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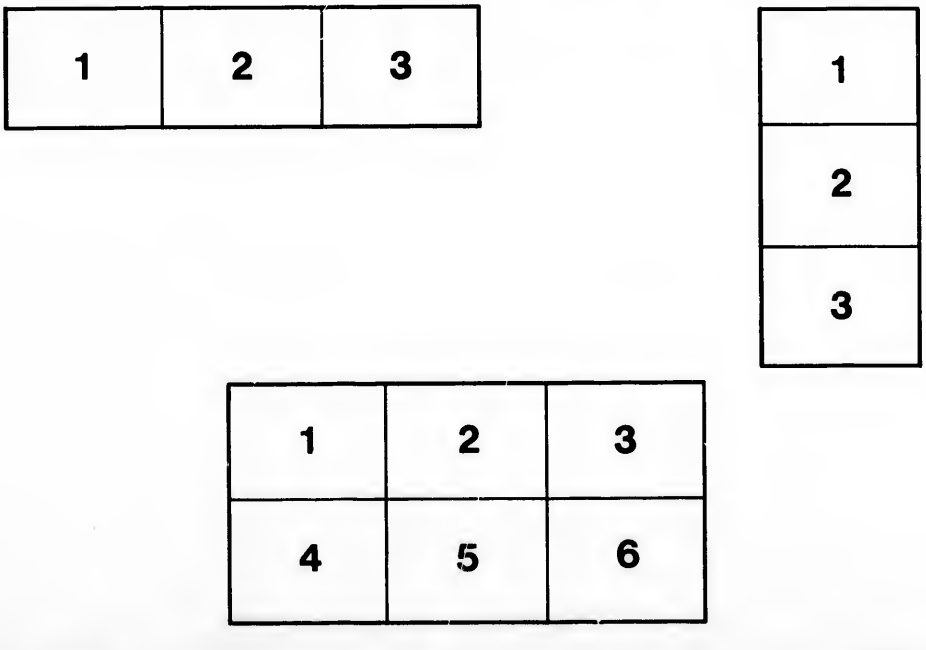

NOMENCLATURE OF CLOUDS, PRIMARY FORMS.

Stratus *Cirrus* *Cumulus* *Nimbus*


Stratus
Cirrus
Cumulus
Nimbus

GENERAL INSTRUCTIONS,

FOR MAKING THE

Meteorological Observations

AT THE

SENIOR COUNTY GRAMMAR SCHOOLS

IN

UPPER CANADA.

Authorised and required by the Grammar School Act, 16 Vict., c. 186, Sec. XVI.

PREPARED UNDER THE AUTHORITY OF THE CHIEF SUPERINTENDENT OF EDUCATION, BY THE DIRECTOR OF THE MAGNETICAL OBSERVATORY, TORONTO.

Approved by Council of Public Instruction, Upper Canada, 14th July, 1857.

TORONTO:
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1857.

PREFATORY REMARKS.

The prosecution of enquiries relative to atmospheric phenomena has occupied of late years much public attention. Provision for meteorological research in connection with exploring expeditions, and through numerous fixed observatories has been made by the various governments of Europe, and by the liberality of individuals. These efforts have not been confined to Europe; in the United States of America, a system co-extensive with those territories is in operation, by which the records of observations made at some hundreds of stations, and according to a uniform plan, are regularly transmitted to Washington.

To elucidate the climatology of North America, however, and to trace its atmospheric phenomena to their origin, it is requisite that the vast, but (as regards its meteorology,) comparatively unexplored regions forming the British dominions, should be occupied by stations for observation; for till the existing meteorological system shall have been thus extended, it will be inadequate to cope with the problem of American storms, and other questions of great practical interest.

It was from considerations such as the foregoing, and with a view of remedying the defect so far as relates to Upper Canada, that the Provincial Legislature passed the Act which provides that meteorological registers be kept at the senior County Grammar Schools.

The clause referred to is as follows:—

"And whereas it is desirable at all seminaries and places of education, to direct attention to natural phenomena, and to encourage habits of observation; and whereas a better knowledge of the climate and meteorology of Canada, will be service-

able to agricultural and other pursuits, and be of value to scientific inquirers: Be it therefore enacted, that it shall be part of the duty of the master of every senior County Grammar School, to make the requisite observations for keeping, and to keep a meteorological journal, embracing such observations, and kept according to such form as shall from time to time be directed by the Council of Public Instruction, and all such journals or abstracts of them, shall be presented annually by the Chief Superintendent of Education, to the Governor General in his Annual Report."

It is earnestly desired that the gentlemen whom this law concerns as well as others disposed to bestow their voluntary aid, will conscientiously labour to carry the provisions of this law into effect. In submitting to the restraint that these observations demand, they should be supported by the recollection that the work they are engaged in is a great one, and likely to issue in results not only of speculative interest, but of great practical benefit to society.

To ensure the uniformity in taking and recording observations that is essential to their utility, the following instructions have been drawn up. As they relate to little more than to matters of routine, observers desirous of additional information are referred to books which treat upon the subject, and which may be obtained on application, at the Department of Public Instruction at Toronto. Particular attention is called to the synopsis at the end of Section III., Art 53.

[G. T. K.]

GENERAL INSTRUCTIONS

FOR

METEOROLOGICAL OBSERVATIONS.

SECTION I.

METEOROLOGICAL INSTRUMENTS.

Art. 1.—*The Barometer.*

The pressure exerted by the atmosphere on a unit of surface is numerically expressed by the height in inches of the column of mercury in a barometer, measured from the surface of the mercury in the cistern, the specific gravity of the mercury being that which it has when at a temperature 32°.

In measuring this height, the lower extremity or zero point of the scale should be brought to coincide with the surface of the mercury in the cistern, by elevating or depressing the cistern by the screw beneath it, till the ivory zero point appears to meet its image reflected from the mercury (see Note *a*). The index should then be adjusted by turning the proper screw till the light is just excluded between the top of the mercurial column and the front and back lower edges of the index, when brought into apparent coincidence (Note *b*). The reading of the scale and vernier (Note *c*) will then indicate the observed height of the barometer, uncorrected for capillarity and index error.

(1 *a*) In the barometers of Newman's construction the coincidence of the zero of the scale with the surface of the mercury in the cistern is effected by depressing or raising the whole scale itself, by a suitable screw. In those instruments whose scales and cisterns are both fixtures, the error in the position of the zero point must be allowed for by applying what is called the correction for capacity.

(1 *b*) To assist the observation, a piece of white paper may be pasted on the board, behind the top of the column.

(1 *c*) The scale is graduated to inches, tenths, and half-tenths, *i.e.*, to parts each ·05 of an inch. The vernier is divided into five parts, each *corresponding* to ·01 of an inch, and these again into five parts, each *corresponding* to ·002 of an inch. The scale reading is thus obtained. Case 1. If the prolongation of the zero line of the

Capillarity causes the mercury to stand lower in the tube than if capillarity did not exist; the correction for it is therefore additive. The index error is that arising from imperfect graduation in the scale. A small table of the algebraical sum of the corrections for capillarity and index error should be suspended near the barometer, and the joint correction applied at the time of observation.

The observed height of the barometric column must now be reduced to the temperature 32°, *i.e.*, corrected for the expansion or contraction produced by changes of temperature on the mercury and scale. The temperature is ascertained by a thermometer attached to the barometer, and the proper correction from a table calculated for that purpose. Appendix Art. 54.

In observing with the barometer, proceed as follows:

1. Lightly tap the tube, near the top of the column, to prevent adhesion of the mercury to the tube.
2. Read the thermometer.
3. Elevate or depress the cistern till the enclosed mercury just meets the ivory point.
4. Adjust the index.
5. Read the scale and vernier, and apply the joint correction for capillarity and index error.
6. Enter the result, together with the reading of the attached thermometer, in the proper columns of the register.

The barometer should be placed in a room or passage subject to as little variation of temperature as possible, in a good light, but shaded from the sun. It should be fixed in a vertical position (Note *d*), and at such a height that the top of the scale

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vernier should coincide with one of the lines of graduation of the *scale*, that line on the scale will be the reading required. Case 2. If the zero line of the vernier, when produced, should not coincide with any line on the scale, that line on the scale which is next below the zero of the vernier must be read and taken as the approximate reading of the scale. That line on the vernier which most nearly forms a straight line with some line on the scale must then be read. The sum of the vernier reading and the approximate scale reading will be the complete scale reading.

(1 *d*) The verticality of the tube may be tested by turning it completely round, and noting whether the ivory point *just* maintains coincidence with the surface of the mercury in the cistern during the whole revolution. This test should be repeated occasionally, and the verticality restored, if required, by the foot-screws.

may be about on a level with the eye of the observer. Its exact height above the ground, and if possible above the sea level, should be ascertained and recorded.

Art. 2.—*The Ordinary Thermometer.*

(See Note *a*.) The thermometer used for shewing the temperature of the air should be entirely in the shade, and placed so as to be affected as little as possible by the heat of surrounding objects, but freely exposed to any existing currents of air.

These conditions will be obtained if the instrument be fixed to a bracket on the north side of the house, from two to three feet from the wall, and with its bulb about three feet from the ground. It should be protected from above by an inclined roof, and on the north, east and west sides by lattice work, extending to about two feet below the bulb. The roof and lattice work should be painted white, to prevent the absorption of heat from external objects. It is desirable that the door by which the thermometer is approached should not communicate directly with the house, on account of the influence which heated air from the house would be likely to exert upon it.

Should a position such as that just described be not attainable the following arrangement will serve :

Select a window facing the north, in a room or passage, not heated, either on the ground floor, first floor, or staircase. At the distance of about ten inches from the window place a horizontal bracket for supporting the instrument. The thermometer should be protected from the weather as before described, the north side of the lattice work being about twenty inches from the window.

The stem of the instrument should be perpendicular, and the middle of the scale about on a level with the observer's eye.

In reading a thermometer it is essential that the eye be so placed that a straight line drawn from it to the top of the column of mercury may be perpendicular to the axis of the tube. Without this precaution errors of observation may be committed even to the extent of one or two degrees. The observer should avoid

(2 *a*) The reader is recommended to consult an article by Captain Lefroy, in the *Canadian Journal*, Sept. and Nov., 1852.

touching the thermometer, or breathing on it, or warming it by a too near approach of his person, and at night he should take care not to heat it with the reading lamp. If it be placed outside a window the reading should be made without opening the window. The degrees must be read and the fractions estimated to tenths.

Most thermometers, even good ones, if compared with an accurate standard, will be found to give a somewhat different reading from it, and the difference will not generally be the same throughout the scale. The difference is called the *index error*. It is marked + or —, according as the thermometer errs in excess or defect. A table giving the differences corresponding to different parts of the scale is called a table of *index errors*. The index *correction* is the index error with its sign changed. A table of index corrections should be kept at hand, and the corrections applied immediately after the observation (See Note *b*.)

Art. 3.—*Self-Registering Thermometers.*

These instruments are used for recording the maximum and minimum temperatures of the air that occur during any proposed interval of time, such, for instance, as the civil day. They should be placed in the same shed with the ordinary thermometer, but with their stems horizontal. (Append x Art. 57.)

Art. 4.—*The Maximum Thermometer.*

When the mercury in this thermometer forms an unbroken column, which will be the case if its reading, corrected for index error, agrees with a correct ordinary thermometer, the instrument is said to be *set*. If the temperature remains constant, or if it rises, the column will continue unbroken; but if the temperature should fall, the mercury below the bend will retreat

(2 *b*) In the original comparisons from which the table of index corrections is derived the differences are frequently marked with the signs that are proper to them as *errors* instead of as *corrections*. As these original comparisons may be sometimes furnished to observers, they must be careful to make the distinction. All tables for correcting thermometers that are furnished by the Director of the Magnetic Observatory are tables of *corrections*. The correction must be added to or subtracted from the observed reading of the thermometer, according as the correction is marked + or —.

into the bulb, leaving stationary the mercury above. The reading of the upper extremity of the column will then be the maximum temperature that has occurred during the interval commencing with the time of setting and ending with the time of reading. To set the instrument, hold it by the upper end, with the bulb downwards, and swing it with a moderate jerk till the continuity of the column is restored. In doing this care must be taken to raise the temperature of the instrument as little as possible by the heat of the hand, as the temperature thus acquired will continue to be the reading of the instrument until it has been exceeded by the increasing temperature of the air.

Art. 5.—*The Minimum Spirit Thermometer.*

When the column of spirit in the thermometer is unbroken, and the upper ends (or ends farthest from the bulb) of the index and of the column of spirit coincide, the index is said to be *set*. Should the temperature descend, the column of spirit will contract, and draw the index with it. If the temperature should afterwards ascend the index will remain stationary while the spirit will expand beyond it. Hence while the maximum thermometer only shows the highest temperature that has occurred since the time that it was set, the minimum thermometer gives two indications. The upper end of the column of spirits will, as in the case of an ordinary thermometer, shew the actual temperature at the time of observation, and the upper end of the index will give the lowest temperature that occurred since the index was set.

To set the index, slightly raise the bulb till the index, aided if necessary by gentle tapping, slides to the top of the column (See Note *a*.)

Art. 6.—In reading the self-registering thermometers the same precautions must be taken, as in the case of the ordinary ther-

(5 *a*) If the column of spirit should break, hold the instrument with the bulb downwards, and gently jerk the index down to the junction of the tube and the bulb; then hold the instrument nearly horizontal, but with the bulb slightly depressed, and jerk it in the direction of its length, and *towards* the bulb, till the different portions of spirit become united. If the detached portions be much separated, the separation may be diminished by the careful application to the bulb of moderately warm water.

mometer, of placing the eye in a line drawn from the top of the column, and perpendicular to the axis.

These instruments, like ordinary thermometers, are liable to be affected by index errors. These errors must be ascertained, so that the requisite corrections may be applied after each observation.

Art. 7.—*The Psychrometer, or Wet-bulb Thermometer.*

The pressure of the atmosphere measured by the barometer, or the total pressure, is made up by the joint action of two pressures; one, that of the atmospheric air, called the gaseous pressure; and another due to the presence of aqueous vapor, suspended in the air. The latter is called the *elastic force of vapor*, or simply the *elasticity.*

The relative moisture of the air, or the *humidity*, is the ratio of the actual mass of vapor contained in a given volume of air to the mass of vapor requisite to saturate that volume at the existing temperature.

The values of the elasticity and humidity are deduced from the simultaneous readings of the ordinary dry-bulb thermometer and the wet-bulb thermometer, with the aid of hygrometrical tables, for an explanation of which see appendix, article 55. The latter instrument is an ordinary thermometer, with its bulb covered with thin muslin. The muslin is kept moist by means of a conducting thread of cotton wick (Note *a*), which connects it with a small vessel containing rain or distilled water, placed a little beneath it, and not too near the dry thermometer.

The temperature indicated by the wet-bulb thermometer is called the *temperature of evaporation;* it is always lower than that of the air, as shewn by the dry-bulb thermometer, owing to the heat lost by evaporation (Note *b.*)

(7 *a*) The cotton wick, before use, should be washed in a solution of carbonate of soda, and it should be changed every two or three months. The muslin and the bulb ought to be occasionally washed, and the muslin renewed when defective.

(7 *b*) Sometimes, in very foggy or damp weather, the wet-bulb has been found to read higher than the dry. This occurrence, however, is rare, and much doubt hangs over the explanation of it. Should it, however, happen at any station, and the observation seem in other respects reliable, it must be entered as a case of full saturation, attention being drawn to it in the returns by a special note.

If the temperature of the air be at or below 32°, the cistern and conducting thread become useless; the bulbs must then be wetted by immersion (Notes *c* and *d*). A film of ice will then be formed, from which evaporation will proceed as before, and the thermometer will attain a stationary temperature lower than that of the air.

The ice on the bulb, whenever its accumulation becomes excessive (Note *e*) should be melted off. It is advisable also to detach any drop of ice that may form beneath the bulb, as this might retain the temperature of the bulb near 32° and thus overpower the effect of evaporation.

In taking readings of the dry and wet-bulb thermometers, the dry should be first read, then the wet, and then the dry again, and if its reading should differ from its former one, the mean of the two should be set down for the adopted reading. The index correction of the wet-bulb thermometer should be applied after each observation.

(7 *c*) This wetting is best effected by lifting up from beneath the bulb the vessel that contains the water.

(7 *d*) Some authorities recommend that the observations should always be made by wetting the bulb, dispensing altogether with the cotton wick and reservoir, and this probably is the surest way. Where this mode is adopted, some judgment is required in estimating the time that should be allowed to elapse, after wetting the bulb, before the observation is taken. In ordinary circumstances, 15 or 20 minutes will be sufficient, but when the air is much charged with moisture, and is calm, upwards of an hour may be necessary; on the other hand, with a brisk wind and dry day, the thermometer may acquire its stationary temperature in two or three minutes, and great care is therefore required in determining whether the actual reading of the thermometer be that of evaporation. It is best to watch the thermometer for half a minute after the observation has been taken; if it show signs of falling the observation has been made too soon; if of rising, too late, and the observation must be repeated. If the mercury remains stationary the reading may be accepted.

(7 *e*) In the observation next following the formation of the film, care must be taken not to be deceived by a false minimum, which may be produced in consequence of the property which water possesses of falling several degrees below the freezing point without actually freezing. Thus on melting off the ice, the thermometer will first rise and then gradually sink, till it falls several degrees (it may be) below the freezing point. The film then freezes, and the thermometer rises to 32°; it then begins to sink again, as evaporation proceeds, and ultimately attains its true temperature of evaporation. See remarks by Capt. Noble, R.A., *Canadian Journal*, January, 1856.

Art. 8.—*The Rain Gauge.*

The rain gauge consists of a vessel of which the general form is that of an inverted cone, terminating in a small tube, which communicates with a receiver beneath. The upper orifice of the gauge is about 10 inches in diameter, and is guarded by a rim, sloping inwards, to prevent the rebound of the rain drops as they fall on the interior conical surface.

The rain collected in the receiver is measured by a glass, graduated to cubic inches (Note *a*). If the volume of water expressed in cubic inches and tenths be divided by the area of the upper orifice, expressed in square inches and decimals, the quotient will give the depth that has fallen on the surface expressed in linear inches and decimals.

To avoid the labor of performing this division, a table has been constructed, which is given in the appendix, art. 56.

The rain gauge should be placed so that it may not be sheltered by trees or buildings, from rain descending obliquely. It should be enclosed in a box or cask, sunk to the level of the ground, with a lid having a circular aperture, just large enough to expose the orifice of the gauge (Note *b*).

SECTION II.

ON PHENOMENA OBSERVED WITHOUT THE AID OF INSTRUMENTS.

Art. 9.—*Wind.*

The *direction* of the wind is denoted by the point of the compass nearest to that *from* which the wind blows. In ordinary cases the direction may be expressed by the nearest of the *eight* principal points, but where great precision is required the nearest of the sixteen principal points must be employed.

The names of the *sixteen* principal points, with the ordinary abbreviations are as follows, the EIGHT principal points being printed in CAPITALS:

(8 *a*) If rain should be actually falling at the hour appointed for measuring it, the rain then in the receiver should be transferred to a jug, that the gauge and receiver may be restored to their places without loss of time.

(8 *b*) To prevent the rain that may fall on the lid or neighbouring ground from bounding into the gauge, a piece of old carpet or some such substance may be spread.

NORTH.	North-north-east.	NORTH-EAST.	East-north-east.
N.	N.N.E.	N.E.	E.N.E.
EAST.	East-south-east.	SOUTH-EAST.	South-south-east.
E.	E.S.E.	S.E.	S.S.E.
SOUTH.	South-south-west.	SOUTH-WEST.	West-south-west.
S.	S.S.W.	S.W.	W.S.W.
WEST.	West north-west.	NORTH-WEST.	North-north-west.
W.	W.N.W.	N.W.	N.N.W.

Art. 10.—The VELOCITY of the wind must be estimated approximately, and expressed by numbers, according to the following scheme, in which it is to be remarked that the numbers denote the *order* of magnitude of the velocities, but not their numerical values:

0. Calm or light air.
1. Very light breeze.
2. Moderate breeze.
3. Fresh breeze.
4. Strong breeze.
5. Moderate gale.
6. Fresh gale.
7. Strong gale.
8. Heavy gale.
9. Hurricane.
10. Very heavy hurricane.

Art. 11.—*Clouds.*

The nomenclature of the primary and secondary form of clouds is explained by two engravings, published by the Smithsonian Institution, and of which a copy is bound up herewith. See Section III, Art. 29

Art. 12.—*On Auroras.*

The classification of auroras to be employed (See Art. 13) is that adopted by the Smithsonian Institution, and which will be understood by the following remarks of Professor Olmsted, in the Smithsonian Contributions to Knowledge. The general directions in Art. 14, also used by the Smithsonian Institution, were principally adopted from those recommended by Captain Lefroy, when Director of the Toronto Observatory.

The Aurora Borealis presents itself under six different forms:

1. ***Auroral Twilight.*** A light in the north, resembling the dawn of day, and of various degrees of intensity.

2. ***Arches.*** Arcs, or circles, or zones, formed at various altitudes, between N.E. and N.W., being sometimes the mere

boundary of a segment, at other times a dense pillar of light, forming a grand columnar arch, which spans the heavens from east to west. It frequently moves from north to south, usually advancing but little further than the zenith.

3. *Streamers.* Acute cones or spindles, usually shooting up from an arch, or from a dark smoky cloud, which lies along the northern horizon, or rises a few degrees above it.

4. *Corona.* A circular zone around the pole of the dipping needle, formed of wreaths of auroral vapor, either of pure white or of various prismatic colors, with streamers radiating from the circumference.

5. *Waves.* Undulations which commonly flow upwards, towards the centre of the corona, along the line of the streamers, but sometimes course along the line of an arch, from east to west.

6. *Auroral Clouds.* A milky, vapory bank, in the north, the quantity and apparent depth of which afford a prognostic of the intensity of the approaching aurora. These clouds are sometimes of a smoky hue, especially in front, while the margins are luminous.

Art. 13.—We shall find it convenient to distribute the different forms of aurora into *four* distinct classes.

Class I. This is characterised by the presence of at least *three* out of four of the most magnificent varieties of form, namely: arches, streamers, corona, and waves. The distinct formation of the corona is the most important characteristic of this class; yet, were the corona distinctly formed, without auroral arches or waves, or crimson vapor, it could not be considered as an aurora of the first class.

Class II. The combination of *two* or more of the leading characteristics of the first class, but wanting in others, would serve to mark the second. Thus the exhibition of arches and streamers, both of superior brilliancy, with a corona, while the waves and crimson columns were wanting, or of streamers with a corona, or of arches with a corona without streamers or columns (if such a case ever occurs), we should designate as an aurora of the second class.

CLASS III. The presence of only *one* of the more rare characteristics, either streamers or an arch, or irregular corruscations, but without the formation of a corona, and with but a moderate degree of intensity, would denote an aurora of the third class.

CLASS IV. In this class we place the most ordinary form of the aurora, as a mere northern twilight, or a few streamers, with none of the characteristics that mark the grander exhibitions of the phenomenon.

Art. 14.—*General Directions* (Note *a*).

1. Make a regular practice of looking out for auroras every clear evening, from 8 to 10 o'clock or later. Record the result, whether there be an aurora or not.
2. Note the time of observation, and compare the watch used with a good clock, as soon after as is convenient.
3. Make a return of the latitude and longitude of the station.
4. Note the class to which the auroral phenomenon belongs.
5. If it be an arch, note the time when the convex side reaches any remarkable stars, passes the zenith, disappears, &c.
6. If the arch be stationary for a time, mark its position among the stars on the map, so that its altitude may be determined.
7. If it be a streamer or beam, mark its position on the map, and the time of its beginning and ending.
8. If motion be observed in the beams, note the direction, whether vertically or horizontally, to the east or west.
9. Note the time of the formation of a corona, and its position among the stars.
10. Note the time of the appearance of any black clouds in the north, near the aurora; also if the sky be suddenly overcast with a mist at any time during the auroral display.
11. Give the direction and force of the wind at the time.
12. Note if any electrical effects are observed.
13. Note the effect upon a delicately suspended magnetic needle.

(14 *a*) These directions may be considered as having reference principally to the observations recorded in the extraordinary register. See Art. 41.

Use of the Map (Note *b*).

1. To define the place and the extent of the aurora, the observer should familiarize himself with the relative position of the stars in the northern sky, by frequent inspection of the map, or a celestial globe.

2. Let the observer place the map before him, with the constellations in the positions in which they actually appear at the time of the observation. This may be done by holding up a plumb-line between the eye and the pole star, noticing the stars which it cuts; then a light pencil drawn through these stars and the pole on the map will be the centre of the heavens, or place of the meridian at the moment.

3. Mark carefully the place among the stars of the arch of the aurora, and show its width by parallel curved lines. Make a note of the time.

4. Draw a light curved line, following, as nearly as can be judged, the outline of the arch drawn down to the horizon, on each side.

5. If the arch changes its position, mark its new place at intervals, noting the time of each observation.

6. Letter each position A, B, C, &c., and note the time and other particulars on the back or margin of the map, or in the register.

7. Beams or corruscations, or streamers of white or colored light, may be marked by lines at right angles to the above, with arrow heads pointing towards the place among the stars to which they tend, or where they would meet if prolonged.

8. To aid in the estimation of angular distances the spaces between certain conspicuous stars have been marked on the map, which will furnish a scale to assist the eye, when actual measurement may be impracticable.

9. The course of brilliant meteors, when they fall within the portion of the heavens included on the map, may be marked by a line, the length of which will show the path of the meteor; the course should be indicated by an arrow, and the time recorded.

(14 *b*) Copies of the map will be furnished to each station.

Art. 15.—*Atmospheric Optical Phenomena.*

Under this head are included many varieties of phenomena, such as peculiar or extraordinary coloring of the sky or clouds, excessive refraction or *mirage*, diverging and converging beams, solar and lunar coronas, rainbows, haloes, parhelia and parselenes, and many others (Note *a*).

SECTION III.

METEOROLOGICAL REGISTERS.

Art. 16.—The registers are four in number:

(1.) The ordinary daily register book.

(2.) The extraordinary register book.

(3.) The book containing the monthly abstracts and yearly summary.

(4.) The monthly, yearly, and occasional returns.

Art. 17.—*The Ordinary Daily Register Book.*

This volume is for receiving the original entries of the ordinary observations at the time they are made, and is arranged for holding the observations of one complete year. It contains about 54 copies of a ruled form, marked (A,) about 14 copies of another form (B,) together with a few blank pages at the beginning and end of the volume.

Art. 18.—*Details.*

In the blank pages at the commencement should be written a table of contents and notices relative to each instrument. These notices should include—the name of the maker, the number or other mark, the date of its arrival at the station, the mode by which it was conveyed, the person from whom it was received, the errors with which it is affected, the position in which it is placed, and mode of fixing it employed. If any change should be made in the position of an instrument, or any experiment made for testing its qualities, the date and occasion of such change or experiment, with the several details, should be entered in the same part of the volume.

(15 *a*) For details consult a paper by Professor Cherriman, published in the *Canadian Journal*, August and September, 1852.

ART. 19.—Form A. This form, which occupies one opening of two pages, is prepared to contain for one week the regular observations made at 7 a. m., 1 p. m., and 9 p. m.

The several columns are to be filled up as follows:

ART. 20.—In the column headed *Barometer observed*, enter the reading of the scale corrected for index correction and capillarity.

In the column *Temperature of Mercury*, enter the reading of the thermometer attached to the barometer.

From the table for correcting the observed height of the barometer for temperature, Appendix Art. 54, take out the requisite correction, and write it in small figures, with its proper sign, under the reading of the barometer observed. Apply the correction, and write the result in the column headed Barometer corrected to 32°.

ART. 21.—*Gaseous Pressure.* The filling up of this column must be deferred till the completion of that for *elasticity*.

ART. 22.—*Temperature of the air observed.* The column will contain the reading of the ordinary or dry-bulb thermometer. Beneath the actual reading write the index correction in small figures with its proper sign. Apply the correction, and write the result in the column headed *Temperature of the air corrected.*

ART. 23.—The columns headed *Observed* and *Corrected Wet-bulb Thermometer* will contain the actual reading of the wet-bulb thermometer, and that reading corrected for index error.

ART. 24.—*Difference of dry and wet-bulb.* In this column is to be entered the excess of the corrected reading of the dry-bulb over the corrected reading of the wet-bulb.

ART. 25.—In the columns for *elasticity* (e''), and *humidity* ($\frac{e''}{e}$), are to be written the elastic force of vapor, and the humidity obtained with the aid of the hygrometric tables, from the entries in the two preceding columns. (Appendix Art. 55.)

ART. 26.—The elasticity (e'') being known, the number to be entered in the column headed *Gaseous Pressure* will be found by subtracting the elasticity (e'') from the total barometric pressure (b).

ART. 27.—*Direction of the wind.* In this column enter that one of the *eight* principal points of the compass which is nearest to the point *from* which the wind was blowing at the hour of observation.

ART. 28.—*Velocity of the wind.* The entry in this column must be made in conformity to the directions given in Section II., Art. 10.

ART. 29.—*Appearance of the sky, &c.* This column is to contain a general description of the state of the sky at the time of observation, including the class of clouds prevalent in different regions of the heavens. The names of the recognized forms of clouds, and the terms descriptive of their position may be expressed by the following abbreviations:

st.	for stratus.	o.	for overcast.
cu.	" cumulus.	lt.	" light.
ci.	" cirrus.	cl.	" clear.
Nim.	" Nimbus.	sp.	" space.
ci-st.	" cirro-stratus.	Z.	" zenith.
cu-st.	" cumulo-stratus.	H.	" horizon.
ci-cu.	" cirro-cumulus.	V.	" distant objects distinctly visible.
sc.	" scud.		

Cloud symbols accompanied by a point of the compass, signify that the clouds referred to prevail in that quarter, and at an elevation varying from 30° to 60° above the horizon.

The addition of Z. or H. denotes that the elevation is above 60° or under 30°.

Z. or H. unaccompanied by any compass symbol, signifies that the clouds prevail close to the zenith, or *completely* round the horizon.

Finally, where two points of the compass are used, it must be understood that the clouds in question prevail from the point first expressed to the second quarter expressed, and reckoned in the direction of the motion of the hands of a watch.

Example (1.)—Ci. Z.: cu. SW-NW. : st. H, would be read cirri prevalent in the zenith; cumuli at an elevation between 30° and 60° in the western quarter, from south-west to north-west; strati completely round the horizon.

Example (2.)—0. Dark Nim. save cl. sp. N. H., would be read, sky overcast with dark nimbi, save some clear spaces in the north horizon.

Art. 30.—*Amount of cloudiness.* In this column should be entered (to the nearest unit) the numerical value of the portion of the sky's surface that is clouded, the unit of surface being the tenth part of the whole hemisphere. (Note *a*.)

Thus 10 will denote that the whole sky is covered with clouds.
5 " " half the sky is covered.
1 " " one-tenth is covered.
0 " " the sky is quite clear of clouds.

Art. 31.—*Clouds in motion.* In this column are to be entered the abbreviations or symbols for the class of clouds seen to be in motion. Their elevation may be expressed by the general terms, lofty, low, very lofty, and very low; and their velocity by rapid, slow, very rapid, very slow, not perceptible. (Note *a*.)

Art. 32.—*Aurora.* When the sky is clear, and no aurora is seen, this column should be entered with (o); if the existence of an aurora or its non-existence cannot be asserted in consequence of the presence of clouds, the entry should be (imp.) for *impossible;* if finally an aurora is observed, the class, I. II. III. IV., to which it belongs, should be entered. (See Art. 13.)

Art. 33.—*General remarks.* In this compartment a brief notice should be made of occasional phenomena occurring not only at the observation hours, but at any other hour of the day or night, such as thunder, lightning, hail, rain, snow, fog, dew, hoar-frost, sudden shifts of wind, atmospheric optical phenomena, together with any remarks that the observer may think useful,

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(30 *a*) The observer may be assisted in making this estimation by remembering that a portion of the surface of a sphere bounded by any circle is proportional to the versine of the angular distance of the circle from its pole. Thus, if the sky be clouded from the zenith downwards to a circle 30° above the horizon, or 60° from the zenith, since the versine of 60° is $\frac{1}{2}$, half the sky will be clouded.

(31 *a*) If there be more than one current as often happens, (especially preceding a storm,) the directions and character of each should be indicated separately in the compartment for remarks.

and for which he can find space (Note *a*). If any phenomenon mentioned in this compartment should be also described in the volume of extra meteorological observations, the fact should be signified by the words, "see extra Met. Reg." (Note *b*.)

ART. 34.—***Sums and Means.*** The columns of which the sums and means are to be taken are those headed, ***Barometer corrected to*** 32°, ***Gaseous Pressure***, ***Temperature of Air Corrected***, ***Wet-bulb Thermometer Corrected***, ***Elasticity***, ***Humidity***, and ***Amount of Cloudiness.***

In calculating a mean, that is in dividing the sum of the individual terms by the number of them, the division should be carried usually to one decimal place further than in the separate terms themselves. Thus the means of the entries for the barometer and gaseous pressure should be entered to four decimal places; the means of the temperature of the air and of the wet-bulb thermometer to two places, and the mean of the clouded sky to one place. The mean of the elasticity, however, is to be entered to the third place only, and the mean of the humidity to the nearest unit, *saturation being expressed by* 100.

ART. 35.—Each page in Form B is designed to contain the observations of one month.

The self-registering thermometers are to be read and again set each evening after the 9 p.m. observations, and their respective readings entered as belonging to that day.

(33 *a*) Amongst the many objects worthy of being noticed in this compartment are *periodical* and *occasional* events, either meteorological, or dependent more or less on meteorological conditions.

Under the head of *periodical events* may be reckoned the last snow and frost in spring, and the first frost and snow in autumn; the beginning and end of the Indian summer; the opening and closing of harbors, rivers, and canals; the first and last arrivals and departures of ships. Under the same class may be placed—events in the vegetable kingdom, such as the leafing, flowering, maturity and fall of the leaf of certain plants, with the progress of agricultural operations; events in the animal kingdom, such as the movements of migratory animals.

Under the head, *occasional events*, may be ranged, floods, droughts, and the prevalence of different forms of disease.

(33 *b*) If the requisite remarks, even in an abridged form, be too numerous to find room in this compartment, the observer may enter them in the supplementary pages at the end of the volume, and notify that he has done so by referring to the page of the supplement. He should take care also in the supplement to give the date to which the additional remarks belong.

In the columns *maximum observed* and *minimum observed*, the actual readings of the instruments are to be entered. In the columns headed *maximum corrected* and *minimum corrected*, enter these readings corrected for index error. (Appendix Art. 57.)

ART. 36.—*Rain began at* and *Rain ended at.* Enter in these columns the hour and minute at which rain commenced and rain ceased to fall. If the rain should fall in frequent showers, the times at which the first shower began and the last ended should be entered, accompanied by the word "showers."

ART. 37.—*Total duration.* This column will contain the aggregate duration of time that rain has been falling. The estimation of the duration will of course be only a rough approximation.

ART. 38.—The quantity of rain that has fallen during the 24 hours is to be measured at 1 p.m., and entered for the same day in the column headed *cubic inches in guage.* The volume may be expressed to the nearest tenth of a cubic inch. The corresponding depth obtained from the table (Appendix Art. 56) will be entered to the nearest thousandth of an inch in the following column. (Appendix Art. 57.)

ART. 39.—Remarks similar to those recently made are applicable to the columns headed *Snow began at*, *Snow ended at*, and *Toial duration.* The depth of snow must be estimated approximately and expressed in inches and tenths. (Appendix Art. 57.)

ART. 40.—In the blank pages at the end of the volume may be written any supplementary remarks for which space could not be found in the compartment allotted for remarks in the daily register. All such entries should be accompanied by the day of the week and month to which they refer.

EXTRA METEOROLOGICAL REGISTER.

ART. 41.—In this book should be entered a detailed description of any phenomenon whose occurrence was mentioned in the compartment *Remarks* of the ordinary daily register. It will contain also a record of readings of the barometer and other instruments, made at other times than the stated hours of

observation, whenever such extra readings may be thought desirable.

ART. 42.—As few observers will have leisure for making many extra observations, or for describing at any length the phenomena they witness, the following points are named as deserving special attention.

The occasions when extra observations are most called for are during the occurrence of *storms*. By a storm is meant an exaggerated condition of any meteorological element, such as barometric pressure, temperature, wind, or an intense exhibition of an occasional phenomenon, as rain, snow, hail, &c. Thus we may speak of a *thermic storm*, a *barometric storm*, a storm of wind, of rain, or of snow, a thunderstorm, and so forth.

As regards the particular element which gives the distinctive name to the storm in question, the extra observations will be made with a view of discovering the following facts: The time and amount of maximum and minimum intensity, if temperature or barometric pressure be the elements concerned, together with the times when the changes, whether of increase or diminution, were most rapid. In a storm of wind notice the quarter from which the gale began, the point from which its violence was the greatest, and that from which its duration was longest, together with the hour and minute at which it began to blow from each of these quarters. Mention also the time of any sudden changes, and state in every case if the changes from one point to another were in the direction of the motion of the hands of a watch, or in the contrary direction. The times of greatest violence, and of sudden squalls and lulls, should be also recorded. In storms of rain or snow, notice the times of greatest intensity, as well as of sudden fall or sudden cessation.

While the fluctuations of the element which gives the storm its name most need to be watched, attention must also be given to the simultaneous condition of other elements, as well as the times of their several changes. Thus, during a barometric storm, the state of the wind at the time of the maximum and minimum heights of the barometer, as well as the times at which the wind changes in direction and intensity, should be recorded. The thermometer should be also occasionally observed. These

remarks are applicable to other storms, but it is to be noticed that as it is the wind that exercises most influence on the other elements, so it is the condition of the wind that deserves particular watchfulness during every class of storm. This is true not only of surface winds, but of those that prevail in the upper strata of the atmosphere, and which are manifested by the moving clouds.

In storms of wind the forms of clouds should be carefully noticed.

ART. 43.—In the case of a thunder storm, the time when it began and ceased is to be mentioned, and the quarter whence it rose. The changes also of wind, with the form and motions of the clouds, and the time of occurrence (and if possible the quantity) of rain or hail should be noted. The state of the barometer and thermometer ought also to be recorded from time to time during the progress of the storm.

ART. 44.—*Shooting Stars.* These are most prevalent about the 10th and 11th of August, and between the 10th and 15th of November. The facts to be noticed relative to a shooting star, are the time and point relatively to the horizon in which it was first seen, the direction, length, and duration of its course, and its general appearance. If such precision cannot be attained, the total number seen by the observer, with the time and quarter of the heavens in which they seemed most to abound, might be given.

ART. 45.—*The Monthly Abstract and Yearly Summary Book.*

This volume is to contain the abstracts of the observations of each of the twelve months forming one year, together with a comparative table or summary of the whole. The headings of the several columns will for the most part explain the proper mode of filling them up. It will be understood that the numbers to be entered are corrected results, and that the uncorrected entries of the daily register are not to be inserted.

The yearly summary contains the monthly means of each meteorological element, together with the hourly means for each month. It contains also the number of times in each month

that certain phenomena occurred, together with the dates of such periodical events as occur but once each year.

Art. 46.—*Periodical Returns.*

The periodical returns are copies of the monthly abstracts and yearly summary made upon loose forms, similar to those bound up in the abstract books. The return for January should be accompanied by a sheet of paper containing a copy of the notices relative to the instruments, as entered in the introduction to the daily register. Whenever any change is made and recorded in the same introduction, the fact should be notified in the return of the month wherein the change referred to took place. The monthly reports should be transmitted punctually to the Chief Superintendent of Education as required by law.

Art. 47.—*Occasional Returns.*

These are copies or abridged copies of the observations entered in the extraordinary register book. Those relating to violent storms of wind or rain should be forwarded as soon as possible after the time of the occurrence of the storm.

Art. 48.—*General Remarks.*

It is very desirable that the entries of the observations should be corrected, and the hygrometric quantities taken out of the tables and entered immediately after the observation has been completed. It is recommended that each calculation be performed *twice.* To do this, it will be a good arrangement for the observer each morning to examine the entries and corrections of the preceding day, and calculate the means. The same means should be examined later in the day and marked as "*examined.*"

Art. 49.—All copies of records should be compared with their originals by two persons, one of whom should read the figures aloud.

Art. 50.—It is of great importance that uniformity of notation be preserved; observers, therefore, are requested to attend to the following rules:

1. The sign minus (—) should be always placed on the ***left*** of the number to which it refers, and never in any other posi-

tion; thus, if the temperature be 10°.5 below zero, it should be written —10°.5, and never 10°.5—or what is worse $\frac{0}{10°.5}$.

2. Vulgar fractions are never to be used, but decimal fractions only; thus, ten and a half degrees should be written 10°.5, and *not* 10½°.

ART. 51.—The observer, in making up his periodical or occasional returns, should be careful not to omit the filling up of the heading. The omission of his name, and of the latitude and longitude of his station, may cause confusion when two stations happen to be similarly named.

ART. 52.—It is also particularly requested that, if an observation should be accidentally omitted, no attempt be made to fill up the blank by conjecture; neither should the observer permit himself to deviate in the slightest degree from entering strictly what he actually observes, however unlikely the observation may seem. The best chance of discovering the cause of an anomaly lies in the same being rigidly recorded, and a few blanks in the columns are of less importance than the detection therein of a conjectural emendation, which would vitiate the whole series by destroying its trustworthiness.

ART. 53.—*Synopsis of Daily Routine of Observation.*

Hours: 7 a.m.; 1 p.m.; 9 p.m.

I. Barometer. 1. Gently tap the tube. (Sec. 1, Art. 1.)
2. Read the attached thermometer.
3. Adjust the cistern.
4. Adjust the index.
5. Read the scale and vernier.

II. Read the dry-bulb thermometer. (Sec. I, Art. 2.)

III. Read the wet-bulb thermometer. (Sec. I, Art. 7.)

IV. Repeat the reading of the dry-bulb.

V. Note the direction and velocity of the wind (Sec. II, Art. 9, 10); the amount of cloudiness (Art. 11); the general appearance of the sky (Sec. III, Art. 27–31), including the class, distribution, and motion of the clouds, with the state of the weather generally.

Additional.

At 1 p.m. measure the rain (Sec. I, Art. 8; Sec. III, Arts. 36-38.)

At 9 p.m. read the maximum and minimum thermometers, and re-set them (Sec. I, Arts. 4, 5).

APPENDIX.

Remarks relative to the tables referred to in the preceding pages.

ART. 54.—*Table I. for reducing the observed reading of the Barometer to the temperature* 32°.

The corrections for temperatures from 0° to 100° is contained in Table I. Should the temperature of the mercury of the barometer fall below zero, the proper correction may be derived with sufficient accuracy from the upper row of numbers in the table, by adding .0025 for each negative degree of temperature.

ART. 55.—The tables to be used for finding the elastic force of vapor and humidity, from the simultaneous reading of the dry and wet-bulb thermometers, are those prepared by Professor Coffin, from the formulæ of Regnault. Professor Coffin has calculated the tables on the supposition that the height of the barometer is 29.725 inches; now, as the reading of the barometer will often differ greatly from this assumed standard, it will be generally necessary to apply to the elasticity a correction depending on the height of the barometer.

Tables II and III have been calculated for the purpose of supplying this correction; II when the temperature of the wet-bulb thermometer is above 32°, and III when that temperature is 32° and under.

(53 *a*) The readings of the instruments may, at the instant of observation, be noted down in a pocket book, or slip of paper, but they should be transferred to the register book immediately after the completion of the observation.

The correction is to be added to the elasticity (e'') when the reading of the barometer is below the standard for which the hygrometrical tables are calculated (2.725 in the present case), and to be subtracted from it when the reading is above the same standard.

The table of corrections will serve for any other hygrometric tables *calculated from the same formulæ*, and in which another standard h' is used, by adding h'—29.725 to the numbers in the second and third columns.

ART. 56.—Tables IV, V, VI, VII and VIII give the depth corresponding to any number of cubic inches of rain received in a gauge with a circular mouth.

The diameter of the guages, from unavoidable errors in workmanship, will frequently differ slightly from any assumed standard; on this account five different tables have been constructed, from which the observer must select that one to which his own

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(56 *a*) If the diameter of the gauge should materially differ from those for which the tables are calculated, the observer had better calculate a table for himself in the following manner:

Area of a circle (diameter d) $= \pi \left(\frac{d}{2}\right)^2$ where $\pi = 3.1415926$.

Hence depth corresponding to 1 cubic inch received in the gauge $= \frac{1}{\pi\left(\frac{d}{2}\right)^2} = \frac{4}{\pi d^2}$

but $\frac{4}{\pi} = 1.273239$ and $d^2 = 102.01$, if $d = 10.1$, as in Table IV, $\therefore$ by division

$\frac{4}{\pi d^2} = .012482$.

By ten successive additions of .01248 to 0 we obtain to five decimal places the depths corresponding to 1, 2, 3, 10 cubic inches, and which constitute the left hand column under the heading 0 tenths.

Again the depths corresponding to .1, .2, .3, and .9 cubic inches, which form the upper horizontal row, are found from the left hand column by moving the decimal point one place to the left. Finally, the nine remaining columns are completed by ten successive additions of the number .01248 to each of the numbers in the upper row. In order that the numbers in the table may be correct to *four* places of decimals, the constant addend .01248 should be correct to *five* places.

In order to secure correctness to *three* decimal places, when cases such as that in Example 4 occur, the tables have been calculated to *four* decimal places.

(56 *a*) The observer is recommended, for the sake of convenient reference, to transcribe the table selected from IV, V, VI, VII, VIII, to which his guage corresponds, and mount it on mill-board.

gauge most nearly corresponds, within the limits 10.1 and 9.9 inches. The mode of using these tables will be at once understood from the following examples :

Examples in the use of Table IV :

Required, the depths to three decimal places, when the volumes of rain received in the gauge measured respectively (1) 5 cubic inches, (2) 0.8 cubic inches, (3) 7.3 cubic inches. Ans. (1) .062 inches, (2) .010 inches, (3) .091 inches.

Example 4. Required, the depth to three decimal places, when the volume of rain was 45.4 cubic inches.

Depth for 10 cubic inches	=	.1248
		4
" " 40 cubic inches		.4992
" " 5.4 cubic inches		.0674
Depth for 45.4 cubic inches	=	.567 inches. Ans.

TABLE I.

Corrections to be applied to the readings of Barometers with *Brass Scales* extending from the Cistern to the top of the Mercurial Column, to reduce the observations to 32°. The correction is to be added for Temperatures 28° and under, and to be subtracted for Temperatures 29° and upwards.

TEMP.	INCHES.							TEMP.
	28	28.5	29	29.5	30	30.5	31	
0°	+.072	+.073	+.074	+.076	+.077	+.078	+.080	0°
1	069	071	072	073	074	076	077	1
2	067	068	069	070	072	073	074	2
3	064	065	067	068	069	070	071	3
4	062	063	064	065	066	067	068	4
5	059	060	061	062	063	065	066	5
6	057	058	059	060	061	062	063	6
7	054	055	056	057	058	059	060	7
8	052	053	054	054	055	056	057	8
9	049	050	051	052	053	054	054	9
10	047	047	048	049	050	051	052	10
11	044	045	046	046	047	048	049	11
12	042	042	043	044	045	045	046	12
13	039	040	040	041	042	043	043	13
14	037	037	038	038	039	040	040	14
15	034	035	035	036	036	037	038	15
16	032	032	033	033	034	034	035	16
17	029	030	030	031	031	032	032	17
18	026	027	027	028	028	029	029	18
19	024	024	025	025	026	026	027	19
20	021	022	022	023	023	023	024	20
21	019	019	020	020	020	021	021	21
22	016	017	017	017	018	018	018	22
23	014	014	014	015	015	015	015	23
24	011	012	012	012	012	012	013	24
25	009	009	009	009	009	010	010	25
26	006	006	007	007	007	007	007	26
27	004	004	004	004	004	004	004	27
28	001	001	001	001	001	001	001	28
29	—.001	—.001	—.001	—.001	—.001	—.001	—.001	29
30	004	004	004	004	004	004	004	30
31	006	006	007	007	007	007	007	31
32	009	009	009	009	009	010	010	32
33	011	012	012	012	012	012	012	33
34	014	014	014	015	015	015	015	34
35	016	017	017	017	018	018	018	35
36	019	019	020	020	020	021	021	36
37	021	022	022	022	023	023	024	37
38	024	024	025	025	026	026	026	38
49	026	027	027	028	028	029	029	39
40	029	029	030	030	031	031	032	40
41	031	032	033	033	034	034	035	41
42	034	034	035	036	036	037	037	42
43	036	037	038	038	039	040	040	43
44	039	040	040	041	042	042	043	44
45	041	042	043	044	044	045	046	45

TABLE I.—(*Concluded.*)

TEMP.	INCHES.							TEMP.
	28	28.5	29	29.5	30	30.5	31	
46	—.044	—.045	—.045	—.046	—.047	—.048	—.049	46
47	046	047	048	049	050	051	051	47
48	049	050	051	052	052	053	054	48
49	051	052	053	054	055	056	057	49
50	054	055	056	057	058	059	060	50
51	056	057	058	059	060	061	062	51
52	059	060	061	062	063	064	065	52
53	061	063	064	065	066	067	068	53
54	064	065	066	067	068	070	071	54
55	066	068	069	070	071	072	073	55
56	069	070	071	073	074	075	076	56
57	071	073	074	075	076	078	079	57
58	074	075	077	078	079	081	082	58
59	076	078	079	080	082	083	085	59
60	079	080	082	083	085	086	087	60
61	081	083	084	086	087	089	090	61
62	084	085	087	088	090	091	093	62
63	086	088	089	091	093	094	096	63
64	089	090	092	094	095	097	098	64
65	091	093	095	096	098	100	101	65
66	094	096	097	099	101	102	104	66
67	096	098	100	102	103	105	107	67
68	099	101	102	104	106	108	109	68
69	101	103	105	107	109	110	112	69
70	104	106	108	109	111	113	115	70
71	106	108	110	112	114	116	118	71
72	109	111	113	115	117	119	120	72
73	111	113	115	117	119	121	123	73
74	114	116	118	120	122	124	126	74
75	116	118	120	122	125	127	129	75
76	119	121	123	125	127	129	131	76
77	121	123	126	128	130	132	134	77
78	124	126	128	130	133	135	137	78
79	126	128	131	133	135	137	140	79
80	129	131	133	136	138	140	143	80
81	131	134	136	138	141	143	145	81
82	134	136	138	141	143	146	148	82
83	136	139	141	143	146	148	151	83
84	139	141	144	146	149	151	154	84
85	141	144	146	149	151	154	156	85
86	144	146	149	151	154	156	159	86
87	146	149	151	154	157	159	162	87
88	149	151	154	157	159	162	165	88
89	151	154	156	159	162	165	167	89
90	153	156	159	162	164	167	170	90
91	156	159	162	165	167	170	173	91
92	158	161	164	167	170	172	175	92
93	161	164	167	170	172	175	178	93
94	163	166	169	172	175	177	180	94
95	166	169	172	175	178	180	183	95
96	168	171	174	178	181	183	186	96
97	171	174	177	180	183	186	189	97
98	173	176	179	183	186	188	191	98
99	176	179	182	185	188	191	194	99
100	178	181	184	188	191	194	197	100

TABLE

Corrections to be applid to e'' for the Height of the Bar

The Corrections are to be added or subtracted accord

The Corrections are given

BAROMETER.			DIFFERENCE OF THE DRY AND									
Difference from Standard.	Height	Height	° 1.0	° 2.0	° 3.0	° 4.0	° 5.0	° 6.0	° 7.0	° 8.0	° 9.0	° 10.0	° 11.0
	in.	in.											
2.0	31.725	27.725	.001	.002	.003	.004	.004	.005	.006	.007	.008	.009	.010
1.8	31.525	27.925	001	002	002	003	004	005	006	006	007	008	009
1.6	31.325	28.125	001	001	002	003	004	004	005	006	006	007	008
1.4	31.125	28.325	001	001	002	002	003	004	004	005	006	006	007
1.2	30.925	28.525	001	001	002	002	003	003	004	004	005	005	006
1.0	30.725	28.725	..	001	001	002	002	003	003	004	004	004	005
0.8	30.525	28.925	..	001	001	001	002	002	002	003	003	004	004
0.6	30.325	29.125	..	001	001	001	001	002	002	002	002	003	003
0.4	30.125	29.325	..	..	001	001	001	001	001	001	002	002	003
0.2	29.925	29.525	..	..	..	..	..	001	001	001	001	001	001

ABLE

of the Bar

ted accord

are given

DRY AND

° .0	° 10.0	° 11.0
08	.009	.010
07	008	009
06	007	008
06	006	007
05	005	006
04	004	005
03	004	004
02	003	003
02	002	002
01	001	001

II.

ometer, the Thermometer being above 32° Fahrenheit.

ing as the height is less or greater than 29.725 inches.

in decimals of an inch.

WET THERMOMETERS IN FAHRENHEIT'S SCALE.

° 12.0	° 13.0	° 14.0	° 15.0	° 16.0	° 17.0	° 18.0	° 19.0	° 20.0	° 21.0	° 22.0	° 23.0	° 24.0	° 25.0	° 26.0
.011	.012	.012	.013	.014	.015	.016	.017	.018	.019	.020	.020	.021	.022	.023
010	010	011	012	013	014	014	015	016	017	018	018	019	020	021
009	009	010	011	011	012	013	014	014	015	016	016	017	018	018
007	008	009	009	010	011	011	012	012	013	014	014	015	016	016
006	007	007	008	009	009	010	010	011	011	012	012	013	013	014
005	006	006	007	007	008	008	008	009	009	010	010	011	011	012
004	005	005	005	006	006	006	007	007	007	008	008	009	009	009
003	003	004	004	004	005	005	005	005	006	006	006	006	007	007
002	002	002	003	003	003	003	003	004	004	004	004	004	004	005
001	001	001	001	001	001	002	002	002	002	002	002	002	002	002

TABLE III.

Corrections for the Height of the Barometer, the Thermometer being below 32° Fahrenheit.

BAROMETER.			DIFFERENCE OF THE DRY AND WET THERMOMETERS IN FAHRENHEIT'S SCALE.																	
Difference from Standard.	Height.	Height.	1.0°	2.0°	3.0°	4.0°	5.0°	6.0°	7.0°	8.0°	9.0°	10.0°	11.0°	12.0°	13.0°	14.0°	15.0°	16.0°	17.0°	18.0°	19.0°	20.0°
in.	in.	in.																				
2.0	31.725	27.725	.001	.002	.002	.003	.004	.005	.005	.006	.007	.008	.008	.009	.010	.011	.011	.012	.013	.014	.014	.015
1.8	31.525	27.925	001	001	002	003	003	004	005	005	006	007	008	008	009	010	010	011	012	012	013	014
1.6	31.325	28.125	001	001	002	002	003	004	004	005	005	006	007	007	008	009	009	010	010	011	012	012
1.4	31.125	28.325	001	001	002	002	003	003	004	004	005	005	006	006	007	007	008	009	009	010	010	011
1.2	30.925	28.525	...	001	001	002	002	003	003	004	004	005	005	005	006	006	007	007	008	008	009	009
1.0	30.725	28.725	...	001	001	002	002	002	003	003	003	004	004	005	005	005	006	006	006	007	008	007
0.8	30.525	28.925	...	001	001	001	002	002	002	002	003	003	003	004	004	004	005	005	005	005	006	006
0.6	30.325	29.125	...	...	001	001	001	001	002	002	002	002	003	003	003	003	003	004	004	004	004	005
0.4	30.125	29.325	...	...	...	001	001	001	001	001	001	002	002	002	002	002	002	002	003	003	003	003
0.2	29.925	29.525	...	...	...	...	...	...	001	001	001	001	001	001	001	001	001	001	001	001	001	002

Tables for finding the depth to the *thousandth* part of an inch, corresponding to (n) cubic inches of rain received in a circular guage, the diameter of whose aperture $= d$. The Tables are calculated for $d = 10.1$ in., 10.05 in., 10 in., 9.95 in. and 9.9 in., from the formula $\text{depth} = \frac{n}{\pi(\frac{d}{2})^2} = \frac{4n}{\pi d^2}$

TABLE IV.

Diameter of aperture = 10.1.

CUBIC INCHES.	TENTHS OF A CUBIC INCH.									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0	.0000	.0012	.0025	.0037	.0050	.0062	.0075	.0087	.0100	.0112
1	0125	0137	0150	0162	0175	0187	0200	0212	0225	0237
2	0250	0262	0275	0287	0300	0312	0325	0337	0349	0362
3	0374	0387	0399	0412	0424	0437	0449	0462	0474	0487
4	0499	0512	0524	0537	0549	0562	0574	0587	0599	0612
5	0624	0637	0649	0662	0674	0687	0699	0711	0724	0736
6	0749	0761	0774	0786	0799	0811	0824	0836	0849	0861
7	0874	0886	0899	0911	0924	0936	0949	0961	0974	0986
8	0999	1011	1024	1036	1048	1061	1073	1086	1098	1111
9	1123	1136	1148	1161	1173	1186	1198	1211	1223	1236
10	1248	1261	1278	1286	1298	1311	1323	1336	1348	1361

TABLE V.

Diameter of aperture = 10.05.

CUBIC INCHES.	TENTHS OF A CUBIC INCH.									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0	.0000	.0013	.0025	.0038	.0050	.0063	.0076	.0088	.0101	.0113
1	0126	0139	0151	0164	0176	0189	0202	0214	0227	0240
2	0252	0265	0277	0290	0303	0315	0328	0340	0353	0366
3	0378	0391	0403	0416	0429	0441	0454	0466	0479	0492
4	0504	0517	0529	0542	0555	0567	0580	0592	0605	0618
5	0630	0643	0656	0668	0681	0693	0706	0719	0731	0744
6	0756	0769	0782	0794	0807	0819	0832	0845	0857	0870
7	0882	0895	0908	0920	0933	0945	0958	0971	0983	0996
8	1088	1021	1034	1046	1059	1072	1084	1097	1109	1122
9	1135	1147	1160	1172	1185	1198	1210	1223	1235	1248
10	1261	1273	1286	1298	1311	1324	1336	1349	1361	1374

TABLE VI.

Diameter of Aperture 10.

CUBIC INCHES.	TENTHS OF A CUBIC INCH.									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0	.0000	.0013	.0025	.0038	.0051	.0064	.0076	.0089	.0102	.0115
1	0127	0140	0153	0166	0178	0191	0204	0216	0229	0242
2	0255	0267	0280	0293	0306	0318	0331	0344	0357	0369
3	0382	0395	0407	0420	0433	0446	0458	0471	0484	0497
4	0509	0522	0535	0547	0560	0573	9586	0598	0611	0624
5	0637	0649	0662	0675	0688	0700	0713	0726	0738	0751
6	0764	0777	0789	0802	9815	0828	0840	0853	0866	0879
7	0891	0904	0917	0929	0942	0955	0968	0980	0993	1006
8	1019	1031	1044	1057	1069	1082	1095	1108	1120	1133
9	1146	1159	1171	1184	1197	1210	1222	1235	1248	1260
10	1273	1286	1299	1311	1324	1337	1350	1362	1375	1388

TABLE VII.

Diameter of Aperture 9.95.

CUBIC INCHES.	TENTHS OF A CUBIC INCH.									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0	.0000	.0013	.0026	.0039	.0051	.0064	.0077	.0090	.0103	.0116
1	0129	0141	0154	0167	0180	0193	0206	0219	0232	0244
2	0257	0270	0283	0296	0309	0322	0334	0347	0360	0373
3	0386	0399	0412	0424	0437	0450	0463	0476	0489	0502
4	0514	0527	0540	0553	0566	0579	0592	0604	0617	0630
5	0643	0656	0669	0682	0694	0707	0720	0733	0746	0759
6	0772	0785	0797	0810	0823	0836	0849	0862	0875	0887
7	0900	0913	0926	0939	0952	0965	0977	0990	1003	1016
8	1029	1042	1055	1067	1080	1093	1106	1119	1132	1145
9	1157	1170	1183	1196	1209	1222	1235	1248	1260	1273
10	1286	1299	1312	1325	1338	1350	1363	1376	1389	1402

TABLE VIII.

Diameter of Aperture 9.9.

CUBIC INCHES.	TENTHS OF A CUBIC INCH.									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0	.0000	.0013	.0026	.0039	.0052	.0065	.0078	.0091	.0104	.0117
1	0130	0143	0156	0169	0182	0195	0208	0221	0234	0247
2	0260	0272	0286	0299	0312	0325	0338	0351	0364	0377
3	0390	0403	0416	0429	0442	0455	0468	0481	0494	0507
4	0520	0533	0546	0559	0572	0585	0598	0611	0624	0637
5	0650	0663	0676	0689	0702	0715	0728	0740	0753	0766
6	0779	0792	0805	0818	0831	0844	0857	0870	0883	0896
7	0909	0922	0935	0948	0961	0974	0987	1000	1013	1026
8	1039	1052	1065	1078	1091	1104	1117	1130	1143	1156
9	1169	1182	1195	1208	1221	1234	1247	1260	1273	1286
10	1299	1312	1325	1338	1351	1364	1377	1390	1403	1416

ART. 57.—*Additional Notes.*

(*Note to Art.* 3.) To prevent the detached mercury of the maximum thermometer from sliding beyond the maximum point, which will sometimes happen if the bulb end of the tube be raised too high, it will be safe to give a slight inclination to the tube, the bulb end being the lower.

(*Notes to Arts.* 29, 31, 45, 46.) In the columns of the monthly abstracts headed "clouds," and "clouds in motion," it will be sufficient to enter a *selection* only from the entries of the corresponding columns of the daily register.

(*Note to Art.* 32.) If the observer be doubtful whether an aurora was observed or not, this doubt may be expressed by a note of interrogation. (?)

(*Notes to Arts.* 35, 36, 37, 38, 39.) If the self-registering thermometers be not read and re-set on Sunday night, the readings on Monday night should be accompanied, in the column of remarks, by the entry "max'm of 48^h. and min'm of 48^h." Similarly the depth of rain measured on Monday at 1 P. M., must be entered as that of 48 hours, unless it be certain that it fell on one of the two days only.

The Sunday entries for the columns headed "rain began at," &c., may be filled in by memory on Monday.

In calculating the total rain and melted snow, one inch of snow may be reckoned as equal to one-tenth of an inch of water. This estimation, though not exact, will serve for ordinary purposes.