

sufficient range to indicate the extremes of temperature that may occur at each station. In connexion with this it must not be forgotten that a cold of  $-23^{\circ}8$  C. ( $10^{\circ}8$  F.) was observed at Agen on the 16th January, 1830, and  $-31^{\circ}3$  C. ( $-24^{\circ}3$  F.) at Pontarlier on the 14th December, 1846. All thermometers being liable for some years after their construction to a displacement of their zero, it is indispensable that observers should verify this point by means of melting ice two or three times a year at first, and afterwards once a year. The position to be given to the thermometers constitutes the greatest difficulty of meteorological observations. Sufficient attention has not hitherto been paid to it; and this is the principal cause of the divergent results obtained at places very near each other. In order that a thermometer should indicate the true temperatures of the air, it should be placed in an open space of considerable extent, at the greatest possible height (at least two or three metres) above a soil covered with grass. Its shelter should be formed of two boards or plates of zinc placed parallel to each other, at a distance of 1 decimètre (4 inches), inclined  $30^{\circ}$  towards the south, and about 1 metre square, the upper board or plate extending beyond the lower one in every direction. Those who may adopt an arrangement of this kind for observations at stated hours of the morning and evening should also place some screens to the east and west, in order to shelter their thermometers from the rays of the sun, but in such a manner as to present no hindrance to the movements of the air.

But most meteorologists make their observations in towns, where it is very difficult to obtain a position at all suitable. In this case the least unfavourable position must be selected. At a window in the streets of a town the temperatures obtained are necessarily erroneous; but they are particularly so at certain hours, according to the season and the direction of the street. For example, those of 9 a.m. in summer will be much exaggerated if the window has a north-north-east instead of a due north exposure. In wide courts the maxima are much too high, whilst in narrow courts into which the sun never penetrates they are often too low. In the last conditions of exposure the minima are about  $1^{\circ}5$  C. ( $2^{\circ}7$  F.), and the extreme minima  $3^{\circ}$  or  $4^{\circ}$  C. ( $4^{\circ}$ — $7^{\circ}$  F.) too high. In order that the temperatures obtained at a window may be of some value, the window must face the north pretty accurately; and it should have before it an open space of considerable extent. But it must not be forgotten that this situation can only give factitious temperatures higher than those of the country, and that it is beyond the power of the observer to remedy this inconvenience. They render the supposed differences of temperature between neighbouring towns and the changes taking place in the same place in course of years completely illusory. The errors being generally errors of diminution, the mean temperatures appear to decrease almost everywhere.

The exact knowledge of the conditions in which the thermometers are placed will allow us to take into account the inevitable errors which they induce. We cannot, therefore, too strongly recommend observers to describe exactly the situation of the places in which they observe, and even to give detailed plans of them. Those observers who reside in towns will find it very useful to place maximum and minimum thermometers in the open country in the manner already described; the numbers furnished by these, compared with those obtained in the town, will determine the error of the latter. Very useful indications may be obtained even when the comparison is made only two or three times a week, provided it is extended throughout the seasons; the observations must be continued longer in proportion as they are less frequent. A small thermometer suspended in a sling (*tourné en fronde*) may also be employed for verifying the indications of a fixed thermometer, the excess of the latter over the sling thermometer being greater in proportion as its position is defective.

It would be interesting to trace the slight variations of temperature occurring in wells and springs, especially those which can be reached near their source. It is sufficient in general to observe these waters once a month; their minimum of temperature is about the vernal equinox, and their maximum towards the autumnal equinox.

*Humidity of the Air.*—The moistened thermometer must be placed a few centimètres from the dry thermometer and in an identical position. The fine linen or muslin with which its bulb is covered must be kept very moist in all parts; when this condition is not fulfilled, especially during hot and dry weather and high winds, the hygrometric degree appears much too high.

*Rain Gauge.*—The instrument destined to give the depth of rain which has fallen must be at least twenty centimètres (about eight inches) in diameter. The most convenient are those in which the funnel is continued below into a cylinder, furnished with a glass tube on one side, and in which the rainfall is decupled. The rain-gauge should be placed in an open space, far from high walls and buildings, but not too much exposed to the wind. It should not be elevated more than six or seven feet (one or two metres) above the

ground. It is a good plan to enclose the reservoir of the rain-gauge in a wooden box, in which, during frost or snow, one or two small oil lamps may be placed. This method, besides preserving the rain-gauge, has the great advantage of giving exactly all the snow which falls upon the funnel. This snow adheres to the funnel and melts upon it, and cannot be carried off by the wind.

Rain-gauges are often placed upon roofs: but this position is very defective, and should not be adopted unless no other arrangement is possible. In this case the resulting error should be determined by comparisons with a rain-gauge placed as just described. The error is particularly important at times and in places where high winds prevail.

*Choice of Hours of Observation.*—This is a matter of great importance. It is a little complicated by the circumstance that it should equally suit both the thermometer and the barometer. It is desirable, moreover, that the observations should assist in the great general work carried on by all the meteorologists of Europe, of which a *résumé* appears in the *Bulletin International de l'Observatoire*. This investigation rests specially upon the observations of 8 a.m. in winter and 7 a.m. in summer. The system of hours, which is in all respects preferable (irrespective of the observations of seven or eight o'clock), consists in observing all the instruments at 4h. 10m. morning and evening, as it gives perfect means of the temperature, humidity, tension of vapour and atmospheric pressure, and also the two maxima and the two minima of the latter, the minima and the maxima of temperature being furnished by the index thermometers. Four o'clock in the morning being an inconvenient hour, observers may substitute for it six, seven, or eight o'clock a.m. at their pleasure, giving the preference to the earliest hour. In this way the true means are certainly not obtained, but the slight error caused by the alteration of the morning hour of observation may be corrected in the monthly means. Six o'clock in the morning and two and ten o'clock p.m., or 7 a.m. and 2 and 9 p.m. will also furnish a good system of observations, which, however, should not be adopted, except when a long series of observations has already been made upon the same model. In any case the observation of the maximum and minimum of temperature should never be neglected.

We pass over the instructions relative to the recording of winds and general atmospheric conditions; the necessity of noting all uncommon atmospheric perturbations with the greatest care is, of course, strongly insisted on.

The "Meteorological Journal" is a *sine qua non*, and the *Association Scientifique* volunteer to suggest forms to suit the requirements of all observers on the receipt of information as to the hours chosen for observation and the instruments which it is intended to employ. *The Reader.*

## V. Departmental Notices.

### 1. DEPARTMENTAL REGULATIONS FOR THE METEOROLOGICAL STATIONS OF UPPER CANADA.

Each observer, at the Grammar School Stations, is required,—

- I. To adhere strictly to the directions contained in the book of "General Instructions for making Meteorological Observations."
- II. To follow carefully the instructions in the "Synopsis of Daily Routine of Observation," (on next page).
- III. To keep accurately the following Registers:

1st Book.	}	Form A.—The Ordinary Daily Register Book.
		" B.—The Daily Register of certain Quantities for the Month.
2nd Book.	}	Form C.—Monthly Abstracts of Meteorological Observations.
		" D.—The Monthly Abstract continued.
		" E.—The Annual Summary Meteorological Observations.
3rd Book.		The Meteorological Record Book, Upper Canada.

- IV. To transmit punctually to the Department, at the close of each month, duly certified, the following abstracts—of which forms are gratuitously issued for that purpose:

1. Form C.—Monthly Abstract of the Daily Record of Meteorological Observations.
2. Form D.—Monthly Abstract of the Daily Record of Barometer, Temperature, Auroras, Meteors, &c.;—and at the end of the year, as above.
3. Form E.—Containing an Annual Summary of Meteorological Observations at the Station.