August leads closely, followed by June and July. Now, although thunder was recorded on this number of days, it must not be supposed that every record is a separate storm. Thunderstorms move at a rate of from 25 to 50 miles an hour, and the same storm may be recorded at Frederickton, Oromocto, Gagetown, St. John, and Point Lepreau. A careful analysis of the record leads me to the conclusion that there were 24 individual storms; and even of these at least one-half would be more properly termed thunder showers.

In this connection it may be mentioned that thunderstorms are of great frequency in equatorial regions, but are not so frequent in northern latitudes. In Java the average for a year is 97; in France, 29; in Finland, 2; in Iceland, 1.

In the rainless area of Peru no thunder is ever heard, while at Pueblo, in Mexico, in summer there is a thunderstorm every afternoon from 2 to 3 o'clock. (Russell.)

Thunder can be heard about 10 miles; lightning can be seen about 200 miles. Thunder and lightning have always been objects of fear, and a recent investigator found "that of 298 classes of objects of fear to which 1,707 persons confessed, thunder and lightning lead all the rest."

Lightning is a powerful destructive agent. Dr. Robert Bell, of the Geological Survey, considers lightning the commonest cause of forest fires, and supposes that such fires took place even in Pleistocene times. I am not aware, however, that this view is generally held. In our own time the destruction of life and property by this means is larger, perhaps, than is generally supposed. From 1880 to 1890 in the United States there were killed annually in this way 200 persons. In the eight years ending 1892 the fire losses due to lightning amounted to $12,663,835. These figures are quoted by McAdie from the "Chronicle Fire Tables," and he considers them reliable.

I will now, as briefly as I can, present a statement of the damage done in this province during 1897.

Persons struck by lightning.—August 6, 2 p. m.—Joseph Wheaton, aged fourteen, killed in a hayfield at Middle Sackville. This was the only death from this cause during the year.

July 9, p. m.—Little girl disrobed and dress torn to tatters at St. George; not otherwise injured. She was playing on a swing, and the tree to which it was attached was shattered.

July 24.—Man knocked down and stunned by "ball lightning" at McAdam, but there were no serious results.

August 1.—A young man slightly burned on the neck and three other persons received slight shocks in a house which was struck in Carleton.

At Lepreau three young men were stunned and slightly burned. They were sitting in a room close to the telegraph office.

September 10.—A man living on the Buctouche road, near Richibucto, was struck on the head and severely cut. The current passed through a bench on which he was sitting and killed a dog and cat lying beneath.

Damage to property.—The damage to property by thunderstorms was considerable, as the following table will show:

	Loss.
Barns (15)	$3,000
Dwellings (7)	450
Bridges and roads	400
General merchandise	100
Telegraph and telephone plant	250
Cattle killed	125
Horse killed	75
Hay, oats, etc. (in barns)	3,350
Standing crops	3,200
Total	10,950

The greatest destruction was caused by lightning where the stroke resulted in fire; rain did considerable damage, and the hail which fell on August 6 and 9 also caused considerable loss to farmers. The following table shows the amount of damage caused by each of these agencies:

	Loss.
Lightning (where fire resulted)	$6,950
Lightning (mechanical)	400
Rain	2,400
Hail	1,200
Total	10,950

From this statement it will be seen that the loss resulting from these storms fell nearly altogether upon our farmers. The losses were largely confined to barns and their contents.

This is what happens in other places, and it shows that a farmer will do well to keep his barns insured. Some insurance policies make no provision for loss by lightning; others pay losses when fire results from the lightning.

Any insurer can have a provision inserted, without extra charge, in his policy protecting the property insured, whether fire results from the lightning stroke or the damage is mechanical, and it would be wise for farmers to bear this in mind when making insurance contracts.

I wish to thank numerous correspondents for aid received in the preparation of this paper, and especially Mr. D. L. Hutchinson, to whom I am indebted for much information.

UPPER CLOUDS AND WEATHER CHANGES.

By GEORGE W. RICHARDS, Voluntary Observer (dated Mapleplain, Minn.).

Referring to the MONTHLY WEATHER REVIEW for May, 1897, page 212, I may say that I have made something of a study of the upper clouds in their relation to the weather of this section, and will mention a few of my resulting rules.[1]

(A) During a cold snap, more especially during the winter season, near the close of a period of clear weather with northwest wind, if the northwest wind becomes very light or nearly calm, when the barometer has about reached its greatest height, either here or to the northward of us, with an area of cirrus and perhaps cirro-stratus covering the sky in the southwest, but moving toward the southeast or east-southeast in the morning, as in Fig. 1, Chart XII, for the first day, *then* the northwest or north wind will become nearly calm, and by the evening will turn to the northeast and perhaps east, and will, almost certainly, be followed by a moderate snowstorm that night or the next day with east to southeast winds.

By the evening of the first day, although the cirrus area is moving southeastward, the bank of clouds still has a tendency to lie farther northward, as will be seen in Fig. 2, and some of the wind will be in the northeast; but this is not the genuine northeast storm, and the snowfall is not nearly so heavy as in that. The wind (see Fig. 3) may be quite heavy from southeast during the night, and remain southeast the next morning. (See note at the end.)

(B) The genuine northeast storm is preceded by northeast wind with but slight change. Sometimes the cirrus with its haze covers the sky in the successive positions shown by Figs. 4, 5, 6.

If the cirrus area in the first afternoon has no more tendency to cover the clear sky to the northwestward than it had in the morning, as shown in Fig. 4, Chart XII, then the wind will most generally become more northerly and the storm has passed, or will pass, in a northeastward direction through Iowa, Wisconsin, etc., far to the east of the station. If later in the first day the cirrus haze, shown in Figs. 4 and 5, has a tendency to cover the clear sky to the northward of

[1] Mapleplain is located approximately in W. 93° 40′, N. 45° 0′, or 30 miles west-northwest of St. Paul.—ED.

the station, as in Fig. 6, although it is itself moving from the southwest, and if the wind remains northeast, then heavy snow will occur during that night or the next day.

During the northeast storm the several forms of cirrus clouds usually move from southwest, the alto-stratus, cirro-cumulus, etc., with attendant pallium haze, from south-southwest or south, although the surface wind is from northeast. These conditions indicate heavy storm or precipitation. (See note at the end.)

Many times there will be no scud or rapidly-moving lower clouds until after the precipitation commences; then these will be seen, through breaks or let-ups of precipitation, to be moving rapidly with the surface wind from the northeast, or very nearly with the wind. While the low surface clouds (which frequently obscure the upper region when the northeast storm is prevailing) are moving with the wind toward the southwest, the whole area of rain, snow, or pallium haze itself, seems to be moving northeastward, as for example in the heavy storm of March 30, 31, and April 1, 1896. On March 31, with high northeast wind, and while the whole upper atmosphere was obscured by a low surface cloud moving from the northeast, a series of thunder showers occurred, moving from the south or southwest, and passing by on the north side of the station. This fact could easily be told by the smooth appearance due to rain, snow, and sleet in the south and southwest, as the whole storm moved northward, and finally disappeared in the north as the thunder moved off in that direction, although without any change in direction of the surface wind or lower cloud moving from northeast.

During the said thunderstorm the temperature was 10° to 13° below freezing.[1] Have noted similar movements of storms opposed to the wind in many cases.

(C) In the spring, when there is a storm in the distant southwest in the morning, with an east or southeast wind at this station, if the pallium haze below the cirrus and also some other upper high clouds move from east or northeast, there is then a heavy storm of rain or snow over Nebraska, South Dakota, southwest corner of Minnesota, and Iowa, but it will not cover Mapleplain but remain approximately stationary where it is. Of course, the upper atmosphere must not be so much obscured by surface scuds as to prevent observation of the upper clouds.

(D) Perhaps one of the most common storm conditions is the following (see Fig. 7):

Northwest wind changes to calm, or to between southwest to southeast by the next morning; during the night cirrus moved from northwest, west-northwest, or west. If pallium haze, cirro-stratus, and alto-stratus do not move with cirrus, they may be moving slightly more from the west or even southwest. If cloudiness increases, snow or rain is likely in afternoon or night; but if the cloudiness decreases it will be fair and warmer, and the rain, if any, may pass far to the northward. (See note at end.)

(E) In spring, summer, and fall I have noted that a storm of rain or snow in the Dakotas may be delayed for two or three days, if there is not much cloudiness, and during the first day or second morning the movement of the cirrus changes to one from a decidedly southerly direction while strong south to southeast winds are prevailing.

(F) As a rule the movements of cirrus and other clouds during the day differ from the movements from northwest or west, given by morning observation; the movement in the latter part of the day may be nearly southwest, or even wholly southwest, with southeast wind below. The delayed storms referred to in the preceding paragraph occur when in the latter part of the day the cirrus comes from south-southwest or south.

[1] How could it have been rain in the southwest; was it not snow?—ED.

(G) When a cloudy cirrus area passes along on the northwest or north side of us the cirrus clouds themselves moving from southwest, and a southeast wind has veered to southwest, and after remaining some little time in southwest has eventually become northwesterly and cooler, there is liable then to be a second storm condition or cloudy area approaching from the south or southwest of this station. The wind will then become northeast, and rain will occur here or pass by near here on our southeastern side, as happened on October 14, 1897, at this place (see Figs. 8, 9, 10, and note at the end).

Northwest wind veers to north or northeast during latter part of day or evening. Rain is apt to fall during the first night or second day.

(H) With cirrus moving from north or northeast rain never falls unless at the very close of a storm with high northerly gales when clearing weather may be expected (see Fig. 11). With this dry weather cirrus either scattering or obscuring sky the wind may blow from the west, southwest, south, or southeast.

(I) As a rule, if cirrus moves from northeast, fair with warm or hot weather may be expected; if it is cold there will be at least a decided rise in temperature the next twelve or twenty-four hours.

(J) If the wind be west, southwest, or south, as long as cirrus moves from northeast, fair warm weather may be expected, most usually lasting for one, two, or three days.

(K) If at the evening observation, on the first day, cirrus or cirro-stratus has changed and is moving from northwest and the wind remains south or southeast, the previous rule is broken and there may be rain or snow.

[NOTE.—Before publishing the above communication by Mr. Richards, it was referred back to him for further elucidation, and in his reply of April 5 he says:

"The condition exhibited in Fig. 1 may first appear somewhat later in the day, instead of in the morning, as in the following cases: February 13, 1898, it appeared in the latter part of the afternoon, and the northwest wind became east on the 14th, with 3 inches of snow on that date. It appeared again about 2 p. m. on the 15th, and the northwest wind became east and southeast on the 16th, with 1 inch of snow that day. It appeared again, March 30, 1897, at 1 p. m., and the northwest wind changed to southeast and northeast on the 31st, with 4.5 inches of snow, which began falling early in the morning of that date."

With regard to Fig. 4, he states that "on January 2, 1897, the clouds covered the south and southeast sky in the morning, but with northwest winds, which afterwards became northeast. This condition changed to Fig. 6 in the evening, followed by 8 inches of snow and a high northeast wind on January 3. On January 22, 1898, Fig. 4 was observed in the morning, and the northeast wind prevailed all day, but as the clouds had no further tendency to cover the sky to the northward of the station, therefore the storm passed away through Wisconsin; there was a covering of stratus moving from the northeast during a part of this day."

With regard to Fig. 7, relative to the approach of southeast storms, he says: "On October 8, 1897, the northwest wind changed to southeast by the morning of the 9th, and 0.23 of rain fell during the 9th and 10th; again, with the decrease of cloudiness, as on December 7, 1897, the conditions of Fig. 8 appeared in the early morning, followed by a southeast wind in the afternoon of that date, and fair weather continued during the night."

Chart XII. Upper Clouds and Weather Changes.

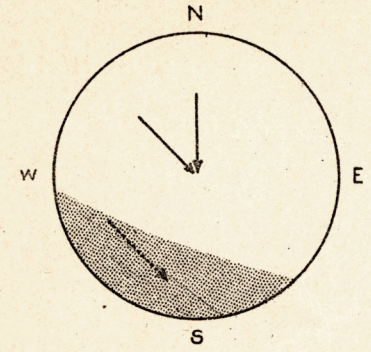

Fig. 1.

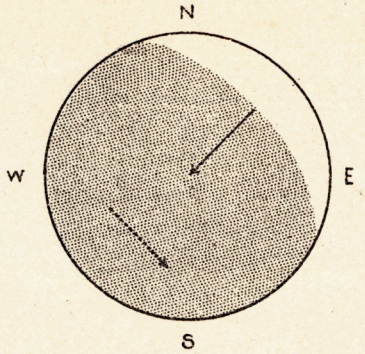

Fig. 2.

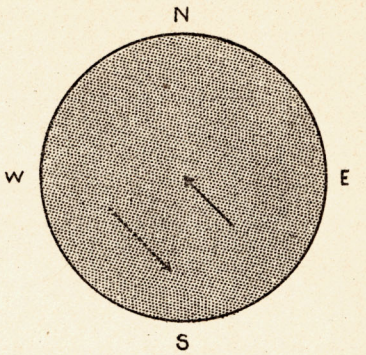

Fig. 3.

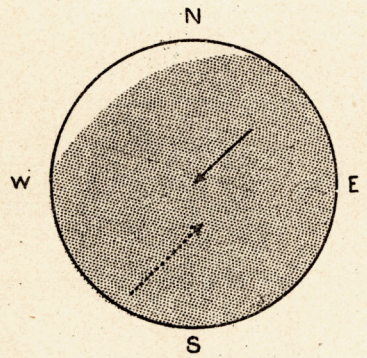

Fig. 4.

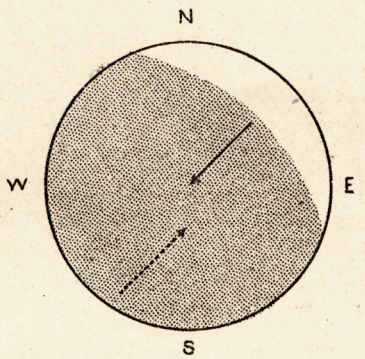

Fig. 5.

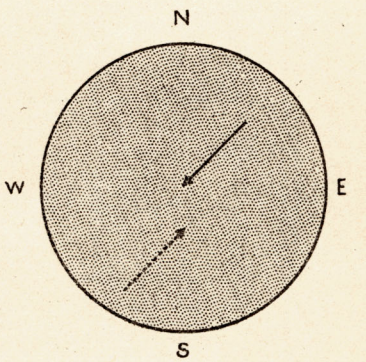

Fig. 6.

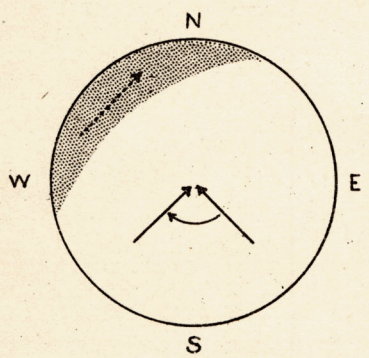

Fig. 8.

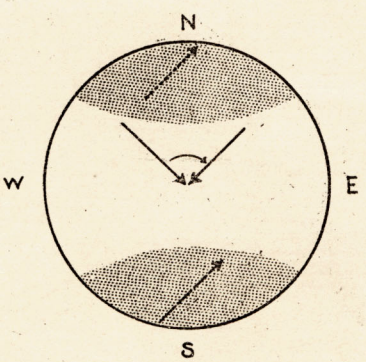

Fig. 9.

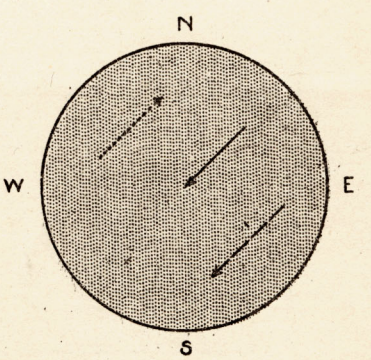

Fig. 10.

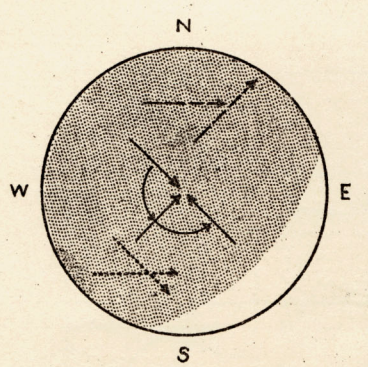

Fig. 7.

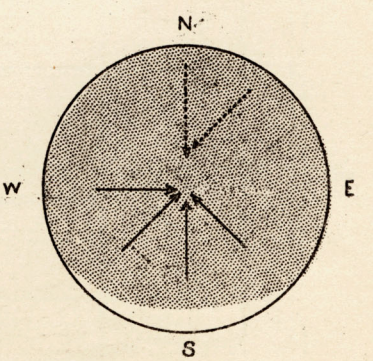

Fig. 11.

Note. — The dotted arrows belong to the highest upper clouds; the dashed arrows belong to the lower clouds; the full-line arrows represent the wind. The circle represents the whole visible sky down to the lowest clouds that can be seen in the horizon.