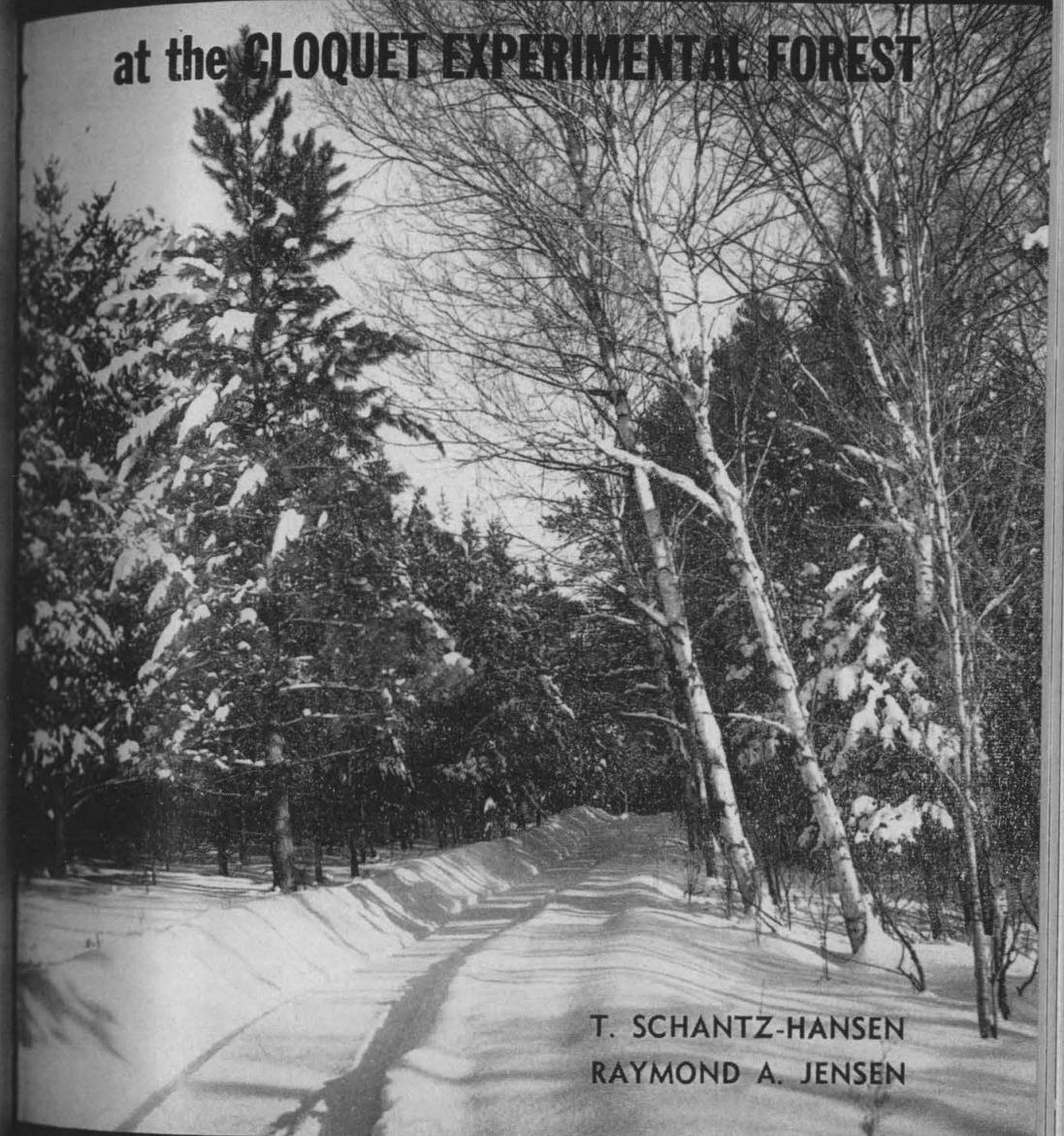


40 YEARS

of Weather...

at the CLOQUET EXPERIMENTAL FOREST



T. SCHANTZ-HANSEN
RAYMOND A. JENSEN

Differences in management were apparent in data showing the adjustment of labor to seasonal changes in output. The plants having the lowest labor cost for the year were those in which labor efficiency was high during the heavy production period.

Comparison of 1947 and 1953 fuel usage indicated that greater volume led to increased fuel efficiency in plants using both coal and oil. Seasonal variations in volume of output also had considerable effect on fuel efficiency. The average amount of fuel used per pound of dry milk produced was much lower during the heavy production months than during the slack period. Cost comparisons between coal and oil could not be made because of transportation charges included in the fuel expense. Only one plant used natural gas and this was found to be the cheapest fuel used.

Depreciation and rent costs were also lower in 1953 than in 1947. This was due to both greater volume and as a result of fulfilling the original lend-lease agreements with the government.

Little change was observed in the seasonal variations in production from 1947 to 1953. Manufacturing costs varied

inversely with monthly changes in the level of production. Average manufacturing costs varied from 2.67 cents per pound of dry milk in May to 5.25 cents in September. Greater management skill is needed if further progress is to be made in reducing the magnitude of seasonal variations in manufacturing costs.

There was a relation between large volume and lower costs in the 1953 data. However, the relationship was not as apparent as in 1947. In general, the larger plants showed lower costs than small plants though some relatively small plants achieved costs lower than some of the largest plants. Comparison of the 1947 and 1953 data indicates that most of the plants included in the study have reached near optimum output with the existing seasonal production.

Further cost reduction may be effected by managerial efforts to achieve greater labor efficiency and the adoption of improved equipment and techniques. Substantial improvements have been made in processing and handling equipment in recent years and any improvement which is applicable should be evaluated as a possible means of reducing costs.

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Forty Years of Weather at the *Cloquet Experimental Forest*

T. Schantz-Hansen and Raymond A. Jensen

WEATHER RECORDS from the past are both interesting and useful. A forester can use these records to explain the success or failure of plantings and natural regeneration, the rate of growth of forest stands, and other biological phenomena, as well as the general occurrence, severity, and duration of fire seasons.

The engineer or construction foreman can tell when the weather is best for construction work and whether he'll need special equipment and precautions because of unfavorable conditions. Weather records can be helpful to the logger in his plan of work in harvesting the timber crop. For example, he can finish felling, bucking, and skidding before the snow gets too deep. Many years ago, it was important to finish hauling while there was still enough snow for sleighing. Today it is the spring break-up which determines the length of the hauling season. Records are important to the shipper of perishable products, for they can indicate the length of season during which special protection must be provided.

The uses of weather data are manifold. But, to be fully useful weather data must be based on a long enough record to provide a true picture of average conditions or climate. In many instances current forecasts should be used in addition.

Cloquet Forest

Since April 1911, daily weather data have been recorded at the Cloquet Experimental Forest. The Forest is located

four miles southwest of Cloquet on a glacial outwash gravel plain. The weather station is located in the northeast corner of the 3,400 acre forest.

The United States Weather Bureau gives the latitude as 46° 31', the longitude as 92° 30', and the elevation as 1,265 feet above sea level. It is located in the St. Louis River drainage basin, although the Mississippi drainage basin comes within a mile of the forest.

Since the data for 1911 did not cover a full calendar year, only the portion of it which made possible a complete record for the winter of 1911-1912 was used. As a co-operative weather bureau station, maximum and minimum temperatures to the nearest degree, precipitation to the nearest one-hundredth inch, snowfall to the nearest one-tenth inch, character of the day, and wind direction have been recorded daily at 5 p.m. central standard time.

The averages in this bulletin may differ from the normal used by the Weather Bureau since they are unadjusted averages. The Weather Bureau's practice is to adjust the actual average of a station by comparing it with a nearby station having a longer record, and either raising or lowering the average as the case may be. These

Weather Bureau normals are usually recomputed at 10-year intervals. Since 40 years is probably a sufficiently long time to establish a true normal, the averages in this bulletin should not vary greatly from the Weather Bureau normals.

Averages or means are of little value except as standards with which to compare current weather. In a general way they also indicate the broad climatic type of region. Table 1 gives us the monthly and mean-annual temperature in degrees Fahrenheit for the period 1912-1951.

Mean Temperatures

The average mean annual temperature of 38.6° indicates a true continental climate. It is often said that our climate is getting warmer. Many old timers contend that the winters are no longer as severe as in the days of their youth. There is a lot of proof that our climate is getting warmer; however, the change is so slight and so gradual that it probably would not be noticeable. The low-

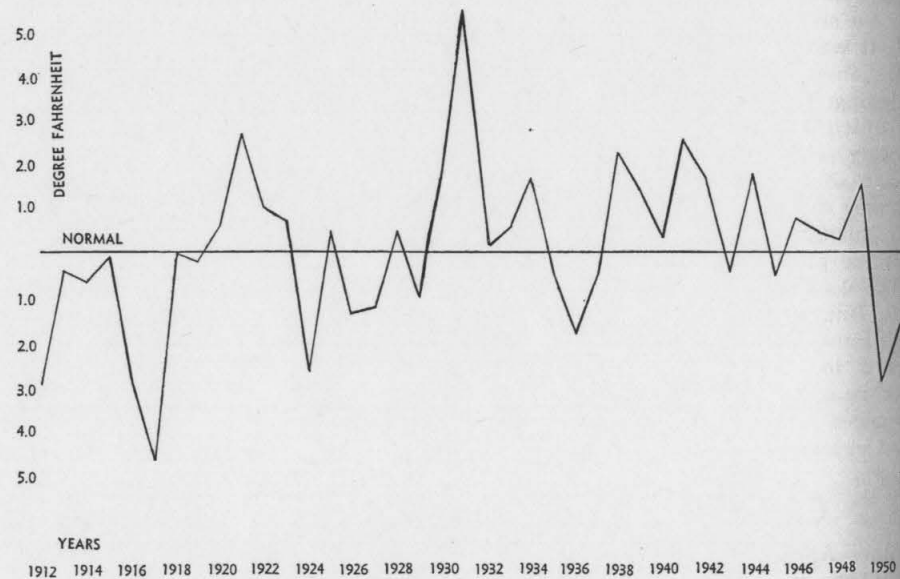


Fig. 1. Departure of the mean annual temperature °F. from normal.

est mean-annual temperature of 33.9° occurred in 1917, the next lowest, 35.6°, occurred in 1950. The highest mean-annual temperature, 44.0°, occurred in 1931 while the second highest, 41.3°, occurred in 1921.

The coldest month is January with a mean temperature of 8.0°. January has had a mean temperature as low as -8.3° in 1912, and as high as 21.0° in 1944. A variation of 29.3° in mean-monthly temperature indicates the great variation possible in this climate.

The coldest February with a mean temperature of -4.6° occurred in 1936 while the warmest, 24.2°, occurred in 1931. The coldest March with a mean temperature of 14.2° occurred in 1923, while the warmest, 34.5°, occurred in 1946. July is the warmest month of the year with a mean temperature of 66.2°. Mean temperatures for July have varied from a high of 72.3° in 1921 to a low of 59.9° in 1915.

Figure 1 gives the departure of the mean-annual from the average of 38.6°. Forty years, is, of course, too short a period to establish long-term trends or

cycles. However, these data show that the period from 1912 to 1929 was predominantly below normal in temperature, while the period from 1930 to 1949 was above normal in temperature.

Table 2 gives the mean temperatures for the 40 winter seasons from 1911 to 1951. A mean temperature of 14.2° for the winter season (for the years 1911 to 1951) does not seem too severe, but it is made up of extremes and it is on these extremes that we base our judgment of the severity of the weather.

Figure 2 shows the departure of the mean winter temperature for each year for 40 years from the mean 14.2°—see table 2. The coldest winter during the 40-year period was in 1916-17 when the mean temperature was 7.3°, the second coldest was in 1935-36 when the mean temperature was 8.4°. The warmest winter was 1930-31 with a mean temperature of 21.5°. Departure of mean winter temperature from normal does not show any definite warming trend, but it does indicate the irregularly cyclic behavior of weather.

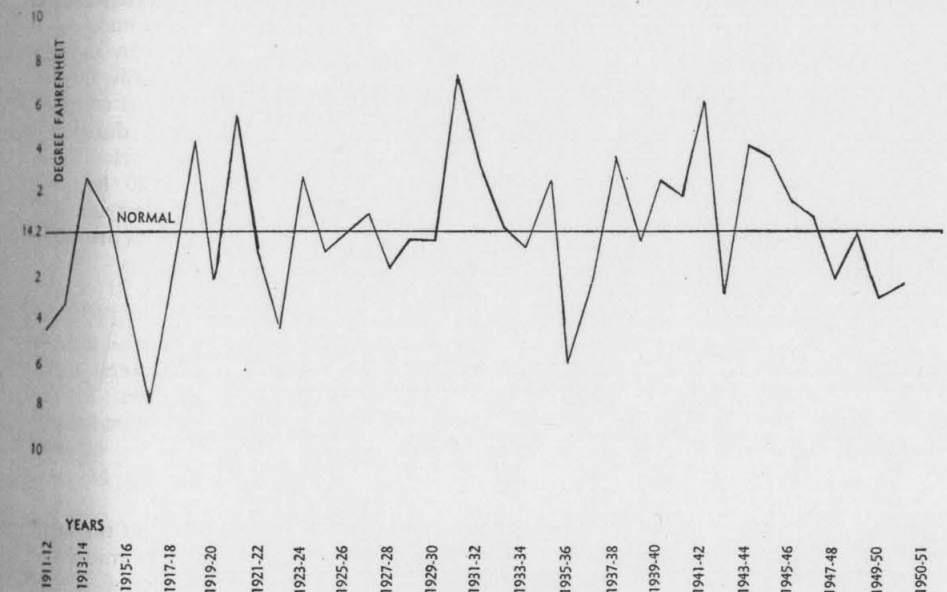


Fig. 2. Departure of the mean winter temperature °F. (December-March) from normal 14.2.

Maximum and Minimum Temperatures

Tables 3 and 4 give the mean maximum and mean minimum temperatures for each month of the 40-year period. July, August, and June show the highest average maximums. July 1936 had the highest maximums with a mean of 88.9°. January, February, and December have the lowest average maximums—all well below freezing. The lowest average minimum temperature occurs in January with February and December following in that order. Average minimum temperatures are below freezing during six months of the year.

Lowest mean minimum for any month was -21.9° in January 1912. Other low average minimums for January occurred in 1918, 1924, 1937, 1944, and 1950. The lowest average minimum recorded for February was -16.1° in 1936. Other low average minimums for February occurred in 1914, 1917, 1923, and 1939. It is interesting to note that

none of these coincide with the low January averages.

Tables 5 and 6 give the actual maximum and minimum temperatures recorded for each month of the 40-year period. Table 7 gives the highest and lowest temperature recorded in each year and the annual range in degrees.

Our activities are influenced by temperature extremes, especially if those periods are of long duration. If it is extremely cold, outdoor activities are limited, communication and travel are slowed down, and schools are often closed. Likewise, if it is excessively warm much outdoor work is slowed down.

The highest temperature recorded during this period was 105° on July 10, 11, 12, and 13 in 1936. The lowest temperature was -45° on January 7 and 12, 1912. Minimum temperatures of -40° and lower have been recorded in 9 years, minimum temperatures of -30° to -39° in 23 years.

It is interesting to note that the highest maximum temperatures recorded in the various months were 52° on January 23, 1942; 56° on February 11, 1918; 79° on March 28, 1946; 86° on April 30, 1913; 94° on May 30, 1939; 98° on June 29, 1931; 105° on July 10, 11, 12, and 13, 1936; 98° on August 5 and 10, 1947; 95° on September 8, 1931; 86° on October 2, 1922; 68° on November 6, 1916; and 55° on December 11, 1913.

The annual range in temperature as shown in table 7 varied from a low of 115° in 1920 to a high of 142° in 1936. In 1936, January and February were exceedingly cold while July and August were exceedingly warm. During 1920, the temperature extremes were not so great.

Degree Days

The use of the Degree Day by heating engineers to gauge fuel consumption is now common. Many people speak of Degree Days without a clear understanding of the meaning of the term. It represents the departure of the daily

mean temperature from 65° F. This temperature was selected because it is generally the point at which heat is needed in homes and buildings.

A mean temperature of 40° F. for any day would be 25 Degree Days. The choice of the term is probably unfortunate since there are usually many Degree Days in the normal winter day. It is so commonly accepted that it would be difficult to change and it is a convenient way of indicating the accumulation of cold. A similar idea is being used to express the accumulation of heat for indicating the maturity of various crops. It would be much better to use the number of Degree Days above a certain point rather than stating the number of growing days required.

At Cloquet we find that Degree Days occur during any month of the year. See table 8 for the average number of Degree Days each day of the year.

The winter months, of course, have the greatest number of Degree Days. The period from November 1 through March 31 has 74 percent of the total Degree Days. A normal heating season usually begins October 1 and ends April 30. This is a period of seven months during which 89 percent of the Degree Days occur. However, for real comfort, heating is definitely needed during 10 months of the year. The period from June 20 through August 20 has the lowest number of Degree Days and it is then that furnaces in this area are often idle.

Frost

The length of the frostless season is of great importance to farmers, nurserymen, and home gardeners. In analyzing these data, three intensities of frosts are recognized: light 32°-30°, moderate 30°-28°, and heavy 28° and lower.

It should be pointed out that the term frost is used here to denote minimum temperatures of 32° and below. These temperatures do not always cause frost to form. The damage caused by these

various intensities may vary considerably depending on the stage of development of the vegetation and the actual duration of the low temperature.

A light frost usually does not prevent further growth except in susceptible species. A heavy frost always ends the growing season, and sometimes a moderate frost may. Table 9 gives the data on frost occurrence.

The average number of days between the last light frost in the spring and the first in the fall is 89, between moderate frosts 113, and between heavy frosts 127. The period between early and late light frost varied from a low of 32 days in 1915 to a high of 130 days in 1939. The period between early and late moderate frosts varied from a low of 68 days in 1917 to a high of 150 days in 1922. The period between heavy frosts varied from 92 days in 1915 to 159 days in 1931.

In 28 of the 40 years, the last light frost has occurred after June 1 and in 11 of these after June 14. This seems to indicate that June 1 is a safe seeding date for garden crops, but that tender

plants like tomatoes should not be set out until after June 7. Even at that date, there is better than a 50-50 chance that frost will occur during the last three weeks of June.

Precipitation

Table 10 gives the total precipitation and precipitation for the growing season for the 40-year period. In this case, it is assumed that the growing season begins May 1 and ends September 30. Before May 1 and after September 30 there is little, if any, growth in any indigenous vegetation.

On the average, 60.5 percent of the annual precipitation of 28.47 inches comes during the growing season. The greatest annual precipitation of 38.85 inches was in 1944. Of this 30.70 inches fell during the growing season. The least annual precipitation of 19.96 inches was in 1923. Of this, 12.69 inches fell during the growing season. The least amount of precipitation during the growing season was in 1934—when 10.72 inches fell.

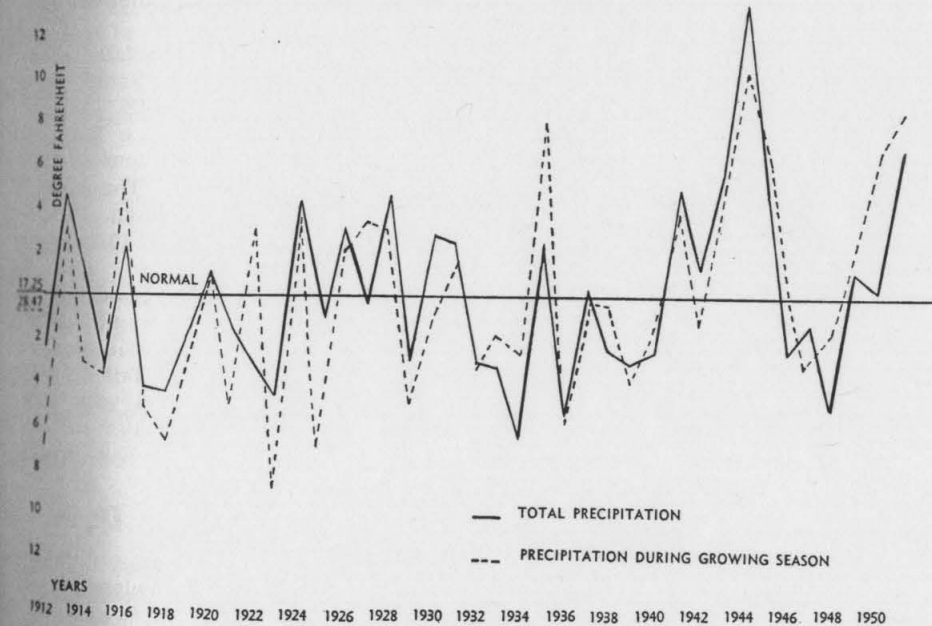


Fig. 3. Departure of precipitation from normal.

Figure 3 shows the departure from the average of the annual and growing season precipitation. It is interesting to note that departure from the growing season average and the annual average follows a similar pattern.

There are variations, however. In 1914, the growing season had an .86 inch excess of precipitation while there was a deficit of 3.20 inches in annual precipitation. In 1922 there was a 2.33 inch deficit in growing season precipitation and an excess of 2.58 inches in annual precipitation. The years 1930, 1937, and 1942 had excess precipitation during the growing season and a deficit in annual precipitation.

During the 40 years, the annual total precipitation has never been above normal for more than three consecutive years; while it has been below normal for five consecutive years. From 1932 through 1940 it was below normal except for 1935 when there was a 7.7 inch excess. The net deficit for that period was 19.88 inches. It is interesting to note that from 1912 through 1918, only 1913 and 1916 had excess precipitation and that the net deficit for that period was 19.75 inches.

The year 1918 is remembered in northeastern Minnesota for its destructive fire season. The fact that 1940 did not have as destructive a fire season as 1918 illustrates the progress made in solving the fire problem, both through education of the public and through greater efficiency in fire fighting.

The distribution of precipitation is also important. There were, on the average, 102 days with measurable precipitation during the year as shown in table 10. The smallest number was 68 days in 1933 while the largest number was 155 in 1951. One-tenth of an inch of precipitation or more fell on the average of 62 days, varying from 50 days in 1933 to 77 days in 1951. Table 11 gives the precipitation by months for the 40-year period.

June is the wettest month with an average precipitation of 4.14 inches.

The greatest June precipitation was in 1944 when 9.73 inches fell; the smallest June precipitation was in 1918, when 1.40 inches fell.

The driest month of the year is February with an average precipitation of .99 inch which has varied from a low of .20 inch in 1912 to a high of 4.45 inches in 1922. The least monthly precipitation during the period was a trace in three consecutive Decembers—1930, 1931, and 1932.

The amount of precipitation that comes as snowfall is always of interest. With the increasing use of automobiles, snow has become a real problem both from a physical and an economic viewpoint. In order that social and economic life may move at its accustomed pace, snow must be cleared from highways, city streets, and sidewalks to permit traffic to flow freely.

The average annual and the average winter's snowfall over a long period should be equal. Since the winter season is part of two calendar years, there will be considerable variation in individual years. The snowfall by winter seasons is given in table 12.

The average annual snowfall is 58.5 inches, while the average winter season's snowfall is 58.1 inches. Annual snowfall has varied from a high of 144.1 inches in 1950 to a low of 10.9 inches in 1931 (table 11). The winter season has varied from a high of 115.8 inches in 1919-20 to a low of 10.9 inches in 1930-31 (table 12).

Winters may be long, often beginning in late October and lasting until early May. The heaviest snowfall comes in January with an average fall of 11.7 inches. February is second with 11.0 inches, March third with 10.7 inches, and December fourth with 10.2 inches.

Clear and Cloudy Days

Table 13 gives the average number of clear, partly cloudy, and cloudy days for each month during the 40-year period. October, November, and December

have the greatest number of cloudy days. March has the greatest number of clear days with February second. However, there is little variation from month to month except for June, November, and December.

Wind Direction

Wind direction has an important local influence on the weather. When the winds are east or northeast, they norm-

ally bring much cooler weather. This is due to the influence of Lake Superior. Because they blow over cool Lake Superior 20 miles to the northeast almost a third of the time during April, May, and June, spring weather is delayed.

During the fall months from September through November, the number of days with east or northeast winds drop to almost one-half of the spring high. During December, January, and February it drops even lower. A northeast

Table 1. Mean Monthly and Annual Temperatures °F., 1912-1951

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean	Departure
1912	-8.3	7.6	16.8	40.5	49.5	57.9	63.6	57.8	54.2	44.8	30.3	15.9	35.8	-2.8
1913	5.0	5.4	16.4	43.2	47.0	60.4	61.2	63.1	53.5	41.0	34.4	26.7	38.1	-0.5
1914	15.0	1.0	24.8	35.8	53.6	57.9	67.0	61.0	55.4	46.4	28.5	8.4	37.9	-0.7
1915	8.3	18.1	24.7	47.8	45.4	54.3	59.9	59.2	54.9	44.1	28.6	17.1	38.5	-0.1
1916	3.6	5.7	17.5	38.2	48.3	54.8	70.8	64.7	51.9	40.3	27.9	6.3	35.8	-2.8
1917	2.0	-3.1	24.2	34.8	45.4	55.7	66.1	59.8	52.2	33.0	33.3	2.8	33.9	-4.7
1918	-0.6	12.2	31.6	36.5	50.3	59.1	63.4	63.9	48.5	43.7	32.9	21.3	38.6	0.0
1919	15.7	13.6	23.0	39.2	50.9	63.1	68.3	64.3	56.9	38.9	21.4	5.7	38.4	-0.2
1920	4.1	11.7	26.1	33.0	52.4	60.2	64.4	62.6	60.6	50.2	26.7	18.1	39.2	+0.6
1921	15.6	17.9	26.5	42.9	53.1	65.3	72.3	64.3	58.2	45.1	21.4	13.5	41.3	+2.7
1922	6.9	7.5	24.8	37.6	56.6	62.9	63.6	65.0	58.4	47.9	34.7	9.5	39.6	+1.0
1923	11.0	4.7	14.2	38.5	52.3	63.9	67.6	60.5	57.0	44.7	35.0	22.0	39.3	+0.7
1924	0.9	17.7	25.7	38.6	46.4	58.5	63.8	64.2	51.2	33.7	27.3	3.6	36.0	-2.6
1925	7.7	15.1	27.4	44.5	49.5	60.8	65.2	67.3	56.5	33.5	26.8	11.9	38.9	+0.3
1926	10.7	15.1	18.8	38.4	53.3	57.8	65.9	63.5	51.8	41.0	21.8	9.8	37.3	-1.3
1927	6.1	14.6	28.7	39.5	46.5	59.1	62.2	60.6	58.4	45.6	23.4	3.8	37.4	-1.2
1928	8.7	13.9	23.5	33.8	53.7	56.6	64.7	63.9	51.7	44.0	32.7	19.1	38.9	+0.3
1929	4.8	4.1	27.6	40.9	48.5	59.2	67.6	65.1	53.6	44.6	24.6	11.0	37.6	-1.0
1930	0.8	18.8	25.3	41.8	52.0	64.0	66.8	67.2	55.7	41.7	30.4	17.5	40.2	+1.6
1931	18.1	24.2	26.2	42.7	50.8	63.2	69.2	63.3	60.9	49.5	34.8	25.2	44.0	+5.4
1932	15.5	12.3	16.8	38.7	53.0	63.9	66.8	66.6	54.6	40.9	24.2	10.6	38.7	+0.1
1933	15.8	8.0	23.3	37.9	51.5	67.5	68.2	64.0	60.2	40.1	23.5	8.8	39.1	+0.5
1934	15.4	8.7	21.1	39.3	56.6	62.0	66.7	62.0	53.3	47.2	33.7	18.0	40.3	+1.7
1935	3.0	19.6	25.3	36.3	48.7	57.6	70.6	65.0	53.5	42.6	22.6	13.8	38.2	-0.4
1936	0.0	-4.6	24.5	33.3	54.6	58.6	71.3	66.4	58.0	38.6	23.6	17.5	36.8	-1.8
1937	0.1	10.2	20.1	37.3	53.4	60.6	67.3	69.9	56.0	41.0	27.4	15.3	38.2	-0.4
1938	6.8	16.3	32.9	40.8	49.7	61.7	65.5	70.1	55.8	49.0	27.5	14.2	40.9	+2.3
1939	13.4	3.7	22.5	35.1	53.5	61.4	67.6	65.7	56.9	42.5	32.8	25.9	40.1	+1.5
1940	5.2	16.7	18.3	37.8	49.6	59.4	66.0	63.1	58.6	47.2	25.8	18.7	38.9	+0.3
1941	11.2	12.0	22.4	44.8	55.3	60.8	68.9	64.2	57.4	45.2	30.9	21.6	41.2	+2.6
1942	15.8	13.2	29.6	46.0	49.2	59.5	65.0	65.0	53.1	47.6	27.9	11.3	40.3	+1.7
1943	4.0	13.2	17.0	39.6	50.8	61.5	68.8	64.4	50.4	45.5	25.6	17.7	38.2	-0.4
1944	21.0	13.0	21.3	37.0	53.1	60.2	64.7	65.0	55.1	45.5	34.3	15.2	40.4	+1.8
1945	8.2	14.0	33.3	37.1	46.4	55.7	64.5	64.3	54.0	42.7	26.5	9.7	38.0	-0.6
1946	10.8	8.7	34.5	43.1	48.9	59.1	65.6	62.5	54.5	44.0	27.7	13.7	39.4	+0.8
1947	13.7	9.4	22.7	36.4	47.7	57.0	67.5	69.0	54.8	51.9	22.7	15.1	39.0	+0.4
1948	4.0	9.2	21.0	41.4	51.3	60.2	66.6	65.2	59.2	45.3	30.0	13.9	38.9	+0.3
1949	12.0	8.8	21.9	43.2	53.5	63.4	66.6	66.5	53.7	45.8	31.8	13.8	40.1	+1.5
1950	1.5	12.5	17.9	30.7	47.7	60.6	62.9	59.0	55.6	46.3	23.3	8.7	35.6	-3.0
1951	6.3	13.2	19.4	38.2	54.3	58.1	65.1	59.8	52.0	42.8	21.6	11.6	36.9	-1.7
Mean	8.2	11.1	23.5	39.1	50.9	60.0	66.2	64.0	55.2	43.6	28.0	14.1		
Total for forty years													1,545.9	
Average for forty years													38.6	

wind during the winter months often brings a heavy snow storm. Westerly winds blow almost two-thirds of the time except during the months of April, May, and June when they blow from

this direction only one-third of the time. Table 14 gives the average number of days the wind has blown from the 8 directions for each month of the 40 years.



Table 2. Mean Temperature °F. During the Winter Seasons, 1911-1951

Year	Dec.	Jan.	Feb.	March	Mean	Departure
1911-12	23.1*	-8.3	7.6	16.8	9.8	-4.4
1912-13	15.9	5.4	5.4	16.4	10.7	-3.5
1913-14	26.7	15.0	1.0	24.8	16.8	+2.6
1914-15	8.4	8.3	18.1	24.7	14.8	+0.6
1915-16	17.1	3.6	5.7	17.5	10.9	-3.4
1916-17	6.3	2.0	-3.1	24.2	7.3	-7.9
1917-18	2.8	-0.6	12.2	31.6	11.5	-2.7
1918-19	21.3	15.7	13.6	23.0	18.4	+4.2
1919-20	5.7	4.1	11.7	26.1	11.9	-2.3
1920-21	18.1	15.6	17.9	26.5	19.5	+5.3
1921-22	13.5	6.9	7.5	24.8	13.2	-1.0
1922-23	9.5	11.0	4.7	14.2	9.8	-4.4
1923-24	22.0	0.9	17.7	25.7	16.6	+2.4
1924-25	3.6	7.7	15.1	27.4	13.4	-0.8
1925-26	11.9	10.7	15.1	18.8	14.1	-0.1
1926-27	9.8	6.1	14.6	28.7	14.8	+0.6
1927-28	3.8	8.7	13.9	23.5	12.5	-1.7
1928-29	19.1	4.8	4.1	27.6	13.9	-0.3
1929-30	11.0	0.8	18.8	25.3	13.9	-0.3
1930-31	17.5	18.1	24.2	26.2	21.5	+7.3
1931-32	25.2	15.5	12.3	16.8	17.4	+3.2
1932-33	10.6	15.8	8.0	23.3	14.4	+0.2
1933-34	8.8	15.4	8.7	21.1	13.5	-0.7
1934-35	18.0	3.0	19.6	25.3	16.5	+2.3
1935-36	13.8	0.0	-4.6	24.5	8.4	-5.8
1936-37	17.5	0.1	10.2	20.1	12.0	-2.2
1937-38	15.3	6.8	16.3	32.9	17.8	+3.6
1938-39	14.2	13.4	3.7	22.5	13.4	-0.8
1939-40	25.9	5.2	16.7	18.3	16.5	+2.3
1940-41	18.7	11.2	12.0	22.4	16.1	+1.9
1941-42	21.6	15.8	13.2	29.6	20.1	+5.9
1942-43	11.3	4.0	13.2	17.0	11.4	-2.8
1943-44	17.7	21.0	13.0	21.3	18.2	+4.0
1944-45	15.2	8.2	14.0	33.3	17.6	+3.4
1945-46	9.7	10.8	8.7	34.5	15.9	+1.7
1946-47	13.7	13.7	9.4	22.7	14.8	+0.6
1947-48	15.1	4.0	9.2	21.0	12.3	-1.9
1948-49	13.9	12.0	8.8	21.9	14.2	0.0
1949-50	13.8	1.5	12.5	17.9	11.4	-2.8
1950-51	8.7	6.3	13.2	19.4	11.9	-2.3
Mean	14.4†	8.2	11.1	23.5	14.2	

* Data from December 1911 included to make possible the use of the 1911-12 winter season.
 † Differs from December mean in table 1 because mean of December 1911 included.

Table 3. Monthly and Annual Mean Maximum Temperature °F., 1912-1951

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
1912	4.6	19.3	30.9	54.0	62.0	73.2	76.6	67.8	66.3	57.8	41.4	25.6	48.3
1913	17.5	17.3	27.7	56.4	60.5	75.0	72.2	74.8	64.9	51.4	44.1	35.8	49.8
1914	23.6	15.2	35.6	46.6	68.0	71.2	81.7	73.2	67.2	58.9	37.6	17.8	49.7
1915	17.7	27.2	37.1	62.1	56.9	67.8	73.9	75.0	67.5	54.5	36.7	24.9	50.1
1916	16.6	18.2	30.4	49.4	60.5	67.4	85.5	78.5	63.8	49.2	37.8	16.8	47.8
1917	13.9	5.1	38.4	46.1	62.6	70.6	79.4	73.8	63.2	41.1	42.4	13.2	45.8
1918	10.4	25.3	44.5	51.5	63.4	73.6	77.4	78.8	62.4	55.1	40.8	28.9	51.0
1919	26.7	22.6	34.7	50.2	65.2	74.9	81.3	76.4	69.3	49.4	29.8	13.7	49.5
1920	15.3	21.7	36.4	44.3	68.6	72.8	77.9	77.4	73.2	61.9	53.5	24.5	52.3
1921	25.0	28.4	38.1	55.1	67.6	79.1	86.1	78.4	70.7	56.3	29.5	22.3	53.1
1922	19.5	18.8	36.4	48.3	70.2	78.0	76.9	78.4	71.1	59.5	40.2	21.2	51.5
1923	22.9	18.8	28.1	52.6	69.6	78.9	81.0	75.7	70.1	57.6	44.6	31.7	52.6
1924	14.0	29.7	38.5	49.9	60.7	74.5	78.9	78.1	63.4	63.9	36.0	13.4	50.1
1925	19.2	24.4	40.2	59.2	66.0	73.4	79.0	81.5	68.1	41.3	37.5	19.8	50.8
1926	21.8	25.9	31.1	53.3	69.4	71.0	81.3	75.3	61.8	50.6	29.4	19.4	49.2
1927	16.0	26.1	39.2	50.9	57.2	69.9	76.7	74.9	70.6	56.9	31.7	14.7	48.7
1928	19.6	24.9	36.2	45.8	69.9	68.6	77.9	76.9	63.0	53.8	40.5	27.7	50.4
1929	6.5	16.0	38.0	54.2	63.7	75.3	82.6	80.4	65.6	55.9	33.3	20.3	49.3
1930	11.2	29.2	37.7	56.6	65.5	77.3	81.3	84.7	70.3	51.3	45.0	26.8	53.1
1931	27.5	35.6	36.7	58.5	66.1	77.3	83.0	76.1	73.8	60.3	43.1	32.5	55.9
1932	24.1	25.2	28.2	51.6	67.6	79.3	81.9	81.5	68.8	51.5	34.5	20.8	51.2
1933	26.6	19.7	33.0	49.3	65.1	83.9	82.7	78.2	72.6	50.8	30.9	19.0	51.0
1934	24.2	20.5	32.6	49.6	73.2	75.9	82.4	75.8	64.3	57.1	41.5	19.5	51.4
1935	13.3	29.5	34.4	46.9	63.4	69.6	83.4	76.0	67.0	52.3	30.3	21.6	49.0
1936	10.4	6.8	33.2	44.7	69.4	73.3	88.9	79.8	71.3	49.5	32.0	25.4	48.7
1937	12.7	21.0	32.2	46.1	67.8	75.2	81.8	83.1	68.2	51.2	35.2	21.9	49.7
1938	15.7	26.7	45.8	53.0	60.8	75.5	78.6	82.0	68.9	60.0	35.6	23.2	52.1
1939	23.2	15.7	33.3	45.6	68.2	70.1	82.3	78.6	69.8	53.7	42.6	34.1	51.4
1940	15.6	27.2	27.6	50.1	63.8	74.3	81.2	73.9	71.6	57.7	34.3	27.3	50.4
1941	20.5	22.8	33.2	55.6	69.3	73.0	82.3	76.4	66.9	55.6	38.6	29.5	51.9
1942	25.6	24.2	38.6	60.8	62.7	72.0	78.0	78.0	63.6	56.9	37.9	20.3	51.5
1943	14.2	26.2	29.1	53.3	64.2	76.0	83.9	77.5	62.4	58.8	34.6	28.8	50.7
1944	30.7	25.7	32.0	49.9	66.1	73.5	77.5	77.5	65.8	58.3	39.0	23.5	51.6
1945	16.9	24.8	45.0	48.6	61.4	67.9	76.9	76.7	65.1	55.3	33.1	18.1	49.2
1946	19.9	19.6	45.6	56.9	62.1	72.4	79.9	75.9	67.1	55.2	37.2	23.3	51.3
1947	24.7	20.4	34.3	46.5	61.6	70.1	82.7	82.5	66.6	63.6	29.6	23.5	50.5
1948	16.7	21.6	33.3	54.4	68.2	73.9	80.6	79.2	74.6	58.9	37.1	23.7	51.9
1949	22.2	20.9	32.7	57.7	69.2	78.9	78.9	79.7	66.4	56.4	39.2	23.6	52.1
1950	14.4	24.7	29.8	39.1	61.0	75.8	76.1	73.4	67.8	56.8	31.8	18.7	47.5
1951	17.4	23.0	29.5	48.6	69.3	70.4	78.9	69.9	62.3	52.1	30.9	19.9	47.7
Mean	18.5	22.4	34.9	51.3	65.2	73.8	80.2	77.3	67.4	55.0	37.0	22.9	50.5

Table 6. Actual Minimum Temperature °F. for Each Month, 1912-1951

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Minimum temperature for each year
1912	-45*	-24	-24	15	25	29	31	32	24	17	-6	-16	-45
1913	-32	-30	-32	11	20	27	36	36	21	5	2	1	-32
1914	-31	-35	0	2	21	35	36	33	26	19	-6	-24	-35
1915	-44	-15	-15	20	23	31	31	26	29	26	5	-11	-44
1916	-41	-38	-25	5	25	30	39	31	21	14	-9	-29	-44
1917	-31	-30	-27	9	16	30	37	28	22	11	3	-37	-37
1918	-35	-30	-1	9	24	29	33	33	20	17	8	-17	-35
1919	-42	-26	-29	11	21	39	42	35	29	12	-12	-31	-42
1920	-28	-23	-15	-5	21	32	38	31	29	14	2	-22	-28
1921	-21	-14	-13	14	22	29	40	35	33	19	-24	-34	-34
1922	-42	-32	-14	8	32	37	39	32	27	15	5	-27	-42
1923	-30	-36	-32	-3	18	33	43	30	22	13	6	-15	-36
1924	-33	-21	-5	0	19	28	36	37	23	22	-3	-30	-33
1925	-31	-23	-25	17	19	32	35	41	27	5	-13	-19	-31
1926	-31	-19	-23	7	19	29	35	42	24	10	-11	-28	-31
1927	-43	-26	-23	19	27	30	35	30	27	20	-2	-25	-43
1928	-30	-22	-16	0	22	26	38	36	25	15	9	-18	-30
1929	-34	-29	-13	16	20	24	33	31	20	21	-18	-28	-34
1930	-30	-32	-13	12	25	39	36	37	23	12	-17	-17	-30
1931	-17	-14	-2	13	23	32	41	34	29	20	-1	-10	-17
1932	-26	-25	17	13	29	38	32	35	29	20	-14	-28	-28
1933	-22	-35	-5	15	26	31	45	33	29	1	-15	-35	-35
1934	-31	-30	-18	18	25	36	36	30	20	20	15	-30	-31
1935	-40	-17	-12	9	23	35	49	33	20	20	-10	-20	-40
1936	-37	-34	-17	0	21	32	39	38	26	0	-8	-31	-37
1937	-39	-31	-11	15	24	37	44	43	26	10	-3	-18	-39
1938	-27	-13	-3	4	24	38	41	42	31	24	8	-28	-28
1939	-25	-41	-30	6	24	40	40	42	21	10	8	-9	-41
1940	-23	-25	-12	5	23	30	35	29	25	20	-21	-29	-29
1941	-18	-24	-23	21	28	33	37	29	28	17	-3	-8	-24
1942	-29	-35	-9	-13	25	30	42	30	23	1	-7	-24	-35
1943	-30	-16	-29	-9	21	30	40	37	23	17	-7	-21	-30
1944	-20	-28	-19	8	16	31	42	42	27	20	5	-21	-28
1945	-32	-23	-19	11	18	24	35	36	24	19	-2	-21	-32
1946	-27	-28	-6	17	21	27	38	35	22	14	-14	-32	-32
1947	-25	-23	-10	15	17	28	36	39	19	26	-8	-18	-25
1948	-37	-33	-27	1	19	30	34	41	30	15	9	-21	-37
1949	-24	-30	-12	13	26	30	45	40	27	13	7	-24	-30
1950	-40	-24	-22	4	24	32	37	31	29	26	-8	-23	-40
1951	-37	-32	-16	12	25	29	38	34	27	10	-10	-19	-37

* Occurred on the following days: 7 and 12.

Table 7. Highest and Lowest Temperature of the Year, Date of Occurrence and Annual Temperature Range, 1912-1951

Year	Highest day	Lowest day	Annual temperature range	Year	Highest day	Lowest day	Annual temperature range
1912	June 25 93	Jan. 7, 12 -45	138	1932	July 12, 18 96	Jan. 31 -26	122
1913	June 29 94	Jan. 12 -32	126	1933	June 19 97	Feb. 8 -35	132
1914	Aug. 8 92	Feb. 12 -40	132	1934	Aug. 18 95	Jan. 29 -31	126
1915	July 12 89	Jan. 28 -44	133	1935	July 3 94	Jan. 23, 27 -40	134
1916	July 29 98	Feb. 2 -38	136	1936	July 10-13 105	Jan. 23 -37	142
1917	July 28 98	Jan. 26 -31	129	1937	July 6 93	Jan. 19 -39	132
1918	July 20 94	Jan. 27 -36	130	1938	Aug. 14 94	Jan. 9 -27	121
1919	July 1, 2 90	Jan. 4 -42	132	1939	Aug. 5 91	Feb. 15 -41	132
1920	June 7, July 28 87	Jan. 18, 25 -28	115	1940	July 22 93	Jan. 16 -33	126
1921	July 11 95	Jan. 17 -21	116	1941	July 26 93	Feb. 18 -24	117
1922	June 23 95	Jan. 24 -42	137	1942	July 17 92	Feb. 19 -35	127
1923	July 19 95	Feb. 5 -40	135	1943	July 13 94	Feb. 14 -31	125
1924	July 15 95	Jan. 21 -35	130	1944	Aug. 9, 10 91	Feb. 18 -28	119
1925	July 11, Aug. 23 92	Jan. 27 -31	123	1945	July 23 93	Jan. 5 -32	125
1926	June 28 93	Jan. 28 -31	124	1946	July 13 91	Dec. 31 -32	123
1927	June 28, 30 93	Jan. 26 -43	136	1947	Aug. 5, 10 98	Jan. 3 -25	123
1928	Aug. 9, 13 89	Jan. 28 -30	119	1948	July 5 95	Jan. 18, 19 -37	132
1929	July 26 98	Jan. 13 -34	132	1949	July 3 96	Feb. 2 -30	126
1930	Aug. 1, 3, 31 95	Feb. 15 -32	127	1950	Aug. 16 90	Jan. 30 -40	130
1931	July 27 99	Jan. 21 -17	116	1951	July 25 89	Jan. 29 -37	126

Table 8. Average Number Degree Days for Each Day of the Year, 1912-1951

Days	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	55.5	59.4	48.1	32.7	17.9	7.6	3.6	2.4	4.6	15.6	29.1	46.3
2	54.5	58.3	48.4	33.1	17.4	8.5	4.1	2.3	5.3	14.6	30.5	45.1
3	56.5	56.1	47.8	32.0	18.1	8.8	3.1	2.1	4.9	14.4	31.1	42.2
4	54.1	57.0	46.8	30.5	17.6	9.4	2.4	2.9	6.1	14.6	30.6	44.1
5	56.5	54.8	47.3	31.0	17.2	7.9	2.3	1.7	5.9	14.3	30.5	46.1
6	56.4	52.8	48.0	31.7	17.9	8.8	2.1	1.5	6.4	15.2	31.5	46.6
7	56.5	57.6	47.7	30.8	18.4	10.4	2.0	2.1	7.3	18.3	32.7	46.4
8	54.7	56.1	48.2	31.5	18.7	9.1	2.1	2.3	7.6	18.4	34.6	48.1
9	53.1	57.5	48.3	30.4	18.5	8.1	1.4	1.7	8.1	18.7	34.1	50.0
10	54.7	55.6	46.6	27.3	17.2	7.3	2.1	2.5	7.8	17.4	34.7	51.2
	552.5	565.2	477.1	311.0	178.9	85.9	25.1	21.5	64.0	161.5	319.4	466.1
11	55.6	54.8	43.3	27.9	16.5	5.9	2.3	3.8	9.0	17.4	35.8	50.9
12	57.9	53.3	42.3	27.4	15.6	5.6	1.8	2.4	9.4	19.0	36.3	50.3
13	57.7	52.3	42.2	25.7	16.5	6.3	1.9	2.6	10.0	20.6	37.0	54.2
14	56.7	53.9	42.6	26.5	16.3	5.9	2.0	2.6	9.1	18.3	37.9	56.0
15	57.5	56.1	40.9	26.5	15.2	5.4	2.4	2.0	9.6	18.1	36.6	53.7
16	57.3	54.4	40.5	26.4	15.1	6.0	2.0	1.7	9.9	18.6	35.9	52.7
17	57.1	53.4	42.7	24.2	15.1	6.8	1.6	2.3	10.1	22.1	35.2	52.5
18	59.7	54.2	42.8	22.7	13.0	6.2	2.2	3.9	10.1	20.1	35.6	54.2
19	58.9	53.3	39.8	23.4	13.6	5.6	2.6	3.6	10.1	22.2	35.2	53.0
20	58.9	54.5	39.1	23.5	12.8	5.3	2.3	3.3	11.8	22.1	36.4	52.9
	577.1	540.3	416.3	254.2	149.7	59.0	21.1	28.2	99.1	198.5	361.9	530.4
21	58.6	52.7	37.5	23.4	12.7	4.8	1.0	3.3	11.8	23.7	38.6	54.1
22	60.5	52.1	37.3	22.6	11.4	4.5	1.5	3.5	12.1	24.9	43.8	53.2
23	59.4	51.1	34.8	21.3	12.0	4.2	1.4	3.4	12.9	27.0	43.9	52.7
24	56.6	49.5	34.4	22.8	12.0	2.7	1.5	4.8	13.1	25.6	42.1	54.6
25	60.5	52.0	34.5	22.0	10.6	3.9	1.2	5.4	14.6	25.8	42.4	54.4
26	61.7	50.8	36.6	21.2	9.8	3.6	1.5	5.7	15.7	26.9	41.3	52.4
27	60.1	49.8	36.4	20.6	10.4	3.1	1.3	6.1	15.9	27.3	43.2	54.0
28	57.8	49.2	36.7	19.2	9.4	2.7	1.6	5.9	16.0	27.3	44.3	56.2
29	54.7	51.1	34.7	19.3	8.9	3.8	1.7	5.6	17.8	27.1	43.8	53.3
30	55.3	35.3	19.8	8.9	4.0	1.4	5.2	17.0	27.5	42.8	42.8	52.4
31	56.4	35.3	8.6	1.6	4.3				28.1			53.6
	641.6	458.3	393.6	212.2	115.7	37.3	15.7	53.2	146.9	291.2	426.2	590.9
Total†	1,771.2	1,563.8	1,287.0	777.4	444.3	182.2	61.9	102.9	310.0	651.2	1,107.5	1,587.4
Percentage of total	18	16	13	8	5	2	1/2*	1	3	7	11	16

* Less than 1 percent.
 † Grand total = 9,846.8.

Table 9. Dates of Spring and Fall Frosts and Length of Frost-Free Periods, 1912-1951

Year	Light Frost (32-30° F.)			Moderate Frost (30-28° F.)			Heavy Frost (28° -lower)		
	Latest in spring	Earliest in fall	Days between	Latest in spring	Earliest in fall	Days between	Latest in spring	Earliest in fall	Days between
1912	June 8	Aug. 2	55	June 7	Sept. 28	113	May 16	Sept. 29	136
1913	June 10	Sept. 18	100	June 9	Sept. 22	105	June 9	Sept. 23	106
1914	June 22	Aug. 24	63	May 16	Sept. 9	116	May 15	Sept. 25	133
1915	June 23	July 25	32	June 17	Aug. 26	70	May 27	Aug. 27	92
1916	June 21	Aug. 13	53	June 21	Sept. 16	87	May 18	Sept. 16	121
1917	June 22	Aug. 25	64	June 22	Aug. 29	68	June 15	Sept. 10	87
1918	June 23	Sept. 4	73	June 22	Sept. 5	75	May 23	Sept. 10	110
1919	May 20	Sept. 25	128	May 20	Sept. 25	128	May 11	Oct. 7	149
1920	June 13	Aug. 1	49	May 15	Sept. 29	137	May 15	Oct. 1	139
1921	June 5	Oct. 1	118	June 4	Oct. 1	119	May 25	Oct. 4	132
1922	May 31	Aug. 29	90	Apr. 28	Sept. 25	150	Apr. 28	Sept. 25	150
1923	May 21	Aug. 22	93	May 17	Sept. 9	115	May 17	Sept. 14	120
1924	June 7	Sept. 6	91	June 7	Sept. 9	94	May 30	Sept. 29	122
1925	June 29	Sept. 12	75	June 27	Sept. 12	77	May 25	Sept. 21	119
1926	June 26	Sept. 12	78	June 3	Sept. 13	102	May 22	Sept. 25	126
1927	June 15	Aug. 23	69	May 20	Sept. 27	130	May 16	Sept. 27	134
1928	June 10	Sept. 4	86	June 4	Sept. 23	111	June 3	Sept. 28	117
1929	June 14	Aug. 15	62	June 8	Sept. 16	100	June 3	Sept. 18	107
1930	May 30	Sept. 18	111	May 29	Sept. 29	123	May 25	Sept. 30	128
1931	June 8	Sept. 24	108	May 31	Sept. 27	119	May 6	Oct. 12	159
1932	May 27	July 4	38	May 1	Sept. 23	145	Apr. 28	Sept. 23	148
1933	June 14	Sept. 21	99	May 10	Sept. 21	134	May 10	Oct. 2	145
1934	May 26	Aug. 20	86	May 22	Sept. 21	122	May 15	Sept. 21	129
1935	May 24	Sept. 1	100	May 24	Sept. 1	100	May 23	Sept. 27	127
1936	June 2	Sept. 17	107	May 14	Sept. 17	126	May 5	Sept. 17	135
1937	May 19	Sept. 19	123	May 15	Sept. 19	127	May 14	Sept. 19	128
1938	May 24	Sept. 18	117	May 24	Oct. 8	137	May 12	Oct. 8	149
1939	May 17	Sept. 24	130	May 15	Sept. 24	132	May 12	Sept. 24	135
1940	June 11	Sept. 12	93	May 11	Sept. 12	124	May 3	Sept. 12	132
1941	May 23	Sept. 29	129	May 23	Sept. 29	129	May 10	Sept. 29	142
1942	June 14	Aug. 24	71	May 22	Sept. 22	123	May 22	Sept. 22	123
1943	May 28	Sept. 13	108	May 19	Sept. 13	117	May 13	Sept. 17	127
1944	June 8	Sept. 7	91	May 9	Sept. 23	137	May 9	Sept. 23	137
1945	June 6	Sept. 16	103	June 6	Sept. 16	102	June 4	Sept. 16	104
1946	June 9	Sept. 2	85	June 3	Sept. 2	91	June 2	Sept. 3	93
1947	June 12	Sept. 22	92	June 2	Sept. 22	112	May 27	Sept. 22	118
1948	June 15	Sept. 22	99	June 15	Sept. 22	99	May 25	Oct. 2	130
1949	June 22	Sept. 20	90	June 8	Sept. 28	112	May 28	Sept. 29	124
1950	June 21	Aug. 18	58	May 27	Sept. 23	119	May 27	Sept. 24	120
1951	June 4	Sept. 24	112	June 4	Sept. 24	112	May 13	Sept. 29	139
Average			88.2			113.4			126.8

Table 12. Snowfall in Inches by Winter Seasons, 1911-1951

Winter of	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	Total
1911-12			9.0	12.0	3.0	2.0	3.5	3.0		32.5
1912-13			3.8	4.0	4.2	7.7	18.3	3.8		41
1913-14		2.0		2.5	13.5	6.5	5.0	5.5		35.0
1914-15				3.5	23.2	11.0			2.0	39.7
1915-16		2.0	2.4	9.6	31.9	5.0	21.5	1.3		73.7
1916-17		8.0	0.6	5.8	8.8	8.1	14.4	6.0		51.7
1917-18		7.5	0.8	10.4	13.7	3.0	4.5	5.7		45.6
1918-19		0.4	T	17.5	6.3	14.0	2.0			40.2
1919-20		24.5	44.8	5.6	19.0	7.5	8.0	6.5		115.9
1920-21			15.2	10.3	6.0	5.8	12.5	3.5		53.3
1921-22			11.5	16.0	10.5	49.3	18.0	11.5		116.8
1922-23			3.0	13.6	23.5	2.6	14.0	1.7		58.4
1923-24			1.5	6.1	3.4	9.8	7.3	10.0	7.0	45.1
1924-25			6.5	7.7	2.6	7.0	3.6	4.5		31.9
1925-26		1.3	3.5	5.0	3.5	11.5	15.5	0.9		41.2
1926-27		3.8	6.8	15.2	4.8	11.8	3.9	1.6		47.9
1927-28			11.5	22.4	5.7	3.2	7.4	11.0		61.2
1928-29				14.3	14.2	2.9	7.5			38.9
1929-30			5.1	12.2	6.4	11.8	5.6			41.1
1930-31				T	1.5	2.6	6.8			10.9
1931-32				T	15.3	4.6	7.4	9.5		36.8
1932-33			3.0	T	7.1	8.2	T	8.0		26.3
1933-34		10.7	12.0	18.5	6.9	2.4	8.8	2.9		62.2
1934-35			2.0	26.3	28.7	3.8	6.8			67.6
1935-36			6.8	5.7	12.8	20.0	16.8	1.0		63.1
1936-37		8.7	14.3	14.6	26.0	17.2	3.5	5.0		89.3
1937-38			2.3	7.6	12.4	6.7	8.1			37.1
1938-39		1.5	5.4	12.9	8.0	38.8	12.9	17.0		96.5
1939-40		1.3	1.5	3.5	4.5	15.7	24.8	T		51.3
1940-41			16.7	5.7	17.9	16.2	15.1	3.6	T	75.2
1941-42		1.0	T	6.3	4.1	4.7	19.1	4.2		39.4
1942-43		7.5	1.4	15.4	11.2	8.2	18.9	1.2		63.8
1943-44			22.5	2.5	3.3	13.5	19.7	2.0	T	63.5
1944-45			4.5	6.3	17.1	23.9	5.0	6.0		62.8
1945-46		T	4.4	9.1	13.7	4.8	0.4	0.7	T	33.1
1946-47		T	5.4	20.0	6.7	3.8	9.0	12.3		57.2
1947-48			23.6	7.4	20.8	17.9	13.4			83.1
1948-49			8.2	10.1	28.5	11.7	8.1			66.6
1949-50			8.8	5.1	30.0	10.0	22.4	29.6	4.6	110.5
1950-51			10.3	37.2	13.8	16.4	32.3	3.3		113.3
40 year average	2.0	7.0	10.2	12.4	10.8	10.8	4.6	0.3		58.1

T—Trace of precipitation; less than .01 inch.

Table 13. Average Number of Days Clear, Partly Cloudy, and Cloudy by Months, 1912-1951

Sky condition	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Clear	10.8	11.7	12.1	11.1	10.3	8.7	11.5	10.7	10.2	10.4	7.8	9.2
Partly cloudy	10.1	8.3	10.1	10.1	11.9	13.3	13.8	14.2	10.9	9.9	9.1	8.4
Cloudy	9.3	8.2	8.8	8.7	8.7	7.7	4.9	6.0	8.8	10.7	13.0	12.5

Table 14. Average Number of Days of Each Wind Direction by Months, 1912-1951

Wind direction	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Percent
N	1.0	1.1	1.1	1.3	1.2	0.5	0.6	0.8	0.7	0.9	1.1	1.2	3.2
NE	1.9	3.0	5.1	4.9	5.1	3.5	1.9	2.0	2.5	2.4	2.2	1.8	10.0
E	1.4	1.3	2.4	4.0	4.9	4.1	3.4	3.5	2.9	2.4	1.5	1.1	9.1
SE	3.2	3.2	3.5	4.0	4.3	5.4	5.5	5.6	5.6	5.1	3.8	3.5	14.5
S	2.2	1.9	2.2	1.8	1.5	1.6	2.5	2.6	2.4	2.3	1.4	1.8	6.7
SW	6.5	4.3	4.3	3.8	3.9	4.6	5.8	4.9	4.8	5.7	5.5	5.3	16.4
W	3.7	3.2	2.5	2.0	2.5	3.3	3.4	3.6	3.3	3.1	3.2	3.7	10.4
NW	11.0	10.1	9.8	8.0	7.5	6.6	7.7	7.8	7.6	8.9	10.9	11.8	29.7

ORGANIZATIONAL PROBLEMS IN DEVELOPING THE SMALL WATERSHEDS OF MINNESOTA



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