OUR WEATHER AND CLIMATE

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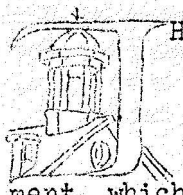
PART I



THE establishment of a "meteorological observatory", as the weather station was fondly referred to in the early days, was the work of Fr. Peter Engel, later fourth Abbot of St. John's. Fr. Peter's interest in weather observation was a natural outgrowth of his work as head of the physics department, which included the department of astronomy. It was in fact the study of astronomy that begot interest in meteorology, and it can truly be said that the weather station began as an offshoot of the astronomical observatory.

The first of the three locations which have served as weather station was the turret which in 1891 was built on the roof of the main building, overlooking the statue of the patron, St. John the Baptist. It began to function on October 12, 1892 (the 400th anniversary of the landing of Columbus), Fr. Peter being the first observer. From its beginning the station was connected, as a voluntary observer, with the U. S. Weather Bureau (then a part of the U. S. Signal Service, later connected with the Department of Agriculture, and now attached to the Department of Commerce). This status it held until July, 1941, when St. John's severed connections with the Bureau upon the close of the old station in the Science Hall.

The equipment from the first seems to have been quite complete, including a barometer, an anemometer with electrical recording attachment, vane, the dry-bulb, wet-bulb, maximum, and minimum thermometers, and a rain gauge with electrical recorder. In later times were added a thermograph, a barograph, and a sunshine recorder.

The establishment of the weather station, says one report, led to the installation of a telegraph system. This is probably true, though the scientific surge had brought interest in telegraphy to St. John's many years before that. According to the catalogues a course had been offered in that field as early as 1873. Plans for a telegraph station did not materialize however until the summer of 1893, when "our local telegraphers" were making preparations for a connection between the University and the Western Union lines. The following year the final arrangement was made, and at the same time an intramural telephone system plus telephone connections with St. Joseph were installed. Two years later, on August 31, 1896, the weather station began making daily use of the telegraphic facilities, and for the next 37 years the telegraph played an important part in the work of the station. It had been the practice, since November of 1894, to have the weather forecast sent from the Minneapolis office in the form of a daily postal card,

and before that, in the form of a daily weather map. Now, however, the forecast was wired each day from Chicago, the operator receiving it about 12 hours in advance of the weather itself. Upon reception at St. John's the forecast was printed by logotype on postal cards and sent on the morning train to some 40 post-offices west of Collegeville. At the same time the appropriate signal flags were displayed by the local bureau. This practice continued until July 17, 1933, when reduced appropriations forced the Weather Bureau to discontinue the daily telegraphic forecast to many of its substations.

Abbot Peter continued as weather man at the institution for several months after his election, but in April of 1895, he assigned this task to Fr. Anselm Ortmann, who later succeeded him in the physics department. Fr. Anselm continued the work of observer until September, 1897, after which he departed for Johns Hopkins, leaving the weather station in the hands of Fr. Bonaventure Hansen. The following January Fr. Theodore Kevenhoerster succeeded Fr. Bonaventure. Fr. Theodore (who died seven years later in the Bahamas) was succeeded by Fr. Werner Schneppenheim in July, 1898. With the turn of the century came Fr. Fridolin Tembruell, who, with the aid of various assistants, had charge of the station for over 19 years (May, 1900-October, 1919). Among those who worked with Fr. Fridolin was Fr. Polycarp Hansen, who has retained his interest in the weather, and, by applying astronomy to meteorology, has "devised a system whereby he can predict the weather for the locality with an accuracy that rivals...that of the U.S. Weather Bureau." (1)

In July of 1913 the weather station with its complete apparatus was transferred from the turret on the main building to the new quarters provided for it on the fourth floor and on the roof of the new Science Hall (completed in 1911).

Fr. Fridolin was succeeded by Fr. Justin Luetmer in October, 1919, and since that date the list of observers comprises the following: Fr. Francis Bernick, Fr. Rudolph Hansen, Fr. Columban Kremer, Fr. Leonard Hagarty, Fr. Alban Fruth, Fr. Stanley Axtman, Fr. Casper Keogh, and the writers.

For a number of reasons it came about that in July, 1941, the weather station was closed. A year later however St. John's decided to build more suitable quarters, and accordingly the clerics, under the supervision of Fr. Casper, erected the present stone structure. The plans were furnished by Fr. Clodoald and the interior carpentry was under the direction of Bro. Philip. On December 1st of the same year (1942) the station was reopened. (2)

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(1) Scriptorium, Vol. V. No. 1, p. 38.

(2) In order to bridge the short gap between July, 1941, and December, 1942, and to compute the proper totals and means, the data from the St. Cloud Airport station for this period was entered in the local records (with proper notations).

Upon the growth of interest in the work of the Agricultural Experimental Station, and in order to make the climatic data collected at St. John's of more widespread utility, application was made to the Weather Bureau in 1945 for reinstatement as a U. S. Weather Bureau Substation. Upon investigation the Bureau accepted the application, and a contract was made, effective April 1st. Besides the weekly report on crops and farm operations, a complete weather summary of St. John's is submitted to the Minneapolis and Chicago offices of the Bureau at the close of each month. Fortunately, all the records made at St. John's--from Fr. Peter's first observation at 8:30 on the morning of October 12, 1892--are still preserved, and they will doubtless be of future value in making studies and surveys of weather and climate for this section.

There are a number of weather phenomena which are definitely a part of the history of St. John's and vicinity. We recount the most notorious of them here. Ten years before the establishment of the weather station, on the afternoon of July 25, 1882, a severe storm passed over the house, causing "great fear and excitement ". Everything "movable" was carried before the wind, says the chronicler, (3) meaninining apparently to exclude the buildings. However, the greater part of the tin roofing on the church was torn away, the rain pouring in through the ceiling and doing some damage to the plastering. There was also damage to the brickyard, and a number of large trees were uprooted.

A diary three years later records that "one evening in...June, 1885, ...a cyclone (then the popular term for tornado) formed in the heavens to the east. All watched it with some consternation, but the threatening peril was broken up by the wind". To this the writer added ominously, "coming events cast their shadows before them". The "event" took place the following spring, but again St. John's was spared. It was the memorable tornado of April 14, 1886, which visited St. Cloud and Sauk Rapids. Because of our affinity to St. Cloud (once the site of the institution) it has found a permanent place in the abbey chronicles and will therefore be described briefly here.

At 3 o'clock that afternoon a violent whirlwind about 1,000 feet in diameter struck in the Masonic cemetery at St. Cloud. Uprooting some trees and twisting off others at the trunk, it dragged them along with huge stones unearthed from the ground, and, moving in a northeasterly direction, wrecked practically everything in its wake. Entering the city, it demolished homes and business houses as it came, swept across St. Germain Street, and continued across the prairie leaving the latter strewn with the furniture, clothing, and timber of some 50 or more of the smaller farm houses. Then, crossing the Mississippi, it entered Sauk Rapids and practically wiped out the village. Leaving Sauk Rapids it continued toward Buckman and beyond in Morrison County. The hospital in St. Cloud, which had been opened two months earlier by the Benedictine Sisters, was left intact in spite of its being directly in the path of the storm. A house on one side of it was carried off and ano-

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(3) St. John's University, p. 69, and History of St. John's Abbey, p. 150.

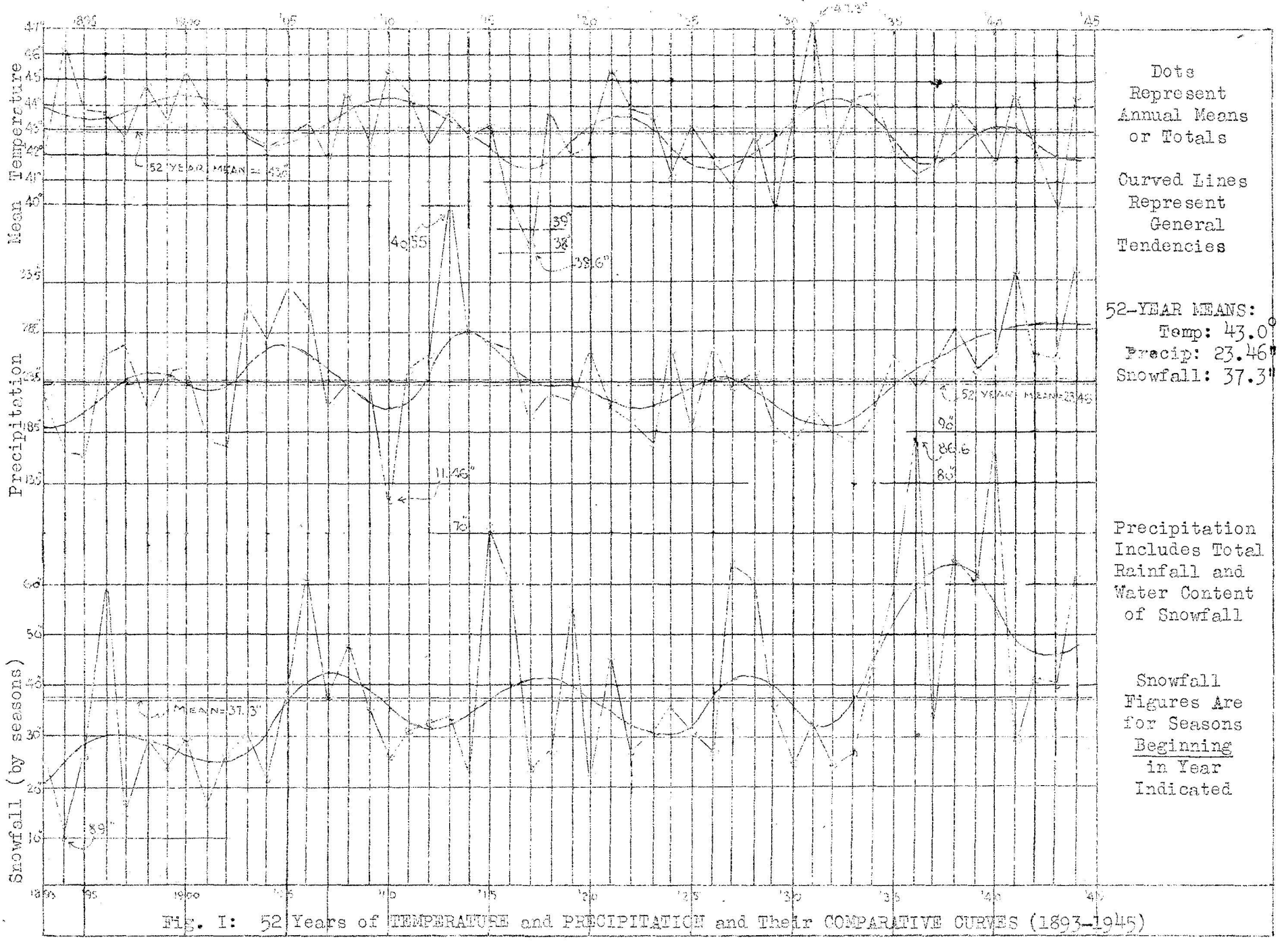

Fig. I: 52 Years of TEMPERATURE and PRECIPITATION and Their COMPARATIVE CURVES (1893-1945)

ther on the opposite side completely demolished. Of the 62 people killed, reports indicate that 16 or 17 were from St. Cloud and over 30 were from Sauk Rapids and vicinity. The other casualties were apparently from the outlying districts and Morrison County. Among the St. Cloud victims was the father of our Fr. Demetrius Juenemann. A grateful St. John's had experienced only "the howling of the wind and the tossing of the trees...followed by a heavy rain and hail". (4)

The tornado eight years later was quite a different story for St. John's. While not nearly as destructive, it hit the abbey buildings squarely. It occurred on June 27, 1894, and is the most famous weather event, not only in the records of the weather station, but in the history of St. John's. In its first "scoop" the St. John's Record for that month tells of the event under the blazing headline: "CYCLONE! St. John's Visited by the Twirling Monster on the Evening of the 27th. Eleven Buildings Wrecked."

There had been several days of oppressive heat, and on that evening the abbey experienced a heavy rain- and hailstorm. Then followed a brief and ominous calm. It was about 8:30 when a heavy funnel-shaped cloud was observed coming toward the buildings from a point some distance south of the institution. As the cloud approached the sky was darkened, and a few seconds later the howling winds were over the lake. Another few seconds and "the air was filled with flying timbers, furniture, the limbs of trees, and everything the wind could pick up". (5) Windows crashed, doors slammed shut or burst open, lightning flashed and in its gleam gave momentary photos of the wreck outside. "The trees in the grove north of the house were broken off like so many matches, and the roofs of the barns and shops were lifted into the air like pieces of cardboard." (6)

Coming over the lake, the tornado first struck the old laundry, making off with its smokestack. Next in its path was the Industrial School in the south wing of the main building. By this time great fear had seized the occupants, and when the big building itself began to quake there was panic on the upper floors and in the dormitories. The prefects rushed to the south wing, and the smaller Indian boys, who had just retired, were hurried out of their quarters into the adjoining rooms. Just as they left, the entire southern half of the second floor of the Industrial School--beds, clothing, furniture and all--was blown away. Fortunately, no lives were lost. Again St. John's was grateful to have escaped with only material loss.

The damage to the abbey property was estimated variously at between $20,000 and $50,000 (but even the highest figure appears very conser-

(4) Autobiography, Vol. IV, p. 5.
(5) St. John's University, p. 106.
(6) The Record, 1894, p. 151 ff.

vative). Except for the Industrial School, the weather turret on the east front, most of the chimneys, and some of the roof and windows of the church, the principal buildings remained substantially intact. The other buildings however fared much worse. "The roof of the bakery was carried off and its tall iron smokestack thrown down; the engine house was almost a total wreck, though the boilers and machinery were spared; the corn-mill adjoining was smashed into splinters; part of the poultry house was unroofed and hundreds of chickens were killed; the roofs of the pig pen, corn crib, and slaughter house were carried off, including the walls of the latter, and hams, sausages, and other meats were scattered far and wide; the smoke-house, shoe shop, and ice house were considerably damaged; a covered bowling alley was totally demolished; and, except for the lower stables, the huge brick barn was a heap of debris." (7) Moreover, trees, lumber, wagons, and machinery were picked up and strewn all over the vicinity. One commentator says (8) that "over 3,000 cords of firewood was bestowed upon us that night". Before it struck St. John's the storm had also done considerable damage elsewhere. The church of St. James at Jacob's Prairie was among the ruins, as was the votive chapel near Cold Spring. The Pearl Lake church was twisted from its foundation, and several farm houses and barns in the adjoining townships shared a similar or worse fate.

Though the buildings at the abbey were sufficiently repaired the same summer to warrant the reopening of the fall school term on the regular date, the thousands of trees that were either stripped or uprooted that night told the tale of June 27, 1894, for many a year.

These were the more memorable weather events of the early days. In later years improved means of communication (and insulation) made the weather of less moment, and the local antics of the elements became only a small part of the day's weather news. Probably most remembered of recent storms is the famous Armistic blizzard of November 11, 1940. The worst November storm in the history of the state, it brought an abrupt end to an ideal autumn. It was the first snow of the season and covered the ground to an average depth of 27 inches. The wind whipped up to gale proportions, piling up the snow in mountainous drifts. All roads were closed, and for several days all transportaion was at a standstill. Many Minnesotans lost their lives. Incidentally, the astronomy class had announced that "on November 11, weather permitting, it would observe a special and rare astronomic phenomena, the transit of Mercury". (9) That month netted us 49 inches of snow, giving the season the highest snowfall figure in the history of the station.

PART II

As the weather station's chief work is in the field of climate, a number of diagrams have been added to give a graphic history of the

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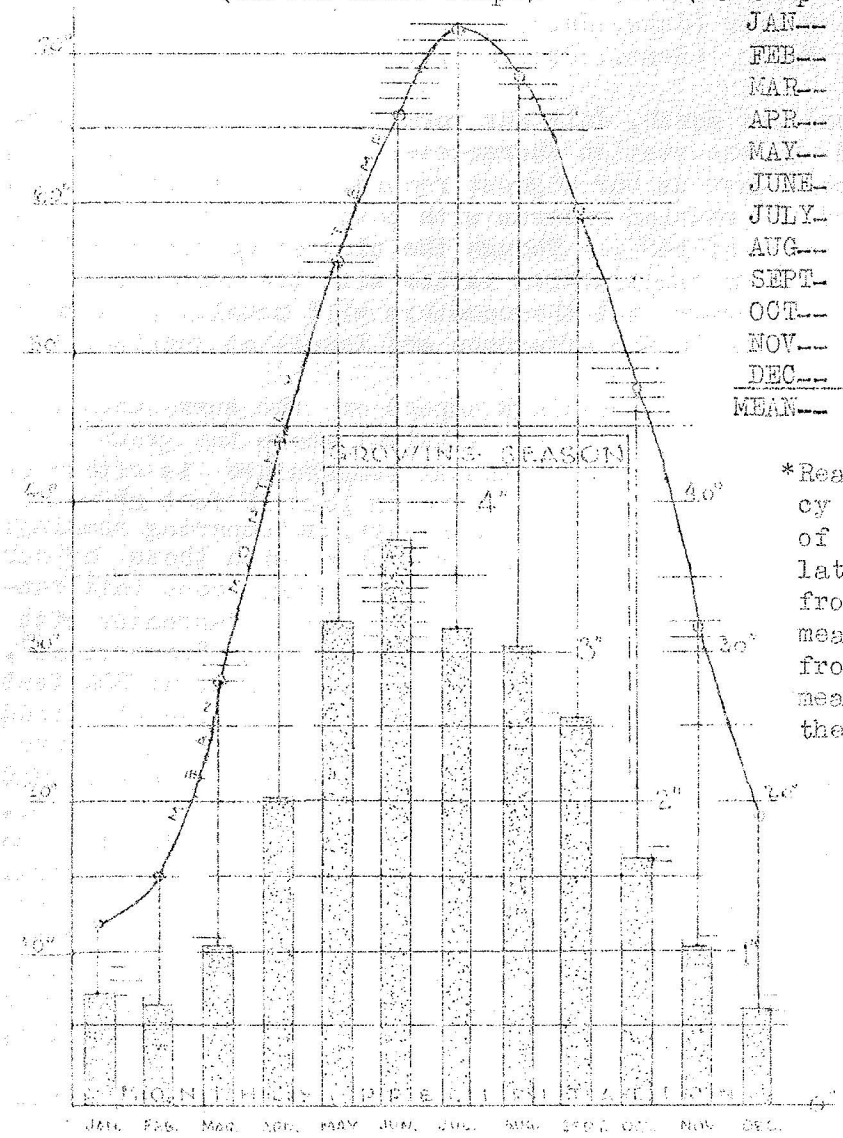
(7) History of St. John's Abbey, p. 215.
(8) Autobiography, Vol. V., p. 59.
(9) The Record, November 14, 1940.

way in which the most important climatic elements have affected St. John's in the past 52 years. Climatology is that branch of meteorology which deals with the weather over long periods of time; and weather itself can be defined as the state, at any given time or place, of the six meteorological elements; temperature, pressure, humidity, precipitation, wind, clouds. All these in their various phases, and with their totals, means, and extremes are observed and recorded twice daily at St. John's. In addition, miscellaneous or extraordinary phenomena such as auroras, halos, coronas, parhelia (or sun dogs), fog, frost, glaze, sleet, blizzards, thunderstorms, etc., form part of the records. The growth of crops and the condition of trees, since they are important factors in studying the climatology of a district, are also recorded.

Fig.2: MEAN MONTHLY TEMPERATURE - MEAN MONTHLY PRECIPITATION
(curved line: temp.) (bars: precipitation)



JAN--	11.9°	JAN--	0.71"
FEB--	14.9°	FEB--	0.65"
MAR--	28.0°	MAR--	1.07"
APR--	44.0°	APR--	2.01"
MAY--	56.1°	MAY--	3.19"
JUNE-	65.7°	JUNE-	3.73"
JULY-	71.7°	JULY-	3.18"
AUG--	68.3°	AUG--	3.05"
SEPT-	59.8°	SEPT-	2.58"
OCT--	47.2°	OCT--	1.64"
NOV--	31.4°	NOV--	1.05"
DEC--	19.0°	DEC--	0.65"
MEAN--	43.0°	TOTAL-	23.46"*

(annual mean)

*Reason for discrepancy in the decimal part of total is that the latter was computed from the 52 annual means, rather than from the monthly means. This gives the final figure greater accuracy.

St. John's is in the North Temperate Zone on latitude 45° 36', at an elevation of 1200 feet above sea level. In the temperate zones the seasons are classified according to temperature, not, as in the equatorial regions, by rainfall. In fact the latitude of St. John's puts it just half way between the equator and the north pole, so that its location is at least a theoretical happy medium between the monotonous heat of the tropics and the continued cold of the polar regions. The over-all average of our temperature in 52 years has been 43.0° (Fig.1). Thus, as Figure 2 indicates, the closest approximation to our average temperature conditions is the month of April.

Of more importance however is our seasonal average, which if found to be as follows:

Winter (Dec., Jan., Feb.):	15.3°
Spring (Mar., Apr., May):	42.7°
Summer (June, July, Aug.):	68.6°
Fall (Sept., Oct.,Nov.):	46.1°

January is our coldest month, July our warmest. The lowest temperature ever recorded by the station thermometer was -39° on January 22, 1936. The same year gave us our highest recording, 106° on July 10. Thus 1936 furnished the station records with both the positive and negative extremes--a range of 145°. Though the time of occurence of the daily maximum and minimum temperatures varies with the seasons, taking the whole year as an average the thermometers will usually be highest from about 2 to 4 o'clock in the afternoon and lowest at sunrise.

It may be well to note that readings depend on the surroundings of the thermometer shelter as well as on its height above the ground. On clear, calm nights, for example, the lowest temperature is either on the ground or very close to it, and a thermometer 10 or 12 feet above the ground may register considerably higher. Moreover, in comparing readings with those of other stations, and in particular with those of our neighboring station at St. Cloud, a number of things come into consideration. Under normal conditions the temperature decreases with altitude, but certain topographies induce what are known as "inversions". For example, St. Cloud's airport station has an elevation about 200 feet lower than the station at St. John's, and this should give St. Cloud (since it is in approximately the same vicinity) an average temperature about one degree higher than St. John's. The fact is, however, that the airport mean is 42.4°, or about one-half degree lower than the St. John's mean of 43.0°. The observer at St. Cloud attributes this to the location of his station between the Mississippi and Sauk Rivers. Because water does not absorb and give off heat as fields or woodland surfaces do, an inversion of temperature is much more likely in river valleys than over an area with a topography like that of St. John's. (10) This is especially true at night and in the early morning when wind velocities are low. In an inversion the cold air, being heavier,

(10) In connection with local topography see the article in this issue entitled "Sagatagan Saga".

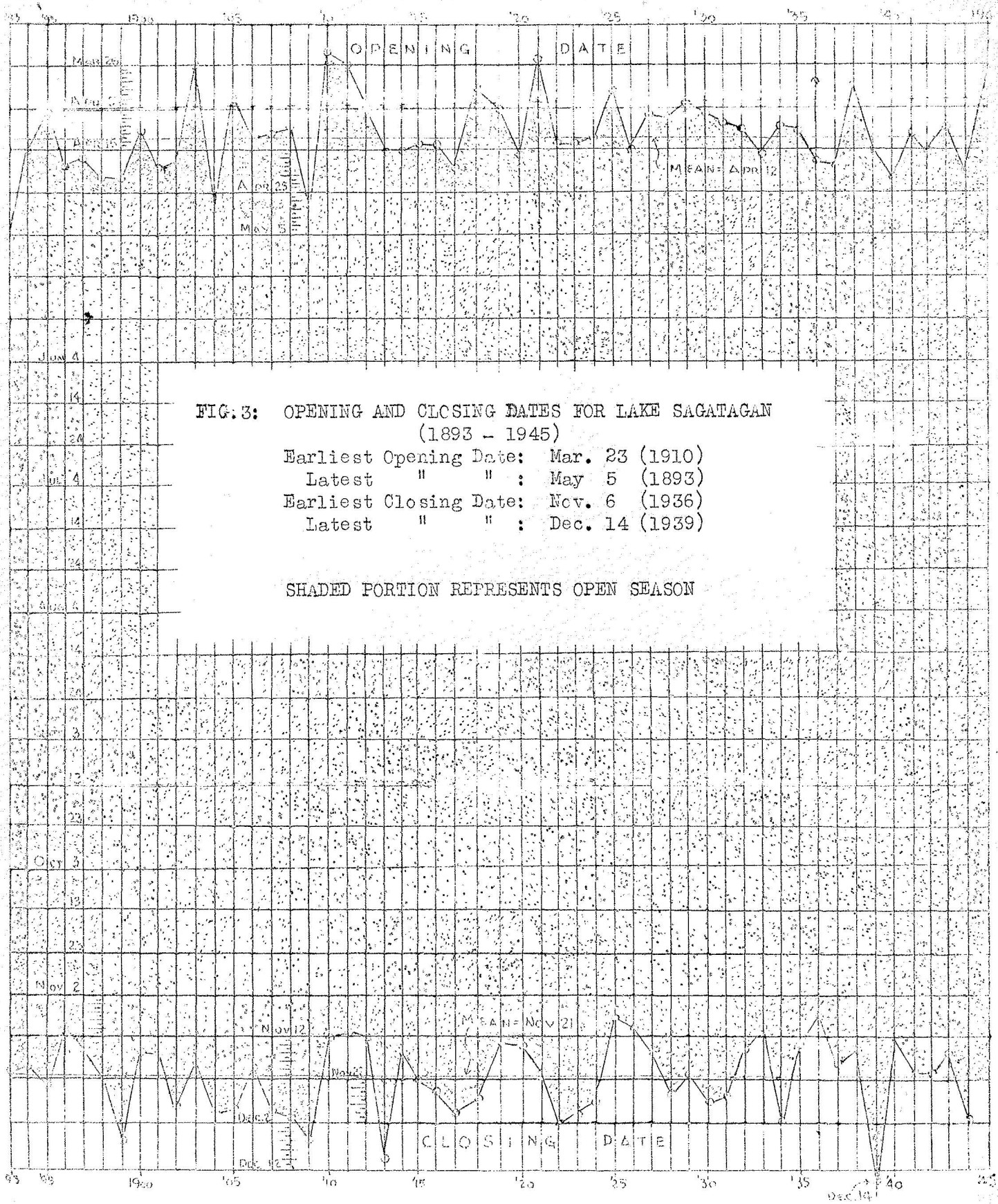


FIG. 3: OPENING AND CLOSING DATES FOR LAKE SAGATAGAN
(1893 - 1945)

Earliest Opening Date: Mar. 23 (1910)
Latest " " : May 5 (1893)
Earliest Closing Date: Nov. 6 (1936)
Latest " " : Dec. 14 (1939)

SHADED PORTION REPRESENTS OPEN SEASON

tends to remain in the lower areas until there is enough wind circulation to equalize the currents. Before the St. Cloud station was removed from the Reformatory to the airport, the St. Cloud mean was the same as that at St. John's, 43°. This is 1.3° higher than the general mean for the whole state of Minnesota, which is 41.7°.

Although, as was said above, our seasons are classified according to temperature rather than rainfall, Figure 2 shows that our seasonal precipitation curve follows the general line of the temperature curve---a fortunate circumstance, since 67% of our total precipitation occurs during the growing season. Moreover, more than half of it occurs during the 4-month period from May 1 to September 1 when the temperature is most favorable for the growth of the staple farm crops. The reason is that in the interior areas of North America the summer winds blowing inland from the water bodies surrounding the continent carry with them plenty of warm, moist air, a prerequisite for precipitation. (11)

As Figure 1 indicates, the average yearly precipitation at St. John's is 23.46". Our average distribution for the seasons (Fig. 2) is as follows:

Winter (Dec., Jan., Feb.):	2.01"	(9%)
Spring (Mar., Apr., May):	6.27"	(27%)
Summer (June, July, Aug.):	9.96"	(42%)
Fall (Sept., Oct., Nov.):	5.27"	(22%)

June tops the scale (though July and August are warmer), while February and December are at the bottom.

A glance through the weekly barometer graphs on the monastic bulletin board will reveal the rather continued passing of air masses of successively high and low pressures, especially in the spring and summer months. (12) This is a typical feature of continental climates, and the position of St. John's in the central section of the North American continent brings it within the important influence of the highs and lows (anticyclones and cyclones) that are continually moving across the northern states from west to east. Therefore, besides the wide seasonal variations in temperature and precipitation, there is the characteristic continental tendency toward day by day extremes in all the elements of the

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(11) The general opinion that the source of the precipitation falling in Minnesota is the Pacific Ocean is challenged by those who are convinced that it comes from the Gulf and possibly even from the Atlantic areas. The reason given is that storms moving inland from the Pacific are forced to drop their precipitation on the western side of the Rockies, condensation taking place as the ascent is made in passing over the mountains. Others attribute at least some of the spring rains to the storms moving in from the North Pacific by way of western Canada.

(12) Mean pressure at St. John's, corrected to sea level, is approximately 30.00 inches. A reading below this indicates an area of more or less low pressure; a half inch below is extremely low.

weather. As the comparatively cold and dry air masses from the polar regions are continually succeeded by cyclonic bodies of warm moist air, we experience fluctuating periods of cold and heat and of clear weather and cloudy or rainy weather.

The frequent thunderstorms, especially during the warm season of June, July, August, are the chief source of our rainfall. An estimated one-half of our total precipitation comes with storms accompanied by local thunder and lightning, and often we share the rainfall of thunderstorms even though the thunder and lightning is not local. We may normally expect about 22 thunderstorms of more or less severity each year. Appreciable damage to property and crops by wind, lightning, hail, or excessive rainfall has been rare.

The possibility of crop failure due to drought is a matter of much less concern than it was 10 years ago. At that time the rather consistent downward trend of the precipitation curve (13) led many to believe that this section of the Northwest was undergoing a change to a drier climate. Many others however felt it was rather the downward period in a long climatic cycle, a theory which the rising curve in recent years has made more plausible.

In connection with the snowfall chart (Fig. 1) it should be noted that an inch of snow represents on the average only about one-tenth of an inch of precipitation (in this case melted snow). In order that the winter precipitation equal that of summer it would have to snow ten times as much in winter as it rains in summer. The tendency of above-normal years to excessively high snowfall figures has more than compensated for the years of deficient snow, and thus the snowfall curve did not always follow the precipitation curve. Our normal snowfall for the winter season is 37.3".

While our comparatively long winters leave a greater impression on the memory, the summer climate is a matter of more concern to the inhabitants of a rural community. Two graphs have been added to give an indirect indication of the comparative length of the seasons (Fig. 3 on the open season of Lake Sagatagan and Fig. 4 on the length of the growing season). The active phase of the crop season, when considered as the period between the last killing frost in the spring and the first killing frost in the fall, extends on the average from May 6 to September 29, supplying a normally safe crop growing season of 146 days. Thus, while it is true that our fields lie practically dormant on the average of 7 months a year, the climate is nevertheless favorable for a great number of crops which require only late spring planting and which mature early in the fall. However, since there is general vegetation considerably beyond the frost bracket (during more than half of the year, as Figure 2 shows), the possibility of an unusually late killing frost in the spring or of an unusually early one in the fall is always a hazard and a matter of considerable importance to farmers in this section. The latest killing

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(13) See Figure 1, 1914-1937, and especially 1928-1935.

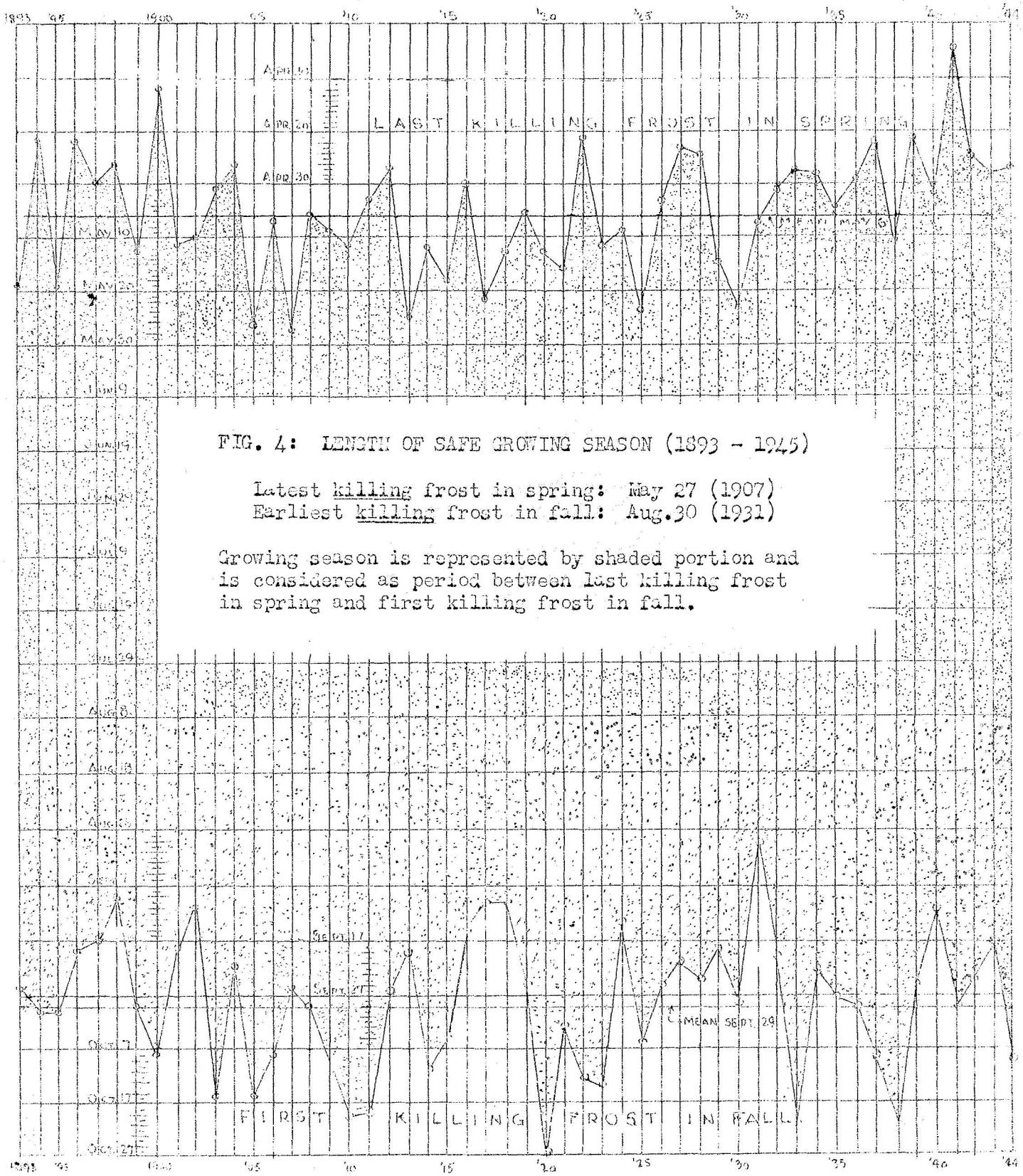

FIG. 4: LENGTH OF SAFE GROWING SEASON (1893 - 1945)

Latest killing frost in spring: May 27 (1907)
Earliest killing frost in fall: Aug.30 (1931)

Growing season is represented by shaded portion and is considered as period between last killing frost in spring and first killing frost in fall.

frost on record occurred on May 27, 1907, and the earliest on August 30, 1931. In this connection it might be noted that frosts are more likely to occur during periods of high barometric pressure and when low humidity and low temperature accompanies clear skies and little wind. The possibility is increased if a low pressure area of overcast skies or light rains has preceded, because then the ground has been deprived of the warmth of the sun's rays or its heat is being consumed in the process of evaporation.

As regards clouds we experience on the average 144 clear days, 91 partly-cloudy days, and 130 cloudy (overcast) days a year. If we consider the partly-cloudy days as days of sunshine, which for the most part they are, we may say that St. John's enjoys the not insignificant physical and psychological benefit of sunny days 64% of the time.

In normal years the prevailing direction of the wind is northwest for all months except June, when northwest and southwest winds prevail equally, and September, when there are ordinarily an equal number of northwest and south winds. We may expect a total wind movement of some 76,800 miles each year, giving our currents an over-all average velocity of 8.7 miles per hour. Variations however are both frequent and wide. The constant passing of highs and lows, as explained above, is the occasion for more or less unstable conditions when the air masses of different temperatures and pressures meet, and velocities up to 30 and 40 miles per hour are not infrequent.

In general the region about St. John's enjoys a climate that is both interesting and physically stimulating because of its wide variations, and one that is economically important because it affords the section a relatively high rank in agricultural production.

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The writers are especially indebted to Mr. Martin Hoyde's notes on pages 933-934 of Climate and Man, to Mr. Millette's format and his general observations on climate, and to Mr. Earl Hoffman and his staff at the St. Cloud airport station.