102	100	100

These results show that except in the case of very small gauges the difference in the amount of rain caught never exceeded two per cent. The adoption of a size from four inches upwards then came to be a matter of convenience, the factors which determine the size being that the instrument shall not on the one hand collect per inch of rainfall an inconveniently small, or, on the other hand, an embarrassingly large volume of water.

The city snow records at the lakes are measured on a board placed in a carefully selected location where it will be free from eddies and drifts. The board is placed level and the snow falling on it is carefully measured with a rule or scale. The depth of melted snow is ascertained by inverting a brass cylinder 3½ inches in diameter on the board. Cylinder and board are then turned upside down so that the cylinder will contain the actual quantity of snow that has fallen within a circle 3½ inches diameter. The snow is melted and measured in a graduated glass in the same manner as rain is measured.

The government observer does not follow the same method for snow measurement, but records the depth of melted snow as one-tenth of the depth of snow falling.

After taking a measurement the snow board is again set perfectly level and at the surface of the snow.

The selection of a site upon which to place a gauge is of primary importance. It should be placed upon a flat stretch of ground, not on the face of a slope, nor on the face of a cliff, nor on a house top. It is a mistake to place it on the top of a dam or embankment, as the accuracy of records obtained from gauges in such positions will be somewhat doubtful. Where the wind is blowing at right angles to the embankment an eddy will be set up parallel to the slope of the bank, which will have a tendency to lift the rain over the top of the bank and produce a comparatively calm area around the gauge.

The volume of rain collected decreases with the height at which the gauge is place above the ground, and experiments have been carried out from time to time to investigate the cause of this decrease. After many heated controversies over the question, it has now been established that this decrease is wholly due to the velocity of the wind and the angle which the rain makes with the horizon. Taking one foot above the ground as representing a catch of 100, at 25 feet above the ground the catch was found to equal about 79 per cent. This gives approximately the ratio of diminution of rain caught with the increase of height. If gauges are not placed at the same level above the ground much of their utility is lost, because it becomes necessary, as in the case of barometic readings, to reduce them to a fundamental level, and the application of such a correction in rainfall work is always open to a doubt. The rim of the gauge should be set perfectly level and one foot above the ground.

While the precipitation records are most valuable in computing the yield of our water-sheds, in order to determine with any degree of accuracy the percentage of rainfall collected and the run-off available for water works or power the evaporation should be determined.

The value of the rainfall for water-works or power-systems is usually determined by the average of the two or three driest years, according to the storage capacity available.

The wettest year was 1896, with a rainfall of 69.862 inches or 25 per cent. greater than the mean for 37 years (55.927 in.)

The driest year was 1894—45.808 inches or 82 per cent. of the mean.

The driest two consecutive years were 1879-80—47.835 and 52.853, an average of 50.344 inches, or 90 per cent. of the mean.

The driest three consecutive years were 1879-80-81, with an average of 50.814 or 91 per cent. of the mean.

The driest twelve months—November 1st, 1904, to November 1st, 1905, 41.685 inches, or 74.5 per cent. of the mean.

The driest twenty-four months, December 1st, 1903, to December 1st, 1905, an average of 50.060, or practically the same as for two calendar years.

The following table gives the maximum, minimum and normal rainfall for each month and for the whole year for thirty-seven years, together with the rainfall during 1905 and the departures from the normal:—

Month.	Year.	Maximum (inches)	Minimum (inches)	Average 1869-1905 (inches)	Rainfall 1905 (inches)	Excess or deficiency	Per cent. above or of mean.
January	1895	10.131	.....	5.682	8.290	+2.608	46.
"	1896	.....	1.720	.....	.....	.....	.....
February ...	1870	9.780	.....	4.769	5.326	+ .557	12.
" ...	1901	.....	0.966	.....	.....	.....	.....
March	1878	10.284	.....	5.458	2.804	-2.654	51.
"	1889	.....	2.046	.....	.....	.....	.....
April	1889	7.403	.....	4.000	1.260	-2.740	31.5
"	1886	.....	0.820	.....	.....	.....	.....
May	1886	8.819	.....	4.025	3.217	- .808	80.
"	1903	.....	0.676	.....	.....	.....	.....
June	1874	7.920	.....	3.800	4.970	+1.170	30.
"	1879	.....	1.191	.....	.....	.....	.....
July	1896	8.729	.....	3.708	1.927	-1.781	52.
"	1894	.....	1.059	.....	.....	.....	.....
August	1887	8 351	.....	4.287	2.733	-1.554	64.
"	1899	.....	1.542	.....	.....	.....	.....
September ..	1896	12.092	.....	3.747	2.753	- .994	74.
" ..	1878	.....	0.800	.....	.....	.....	.....
October.....	1896	15.039	.....	5.520	1.539	-3.981	28.
"	1897	.....	0.746	.....	.....	.....	.....
November .	1898	10.248	.....	5.718	6.348	+ .631	11.
" ..	1882	.....	1.392	.....	.....	.....	.....
December...	1893	10.167	.....	5.213	6.628	+1.055	20.
" ...	1875	.....	1.614	.....	.....	.....	.....
Totals 1896		69.862	.....	55.927	47.795	-8.132	85.
" 1894		.....	45.808	.....	.....	.....	.....

PRECIPITATION AT HALIFAX, N. S.

TABLE SHOWING THE MONTHLY AND ANNUAL DEPTH OF RAIN AND MELTED SNOW, EXPRESSED IN INCHES; ALSO THE AMOUNT THAT HAS FALLEN FROM JANUARY 1ST TO THE END OF EACH MONTH, INCLUSIVE DURING EACH YEAR.

YEAR.	January.	February.	January to February, inclusive	March.	January to March, inclusive.	April.	January to April, inclusive.	May.	January to May, inclusive.	June.	January to June, inclusive.
1869	4.530	4.380	8 910	7.950	16.860	2.570	19.430	5.570	25.000	3.920	28.920
1870	6.670	9.780	16 450	3.080	19.530	3.860	23.390	3.190	26.578	1.690	28.270
1871	3.730	5 880	9 610	6.160	15 770	4 880	20.650	2.590	23.240	2.960	26.200
1872	3.880	4.490	8.370	5.370	13 740	2 850	16.590	4.440	21.030	4.230	25.260
1873	7.830	1.610	9 440	4 090	13.530	2.860	16 390	2.340	18.730	2.960	21.690
1874	5.420	5.310	10 730	3.980	14.710	4.550	19.260	4.770	24.030	7.920	31.950
1875	3 481	5.877	9.378	2.113	11.491	3.378	14.869	3.977	18.846	4.067	22.913
1876	3.451	6.456	9.907	6.334	16.241	3.125	19.366	4 664	24 030	3.384	27.414
1877	4 2 0	1.809	6.009	8.666	14.675	3.801	18.476	4.024	22 500	3.841	26.341
1878	7 522	2 697	10.219	10.284	20.503	3.502	24.005	5.759	29 764	4.477	34.241
1879	4.400	3.001	7.401	6.202	13.603	3.481	17.084	4.687	21.771	1.191	22.962
1880	7.733	5.122	12.855	3.365	16 220	4.797	21.717	4.088	25.105	1.343	26.448
1881	3.607	5.329	8.936	6.556	15.492	3.498	18.990	2.460	21.450	5.308	26.751
1882	6.840	5.949	12 789	7.068	19.857	4.824	24.681	4.677	29.358	5.507	34 865
1883	4.930	3.860	8.790	4 941	13.731	3.703	17.434	8.613	26.047	3.322	29.369
1884	4.406	6.161	10.567	7.034	17.601	7.213	24.814	3 629	28.443	3.773	32.216
1885	6 388	5.090	11.478	3.889	15.367	3.520	18.887	3.282	22.169	2.749	24.918
1886	8.670	3.842	12.512	4.027	16.539	0.823	17.362	8.819	26 181	2.708	28.889
1887	7.706	6.735	14.441	4.449	18.890	6.396	25.286	2.126	27.412	2.121	29.533
1888	5.442	6.284	11.726	4.310	16.036	3.675	19.711	2.877	22.588	4.939	27.527
1889	4.391	6.181	10.572	2.046	12.618	7.403	20.021	3.871	23.892	3.755	27.647
1890	3.963	4 645	8.608	9 889	18.497	2.958	21.455	3.970	25.425	3.440	28.865
1891	8.383	8 740	17.123	2.685	19.808	4.010	23 818	4.195	28 013	4.131	32.144
1892	6.321	2.605	8.926	5.986	14.912	2.653	17.565	5.459	23.024	3.638	26.662
1893	4.781	5.979	10.760	2.303	13.063	4.209	17.272	5.054	22 326	1.753	24.079
1894	7.122	3.571	10.693	3 623	14.316	5.648	19 964	1.769	21.733	3.803	25.536
1895	10.131	4.605	14.736	5.931	20.667	3.956	24 623	4.089	28.712	1.827	30 539
1896	1.720	4.199	5.919	8.786	14.705	1.413	16.118	2.532	18.650	4.671	23 321
1897	5.896	2.898	8.794	5.470	14.264	6.211	20.475	4.613	25.088	6.070	31.158
1898	4.060	4.422	8.482	4.068	12.550	7.346	19.896	2.366	22.262	5.598	27.860
1899	5 083	3.613	8 696	7.178	15 874	3.278	19.152	3.677	22 829	3 875	26.704
1900	8.532	5.277	13.809	6.577	20.386	3 949	24.335	4.254	28.589	2.656	31.245
1901	6.043	0.966	7.009	4.102	11.111	6.318	17.429	5.556	22.985	6 959	29.944
1902	3.289	2.735	6.024	7.757	13.781	3.067	16.848	3.725	20.573	4.908	25.481
1903	5.082	3.712	8.794	7.294	16.088	5.515	21.603	0.676	22.279	3.493	25 772
1904	6.318	5.328	11.646	5.590	17.236	5.912	23.148	3.315	26.463	2.668	29 131
1905	8.290	5.326	13.616	2.804	16.420	1.260	17.680	3.217	20.897	4.970	25.867
1894	7.122	3.571	10.693	3.623	14.316	5.648	19.964	1.769	21.733	3.803	25.536
Average	5.682	4.769	10.451	5.458	15.909	4.000	19.909	4.025	23.934	3.800	27.734

PRECIPITATION AT HALIFAX, N. S.

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YEAR.	July.	January to July, inclusive.	August.	January to August, inclusive.	September.	January to September, inclusive.	October.	January to October, inclusive.	November.	January to November, inclusive.	December.	Total for the Year.
1869 ..	2.920	31.840	2.580	34.420	1 570	35.990	7.300	43.290	5.470	48.760	5.770	54.530
1870 ..	3.210	31.480	2.200	33.680	3.330	37.010	6.830	43.840	6.440	50.280	5.880	56.160
1871 ..	3.380	29.580	3 690	33.270	4.810	38.080	4.490	42.570	4.180	46 750	4.390	51.140
1872 ..	2.880	28.140	6.820	34.960	1.410	36.370	4.880	41.250	6.650	47.900	6.160	54.060
1873 ..	3.900	25.590	4.450	30.040	4.480	34.520	8.630	43 150	7.980	51.130	4.310	55.440
1874	2.290	34.240	3.370	37.610	5.040	42.650	2.460	45 110	3.580	48.690	5.490	54.180
1875 ..	5.612	28.525	3.555	32.080	2.060	34.140	9.976	44.116	5.544	49.660	1.614	51.274
1876 ..	3.914	31 328	1.909	33.237	6.094	39.331	4.068	43.397	7.397	50.796	3.176	53.972
1877 ..	4.468	30.809	3.539	34.348	3.164	37.512	6.857	44.369	8.678	53.047	4.493	57.540
1878 ..	1.483	35.724	3.127	38.851	0.800	39.651	5 061	44.712	6.909	51.621	5.119	56.740
1879 ..	3.843	26.805	4 827	31.632	2.596	34.228	4.755	38.983	4.823	43.806	4.029	47.835
1880 ..	3.086	29.534	3.920	33.454	5.712	39.166	4.590	43.756	4.704	48.460	4.393	52.853
1881 ..	3.177	29.935	3.062	32.990	3.105	36.095	4.206	40 301	4.420	44.721	7.034	51.755
1882 ..	5.071	39.936	3.925	43.861	5.914	49.775	7.403	57.178	1.392	58.570	3 452	62.022
1883 ..	3.540	32.909	5.34	38.251	3.864	42.115	5.841	47.956	3.478	51.434	6.678	58.112
1884 ..	8.294	40.510	2.771	43 281	1.788	45.069	3.093	48.162	5.992	54.154	9.124	63.278
1885 ..	5.817	30.735	3.001	33.736	2.497	36.233	6.280	42.513	5.423	47.936	8.693	56.629
1886 ..	6.525	35.414	4.526	39.940	4.459	44.399	2.135	46.534	5.284	51.818	5.469	57.287
1887 ..	2.045	31.578	8 351	39.929	3.308	43.237	3.058	46.295	6.718	53.013	4.120	57.133
1888 ..	5.001	32.528	7.000	39.528	5 331	44.859	6.859	51.718	6.802	58.520	7.774	66.294
1889 ..	2.668	30.315	2.633	32.948	1.399	34.347	4.179	38.526	7.145	45.671	2.988	48.659
1890 ..	2.141	31.006	7.042	38.048	4.534	42.582	6.603	49.185	3.716	52.901	7.202	60.103
1891 ..	4.003	36.147	3.385	39.532	3.052	42.584	9.621	52.205	2.388	54 593	4.076	58.669
1892 ..	2.710	29.372	6.809	36.181	1.744	37.925	3.472	41.397	9.240	50.637	3.053	53.690
1893 ..	4.757	28.836	5.954	34 790	4.391	39.181	5.640	44.821	3.760	48.581	10.167	58.748
1894 ..	1.059	26.595	3.993	30.588	1 010	31.598	3.863	35.461	5.785	41.246	4.562	45 808
1895 ..	3.924	34.463	5.502	39.965	2.491	42.456	5.627	48.083	8.223	56.306	5.846	62.152
1896 ..	8.729	32.050	3.037	35.087	12.092	47.179	15.039	62.218	4.396	66.614	3 248	69.862
1897 ..	3.661	34.819	5.185	40.004	1.169	41.173	0.716	41.919	6.051	47.970	3.552	51.522
1898 ..	3.652	31 512	5.651	37.163	4.158	41.321	4.845	46 166	10.248	56.414	4.066	60.480
1899 ..	5.747	32.451	1.542	33.993	3.201	37.194	6.191	43.385	4.590	47.975	5.038	53 013
1900 ..	1.872	33.117	3.993	37.110	5.043	42.153	7.365	49.518	6 858	56.376	3.321	59.697
1901 ..	1.585	31.529	3 656	35.185	6.872	42.057	4.906	46.963	2 560	49.523	8 573	58 096
1902 ..	1.651	27.132	4.767	31.899	4.657	36.556	4.252	40.808	3.813	44.621	7.295	51.916
1903 ..	4.313	30.085	4.247	34.332	4.237	38.569	6.368	44.937	9.598	54.535	4.590	59.125
1904 ..	2.323	31.454	6.511	37.965	4.502	42.467	5.031	47.498	5 007	52.605	1.859	57.194
1905 ..	1.927	27.794	2.733	30.527	2.753	33.280	1.539	34.819	6.348	41.167	6.268	47.435
1894 ..	1.059	26.595	3.993	30.588	1.010	31.598	3.863	35.461	5.785	41.246	4.562	45.808
Aver..	3 708	31.442	4.287	35.729	3.747	39.476	5 520	44.996	5.718	50.714	5 213	55.927

PRECIPITATION AT HALIFAX, N. S., 1905.

TABLE COMPILED FROM RETURNS OF DOMINION GOVERNMENT METEOROLOGICAL AGENT, SHOWING DEPTH OF RAINFALL AND MELTED SNOW IN INCHES AND DURATION OF EACH STORM IN HOURS. (T = trace.)

Day of Month.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.	
	Hours.	Inches.	Hours.	Inches.	Hours.	Inches.	Hours.	Inches.	Hours.	Inches.	Hours.	Inches.
1	1.0	.050	....	....	6.2	.470	....	.....	3.3	.298	....	.....
2	3.0	.020	....	.....	....	.. .	1.3	T	1.0	.154	6.0	.925
3	9.0	.334	1.0	.010	....	.....	6.0	.020	2.7	.082	1.0	.054
4	13.5	2.128	....	.....	.3	T	....	.....	11.6	.704	....	.....
5	.3	T	....	.....	.5	T	2.0	.027	....	....	....	....
6	....	.....	3.0	.030	11.0	.240	19.5	.258	1.0	.020	8.0	1.681
7	1.8	.184	8.2	.390	....	.....	9.0	.136	10.0	.332	....	.... .
8	5.0	.592	2.5	.040	15.5	.634	....	....	....	....	6.8	.328
9	.1	T	....	.....	4.7	.300	....	.....	4.6	.467	....	.....
10	4.3	.325	6.0	.220	12.8	.402	3.0	.034	2.5	.058	1.0	.038
11	....	.....	.8	.020	....	.....	2.5	.032	....	.....	....	.... .
12	10.5	.880	....	.....	....	....	6.0	.128	....	.....	.8	.032
13	3.0	.190	10.0	.958	....	... .	.. .	....	....	.....	15.2	.452
14	....	.....	1.0	.048	....	.....	1.0	.062	.4	T	....	T
15	....	.....	1.0	.020	....	.. ..	....	....	.3	T	...	.....
16	...	.....	17.7	1.870	....	.....	....	.....	.4	T	....	T
17	2.0	0.60	1.8	.020	....	.....	....	T	7.0	.082	.5	.010
18	....	.....	2.5	.090	....	....	...	.....	9.3	.270	10.5	.696
19	2.2	.067	....	.....	2.0	.080	....	. ...	....	..	....	.. ...
20	....	.....	1.8	.040	2.5	.030	....	....	4.0	.090	....	.....
21	....	.....	1.8	.110	....	.. .	2 9	.056	.5	T	3.7	.054
22	.50	T	....	.....	....	...	5.3	.253	....	... ..	7.5	.048
23	6.8	.820	7.5	.440	....	.....	.5	T	....	.....	5.5	.010
24	....	.....	10.0	.140	....	.....	....	....	....	.. ..	....	.....
25	5.0	.420	13.0	.270	....	.....	.5	.010	....	.....	2.0	.010
26	18.0	1.180	....	.....	2.0	.120	....	.....	....	....	8.5	.268
27	3.5	.140	5.5	.580	2.5	.090	....	.....	2.2	.036	12.0	.270
28	1.8	.020	1.6	.030	10.3	.426	....	.....	3.6	.392	7.8	.082
29	5.0	.100	...	.....	.5	.012	9.5	.144	.5	.010	1.0	.012
30	....	.....	....	.....	....	.....	4.8	.100	4.5	.222	....	.....
31	18.0	.780	...	.....	....	.....	....	.....	....	.....	....	.....
	....	8.290	....	5.326	....	2.804	....	1.260	....	3.217	....	4.970

PRECIPITATION AT HALIFAX, N. S., 1905

TABLE COMPILED FROM RETURNS OF DOMINION GOVERNMENT METEOROLIGICAL AGENT, SHOWING DEPTH OF RAINFALL AND MELTED SNOW IN INCHES AND DURATION OF EACH STORM IN HOURS. (T = trace.)

Day of Month.	JULY.		AUGUST.		SEPTEMBER		OCTOBER.		NOVEMBER		DECEMBER.	
	Hours.	Inches.	Hours.	Inches.	Hours.	Inches.	Hours.	Inches.	Hours.	Inches.	Hours.	Inches.
1	....	.....	2.8	.028	....	.....	....	.....	7.0	.460	....	.....
2	....	.....	13.5	.315	....	.. ..	....	.....	1.5	.185	....	.328
3	13.8	.436	....	.. ..	....	. .	....	.....	....	.... .	....	1.086
4	.5	.011	....	.....	12.6	1.116	....	.....	2.5	.048	....	T
5	....	.....	....	.....	6.0	.558	....	.... .	4.5	.608	....	.....
6	....	T	4 5	.372	4.7	.134	.3	T	....	....	....	.....
7	....	.....	2.5	.986	5.3	.182	....	.....	8.2	.732	....	T
8	....	.....	....	.....	. ..	.....	....	.....	.5	T	....	. ...
9	....	.....	....	.....	....	. .. .	....	.....	1.4	.098	....	2 380
10	....	.....	1.5	.061	....	.....	....	.....	....	.....	....	.034
11	....	.....	....	.....	....	.....	....	.....	....	....	....	.....
12	....	.....	8	.028	....	.....	....	.....	.3	T	....	.396
13	.5	T	.7	.020	4.5	.228	3.1	.188	....	....	....	.010
14	....	.... ..	.	.....	2.0	.126	....	.... .	2.0	.040	....	.....
15	2.5	160	....	....	....	....	....	.... .	....	.....	....	.....
16	..	.....	13 8	.426	2.0	.035	....	.....	6.5	.172	....	.....
17	4.8	.088	....	.....	....	....	....	.....	19.3	1.803	....	.....
18	3.2	.052	....	.....	5.2	.072	....	.....	....	.....	....	.428
19	....	.....	....	.....	2.0	.028	8.6	.184	....	....	....	.....
20	.. .	.....	7.3	.165	11.5	.236	13.0	.728	....	.... .	....	.....
21	....	... ..	...	... .	1.0	.038	2.8	.071	....	.....	....	.100
22	....	.....	....	.....	....	.....	....	.....	....	.....	....	.822
23	....	.....	1.0	.312	....	.....	....	...	....	.....	. ..	.046
24	.1	T	....	....	....	.....	....	.....	....	.....	....	108
25	.2	T	....	.....	.2	T	4.0	.368	6.8	.010	....	.....
26	....	.....	....	.....	.1	T	....	.....	....	.....	....	.....
27	.5	.034	...	.....	....	.....	....	.....	3 5	.112	....	.... .
28	.1	T	.3	T	..	.....	....	.... .	1.5	.020	....	T
29	....	... .	....	.....	....	.....	....	.... .	17.0	1.488	....	.392
30	....	. ..	.3	.020	....	.....	....	.....	5.5	.572	....	.498
31	13.5	1.146	....	. ..	....	.....	....	...	....	. ...	....	T
	....	1.927	....	2.733	.. .	2.753	....	1.539	....	6.348	....	6 628

PRECIPITATION AT HALIFAX, N. S.

TABLE SHOWING THE NUMBER OF TIMES THAT THE TOTAL PRECIPITATION, EACH DAY FROM 1894 TO 1905, INCLUSIVE, HAS BEEN NEAREST TO A SERIES OF AMOUNTS RANGING FROM ONE-HUNDREDTH OF AN INCH TO FOUR AND A HALF INCHES.

YEAR.	QUANTITY IN INCHES.																							Total Rainfall for the Year.	YEAR.
	1/100	1/10	2/10	3/10	4/10	5/10	6/10	7/10	8/10	9/10	1	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4	4¼	4½		
1894.....	50	42	13	16	9	7	5	5	5	6	2	2	2	....	....	....	....	....	1	....	....	....	....	....	....	45.808	1894
1895.....	33	31	23	14	10	6	4	10	7	1	8	5	3	2	....	2	....	....	....	....	....	....	....	....	....	62.152	1895
1896.....	45	30	19	12	10	8	5	7	6	3	2	3	6	1	....	....	1	....	....	1	1	....	1	....	1	69 862	1896
1897.....	48	54	15	16	7	11	6	4	2	5	3	4	1	1	....	....	..	....	1	....	....	....	....	....	....	51 522	1897
1898.....	46	34	20	17	14	9	6	6	6	4	3	8	2	....	....	1	....	1	....	....	....	....	....	..	....	60.480	1898
1899.....	49	23	16	7	5	7	7	5	8	5	3	5	3	1	....	1	....	1	....	....	....	....	....	....	....	53.013	1899
1900.....	38	47	18	13	12	6	12	4	2	6	5	5	2	2	1	1	....	....	....	....	....	....	....	....	....	59.697	1900
1901.....	56	41	11	18	8	4	2	3	4	1	5	5	4	2	2	1	....	....	1	....	....	....	1	....	....	58.096	1901
1902.....	46	44	17	20	15	5	3	7	5	3	4	2	2	1	....	1	....	....	1	....	....	....	....	....	....	51.916	1902
1903.....	38	24	23	24	9	10	5	6	3	2	4	3	2	3	3	....	....	1	....	....	....	....	....	....	....	59.125	1903
1904.....	37	36	20	18	10	8	6	6	4	3	4	5	2	1	3	....	1	....	....	....	....	....	....	....	....	57.194	1904
1905.....	44	35	15	15	13	5	6	4	3	2	4	2	1	2	2	....	1	....	....	....	....	....	....	....	....	47.795	1905
Totals ..	530	441	210	190	122	86	67	67	55	41	47	49	30	16	11	7	3	3	4	1	1	....	2	....	1	676 660	Totals.
Means...	44	37	17	16	10	7	5.6	5.6	4.6	3.4	4	4	2.5	1.3	1	.6	25	.25	3	.1	.1	....	.17	....	.1	56.388	Means.

QUANTITY OF WATER DISCHARGED OVER LONG LAKE WASTE-WEIR IN GALLONS.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August	Septemb'r	October.	Novemb'r	December	Total.	Precipitation in inches.	No. of days Rain or Snow fall.
1892	211,226,360	.....	241,903,243	57,186,763	84,085,451	17,123,963	12,381,389	55,196,703	5,831,022	.....	229,960,879	95,307,034	1,010,202,807	53.690	.....
1893	982,576	60,758,585	.....	332,062,217	173,923,963	.....	.....	.....	.....	.....	.....	521,481,528	1,089,208,879	58.740	.....
1894	17,198,557	118,639,579	189,455,675	582,602,480	12,516,049	.....	.....	.....	.....	.....	.....	.....	920,412,340	45.808	166
1895	187,238,515	15,399,804	104,959,943	398,219,715	7,042,134	2,779,021	.....	.....	.....	.....	.....	199,308,252	914,947,384	62.152	161
1866	10,639,329	.....	495,949 894	78,609,225	.....	.....	.....	.....	412 374,620	1,045,458,665	80,678 961	49,409,208	2,173,119,902	69.862	183
1897	101,190,514	.....	88,923,753	447,206,304	120.165,769	96,958,138	13 240,719	.....	.....	.....	.....	.....	867,685,197	51.522	193
1898	.....	.....	38,354,174	681,939,737	62,736,359	224,848,481	.....	5,088,822	.....	48,802,036	758,002,940	233,351,627	2,053,124,176	60.480	196
1899	264,355,317	.....	305,513,150	682,500,339	98 583,572	26,698,635	.....	.....	.....	.....	44,555,834	103,361,274	1,524,568,121	53.013	169
1900	73,594,939	643,645,456	744,897,071	416,994 078	403,136,002	.....	.....	.....	.....	.....	.....	.....	2,282,267,546	59.697	198
1901	163,528,558	14,417 228	142,220,672	723,579,284	99,238,010	227,294,520	725,898	.....	.....	.....	.....	108,307,998	1,479,312,168	58.096	195
1902	238,435,990	.....	664,586,695	184 352,747	.....	.....	.....	.....	.....	.....	.....	10,665,474	1,098,040,906	51.916	188
1903	171,178,014	.....	456,210,407	524,039,759	.....	.....	.....	.....	.....	.....	161,989,078	337,810,982	1,651,228,240	59.125	179
1904	54,293,952	23,023,428	402,429,789	568,754,199	112,990,817	7,877,994	.....	.....	.....	.....	.....	.....	1,169,370 179	57.194	196
1905	.....	.....	43,832,254	914,509,990	113,896 013	.....	.....	.....	.....	.....	.....	.....	1,072,238,257	47.795	182
Avg	106,704,473	62,563,149	279,945,480	470,894,774	92,022.438	43,041,482	1,882,000	4,306,109	29,871,832	78,161,479	91,084,835	118,500,242	1 378,980,436	56.364	184