# SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Haddo House, County of Aberdeen, in Lat. 57°24', Long. 2° 14', Distance from Sea 12 miles.

Height of Cistern of the Barometer above Mean Sea-Level 180 feet, above Ground 4 feet. During the MONTH of January 1894.

The Hours of Observation are of Greenwich Time.

| Days of Month | BAROMETER. 9 h. A.M. Barometer. No. | Attached Thermometer | 9 h. P.M. Barometer. No. | Attached Thermometer | SELF-REGISTERING THERMOMETERS, Read Daily, at 9 P.M. Protected in Shade, 4 feet above Ground. Max. | Min. | Exposed Black Bulbs. Max. in Sun's rays No. | Min. on Grass No. | HYGROMETER. Dry No. Wet No. 9 h. A.M. Dry bulb. | Wet bulb. | 9 h. P.M. Dry bulb. | Wet bulb. | Rain. No. of Days on which it fell. | Amount in inches. No. | WIND. 9 h. A.M. Direction. | Force | 9 h. P.M. Direction. | Force | Readings of the H. Cup Anemometer. No. 9 h. A.M. | CLOUDS. 9 A.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | P.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | SUNSHINE. Hours. | THERMOMETERS under Ground. 9 h. A.M. No. 3 inches. | No. 12 inches. | No. 22 inches. | Temperature of WELL at depth of feet, No. | SEA. Temperature at 1 fathom, and Density. | OZONE. 0—10. 9 A.M. | 9 P.M. | GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. *Mention the hour at which Storms, including Thunder and Lightning, began and ended.* | Days of Month |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches. | ° | inches. | ° | ° | ° | ° | ° | ° | ° | ° | ° | + | | | | | | | | | | | | | | | | | | | | | |
| 1 | 30·202 | 37 | 30·228 | 35 | 36 | 32 | 36 | 28 | 34 | 32 | 33·5 | 32·5 | + | | N | | N | | 6415 | | | | | 34 | 36 | 39 | | | 4 | 7 | | 1 |
| 2 | 30·204 | 34 | 30·458 | 33 | 34 | 30 | 32 | 25 | 32 | 30·5 | 32 | 31 | | | N.E | | S.E | | 6428 | | | | | 34 | 36 | 39 | | | 8 | 9 | | 2 |
| 3 | 30·516 | 32·5 | 30·566 | 33 | 34 | 29·5 | 33 | 26 | 32 | 30 | 32 | 30 | | | S.E | | S.E | | 7559 | | | | | 34 | 38 | 39 | | | 6 | 5 | | 3 |
| 4 | 30·406 | 34 | 30·260 | 34 | 34 | 29 | 35 | 27 | 32 | 30·5 | 34 | 32 | + | | E | | E | | 8143 | | | | | 34 | 36 | 39 | | | 4 | 8 | | 4 |
| 5 | 30·008 | 34 | 29·632 | 32 | 34 | 29 | 34 | 29 | 32·5 | 31 | 30 | 30 | + | | E | | E | | 9628 | | | | | 33 | 36 | 38 | | | 5 | 9 | | 5 |
| 6 | 29·388 | 25 | 29·438 | 13 | 31 | 5 | 32 | 3 | 23 | 23 | 9 | 9 | + | | S | | S.E | | 1637 | | | | | 32 | 35 | 38 | | | 8 | 4 | 3 in of Snow | 6 |
| 7 | 29·468 | 14 | 29·656 | 27 | 28·5 | 4 | 26 | 2 | 12 | 12 | 28 | 28 | | ·48 | S | | S.W. | | 1805 | | | | | 30 | 34 | 37 | | | 6 | 5 | | 7 |
| 8 | 29·842 | 26 | 29·678 | 35 | 36 | 14 | 35 | 9 | 25 | 25 | 36 | 34 | + | | S | | S. | | 1846 | | | | | 31 | 35 | 37 | | | 7 | 7 | | 8 |
| 9 | 29·470 | 36 | 29·516 | 36 | 38 | 35 | 38 | 30 | 37 | 36 | 38 | 37 | + | | S | | S.E | | 3166 | | | | | 32 | 35 | 37 | | | 10 | 6 | | 9 |
| 10 | 29·268 | 29 | 29·386 | 42·5 | 45 | 38 | 43 | 37 | 40 | 39 | 43 | 42 | + | | S.E | | S. | | 4108 | | | | | 32 | 35 | 37 | | | 10 | 6 | | 10 |
| 11 | 29·242 | 43·5 | 29·552 | 42 | 48 | 37·5 | 47 | 32 | 45 | 44 | 42 | 41·5 | + | | S.E | | S.W | | 5134 | | | | | 34 | 35 | 37 | | | 3 | 6 | | 11 |
| 12 | 29·370 | 43 | 29·606 | 40·5 | 47 | 39 | 46 | 34 | 43 | 42·5 | 40 | 38·5 | + | | S.E | | S.W | | 6376 | | | | | 37 | 36 | 37 | | | 10 | 7 | | 12 |
| 13 | 29·422 | 43 | 29·442 | 44·5 | 46 | 39 | 45 | 36 | 44 | 42·5 | 45 | 43 | + | | S | | S | | 7375 | | | | | 39 | 37 | 37 | | | 7 | 7 | | 13 |
| 14 | 29·468 | 41 | 29·518 | 37 | 45 | 32 | 45 | 29 | 40·5 | 39·5 | 34 | 32·5 | + | ·53 | S.W | | S | | 8283 | | | | | 39 | 38 | 37 | | | 8 | 6 | | 14 |
| 15 | 29·536 | 32 | 29·408 | 39·5 | 41 | 28 | 39 | 23 | 28·5 | 28 | 39·5 | 38·5 | | | W | | S.E | | 8338 | | | | | 34 | 37 | 37 | | | 6 | 8 | | 15 |
| 16 | 29·192 | 41·5 | 29·158 | 43 | 46 | 34 | 46 | 31 | 42·5 | 41·5 | 42 | 40·5 | + | | S.W | | S.W | | 8710 | | | | | 36 | 37 | 37 | | | 8 | 7 | | 16 |
| 17 | 29·024 | 43 | 28·952 | 40 | 46 | 38 | 48 | 35 | 43·5 | 42·5 | 39·5 | 38·5 | + | | S.E | | S.W | | 9018 | | | | | 38 | 37 | 37 | | | 9 | 8 | | 17 |
| 18 | 28·960 | 42 | 29·234 | 41 | 45 | 34 | 45 | 30 | 41 | 39 | 41 | 38·5 | + | | W | | S.W | | 9477 | | | | | 38 | 37 | 37 | | | 8 | 6 | | 18 |
| 19 | 29·368 | 35 | 28·956 | 44 | 45 | 31 | 44 | 26 | 34 | 32 | 43 | 42 | + | | S | | N.W | | 0787 | | | | | 38 | 37 | 38 | | | 5 | 7 | | 19 |
| 20 | 28·636 | 42 | 29·046 | 38 | 46 | 36 | 52 | 31 | 41 | 39 | 37 | 35 | | | S.W | | S.E | | 1366 | | | | | 39 | 38 | 38 | | | 6 | 8 | | 20 |
| 21 | 29·106 | 40 | 29·024 | 35 | 47 | 30 | 49 | 24 | 40 | 38 | 32 | 30 | | ·15 | S.W | | W | | 2637 | | | | | 36 | 38 | 38 | | | 6 | 5 | | 21 |
| 22 | 28·876 | 37 | 29·026 | 34·5 | 41 | 30 | 45 | 25 | 36 | 34·5 | 33 | 32 | + | | W | | N | | 4501 | | | | | 34 | 37 | 38 | | | 6 | 10 | | 22 |
| 23 | 29·448 | 32 | 29·648 | 28 | 34 | 22 | 43 | 15 | 29 | 28 | 25 | 24·5 | + | | N | | W | | 6086 | | | | | 34 | 37 | 38 | | | 10 | 6 | | 23 |
| 24 | 29·292 | 35 | 29·020 | 44 | 48·5 | 24 | 46 | 17 | 35 | 34·5 | 48·5 | 45 | + | | S | | W | | 6707 | | | | | 34 | 37 | 38 | | | 8 | 7 | | 24 |
| 25 | 29·128 | 37 | 28·978 | 35 | 48 | 33 | 48 | 32 | 36·5 | 34 | 33 | 32·5 | + | | W | | W | | 8412 | | | | | 34 | 37 | 38 | | | 5 | 8 | | 25 |
| 26 | 29·036 | 31·5 | 28·968 | 35 | 35 | 28 | 44 | 22 | 30 | 28·5 | 35 | 34 | | | W | | S | | 9441 | | | | | 33 | 36 | 37 | | | 9 | 6 | | 26 |
| 27 | 28·606 | 41 | 28·708 | 35 | 49 | 34 | 47 | 30 | 43·5 | 41·5 | 36 | 32 | + | ·45 | N.W | | N.W | | 1001 | | | | | 35 | 36 | 37 | | | 7 | 7 | | 27 |
| 28 | ~~29~~ 24·566 | 34 | 29·258 | 34 | 38·5 | 30 | 41 | 27 | 34 | 32 | 33 | 31 | + | | S.W | | N.W | | 3086 | | | | | 34 | 36 | 37 | | | 9 | 6 | Lake Gale | 28 |
| 29 | 29·306 | 32 | 28·820 | 36 | 36 | 27 | 40 | 22 | 31 | 31 | 36 | 35 | + | | W | | S.E | | 4402 | | | | | 33 | 35 | 37 | | | 5 | 8 | Gale | 29 |
| 30 | 28·718 | 37 | 28·696 | 36 | 41 | 33 | 44 | 31 | 37 | 34 | 37 | 35 | | | S.W | | W | | 5747 | | | | | 33 | 35 | 37 | | | 7 | 6 | Gale | 30 |
| 31 | 28·788 | 37 | 29·088 | 33·5 | 37 | 31 | 37 | 26 | 36 | 32 | 31·5 | 29·5 | | ·05 | N.W | | | | 8588 | | | | | 33 | 35 | 37 | | | 4 | 6 | | 31 |
| Sums. | ~~960~~ 29·808 | 1111 | ~~960~~ 29·926 | 1116 | ~~1240~~ 1240 | ~~516~~ 516 | 1283 | 784 | ~~1090~~ 1090 | ~~470~~ 470 | ~~1078~~ 1078 | ~~1245~~ 1245 | | 1·61 | | | | | | | | | | 1071 | 1122 | 1165 | | | 211 | | | |
| Means. | 29·357 | 35·8 | 29·384 | 36 | 41·0 | 29·6 | 41·4 | 25·2 | ~~35·2~~ 35·2 | ~~33·8~~ 33·8 | ~~35·4~~ 35·4 | ~~34·0~~ 34·0 | | | | | | | | | | | | 34·5 | 36 | 37·6 | | | 6·9 | 6·8 | | |
| † Total Corrections for Instrumental Errors. | +035 | | +035 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ‡ Corrections for Diurnal Range. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "Corrected Means." | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. of Column. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | |

## NOTATION USED IN GENERAL REMARKS.

| | | | | | |
|---|---|---|---|---|---|
| a. | *denotes* aurora. | | m. | *enotes* meteor. | |
| ci. | ,, | cirrus. | ms. | ,, | meteors. |
| ci.-cu. | ,, | cirro-cumulus. | n. | ,, | nimbus. |
| ci.-s. | ,, | cirro-stratus. | r. | ,, | rain. |
| cu. | ,, | cumulus. | h. r. | ,, | heavy rain. |
| cu.-s. | ,, | cumulo-stratus. | c. h. r. | ,, | continued heavy rain. |
| d. | ,, | dew. | s. | ,, | stratus. |
| f. | ,, | fog. | sc. | ,, | scud. |
| fr. | ,, | frost. | s. | ,, | sleet. |
| h.-fr. | ,, | hoar-frost. | s. | ,, | snow. |
| h. | ,, | haze. | so. ha. | ,, | solar halo. |
| h. d. | ,, | heavy dew. | sq. | ,, | squall. |
| hl. | ,, | hail. | sqs. | ,, | squalls. |
| l. | ,, | lightning. | t. | ,, | thunder. |
| li. cl. | ,, | light clouds. | t. s. | ,, | thunder-storm. |
| li. sh. | ,, | light showers. | w. | ,, | wind. |
| lu. co. | ,, | lunar corona. | g. | ,, | gale of wind. |
| lu. ha. | ,, | lunar halo. | | | |

## TABLE FOR ESTIMATING FORCE OF WIND.

| Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. |
|---|---|---|---|---|---|
| 0 | Calm | 1·5 | Light breeze | 4 | Blowing hard |
| 0·5 | Very light air | 2· | Fresh breeze | 5 | Blowing a gale |
| 1· | Light air | 3· | Very fresh | 6 | Violent gale |

**BAROMETER**, "corrected Mean" at 9 A.M., *minus* the Correction †† for Temp. (Col. 2), = 29·392 − 19 = 29·373

"Corrected Mean" of Barometer at 9 P.M., *minus* the Correction †† for Temp. (Col. 4), = 29·419 − 20 = 29·399

**Mean at Station, corrected, and at 32°**, = 29·386

Correction for height, feet above Mean Sea-level, = 203

**Mean, reduced to 32°, and Sea-level**, = 29·589

Highest Reading, corrected for Index error, on the 3 th, = 30·566

Lowest Do. Do., on the 26 th, = 28·566

Difference, or **Monthly Range**, = 2·000

**S.-R. THERMOMETER**, (in shade, etc.), **Highest in Month**, (corrected for Index Errors), on the 24 th, = 48·5

**Lowest in Month**, corrected for Index errors, on the 4 th, = 4·0

Difference, or **Monthly Range**, = 44·5

"Corrected **Mean" of all the Highest**, (Col. 5), = 41·0

"Corrected **Mean" of all the Lowest**, (Col. 6), = 29·6

Difference, or **Mean Daily Range**, = 11·4

** Calculated **Mean Temperature** of Month, = 35·3

**S.-R. THERMOMETER, Black Bulb in Sun, Highest**, (corrected for Index Errors), on the 20 th, = 52·0

"Corrected **Mean**," (Col. 7), **of Black Bulb, Max. in Sun**, = 41·4

**Lowest at Night**, Black Bulb (corrected for Index errors), on the 7 th, = 2·8

"Corrected **Mean**," (Col. 8), **of Black Bulb, Min.** on grass, = 25·2

Difference of above means or range ("exposed"), =

**HYGROMETER, Mean** (corrected) A.M. and P.M. Reading **of Dry Bulb**, (Cols. 9 and 11), = 35·3

**Mean** (corrected) A.M. and P.M. Reading **of Wet Bulb**, (Cols. 10 and 12), = 33·9

‡‡ Computed **Temperature of Dew-Point**, = 31·9

‡‡ Do. **Elastic Force of Vapour**, = 180

‡‡ Do. **Weight of Vapour in a Cubic Foot of Air**, =

‡‡ **Relative Humidity (Saturation = 100)**, = 88

**RAIN** fell on 22 Days; **Amount in Inches**, = 1·61

| WIND. SUMMARY. Direction. | N | NE | E | SE | S | SW | W | NW | Calm or Variable. | Mean Force. | Mean Velocity in miles per day. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. | 2 | 1 | 2 | 5 | 7 | 6 | 6 | 2 | | | |
| P.M | 2 | | 2 | 7 | 5 | 6 | 5 | 3 | | | |
| Mean. | 2 | 1 | 2 | 6 | 6 | 6 | 5 | 3 | 0 | | |

* Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S."; and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.
† Embracing corrections for both capillarity and Index Errors
‡ The Diurnal Range for Scotland is as yet unknown.
†† *Practically*, though not *absolutely* a *minus* correction.
‡‡ These "Hygrometrical Deductions" are calculated from Glaisher's Hygrometrical Tables, Second Edition *only*.
** While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature."
Any observations not taken under the Conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. *See over.*

*Observations made and Return verified by* _____

(*Signed*) _____

# INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS,

## WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the chief objects that the SCOTTISH METEOROLOGICAL SOCIETY proposed to itself when the Society was established in 1855, was to secure PERFECT UNIFORMITY in the system of observation pursued at all its Stations. Uniformity in the observations is absolutely necessary to justify the publication of Monthly Results from different observations, it being found that differences between the Returns from two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those who kindly furnish Reports to the Society will, by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

**Hour of Observation.**

The Council recommend that Observations be made precisely at 9 A.M. and 9 P.M. (Greenwich or Railway Time only), as specified in the following remarks, or at the top of the columns of the Schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading the time at which it was taken, if not at 9 A.M. or 9 P.M.

**Barometer.**

Weather-Glasses and Aneroids, though well suited to indicate roughly variations of atmospheric pressure, are not fitted for scientific purposes. No Barometer should be used for Meteorological Observation that is not supplied with some means of adjustment or compensation which will secure that the height of the mercury in the tube is accurately measured from the fluctuating surface of the mercury in the cistern.

The Barometer in which the error arising from the fluctuating surface of the mercury in the cistern is entirely got rid of is FORTIN'S Barometer, the arrangement consisting in applying pressure by means of a screw to the bottom of the cistern, which is made of flexible leather, thus raising or depressing the surface till it just meets the ivory point which forms the zero point of the fixed scale.

The Barometer originally constructed by Mr. Adie of London, and usually called the Board of Trade Barometer, has the great convenience of requiring no adjustment of the cistern. Its scale-inches are not true inches, but so much shorter as to compensate the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This is an excellent Barometer for ordinary Observers, inasmuch as it entirely eliminates the error of observation likely to arise in not a few cases in setting the instrument to the zero point of the fixed scale when the light is not good. To show the accuracy with which these Barometers are made, it may be stated, that one was compared, during a whole year, with the Society's Standard Barometer, particular care being given to make the comparison when atmospheric pressure was rising or falling very rapidly, with the result that none of the readings differed from those of the Standard more than 0·003 inch.

A modification of Fortin's Barometer is used at a number of the Society's Stations, by which the coincidence of the zero point with the surface of the mercury is indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the index-line on this little piston-rod is brought, by the adjusting screw, to form one straight line with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this preliminary setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the vernier.

It is absolutely necessary that the Barometer which is to be used shall have been compared with a Standard Barometer.

The Barometer should be suspended in as good a light as can be secured, and to facilitate the reading, a piece of white paper may be put behind the tube. It must be hung truly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire, and must not be hung against a wall heated by a flue. The object being to secure that the whole instrument, including the brass fittings, the contained mercury, and the attached Thermometer, shall be, when read, at one uniform temperature, it is evident that the best position is that which is least liable to sudden changes of temperature.

In taking an Observation, the Attached Thermometer is first noted: the tube must then be gently tapped, and the cistern-adjustment carefully made. The eye, by raising and lowering it, must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted so as to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will facilitate an accurate adjustment and reading of the Barometer. A mistake not unfrequently made by those beginning to observe, consisting in setting the edge of the vernier to the level of the clear surface of the mercury which is in direct contact with the glass tube, must be carefully avoided.

The errors most frequently made in reading the Barometer are errors of 1·000 inch, 0·500 inch, and 0·050 inch; that is to say, instead of 29·365 inches, either of the following is sometimes set down—viz. as 30·365 inches, 28·365 inches, 29·865 inches, or 29·815 inches. Experience having shown that even the very best Observers make these mistakes, particular attention is directed to the matter.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must first be screwed so as to form a tight plug to the cistern, thus preventing the escape of the mercury. Then screw up the mercury not quite to the top of the tube, but to within a quarter of an inch of it, and take down the instrument; it should then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case if, on inclining the instrument, a sharp tap is produced when the mercury strikes the top of the tube. If a dull tap is heard, there is air in the tube, which must be got rid of.

As Barometers are liable to be deranged by the introduction of air into their tubes, on removal from place to place, or in being roughly handled, it may be useful to Observers to know how the air may be expelled. First close up the cistern by screwing the ivory peg tight, so as to prevent the escape of mercury; then screw up the mercury to about half an inch from the top of the tube; and having slowly inverted the instrument, place the top of it on a yielding substance, such as the boot, and gently tap on the cistern with the palm of the hand, so as to induce the air to ascend through the column to the cistern, whence it may escape. Since there is the weight of two atmospheres—the pressure of the mercury in the Barometer, and the air outside—pressing on any air that may be inside the tube, it is usually a tedious operation to get it wholly expelled. After repeated trials, however, it is generally accomplished; and the clear metallic sound of the mercury, when gently struck against the top of the glass tube, will show when the whole of the air has been expelled. On hanging up the Barometer, care must be taken to screw down the mercury in the tube before unfastening the float of the cistern, for, if this be not attended to, the mercury will flow out, and the instrument be seriously damaged.

**Protection and Position of Thermometers.**

The Council of the Society recommend that the Self-Registering Thermometers, and the Dry and Wet Bulb Hygrometer, be kept in Stevenson's Louvre-boarded Box for Thermometers, painted white inside and outside, and screwed to four stout posts, also painted white, firmly fixed in the ground. The posts must be of such a length that when the Thermometers are hung in position the Bulbs of the Minimum Thermometer, and of the Dry and Wet Bulb Thermometers, will be exactly at the same height of FOUR FEET above the ground, the Maximum Thermometer being hung immediately above the Minimum Thermometer. The Thermometer Box is to be placed over a plot of grass, and in a free open space to which the sun's rays have free access during as much of the day as surrounding conditions enable the Observer to secure. The Thermometers are suspended on cross-laths in the centre of the Box, and face the door, which should open to the north.

The Council regard the question of UNIFORMITY OF HEIGHT ABOVE GROUND, AND METHOD IN PROTECTING THE THERMOMETERS, as vital in every system of Meteorological Observation, since without it Observations made at different Stations are incomparable, thus rendering it impossible to compare the Climates of places with each other as regards their most important features.

**Self-Registering Thermometers.**

Professor Phillips, and Negretti and Zambra's Maximum Thermometers, and Rutherford's Minimum Thermometer, are recommended. It is recommended that these Thermometers be graduated on the glass stem. The Minimum Thermometer is liable to two derangements—viz., the column of spirit breaking, and part of the spirit distilling by high temperature and lodging at the top of the tube. This derangement is of occasional occurrence with protected Thermometers, but of frequent occurrence with exposed Thermometers. Hence a systematic examination of Minimum Thermometers ought to be a regular part of the work carried on by each Observer.

Fortunately, Spirit Thermometers may be easily set right by any one, when the column of spirit chances to separate. Let the Thermometer be taken in the hand by the end farthest from the bulb, raised above the head, and then forcibly swung down towards the feet; the object being, on the principle of centrifugal force, to send down the detached portion of spirit till it unites with the column. A few throws, or swinging strokes, will generally be sufficient for the purpose; after which the Thermometer should be placed in a slanting position, to allow the rest of the spirit still adhering to the sides of the tube to drain down to the column. But another method must be adopted, if the portion of spirit in the top of the tube be small. Heat should be applied slowly and cautiously to the top end of the tube where the detached portion of spirit is, which, being turned into vapour by the heat, will condense on the surface of the unbroken column of spirit. Care must be taken that the heat is not applied too quickly; for, if this be done, the tube will break and the instrument be destroyed. The best way to apply the requisite amount of heat is by bringing the end of the tube slowly down towards a minute flame from a gas-burner; or, if gas be not at hand, a piece of heated metal will serve instead.

**Black-Bulb Thermometers.**

The bulbs of the Thermometers for registering the greatest heat from the sun's rays, and the least from radiation during night, have a black coating, which may easily be made, or mended, by the application of a mixture of lampblack and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind, The Maximum should be freely exposed to the sun, and the Minimum should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation. Black-bulbs enclosed in 'glass jackets' may also be used, being indeed preferable to the above. It must, however, be added, that the whole subject of the observation of Solar and Terrestrial Radiation is not yet in a sufficiently advanced state to warrant the exclusive recommendation of any one of these methods.

**Dry and Wet Bulb Hygrometer.**

The Hygrometer in use at the Society's Stations consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved form of this apparatus seriously vitiate the Hygrometrical Observations, Observers are specially requested to attend to the following conditions:—The bulbs must hang down by at least an inch free from the scales and frame to which they are attached; the frame must be such as will bring the tubes forward by an inch from any board on which it may be suspended; the water-cup must be covered, and altogether placed to the side, and a little below the level of the wet bulb, but in no case under the bulbs; the muslin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the Observer that the muslin is always clean and moist, and the water pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

**Reading of the Thermometer.**

In reading the Thermometer great care must be taken to bring the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or $40\frac{1}{2}$°, respectively. So also $40\frac{1}{4}$°, and $40\frac{3}{4}$°, more or less, must be registered 40°·2, or 40°·3, and 40°·7, or 40°·8 respectively. In reading Rutherford's Minimum Thermometer, the indication of that end of the index which is next the surface of the spirit is alone noted. On opening the Thermometer Box, the Dry and Wet Bulb Thermometers are to be first, and rapidly, read, inasmuch as they are readily affected by heat from the person of the Observer.

**Hour of observing Temperature.**

The Hygrometer is read at 9 A.M. and 9 P.M. The Self-Registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the Self-Registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 3d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

**Verification of Thermometers.**

No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a standard Thermometer. When such Thermometers as are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being re-tested. The Self-Registering, especially the Minimum Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer, marked by a scratch on the tube, ought to be tested once a year, in snow or melting ice.

In selecting instruments, the following points require attention:—The divisions of the vernier of Barometers in reference to their scales, and the perfect freedom of the Barometer from air; the correct numbering of the scale of every instrument; the rejection of Thermometers the frameworks of which are not likely to stand exposure to the weather, as shown in the past by repeated and annoying breakages of Thermometers of similar construction; and as regards Maximum Thermometers, either Negretti and Zambra's, or Phillip's, whether they will act at the highest temperatures they may be required to register. By the laws of the Society, Members and Observers have a right to have their instruments compared by the Secretary, and to advise with him regarding the purchase of instruments.

**Wind.**

Very great care should be bestowed on the Observations of the Wind, the accuracy of which, both as regards Direction and Force, is so essential towards the right discussion of many of the more important problems of the science.

**1. As regards Direction.**

A Wind-Vane ought to be elevated at least 12 feet above surrounding objects. When it oscillates incessantly, the mean direction should be taken. In all cases, but especially when the Vane is stationary, and when the wind is feeble, reference may be made to the direction of smoke, etc., in well-exposed situations. Careful observations are recommended to be made on the changes in the direction of the wind; and during storms, extra observations at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, is likely to give highly valuable and important results, particularly in connection with the system of thickly-planted Stations over a limited district round Edinburgh called STORM STATIONS, in the course of being established by the Society for the systematic investigation of the relation of the force of the wind to BAROMETRIC GRADIENTS, and other points connected with storms.

**2. As regards Velocity and Pressure.**

The Council would recommend the Hemispherical Cup Anemometer,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the mean Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, the Pressure Anemometers recently brought under the notice of the Society by Mr. T. Stevenson, the Honorary Secretary, and Mr. R. Ballingall, the Society's Observer at Eallabus, are recommended as likely to secure uniformity in making observations on the Force of the Wind.

**Rain Gauges.**

Many causes conspire to produce anomalies in Rain Returns, arising partly from the difficulty of obtaining a perfectly unobjectionable situation for observation, and partly from the defective nature of the instruments used. The Rain Gauge should not be placed on a slope or terrace, but on a level piece of ground, in as open a situation as the Observer can secure for it. As it is often difficult to obtain a position as free and unobstructed by surrounding objects as is desirable, care should be taken to place it at some distance from shrubs, trees, buildings, or other obstructions, at least as many feet from their base as they are in height. The more important directions, towards which it is most desirable to have a free exposure, are, in the order of their importance, S.W., N.E., S.E., S., and W. The rim of the gauge must be perfectly level, and fixed so that it will remain level in all weathers, and be at a height of one foot above ground, over grass. In such gauges as Fleming's, which are furnished with a measuring-rod attached to a float, the rod ought to be fixed down, and the float rise to its height only at the time the instrument is read, it being found that a stem projecting above the rim of the gauge seriously interferes with the proper measurement of the Rain-fall. When a measuring-glass is used, care should be taken to hold it quite perpendicular. The Rain Gauge ought to be read daily at 9 A.M., and the reading entered in the Returns of the previous day. If the Gauge is read once a month, the reading is to be made on the first of the month, and the amount entered for the previous month.

**Snow-falls.**

Snow-falls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs, it should be noted in the 'Remarks,' and the letter S affixed to the depth of water received in Gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the Rain Gauge. For wind, rain, and snow, as indeed in every column, the Observer cannot be too careful to register observations only; and nothing that partakes of the nature of deduction or inference.

**Clouds.**

Convenient abbreviations for the nomenclature of Clouds will be found on the other side. The amount of Cloud ought to be estimated from the greater or less obscuration of the sky overhead (*i.e.* within 20° or 30° of the zenith). The strata of Clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the Clouds' column, though their appearance and changes may be noted among the Remarks. The amount of Cloud is entered from a scale of 0 to 10; thus, when the sky overhead is free from Clouds it is entered 0, when half-covered by Clouds, 5, wholly covered, 10, and so on.

Observations of the Clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—Thus, in the column Velocity and Direction, 6, S. W.

——— will indicate that the upper strata of Clouds travel with 2, W.

extreme velocity from S.W., and those in the lower regions from W., with one-third the speed of the former. Again, in the second 4, st.

Cloud column, an entry of ——— will indicate that the higher 2, cu-st.

regions are covered to the amount of 4-tenths with stratus Clouds; and that the sky is further obscured to the extent of 2-tenths by lower Clouds of the cumulo stratus kind.

Remarks on peculiar Clouds, accompanied with drawings, will assist materially in the development of a more exact nomenclature of Clouds, as well as throw light on the electrical, and other of the more obscure phenomena of Meteorology.

**Sunshine.**

The approximate number of Hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

**Underground Thermometers.**

As the germination and growth of crops and plants generally depend greatly on the temperature of the soil,—its amount and constancy,—the Council recommend that Observations in this interesting department be made at 9 A.M., by Thermometers permanently fixed in the soil, their bulbs being sunk to depths of 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames.

**Temperature of the Sea.**

A knowledge of the Temperature of the Sea is not only in itself, but in its relations to that of our island, a most important branch of Meteorology. The Council therefore recommend that the Temperature of the Sea be carefully taken by a properly constructed apparatus, from boats, or, if this be impracticable, from the ends of piers and rocks round the coast, where it is not influenced by that of river water, and as little influenced as possible by currents sweeping along the coast, and thus acquiring the temperature of the land, either greatly heated by the sun or cooled by nocturnal radiation. At or near the time of high water, in cases where the observations cannot be taken daily, the observation may be made on the 5th, 15th, and 25th of each month. When convenient, extra Sea Observations might be taken for other and greater depths, noting always the Temperature of the Air, and the Hour of Observation. It is also very desirable that observations on the daily Maxima and Minima by Thermometers continuously immersed, be instituted at points along the coast, by the method proposed by Mr. T. Stevenson, and already commenced at Peterhead and Liverpool.

**Temperature of Wells.**

The Temperature of the water at the bottom of Wells ought, when practicable, to be taken, both the depth of the Well and of the water being noted.

**Ozone.**

Mention what Test-Papers are used, Schönbein's or Moffat's, etc. The Paper is affixed by a pin to a board in the Thermometer Box, and the indications registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus $3^{\frac{N.W.}{1}}$, as an Ozone entry in the schedule will indicate that the Ozone paper is tinted as 3 on the scale, that the wind is from the N.W., and that its force on the scale 0—5 is 4, or blowing fresh.

**Atmospheric Electricity.**

Too much importance cannot be attached to the electric condition of the atmosphere in connection with terrestrial magnetism, barometrical, thermometrical, and meteorological phenomena generally. A proper Electrometer is, in truth, necessary to every complete meteorological observatory.

**Remarks.**

The Remarks column is unavoidably too narrow. Some of the most valuable Observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are in general use is given at the foot of the column. Besides special and extraordinary Observations, great prominence ought to be given in this column to Prevalent Diseases, differences in character, colour, velocity, and direction between the Lower and Upper Strata of clouds, the Colour of the Sky, etc. Remarks ought to be made on the occurrence of Meteors, Auroræ Boreales, remarkable depressions, elevations, and fluctuations of the Barometer, Thunder-Storms, and remarkable falls of Snow, Hail, or Rain, the Hour of Storms of Wind commencing, attaining their maximum, and ending, as well as such Notes on Storms as have been hinted at above. When lofty hills are in the vicinity of a Station, the Height of Clouds and of the Snow-line in winter should be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. should be registered, either in two columns, otherwise unoccupied, or ruled off for the purpose, from the column of 'Remarks.'

**Observations in connection with the Periodic Return of the Seasons.**

Observations in connection with the Periodic Return of the Seasons, possess not only great scientific value, but are of considerable importance in connection with Agriculture, Horticulture, and Natural History. The Council would direct the special attention of Observers to the registration of such phenomena, so that the published Summaries may fairly represent the whole of Scotland. Observations ought to be confined to individual trees and shrubs; to particular species of birds, and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm. The Annual Table, published yearly in the Society's Journal, will indicate the species of plants and animals to which special attention is more particularly directed.

The Council recommend Observers, before purchasing new instruments, and in repairing old ones, to communicate with the Meteorological Secretary, in order that every instrument may be examined and improved before being used; and they consider it necessary that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, *December* 1891.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

| FOREST TREES. | In Flower. | Leaf Buds first Appear. | In Leaf. | Divested of Leaves. |
|---|---|---|---|---|
| Alder, | | | | |
| Ash, | | | | |
| Beech, | | | | |
| Birch, | | | | |
| Elm, | | | | |
| Larch, | | | | |
| Lime, | | | | |
| Oak, | | | | |
| Sycamore or Plane, | | | | |

| SHRUBS, ETC. | First in Blossom. |
|---|---|
| Barberry, | |
| Bourtree or Elder, | |
| Broom, | |
| Hazel, | |
| Hawthorn, | |
| Holly, | |
| Laburnum, | |
| Lilac, | |
| Mezereon, | |
| Mountain Ash or Rowan, | |
| Red Flowering Currant, | |
| Rhododendron Ponticum, | |
| Whin, | |

| FRUITS. | First in Blossom. | Fruit Ripe, generally. |
|---|---|---|
| Apple, | | |
| Black Currant, | | |
| Cherry, | | |
| Gean, | | |
| Gooseberry, | | |
| Peach, | | |
| Pear, | | |
| Plum, | | |
| Strawberry, | | |

| CROPS, mentioning variety. | Sowing or Planting. | Appearing above Ground. | In Ear or Flower. | First Cut or Raised. |
|---|---|---|---|---|
| Barley, | | | | |
| Bere or Bigg, | | | | |
| Oats, | | | | |
| Wheat, | | | | |
| Beans, | | | | |
| Pease, | | | | |
| Potatoes, | | | | |
| Turnips, | | | | |
| Rye Grass, | | | | |

| MIGRATORY BIRDS. | First Arrival. | Departure. |
|---|---|---|
| Cuckoo, | | |
| Curlew, | | |
| House-Swallow, | | |
| Lapwing, | | |
| Plover, | | |
| Sand-Martin, | | |
| Starling, | | |
| Swan, | | |
| Rail or Corn Crake, | | |

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

To the SECRETARY
Scottish Meteorological Society,
122 George Street,
EDINBURGH.

BOOK POST.

# SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Haddo House, County of Aberdeen, in Lat. 57°24', Long. 2°14', Distance from Sea 12 miles.

Height of Cistern of the Barometer above Mean Sea-Level 180 feet, above Ground 4 feet. During the MONTH of February 1894.

The Hours of Observation are of Greenwich Time.

| Days of Month. | BAROMETER. 9 h. A.M. Barometer. No. | Attached Thermometer | 9 h. P.M. Barometer. No. | Attached Thermometer | SELF-REGISTERING THERMOMETERS, Read Daily, at 9 P.M. Protected in Shade, 4 feet above Ground. Max. No. | Min. No. | Exposed Black Bulbs. Max. in Sun's rays No. | Min. on Grass No. | HYGROMETER. Dry No. ___ Wet No. ___ 9 h. A.M. Dry bulb. | Wet bulb. | 9 h. P.M. Dry bulb. | Wet bulb. | Rain. No. of days in which it fell. | Amount in inches. No. | WIND. 9 h. A.M. Direction. | Force | 9 h. P.M. Direction. | Force | Readings of the H. Cup Anemometer. No. 9 h. A.M. | CLOUDS. 9 A.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | P.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | SUNSHINE. Hours. | THERMOMETERS under Ground. 9 h. A.M. No. 3 inches. | No. 12 inches. | No. 22 inches. | Temperature of WELL at depth of feet, No. | SEA. Temperature and Direction, and Density. | OZONE. 0—10. 9 A.M. | 9 P.M. | GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. *Mention the hour at which Storms, including Thunder and Lightning, began and ended.* | Days of Month. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches. | ° | inches. | ° | ° | ° | ° | ° | ° | ° | ° | ° | | | | | | | | | | | | | ° | ° | | | | | | | | |
| 1 | 29·250 | 29 | 29·026 | 34 | 35⁻ | 26 | 38 | 20 | 28·5⁻ | 28 | 33·5⁻ | 32 | + | | W | | S | | 9440 | | | | | | 33 | 35⁻ | 36 | | | 6 | 8 | 2 inches of Snow | 1 |
| 2 | 29·182 | 41 | 29·148 | 41 | 52 | 36 | 57 | 31 | 43·5⁻ | 40 | 43 | 39 | + | | W | | W | | 0565⁻ | | | | | | 33 | 35⁻ | 36 | | | 7 | 6 | | 2 |
| 3 | 29·270 | 41 | 29·736 | 38 | 44·5⁻ | 36 | 50 | 32 | 41 | 38 | 37·5⁻ | 35⁻ | + | | W | | N.W | | 2591 | | | | | | 34 | 35⁻ | 36 | | | 5 | 6 | | 3 |
| 4 | 29·706 | 43 | 29·712 | 41 | 52·5⁻ | 35⁻ | 52 | 30 | 45⁻ | 42 | 42·5⁻ | 39 | + | | W | | W | | 4210 | | | | | | 35⁻ | 35⁻ | 36 | | | 7 | 7 | | 4 |
| 5 | 29·960 | 36·5⁻ | 29·782 | 38 | 46 | 31 | 53 | 24 | 36·5⁻ | 33 | 37 | 35·5⁻ | | | W | | S.E | | 5750 | | | | | | 34 | 36 | 36 | | | 6 | 6 | | 5 |
| 6 | 29·312 | 44 | 28·924 | 46 | 53 | 37 | 52 | 37 | 45 | 43 | 48 | 46·5⁻ | + | | W | | S.W | | 6822 | | | | | | 38 | 36 | 36 | | | 5⁻ | 6 | | 6 |
| 7 | 28·992 | 43 | 29·182 | 39 | 51 | 36 | 48 | 31 | 46 | 43·5⁻ | 38 | 35⁻ | + | | N.W | | N.W | | 8753 | | | | | | 40 | 37 | 36 | | | 7 | 7 | | 7 |
| 8 | 29·401 | 41 | 29·444 | 41·5⁻ | 47 | 36 | 54 | 32 | 41 | 37·5⁻ | 42·5⁻ | 38·5⁻ | | | N.W | | W | | 0564 | | | | | | 36 | 37 | 37 | | | 6 | 5⁻ | | 8 |
| 9 | 29·046 | 41 | 28·996 | 38 | 48 | 35⁻ | 57 | 32 | 42 | 39 | 36 | 35⁻ | + | | S.W | | W | | 3252 | | | | | | 37 | 37 | 37 | | | 6 | 7 | | 9 |
| 10 | 28·816 | 35⁻ | 28·998 | 34 | 38 | 31 | 42 | 29 | 33·5⁻ | 32 | 33 | 32 | + | ·41 | W | | W | | 5987 | | | | | | 35⁻ | 37 | 37 | | | 10 | 9 | Gale and Snow storm | 10 |
| 11 | 28·882 | 34 | 28·236 | 35⁻ | 36 | 27 | 35⁻ | 23 | 33 | 32·5⁻ | 34 | 33·5⁻ | + | | S.W | | S | | 8061 | | | | | | 33 | 36 | 37 | | | 6 | 9 | 3 inches of Snow. Fog | 11 |
| 12 | 28·692 | 35 | 29·114 | 32 | 38 | 30 | 42 | 26 | 34 | 32 | 30·5⁻ | 29·5⁻ | + | | N.W | | N.W | | 8522 | | | | | | 34 | 36 | 37 | | | 10 | 8 | | 12 |
| 13 | 29·520 | 33·5⁻ | 29·705⁻ | 30 | 35⁻ | 28 | 47 | 23 | 32 | 32 | 29·5⁻ | 29·5⁻ | + | | N.W | | N.W | | 9885⁻ | | | | | | 33 | 36 | 37 | | | 9 | 7 | | 13 |
| 14 | 29·846 | 28·5⁻ | 29·912 | 30 | 35⁻ | 24 | 50 | 20 | 27 | 26·5⁻ | 29 | 29 | | | N.W | | N.E | | 1037 | | | | | | 33 | 36 | 37 | | | 7 | 6 | | 14 |
| 15 | 29·798 | 20 | 29·802 | 36 | 37 | 11 | 41 | 7 | 16 | 16 | 36 | 35⁻ | + | | S | | S.E | | 1401 | | | | | | 32 | 36 | 37 | | | 7 | 9 | | 15 |
| 16 | 29·802 | 37 | 29·928 | 36 | 38 | 35⁻ | 38 | 33 | 38 | 37 | 36 | 35⁻ | + | | S.E | | S.E | | 2506 | | | | | | 33 | 36 | 37 | | | 10 | 11 | | 16 |
| 17 | 29·932 | 35⁻ | 30·058 | 34 | 35⁻ | 32 | 35⁻ | 32 | 35⁻ | 34 | 34 | 33 | + | 1·64 | S.E | | S.E | | 5402 | | | | | | 33 | 36 | 37 | | | 10 | 9 | | 17 |
| 18 | 30·146 | 36 | 30·216 | 34 | 37 | 33 | 41 | 31 | 36 | 34 | 34 | 31·5⁻ | | | S | | S.E | | 7025⁻ | | | | | | 34 | 35⁻ | 36 | | | 9 | 6 | | 18 |
| 19 | 30·060 | 34 | 30·648 | 36 | 40 | 32 | 40 | 31 | 33 | 30 | 35·5⁻ | 33·5⁻ | | | S.E. | | S | | 7931 | | | | | | 33 | 35⁻ | 36 | | | 5⁻ | 6 | | 19 |
| 20 | 30·128 | 35⁻ | 30·124 | 37 | 48 | 32 | 55⁻ | 28 | 34 | 32·5⁻ | 38 | 36 | | | W | | S.W | | 8591 | | | | | | 33 | 35⁻ | 36 | | | 7 | 5⁻ | | 20 |
| 21 | 29·834 | 36 | 30·012 | 37 | 50 | 32 | 60 | 28 | 37·5⁻ | 36 | 34·5⁻ | 33·5⁻ | | | S.W | | W | | 9008 | | | | | | 35⁻ | 36 | 36 | | | 6 | 6 | Aurora | 21 |
| 22 | 30·008 | 38 | 29·688 | 38 | 47·5⁻ | 31 | 58 | 24 | 38·5⁻ | 35⁻ | 38·5⁻ | 35·5⁻ | | | S.W | | S.E | | 9862 | | | | | | 34 | 36 | 36 | | | 6 | 5⁻ | | 22 |
| 23 | 29·378 | 39 | 28·716 | 38 | 48 | 34 | 48 | 28 | 39 | 37 | 38 | 34 | + | | S.W | | N.W | | 0477 | | | | | | 35⁻ | 36 | 37 | | | 8 | 7 | Aurora | 23 |
| 24 | 28·960 | 38 | 29·228 | 35⁻ | 41 | 31 | 51 | 28 | 35·5⁻ | 32 | 34 | 33 | + | | W | | W | | 2536 | | | | | | 34 | 36 | 37 | | | 6 | 8 | | 24 |
| 25 | 28·896 | 37 | 28·758 | 36 | 51 | 31 | 59 | 26 | 36·5⁻ | 35⁻ | 35⁻ | 34 | + | | S.W | | W | | 4386 | | | | | | 34 | 36 | 36 | | | 5⁻ | 9 | Aurora | 25 |
| 26 | 28·980 | 37 | 29·018 | 39 | 48 | 33 | 63 | 29 | 37 | 35⁻ | 40 | 39 | + | | S.W | | S | | 6501 | | | | | | 35⁻ | 36 | 37 | | | 7 | 6 | | 26 |
| 27 | 29·036 | 41 | 29·336 | 36 | 45⁻ | 34 | 54 | 29 | 40 | 36 | 35⁻ | 32 | + | | N.W | | W | | 8094 | | | | | | 35⁻ | 37 | 37 | | | 9 | 6 | | 27 |
| 28 | 29·312 | 37 | 29·438 | 36·5⁻ | 46 | 30 | 58 | 25⁻ | 36·5⁻ | 34 | 36·5⁻ | 33 | | ·15 | W | | W | | 0126 | | | | | | 34 | 37 | 37 | | | 5⁻ | 6 | Aurora very bright | 28 |
| 29 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 29 |
| 30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 30 |
| 31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 31 |
| Sums. | 824·145⁻ | 1025⁻ | 824·235⁻ | 1026 | 1222⁻ | 879 | 1378 | 769 | 1020·5⁻ | 962·5⁻ | 1019 | 960·5⁻ | | 2·20 | | | | | | | | | | | 962 | 1005⁻ | 1023 | | | 197 | 196 | | |
| Means. | 29·433 | 36·6 | 29·437 | 36·6 | 43·4 | 31·4 | 49·2 | 27·4 | 36·4 | 34·4 | 36·4 | 34·3 | | | | | | | | | | | | | 34·3 | 35·9 | 36·5⁻ | | | 7·0 | 7·0 | | |
| † Total Corrections for Instrumental Errors. | +035 | | +035 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ‡ Corrections for Diurnal Range. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "Corrected Means." | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. of Column. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | | |

NOTATION USED IN GENERAL REMARKS.

| | | *denotes* | | *denotes* | |
|---|---|---|---|---|---|
| a. | | aurora. | m. | | meteor. |
| ci. | ,, | cirrus. | ms. | ,, | meteors. |
| ci.-cu. | ,, | cirro-cumulus. | n. | ,, | nimbus. |
| ci.-s. | ,, | cirro-stratus. | r. | ,, | rain. |
| cu. | ,, | cumulus. | h. r. | ,, | heavy rain. |
| cu.-s. | ,, | cumulo-stratus. | c. h. r. | ,, | continued heavy rain. |
| d. | ,, | dew. | s. | ,, | stratus. |
| f. | ,, | fog. | sc. | ,, | scud. |
| fr. | ,, | frost. | s. | ,, | sleet. |
| h.-fr. | ,, | hoar-frost. | s. | ,, | snow. |
| h. | ,, | haze. | so. ha. | ,, | solar halo. |
| h. d. | ,, | heavy dew. | sq. | ,, | squall. |
| hl. | ,, | hail. | sqs. | ,, | squalls. |
| l. | ,, | lightning. | t. | ,, | thunder. |
| li. cl. | ,, | light clouds. | t. s. | ,, | thunder-storm. |
| li. sh. | ,, | light showers. | w. | ,, | wind. |
| lu. co. | ,, | lunar corona. | g. | ,, | gale of wind. |
| lu. ha. | ,, | lunar halo. | | | |

TABLE FOR ESTIMATING FORCE OF WIND.

| Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. |
|---|---|---|---|---|---|
| 0 | Calm | 1·5 | Light breeze | 4 | Blowing hard |
| 0·5 | Very light air | 2· | Fresh breeze | 5 | Blowing a gale |
| 1· | Light air | 3· | Very fresh | 6 | Violent gale |

**BAROMETER**, "corrected Mean" at 9 A.M., *minus* the Correction †† for Temp. (Col. 2), = 29·488 — 2·1 = 29·467

"Corrected Mean" of Barometer at 9 P.M., *minus* the Correction †† for Temp. (Col. 4), = 29·472 — 2·1 = 29·451

**Mean at Station, corrected, and at 32°**, = 29·449

Correction for height, feet above Mean Sea-level, = 202

**Mean, reduced to 32°, and Sea-level**, = 29·651

Highest Reading, corrected for Index error, on the 18th, = 30·216

Lowest Do. Do., on the 11th, = 28·236

Difference, or **Monthly Range**, = 1·980

**S.-R. THERMOMETER**, (in shade, etc.), **Highest in Month**, (corrected for Index Errors), on the 6th, = 53·0

**Lowest in Month**, corrected for Index errors, on the 15th, = 11·0

Difference, or **Monthly Range**, = 42·0

"Corrected **Mean**" **of all the Highest**, (Col. 5), = 43·4

"Corrected **Mean**" **of all the Lowest**, (Col. 6), = 31·4

Difference, or **Mean Daily Range**, = 12·0

** Calculated **Mean Temperature** of Month, = 37·4

**S.-R. THERMOMETER, Black Bulb in Sun, Highest**, (corrected for Index Errors), on the 26th, = 63·0

"Corrected **Mean**," (Col. 7), **of Black Bulb, Max. in Sun**, = 49·2

**Lowest at Night**, Black Bulb (corrected for Index errors), on the 15th, = 7·0

"Corrected **Mean**," (Col. 8), **of Black Bulb, Min.** on grass, = 27·4

Difference of above means or range ("exposed"), =

**HYGROMETER, Mean** (corrected) A.M. and P.M. Reading **of Dry Bulb**, (Cols. 9 and 11), = 36·4

**Mean** (corrected) A.M. and P.M. Reading **of Wet Bulb**, (Cols. 10 and 12), = 34·4

‡‡ Computed **Temperature of Dew-Point**, = 31·5⁻

‡‡ Do. **Elastic Force of Vapour**, = ·178

‡‡ Do. **Weight of Vapour in a Cubic Foot of Air**, =

‡‡ **Relative Humidity** (**Saturation** = 100), = 83

**RAIN** fell on 19 **Days**; **Amount in Inches**, = 2·20

| WIND. Direction. | SUMMARY. N | NE | E | SE | S | SW | W | NW | Calm or Variable. | Mean Force. | Mean Velocity in miles per day. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. | | . | . | 3 | 2 | 7 | 10 | 6 | | | |
| P.M | | 1 | | 6 | 4 | 2 | 10 | 5⁻ | | | |
| Mean. | 0 | 1 | 0 | 4 | 3 | 4 | 10 | 6 | 0 | | |

* Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S."; and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.
† Embracing corrections for both capillarity and Index Errors
‡ The Diurnal Range for Scotland is as yet unknown.
†† *Practically*, though not *absolutely* a *minus* correction.
‡‡ These "Hygrometrical Deductions" are calculated from Glaisher's Hygrometrical Tables, Second Edition *only*.
** While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature."
Any observations not taken under the Conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. *See over.*

*Observations made and Return verified by* John Forrest

(*Signed*)

# INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS,

## WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the chief objects that the SCOTTISH METEOROLOGICAL SOCIETY proposed to itself when the Society was established in 1855, was to secure PERFECT UNIFORMITY in the system of observation pursued at all its Stations. Uniformity in the observations is absolutely necessary to justify the publication of Monthly Results from different observations, it being found that differences between the Returns from two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those who kindly furnish Reports to the Society will, by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

**Hour of Observation.** The Council recommend that Observations be made precisely at 9 A.M. and 9 P.M. (Greenwich or Railway Time only), as specified in the following remarks, or at the top of the columns of the Schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading the time at which it was taken, if not at 9 A.M. or 9 P.M.

**Barometer.** Weather-Glasses and Aneroids, though well suited to indicate roughly variations of atmospheric pressure, are not fitted for scientific purposes. No Barometer should be used for Meteorological Observation that is not supplied with some means of adjustment or compensation which will secure that the height of the mercury in the tube is accurately measured from the fluctuating surface of the mercury in the cistern.

The Barometer in which the error arising from the fluctuating surface of the mercury in the cistern is entirely got rid of is FORTIN'S Barometer, the arrangement consisting in applying pressure by means of a screw to the bottom of the cistern, which is made of flexible leather, thus raising or depressing the surface till it just meets the ivory point which forms the zero point of the fixed scale.

The Barometer originally constructed by Mr. Adie of London, and usually called the Board of Trade Barometer, has the great convenience of requiring no adjustment of the cistern. Its scale-inches are not true inches, but so much shorter as to compensate the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This is an excellent Barometer for ordinary Observers, inasmuch as it entirely eliminates the error of observation likely to arise in not a few cases in setting the instrument to the zero point of the fixed scale when the light is not good. To show the accuracy with which these Barometers are made, it may be stated, that one was compared, during a whole year, with the Society's Standard Barometer, particular care being given to make the comparison when atmospheric pressure was rising or falling very rapidly, with the result that none of the readings differed from those of the Standard more than 0·003 inch.

A modification of Fortin's Barometer is used at a number of the Society's Stations, by which the coincidence of the zero point with the surface of the mercury is indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the index-line on this little piston-rod is brought, by the adjusting screw, to form one straight line with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this preliminary setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the vernier.

It is absolutely necessary that the Barometer which is to be used shall have been compared with a Standard Barometer.

The Barometer should be suspended in as good a light as can be secured, and to facilitate the reading, a piece of white paper may be put behind the tube. It must be hung truly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire, and must not be hung against a wall heated by a flue. The object being to secure that the whole instrument, including the brass fittings, the contained mercury, and the attached Thermometer, shall be, when read, at one uniform temperature, it is evident that the best position is that which is least liable to sudden changes of temperature.

In taking an Observation, the Attached Thermometer is first noted: the tube must then be gently tapped, and the cistern-adjustment carefully made. The eye, by raising and lowering it, must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted so as to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will facilitate an accurate adjustment and reading of the Barometer. A mistake not unfrequently made by those beginning to observe, consisting in setting the edge of the vernier to the level of the clear surface of the mercury which is in direct contact with the glass tube, must be carefully avoided.

The errors most frequently made in reading the Barometer are errors of 1·000 inch, 0·500 inch, and 0·050 inch; that is to say, instead of 29·365 inches, either of the following is sometimes set down—viz. as 30·365 inches, 28·365 inches, 29·865 inches, or 29·815 inches. Experience having shown that even the very best Observers make these mistakes, particular attention is directed to the matter.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must first be screwed so as to form a tight plug to the cistern, thus preventing the escape of the mercury. Then screw up the mercury not quite to the top of the tube, but to within a quarter of an inch of it, and take down the instrument; it should then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case if, on inclining the instrument, a sharp tap is produced when the mercury strikes the top of the tube. If a dull tap is heard, there is air in the tube, which must be got rid of.

As Barometers are liable to be deranged by the introduction of air into their tubes, on removal from place to place, or in being roughly handled, it may be useful to Observers to know how the air may be expelled. First close up the cistern by screwing the ivory peg tight, so as to prevent the escape of mercury; then screw up the mercury to about half an inch from the top of the tube; and having slowly inverted the instrument, place the top of it on a yielding substance, such as the boot, and gently tap on the cistern with the palm of the hand, so as to induce the air to ascend through the column to the cistern, whence it may escape. Since there is the weight of two atmospheres—the pressure of the mercury in the Barometer, and the air outside—pressing on any air that may be inside the tube, it is usually a tedious operation to get it wholly expelled. After repeated trials, however, it is generally accomplished; and the clear metallic sound of the mercury, when gently struck against the top of the glass tube, will show when the whole of the air has been expelled. On hanging up the Barometer, care must be taken to screw down the mercury in the tube before unfastening the float of the cistern, for, if this be not attended to, the mercury will flow out, and the instrument be seriously damaged.

**Protection and Position of Thermometers.** The Council of the Society recommend that the Self-Registering Thermometers, and the Dry and Wet Bulb Hygrometer, be kept in Stevenson's Louvre-boarded Box for Thermometers, painted white inside and outside, and screwed to four stout posts, also painted white, firmly fixed in the ground. The posts must be of such a length that when the Thermometers are hung in position the Bulbs of the Minimum Thermometer, and of the Dry and Wet Bulb Thermometers, will be exactly at the same height of FOUR FEET above the ground, the Maximum Thermometer being hung immediately above the Minimum Thermometer. The Thermometer Box is to be placed over a plot of grass, and in a free open space to which the sun's rays have free access during as much of the day as surrounding conditions enable the Observer to secure. The Thermometers are suspended on cross-laths in the centre of the Box, and face the door, which should open to the north.

The Council regard the question of UNIFORMITY OF HEIGHT ABOVE GROUND, AND METHOD IN PROTECTING THE THERMOMETERS, as vital in every system of Meteorological Observation, since without it Observations made at different Stations are incomparable, thus rendering it impossible to compare the Climates of places with each other as regards their most important features.

**Self-Registering Thermometers.** Professor Phillips, and Negretti and Zambra's Maximum Thermometers, and Rutherford's Minimum Thermometer, are recommended. It is recommended that these Thermometers be graduated on the glass stem. The Minimum Thermometer is liable to two derangements—viz., the column of spirit breaking, and part of the spirit distilling by high temperature and lodging at the top of the tube. This derangement is of occasional occurrence with protected Thermometers, but of frequent occurrence with exposed Thermometers. Hence a systematic examination of Minimum Thermometers ought to be a regular part of the work carried on by each Observer.

Fortunately, Spirit Thermometers may be easily set right by any one, when the column of spirit chances to separate. Let the Thermometer be taken in the hand by the end farthest from the bulb, raised above the head, and then forcibly swung down towards the feet; the object being, on the principle of centrifugal force, to send down the detached portion of spirit till it unites with the column. A few throws, or swinging strokes, will generally be sufficient for the purpose; after which the Thermometer should be placed in a slanting position, to allow the rest of the spirit still adhering to the sides of the tube to drain down to the column. But another method must be adopted, if the portion of spirit in the top of the tube be small. Heat should be applied slowly and cautiously to the top end of the tube where the detached portion of spirit is, which, being turned into vapour by the heat, will condense on the surface of the unbroken column of spirit. Care must be taken that the heat is not applied too quickly; for, if this be done, the tube will break and the instrument be destroyed. The best way to apply the requisite amount of heat is by bringing the end of the tube slowly down towards a minute flame from a gas-burner; or, if gas be not at hand, a piece of heated metal will serve instead.

**Black-Bulb Thermometers.** The bulbs of the Thermometers for registering the greatest heat from the sun's rays, and the least from radiation during night, have a black coating, which may easily be made, or mended, by the application of a mixture of lampblack and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind, The Maximum should be freely exposed to the sun, and the Minimum should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation. Black-bulbs enclosed in 'glass jackets' may also be used, being indeed preferable to the above. It must, however, be added, that the whole subject of the observation of Solar and Terrestrial Radiation is not yet in a sufficiently advanced state to warrant the exclusive recommendation of any one of these methods.

**Dry and Wet Bulb Hygrometer.** The Hygrometer in use at the Society's Stations consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved form of this apparatus seriously vitiate the Hygrometrical Observations, Observers are specially requested to attend to the following conditions:—The bulbs must hang down by at least an inch free from the scales and frame to which they are attached; the frame must be such as will bring the tubes forward by an inch from any board on which it may be suspended; the water-cup must be covered, and altogether placed to the side, and a little below the level of the wet bulb, but in no case under the bulbs; the muslin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the Observer that the muslin is always clean and moist, and the water pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

**Reading of the Thermometer.** In reading the Thermometer great care must be taken to bring the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40½°, respectively. So also 40¼°, and 40¾°, more or less, must be registered 40°·2, or 40°·3, and 40°·7, or 40°·8 respectively. In reading Rutherford's Minimum Thermometer, the indication of that end of the index which is next the surface of the spirit is alone noted. On opening the Thermometer Box, the Dry and Wet Bulb Thermometers are to be first, and rapidly, read, inasmuch as they are readily affected by heat from the person of the Observer.

**Hour of observing Temperature.** The Hygrometer is read at 9 A.M. and 9 P.M. The Self-Registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the Self-Registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 3d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

**Verification of Thermometers.** No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a standard Thermometer. When such Thermometers as are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being re-tested. The Self-Registering, especially the Minimum Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer, marked by a scratch on the tube, ought to be tested once a year, in snow or melting ice.

In selecting instruments, the following points require attention:—The divisions of the vernier of Barometers in reference to their scales, and the perfect freedom of the Barometer from air; the correct numbering of the scale of every instrument; the rejection of Thermometers the frameworks of which are not likely to stand exposure to the weather, as shown in the past by repeated and annoying breakages of Thermometers of similar construction; and as regards Maximum Thermometers, either Negretti and Zambra's, or Phillip's, whether they will act at the highest temperatures they may be required to register. By the laws of the Society, Members and Observers have a right to have their instruments compared by the Secretary, and to advise with him regarding the purchase of instruments.

**Wind.** Very great care should be bestowed on the Observations of the Wind, the accuracy of which, both as regards Direction and Force, is so essential towards the right discussion of many of the more important problems of the science.

**1. As regards Direction.** A Wind-Vane ought to be elevated at least 12 feet above surrounding objects. When it oscillates incessantly, the mean direction should be taken. In all cases, but especially when the Vane is stationary, and when the wind is feeble, reference may be made to the direction of smoke, etc., in well-exposed situations. Careful observations are recommended to be made on the changes in the direction of the wind; and during storms, extra observations at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, is likely to give highly valuable and important results, particularly in connection with the system of thickly-planted Stations over a limited district round Edinburgh called STORM STATIONS, in the course of being established by the Society for the systematic investigation of the relation of the force of the wind to BAROMETRIC GRADIENTS, and other points connected with storms.

**2. As regards Velocity and Pressure.** The Council would recommend the Hemispherical Cup Anemometer,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the mean Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, the Pressure Anemometers recently brought under the notice of the Society by Mr. T. Stevenson, the Honorary Secretary, and Mr. R. Ballingall, the Society's Observer at Eallabus, are recommended as likely to secure uniformity in making observations on the Force of the Wind.

**Rain Gauges.** Many causes conspire to produce anomalies in Rain Returns, arising partly from the difficulty of obtaining a perfectly unobjectionable situation for observation, and partly from the defective nature of the instruments used. The Rain Gauge should not be placed on a slope or terrace, but on a level piece of ground, in as open a situation as the Observer can secure for it. As it is often difficult to obtain a position as free and unobstructed by surrounding objects as is desirable, care should be taken to place it at some distance from shrubs, trees, buildings, or other obstructions, at least as many feet from their base as they are in height. The more important directions, towards which it is most desirable to have a free exposure, are, in the order of their importance, S.W., N.E., S.E., S., and W. The rim of the gauge must be perfectly level, and fixed so that it will remain level in all weathers, and be at a height of one foot above ground, over grass. In such gauges as Fleming's, which are furnished with a measuring-rod attached to a float, the rod ought to be fixed down, and the float rise to its height only at the time the instrument is read, it being found that a stem projecting above the rim of the gauge seriously interferes with the proper measurement of the Rainfall. When a measuring-glass is used, care should be taken to hold it quite perpendicular. The Rain Gauge ought to be read daily at 9 A.M., and the reading entered in the Returns of the previous day. If the Gauge is read once a month, the reading is to be made on the first of the month, and the amount entered for the previous month.

**Snow-falls.** Snow-falls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs, it should be noted in the 'Remarks,' and the letter S affixed to the depth of water received in Gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the Rain Gauge. For wind, rain, and snow, as indeed in every column, the Observer cannot be too careful to register observations only; and nothing that partakes of the nature of deduction or inference.

**Clouds.** Convenient abbreviations for the nomenclature of Clouds will be found on the other side. The amount of Cloud ought to be estimated from the greater or less obscuration of the sky overhead (*i.e.* within 20° or 30° of the zenith). The strata of Clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the Clouds' column, though their appearance and changes may be noted among the Remarks. The amount of Cloud is entered from a scale of 0 to 10; thus, when the sky overhead is free from Clouds it is entered 0, when half-covered by Clouds, 5, wholly covered, 10, and so on.

Observations of the Clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—Thus, in the column Velocity and Direction, 6, S. W.

——— will indicate that the upper strata of Clouds travel with 2, W.

extreme velocity from S.W., and those in the lower regions from W., with one-third the speed of the former. Again, in the second 4, st.

column, an entry of ——— will indicate that the higher 2, cu-st.

regions are covered to the amount of 4-tenths with stratus Clouds; and that the sky is further obscured to the extent of 2-tenths by lower Clouds of the cumulo stratus kind.

Remarks on peculiar Clouds, accompanied with drawings, will assist materially in the development of a more exact nomenclature of Clouds, as well as throw light on the electrical, and other of the more obscure phenomena of Meteorology.

**Sunshine.** The approximate number of Hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

**Underground Thermometers.** As the germination and growth of crops and plants generally depend greatly on the temperature of the soil,—its amount and constancy,—the Council recommend that Observations in this interesting department be made at 9 A.M., by Thermometers permanently fixed in the soil, their bulbs being sunk to depths of 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames.

**Temperature of the Sea.** A knowledge of the Temperature of the Sea is not only in itself, but in its relations to that of our island, a most important branch of Meteorology. The Council therefore recommend that the Temperature of the Sea be carefully taken by a properly constructed apparatus, from boats, or, if this be impracticable, from the ends of piers and rocks round the coast, where it is not influenced by that of river water, and as little influenced as possible by currents sweeping along the coast, and thus acquiring the temperature of the land, either greatly heated by the sun or cooled by nocturnal radiation. At or near the time of high water, in cases where the observations cannot be taken daily, the observation may be made on the 5th, 15th, and 25th of each month. When convenient, extra Sea Observations might be taken for other and greater depths, noting always the Temperature of the Air, and the Hour of Observation. It is also very desirable that observations on the daily Maxima and Minima by Thermometers continuously immersed, be instituted at points along the coast, by the method proposed by Mr. T. Stevenson, and already commenced at Peterhead and Liverpool.

**Temperature of Wells.** The Temperature of the water at the bottom of Wells ought, when practicable, to be taken, both the depth of the Well and of the water being noted.

Mention what Test-Papers are used, Schönbein's or Moffat's, etc.

**Ozone.** The Paper is affixed by a pin to a board in the Thermometer Box, and the indications registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus $3^{N.W.}_{+}$, as an Ozone entry in the schedule will indicate that the Ozone paper is tinted as 3 on the scale, that the wind is from the N.W., and that its force on the scale 0—5 is 4, or blowing fresh.

**Atmospheric Electricity.** Too much importance cannot be attached to the electric condition of the atmosphere in connection with terrestrial magnetism, barometrical, thermometrical, and meteorological phenomena generally. A proper Electrometer is, in truth, necessary to every complete meteorological observatory.

**Remarks.** The Remarks column is unavoidably too narrow. Some of the most valuable Observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are in general use is given at the foot of the column. Besides special and extraordinary Observations, great prominence ought to be given in this column to Prevalent Diseases, differences in character, colour, velocity, and direction between the Lower and Upper Strata of clouds, the Colour of the Sky, etc. Remarks ought to be made on the occurrence of Meteors, Auroræ Boreales, remarkable depressions, elevations, and fluctuations of the Barometer, Thunder-Storms, and remarkable falls of Snow, Hail, or Rain, the Hour of Storms of Wind commencing, attaining their maximum, and ending, as well as such Notes on Storms as have been hinted at above. When lofty hills are in the vicinity of a Station, the Height of Clouds and of the Snow-line in winter should be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. should be registered, either in two columns, otherwise unoccupied, or ruled off for the purpose, from the column of 'Remarks.'

**Observations in connection with the Periodic Return of the Seasons.** Observations in connection with the Periodic Return of the Seasons, possess not only great scientific value, but are of considerable importance in connection with Agriculture, Horticulture, and Natural History. The Council would direct the special attention of Observers to the registration of such phenomena, so that the published Summaries may fairly represent the whole of Scotland. Observations ought to be confined to individual trees and shrubs; to particular species of birds, and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm. The Annual Table, published yearly in the Society's Journal, will indicate the species of plants and animals to which special attention is more particularly directed.

The Council recommend Observers, before purchasing new instruments, and in repairing old ones, to communicate with the Meteorological Secretary, in order that every instrument may be examined and improved before being used; and they consider it necessary that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, *December* 1891.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

| FOREST TREES. | In Flower. | Leaf Buds first Appear. | In Leaf. | Divested of Leaves. |
|---|---|---|---|---|
| Alder, | | | | |
| Ash, | | | | |
| Beech, | | | | |
| Birch, | | | | |
| Elm, | | | | |
| Larch, | | | | |
| Lime, | | | | |
| Oak, | | | | |
| Sycamore or Plane, | | | | |

| SHRUBS, ETC. | First in Blossom. |
|---|---|
| Barberry, | |
| Bourtree or Elder, | |
| Broom, | |
| Hazel, | |
| Hawthorn, | |
| Holly, | |
| Laburnum, | |
| Lilac, | |
| Mezereon, | |
| Mountain Ash or Rowan, | |
| Red Flowering Currant, | |
| Rhododendron Ponticum, | |
| Whin, | |

| FRUITS. | First in Blossom. | Fruit Ripe generally. |
|---|---|---|
| Apple, | | |
| Black Currant, | | |
| Cherry, | | |
| Gean, | | |
| Gooseberry, | | |
| Peach, | | |
| Pear, | | |
| Plum, | | |
| Strawberry, | | |

| CROPS, mentioning variety. | Sowing or Planting. |
|---|---|
| Barley, | |
| Bere or Bigg, | |
| Oats, | |
| Wheat, | |
| Beans, | |
| Pease, | |
| Potatoes, | |
| Turnips, | |
| Rye Grass, | |

| MIGRATORY BIRDS. | First Arrival. | Departure. |
|---|---|---|
| Cuckoo, | | |
| Curlew, | | |
| House-Swallow, | | |
| Lapwing, | | |
| Plover, | | |
| Sand-Martin, | | |
| Starling, | | |
| Swan, | | |
| Rail or Corn Crake, | | |

| Appearing above Ground. | In Ear or Flower. | First Cut or Raised. |
|---|---|---|
| | | |

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

*To the SECRETARY*
*Scottish Meteorological Society,*
*122 George Street,*
*EDINBURGH.*

BOOK POST.

# SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Hadds House, County of Aberdeen, in Lat. 57° 24', Long. 2° 14, Distance from Sea 12 miles.

Height of Cistern of the Barometer above Mean Sea-Level 150 feet, above Ground 4 feet. During the MONTH of March 1894.

The Hours of Observation are of Greenwich Time.

| Days of Month. | BAROMETER. 9 h. A.M. Barometer. * No. | Attached Thermometer | 9 h. P.M. Barometer. No. | Attached Thermometer | SELF-REGISTERING THERMOMETERS, Read Daily, at 9 P.M. Protected in Shade, 4 feet above Ground. Max. | Min. | Exposed Black Bulbs. Max. in Sun's rays No. | Min. on Grass No. | HYGROMETER. Dry No. Wet No. 9 h. A.M. Dry bulb. | Wet bulb. | 9 h. P.M. Dry bulb. | Wet bulb. | Rain. No. of days in which it fell. | Amount in inches. No. | WIND. 9 h. A.M. Direction. | Force | 9 h. P.M. Direction. | Force | Readings of the H. Cup Anemometer. No. 9 h. A.M. | CLOUDS. 9 A.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | P.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | SUNSHINE. Hours. | THERMOMETERS under Ground. 9 h. A.M. No. 3 inches. | No. 12 inches. | No. 22 inches. | Temperature of WELL at depth of feet, No. | SEA. Temperature at 1 Fathom, and Density. | OZONE. 0—10. 9 A.M. | 9 P.M. | GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. *Mention the hour at which Storms, including Thunder and Lightning, began and ended.* | Days of Month. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches. | ° | inches. | ° | ° | ° | ° | ° | ° | ° | ° | ° | | | | | | | | | | | | | | ° | ° | ° | ° | ° | | | | |
| 1 | 28·951 | 43·5 | 29·002 | 39·5 | 49 | 35 | 66 | 32 | 45 | 42 | 39 | 35 | + | | S.W | | S.W | | 1474 | | | | | | 37 | 37 | 37 | | | 6 | 6 | | 1 |
| 2 | 29·010 | 41·5 | 29·601 | 38 | 48 | 36 | 61 | 29 | 42·5 | 38·5 | 36 | 33·5 | | | W | | W | | 4361 | | | | | | 37 | 37 | 37 | | | 5 | 5 | | 2 |
| 3 | 29·628 | 41 | 29·506 | 37 | 48·5 | 33 | 58 | 26 | 43·5 | 39 | 35·5 | 33 | | | S | | S.W | | 6230 | | | | | | 35 | 37 | 37 | | | 7 | 6 | | 3 |
| 4 | 29·430 | 36 | 29·678 | 36 | 47 | 32 | 62 | 27 | 35 | 34 | 35 | 32 | + | | S.W | | W | | 6708 | | | | | | 35 | 37 | 37 | | | 7 | 7 | | 4 |
| 5 | 29·728 | 38·5 | 29·032 | 39·5 | 41·5 | 31 | 41 | 27 | 36 | 33·5 | 41 | 38·5 | + | | S.W | | W | | 7583 | | | | | | 35 | 37 | 37 | | | 5 | 6 | | 5 |
| 6 | 28·844 | 42 | 29·398 | 40 | 47·5 | 38 | 58 | 33 | 42 | 40 | 39 | 37·5 | + | | N.W | | N. | | 9157 | | | | | | 37 | 37 | 37 | | | 5 | 7 | | 6 |
| 7 | 29·516 | 39·5 | 29·268 | 39 | 44 | 28 | 53 | 23 | 41 | 39 | 39 | 37·5 | + | | W | | S.E | | 0072 | | | | | | 36 | 37 | 37 | | | 5 | 7 | | 7 |
| 8 | 28·472 | 41·5 | 29·110 | 37 | 48·5 | 33 | 65 | 28 | 41 | 39 | 33 | 31·5 | + | | W | | W | | 1463 | | | | | | 40 | 38 | 37 | | | 10 | 5 | Aurora | 8 |
| 9 | 29·124 | 41 | 28·866 | 40 | 45 | 32·5 | 50 | 27 | 40 | 38·5 | 39 | 37 | + | | S | | W | | 2268 | | | | | | 37 | 38 | 38 | | | 6 | 8 | | 9 |
| 10 | 28·954 | 41 | 29·022 | 38 | 49 | 29 | 63 | 24 | 41 | 37 | 37·5 | 35 | | ·27 | S.W | | S | | 3285 | | | | | | 35 | 38 | 39 | | | 6 | 5 | | 10 |
| 11 | 28·446 | 40·5 | 28·724 | 38 | 47 | 34 | 58 | 31 | 44·5 | 37·5 | 37·5 | 34 | | | S.W | | N.W | | 3067 | | | | | | 39 | 38 | 38 | | | 9 | 5 | Gale | 11 |
| 12 | 28·772 | 40 | 28·804 | 38 | 47·5 | 31 | 55 | 28 | 41 | 37 | 37 | 34·5 | | | W | | W | | 7763 | | | | | | 37 | 38 | 38 | | | 5 | 7 | | 12 |
| 13 | 28·608 | 37 | 28·780 | 38 | 49 | 33 | 61 | 25 | 34·5 | 32·5 | 37 | 35 | + | | S.W | | N.W | | 8960 | | | | | | 35 | 38 | 38 | | | 7 | 7 | | 13 |
| 14 | 29·020 | 40·5 | 29·096 | 37 | 48·5 | 32 | 62 | 26 | 39·5 | 36 | 34 | 31·5 | | | W | | W | | 9035 | | | | | | 36 | 38 | 38 | | | 8 | 6 | | 14 |
| 15 | 29·168 | 40·5 | 29·376 | 34 | 48 | 31 | 70 | 26 | 39 | 35·5 | 33 | 30·5 | | | W | | N.W | | 0660 | | | | | | 35 | 38 | 38 | | | 5 | 6 | | 15 |
| 16 | 29·598 | 41 | 29·784 | 33 | 48·5 | 29 | 73 | 24 | 39 | 36·5 | 32 | 30 | | | N.W | | N.W | | 1311 | | | | | | 35 | 38 | 38 | | | 6 | 7 | | 16 |
| 17 | 29·878 | 40·5 | 29·892 | 37 | 52 | 22 | 68 | 18 | 40·5 | 37 | 35 | 33 | | ·02 | S.W | | W | | 1426 | | | | | | 34 | 38 | 38 | | | 8 | 6 | | 17 |
| 18 | 29·834 | 41 | 29·908 | 47 | 64 | 22·5 | 81 | 18 | 45 | 41·5 | 49·5 | 46 | | | N.E | | S.W | | 1675 | | | | | | 35 | 38 | 38 | | | 6 | 5 | | 18 |
| 19 | 29·974 | 47 | 30·030 | 47 | 61 | 41·5 | 73 | 35 | 46 | 44 | 42 | 41·5 | + | | N.W | | W | | 2224 | | | | | | 42 | 40 | 38 | | | 8 | 6 | | 19 |
| 20 | 30·032 | 46 | 29·980 | 48 | 58 | 36 | 80 | 31 | 46 | 43 | 37 | 35·5 | | | W | | S.E | | 2563 | | | | | | 43 | 41 | 39 | | | 7 | 6 | | 20 |
| 21 | 29·930 | 41 | 30·020 | 43 | 61 | 26·5 | 75 | 22 | 45 | 42 | 39·5 | 37·5 | | | S.W | | S.W | | 2854 | | | | | | 40 | 42 | 40 | | | 6 | 5 | | 21 |
| 22 | 30·106 | 45 | 30·198 | 41 | 62 | 27 | 76 | 24 | 46 | 43 | 38·5 | 37·5 | | | S.E | | S.E | | 3289 | | | | | | 40 | 42 | 40 | | | 7 | 4 | Fog | 22 |
| 23 | 30·222 | 40·5 | 30·284 | 44 | 68 | 27 | 80 | 22 | 42 | 40 | 40·5 | 38 | | | S.E | | S.E | | 3501 | | | | | | 40 | 42 | 40 | | | 5 | 4 | Fog | 23 |
| 24 | 30·234 | 44 | 30·174 | 41 | 63 | 26 | 78 | 22 | 45 | 41 | 36 | 34·5 | | | S.W | | S.W | | 3743 | | | | | | 40 | 42 | 40 | | | 5 | 4 | | 24 |
| 25 | 30·034 | 43 | 29·974 | 41 | 59 | 29 | 79 | 24 | 43·5 | 42·5 | 37 | 35·5 | | | S.E | | S.E | | 4023 | | | | | | 41 | 42 | 41 | | | 8 | 7 | Fog | 25 |
| 26 | 29·862 | 46·5 | 29·864 | 39 | 55 | 27·5 | 67 | 22·5 | 47·5 | 43 | 36 | 34·5 | | | S | | E | | 4365 | | | | | | 41 | 42 | 41 | | | 8 | 7 | | 26 |
| 27 | 29·948 | 40 | 30·048 | 39 | 41 | 27 | 43 | 22 | 38 | 38 | 38 | 37·5 | | | E | | S.E | | 4692 | | | | | | 41 | 42 | 41 | | | 8 | 12 | Fog | 27 |
| 28 | 30·036 | 43 | 29·966 | 38 | 53 | 33 | 70 | 29 | 40 | 38 | 36 | 35 | | | S.E | | S | | 5358 | | | | | | 41 | 42 | 41 | | | 10 | 7 | | 28 |
| 29 | 29·848 | 55 | 29·776 | 48 | 67 | 29 | 78 | 25 | 53 | 47·5 | 47·5 | 43 | | | W | | S.W | | 5957 | | | | | | 42 | 42 | 42 | | | 9 | 5 | | 29 |
| 30 | 29·670 | 55 | 29·462 | 40 | 63 | 31 | 76 | 25·5 | 53 | 45 | 46·5 | 38 | | | S.W | | S.W | | 6358 | | | | | | 42 | 42 | 42 | | | 7 | 6 | Aurora | 30 |
| 31 | 29·512 | 43 | 29·642 | 44 | 61 | 34·5 | 68 | 28 | 40·5 | 40 | 43 | 40·5 | + | | S.E | | | | 6848 | | | | | | 42 | 43 | 42 | | | 9 | 7 | Fog | 31 |
| Sums. | ~~448·889~~ 15 | 1314·6 | ~~446·265~~ 17 | 1229 | 1644 | 953 | 2043 | 794 | 1315·5 | 1216 | 1186·5 | 1113·5 | 8 | ·29 | | | | | | | | | | | 1185 | 1219 | 1193 | | | 220 | 193 | | |
| Means. | 29·513 | 42·6 | 29·556 | 39·6 | 53·1 | 30·9 | 65·9 | 25·5 | 42·4 | 39·4 | 38·3 | 35·9 | 9 | ·29 | | | | | | | | | | | 38·2 | 39·3 | 38·5 | | | 7·1 | 6·2 | | |
| † Total Corrections for Instrumental Errors. | +035 | | +035 | | | | | | | | | | | | | | | | | | | | | | | | | | | 6·6 | | | |
| ‡ Corrections for Diurnal Range. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "Corrected Means." | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. of Column. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | |

NOTATION USED IN GENERAL REMARKS.

| | | | |
|---|---|---|---|
| a. | *denotes* aurora. | m. | *enotes* meteor. |
| ci. | ,, cirrus. | ms. | ,, meteors. |
| ci.-cu. | ,, cirro-cumulus. | n. | ,, nimbus. |
| ci.-s. | ,, cirro-stratus. | r. | ,, rain. |
| cu. | ,, cumulus. | h. r. | ,, heavy rain. |
| cu.-s. | ,, cumulo-stratus. | c. h. r. | ,, continued heavy rain. |
| d. | ,, dew. | s. | ,, stratus. |
| f. | ,, fog. | sc. | ,, scud. |
| fr. | ,, frost. | s. | ,, sleet. |
| h.-fr. | ,, hoar-frost. | s. | ,, snow. |
| h. | ,, haze. | so. ha. | ,, solar halo. |
| h. d. | ,, heavy dew. | sq. | ,, squall. |
| hl. | ,, hail. | sqs. | ,, squalls. |
| l. | ,, lightning. | t. | ,, thunder. |
| li. cl. | ,, light clouds. | t. s. | ,, thunder-storm. |
| li. sh. | ,, light showers. | w. | ,, wind. |
| lu. co. | ,, lunar corona. | g. | ,, gale of wind. |
| lu. ha. | ,, lunar halo. | | |

TABLE FOR ESTIMATING FORCE OF WIND.

| Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. |
|---|---|---|---|---|---|
| 0 | Calm | 1·5 | Light breeze | 4 | Blowing hard |
| 0·5 | Very light air | 2· | Fresh breeze | 5 | Blowing a gale |
| 1· | Light air | 3· | Very fresh | 6 | Violent gale |

**BAROMETER**, "corrected Mean" at 9 A.M., *minus* the Correction †† for Temp. (Col. 2), = 29·547 − ·37 = 29·510

"Corrected Mean" of Barometer at 9 P.M., *minus* the Correction †† for Temp. (Col. 4), = 29·591 − ·30 = 29·561

**Mean at Station, corrected, and at 32°**, = 29·536

Correction for height, feet above Mean Sea-level, = ·200

**Mean, reduced to 32°, and Sea-level**, = 29·736

Highest Reading, corrected for Index error, on the 23 th, = 30·319

Lowest Do. Do., on the 13 th, = 28·608

Difference, or **Monthly Range**, = 1·711

**S.-R. THERMOMETER**, (in shade, etc.), **Highest in Month**, (corrected for Index Errors), on the 23 th, = 68·0

**Lowest in Month**, corrected for Index errors, on the 17 th, = 22·0

Difference, or **Monthly Range**, = 46·0

"Corrected **Mean**" **of all the Highest**, (Col. 5), = 53·1

"Corrected **Mean**" **of all the Lowest**, (Col. 6), = 30·9

Difference, or **Mean Daily Range**, = 22·2

** Calculated **Mean Temperature** of Month, = 42·0

**S.-R. THERMOMETER, Black Bulb in Sun, Highest**, (corrected for Index Errors), on the 18 th, = 81·0

"Corrected **Mean**," (Col. 7), **of Black Bulb, Max. in Sun**, = 65·9

**Lowest at Night**, Black Bulb (corrected for Index errors), on the 17 th, = 18·0

"Corrected **Mean**," (Col. 8), **of Black Bulb, Min.** on grass, = 25·5

Difference of above means or range ("exposed"), =

**HYGROMETER, Mean** (corrected) A.M. and P.M. Reading **of Dry Bulb**, (Cols. 9 and 11), = 40·4

**Mean** (corrected) A.M. and P.M. Reading **of Wet Bulb**, (Cols. 10 and 12), = 37·6

‡‡ Computed **Temperature of Dew-Point**, = 34·1

‡‡ Do. **Elastic Force of Vapour**, = ·196

‡‡ Do. **Weight of Vapour in a Cubic Foot of Air**, =

‡‡ **Relative Humidity** (**Saturation** = 100), = 79

**RAIN** fell on 9 **Days; Amount in Inches**, = ·29

| WIND. Direction. | SUMMARY. N | NE | E | SE | S | SW | W | NW | Calm or Variable. | Mean Force. | Mean Velocity in miles per day. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. | | 1 | 1 | 5 | 3 | 10 | 8 | 3 | | | |
| P.M | 1 | | 1 | 6 | 2 | 7 | 9 | 4 | | | |
| Mean. | 1 | 1 | 1 | 5 | 3 | 8 | 8 | 4 | 0 | | |

* Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S."; and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.
† Embracing corrections for both capillarity and Index Errors
‡ The Diurnal Range for Scotland is as yet unknown.
†† *Practically*, though not *absolutely* a *minus* correction.
‡‡ These "Hygrometrical Deductions" are calculated from Glaisher's Hygrometrical Tables, Second Edition *only*.
** While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature." Any observations not taken under the Conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. *See over.*

*Observations made and Return verified by* John Forrest

(*Signed*)

# INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS,

## WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the chief objects that the SCOTTISH METEOROLOGICAL SOCIETY proposed to itself when the Society was established in 1855, was to secure PERFECT UNIFORMITY in the system of observation pursued at all its Stations. Uniformity in the observations is absolutely necessary to justify the publication of Monthly Results from different observations, it being found that differences between the Returns from two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those who kindly furnish Reports to the Society will, by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

**Hour of Observation.** The Council recommend that Observations be made precisely at 9 A.M. and 9 P.M. (Greenwich or Railway Time only), as specified in the following remarks, or at the top of the columns of the Schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading the time at which it was taken, if not at 9 A.M. or 9 P.M.

**Barometer.** Weather-Glasses and Aneroids, though well suited to indicate roughly variations of atmospheric pressure, are not fitted for scientific purposes. No Barometer should be used for Meteorological Observation that is not supplied with some means of adjustment or compensation which will secure that the height of the mercury in the tube is accurately measured from the fluctuating surface of the mercury in the cistern.

The Barometer in which the error arising from the fluctuating surface of the mercury in the cistern is entirely got rid of is FORTIN'S Barometer, the arrangement consisting in applying pressure by means of a screw to the bottom of the cistern, which is made of flexible leather, thus raising or depressing the surface till it just meets the ivory point which forms the zero point of the fixed scale.

The Barometer originally constructed by Mr. Adie of London, and usually called the Board of Trade Barometer, has the great convenience of requiring no adjustment of the cistern. Its scale-inches are not true inches, but so much shorter as to compensate the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This is an excellent Barometer for ordinary Observers, inasmuch as it entirely eliminates the error of observation likely to arise in not a few cases in setting the instrument to the zero point of the fixed scale when the light is not good. To show the accuracy with which these Barometers are made, it may be stated, that one was compared, during a whole year, with the Society's Standard Barometer, particular care being given to make the comparison when atmospheric pressure was rising or falling very rapidly, with the result that none of the readings differed from those of the Standard more than 0·003 inch.

A modification of Fortin's Barometer is used at a number of the Society's Stations, by which the coincidence of the zero point with the surface of the mercury is indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the index-line on this little piston-rod is brought, by the adjusting screw, to form one straight line with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this preliminary setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the vernier.

It is absolutely necessary that the Barometer which is to be used shall have been compared with a Standard Barometer.

The Barometer should be suspended in as good a light as can be secured, and to facilitate the reading, a piece of white paper may be put behind the tube. It must be hung truly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire, and must not be hung against a wall heated by a flue. The object being to secure that the whole instrument, including the brass fittings, the contained mercury, and the attached Thermometer, shall be, when read, at one uniform temperature, it is evident that the best position is that which is least liable to sudden changes of temperature.

In taking an Observation, the Attached Thermometer is first noted: the tube must then be gently tapped, and the cistern-adjustment carefully made. The eye, by raising and lowering it, must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted so as to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will facilitate an accurate adjustment and reading of the Barometer. A mistake not unfrequently made by those beginning to observe, consisting in setting the edge of the vernier to the level of the clear surface of the mercury which is in direct contact with the glass tube, must be carefully avoided.

The errors most frequently made in reading the Barometer are errors of 1·000 inch, 0·500 inch, and 0·050 inch; that is to say, instead of 29·365 inches, either of the following is sometimes set down—viz. as 30·365 inches, 28·365 inches, 29·865 inches, or 29·815 inches. Experience having shown that even the very best Observers make these mistakes, particular attention is directed to the matter.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must first be screwed so as to form a tight plug to the cistern, thus preventing the escape of the mercury. Then screw up the mercury not quite to the top of the tube, but to within a quarter of an inch of it, and take down the instrument; it should then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case if, on inclining the instrument, a sharp tap is produced when the mercury strikes the top of the tube. If a dull tap is heard, there is air in the tube, which must be got rid of.

As Barometers are liable to be deranged by the introduction of air into their tubes, on removal from place to place, or in being roughly handled, it may be useful to Observers to know how the air may be expelled. First close up the cistern by screwing the ivory peg tight, so as to prevent the escape of mercury; then screw up the mercury to about half an inch from the top of the tube; and having slowly inverted the instrument, place the top of it on a yielding substance, such as the boot, and gently tap on the cistern with the palm of the hand, so as to induce the air to ascend through the column to the cistern, whence it may escape. Since there is the weight of two atmospheres—the pressure of the mercury in the Barometer, and the air outside—pressing on any air that may be inside the tube, it is usually a tedious operation to get it wholly expelled. After repeated trials, however, it is generally accomplished; and the clear metallic sound of the mercury, when gently struck against the top of the glass tube, will show when the whole of the air has been expelled. On hanging up the Barometer, care must be taken to screw down the mercury in the tube before unfastening the float of the cistern, for, if this be not attended to, the mercury will flow out, and the instrument be seriously damaged.

**Protection and Position of Thermometers.** The Council of the Society recommend that the Self-Registering Thermometers, and the Dry and Wet Bulb Hygrometer, be kept in Stevenson's Louvre-boarded Box for Thermometers, painted white inside and outside, and screwed to four stout posts, also painted white, firmly fixed in the ground. The posts must be of such a length that when the Thermometers are hung in position the Bulbs of the Minimum Thermometer, and of the Dry and Wet Bulb Thermometers, will be exactly at the same height of FOUR FEET above the ground, the Maximum Thermometer being hung immediately above the Minimum Thermometer. The Thermometer Box is to be placed over a plot of grass, and in a free open space to which the sun's rays have free access during as much of the day as surrounding conditions enable the Observer to secure. The Thermometers are suspended on cross-laths in the centre of the Box, and face the door, which should open to the north.

The Council regard the question of UNIFORMITY OF HEIGHT ABOVE GROUND, AND METHOD IN PROTECTING THE THERMOMETERS, as vital in every system of Meteorological Observation, since without it Observations made at different Stations are incomparable, thus rendering it impossible to compare the Climates of places with each other as regards their most important features.

**Self-Registering Thermometers.** Professor Phillips, and Negretti and Zambra's Maximum Thermometers, and Rutherford's Minimum Thermometer, are recommended. It is recommended that these Thermometers be graduated on the glass stem. The Minimum Thermometer is liable to two derangements—viz., the column of spirit breaking, and part of the spirit distilling by high temperature and lodging at the top of the tube. This derangement is of occasional occurrence with protected Thermometers, but of frequent occurrence with exposed Thermometers. Hence a systematic examination of Minimum Thermometers ought to be a regular part of the work carried on by each Observer.

Fortunately, Spirit Thermometers may be easily set right by any one, when the column of spirit chances to separate. Let the Thermometer be taken in the hand by the end farthest from the bulb, raised above the head, and then forcibly swung down towards the feet; the object being, on the principle of centrifugal force, to send down the detached portion of spirit till it unites with the column. A few throws, or swinging strokes, will generally be sufficient for the purpose; after which the Thermometer should be placed in a slanting position, to allow the rest of the spirit still adhering to the sides of the tube to drain down to the column. But another method must be adopted, if the portion of spirit in the top of the tube be small. Heat should be applied slowly and cautiously to the top end of the tube where the detached portion of spirit is, which, being turned into vapour by the heat, will condense on the surface of the unbroken column of spirit. Care must be taken that the heat is not applied too quickly; for, if this be done, the tube will break and the instrument be destroyed. The best way to apply the requisite amount of heat is by bringing the end of the tube slowly down towards a minute flame from a gas-burner; or, if gas be not at hand, a piece of heated metal will serve instead.

**Black-Bulb Thermometers.** The bulbs of the Thermometers for registering the greatest heat from the sun's rays, and the least from radiation during night, have a black coating, which may easily be made, or mended, by the application of a mixture of lampblack and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind, The Maximum should be freely exposed to the sun, and the Minimum should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation. Black-bulbs enclosed in 'glass jackets' may also be used, being indeed preferable to the above. It must, however, be added, that the whole subject of the observation of Solar and Terrestrial Radiation is not yet in a sufficiently advanced state to warrant the exclusive recommendation of any one of these methods.

**Dry and Wet Bulb Hygrometer.** The Hygrometer in use at the Society's Stations consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved form of this apparatus seriously vitiate the Hygrometrical Observations, Observers are specially requested to attend to the following conditions:—The bulbs must hang down by at least an inch free from the scales and frame to which they are attached; the frame must be such as will bring the tubes forward by an inch from any board on which it may be suspended; the water-cup must be covered, and altogether placed to the side, and a little below the level of the wet bulb, but in no case under the bulbs; the muslin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the Observer that the muslin is always clean and moist, and the water pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

**Reading of the Thermometer.** In reading the Thermometer great care must be taken to bring the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40½°, respectively. So also 40½°, and 40¾°, more or less, must be registered 40°·2, or 40°·3, and 40°·7, or 40°·8 respectively. In reading Rutherford's Minimum Thermometer, the indication of that end of the index which is next the surface of the spirit is alone noted. On opening the Thermometer Box, the Dry and Wet Bulb Thermometers are to be first, and rapidly, read, inasmuch as they are readily affected by heat from the person of the Observer.

**Hour of observing Temperature.** The Hygrometer is read at 9 A.M. and 9 P.M. The Self-Registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the Self-Registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 3d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

**Verification of Thermometers.** No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a standard Thermometer. When such Thermometers as are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being re-tested. The Self-Registering, especially the Minimum Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer, marked by a scratch on the tube, ought to be tested once a year, in snow or melting ice.

In selecting instruments, the following points require attention:—The divisions of the vernier of Barometers in reference to their scales, and the perfect freedom of the Barometer from air; the correct numbering of the scale of every instrument; the rejection of Thermometers the frameworks of which are not likely to stand exposure to the weather, as shown in the past by repeated and annoying breakages of Thermometers of similar construction; and as regards Maximum Thermometers, either Negretti and Zambra's, or Phillip's, whether they will act at the highest temperatures they may be required to register. By the laws of the Society, Members and Observers have a right to have their instruments compared by the Secretary, and to advise with him regarding the purchase of instruments.

**Wind.** Very great care should be bestowed on the Observations of the Wind, the accuracy of which, both as regards Direction and Force, is so essential towards the right discussion of many of the more important problems of the science.

**1. As regards Direction.** A Wind-Vane ought to be elevated at least 12 feet above surrounding objects. When it oscillates incessantly, the mean direction should be taken. In all cases, but especially when the Vane is stationary, and when the wind is feeble, reference may be made to the direction of smoke, etc., in well-exposed situations. Careful observations are recommended to be made on the changes in the direction of the wind; and during storms, extra observations at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, is likely to give highly valuable and important results, particularly in connection with the system of thickly-planted Stations over a limited district round Edinburgh called STORM STATIONS, in the course of being established by the Society for the systematic investigation of the relation of the force of the wind to BAROMETRIC GRADIENTS, and other points connected with storms.

**2. As regards Velocity and Pressure.** The Council would recommend the Hemispherical Cup Anemometer,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the mean Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, the Pressure Anemometers recently brought under the notice of the Society by Mr. T. Stevenson, the Honorary Secretary, and Mr. R. Ballingall, the Society's Observer at Eallabus, are recommended as likely to secure uniformity in making observations on the Force of the Wind.

**Rain Gauges.** Many causes conspire to produce anomalies in Rain Returns, arising partly from the difficulty of obtaining a perfectly unobjectionable situation for observation, and partly from the defective nature of the instruments used. The Rain Gauge should not be placed on a slope or terrace, but on a level piece of ground, in as open a situation as the Observer can secure for it. As it is often difficult to obtain a position as free and unobstructed by surrounding objects as is desirable, care should be taken to place it at some distance from shrubs, trees, buildings, or other obstructions, at least as many feet from their base as they are in height. The more important directions, towards which it is most desirable to have a free exposure, are, in the order of their importance, S.W., N.E., S.E., S., and W. The rim of the gauge must be perfectly level, and fixed so that it will remain level in all weathers, and be at a height of one foot above ground, over grass. In such gauges as Fleming's, which are furnished with a measuring-rod attached to a float, the rod ought to be fixed down, and the float rise to its height only at the time the instrument is read, it being found that a stem projecting above the rim of the gauge seriously interferes with the proper measurement of the Rainfall. When a measuring-glass is used, care should be taken to hold it quite perpendicular. The Rain Gauge ought to be read daily at 9 A.M., and the reading entered in the Returns of the previous day. If the Gauge is read once a month, the reading is to be made on the first of the month, and the amount entered for the previous month.

**Snow-falls.** Snow-falls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs, it should be noted in the 'Remarks,' and the letter S affixed to the depth of water received in Gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the Rain Gauge. For wind, rain, and snow, as indeed in every column, the Observer cannot be too careful to register observations only; and nothing that partakes of the nature of deduction or inference.

**Clouds.** Convenient abbreviations for the nomenclature of Clouds will be found on the other side. The amount of Cloud ought to be estimated from the greater or less obscuration of the sky overhead (*i.e.* within 20° or 30° of the zenith). The strata of Clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the Clouds' column, though their appearance and changes may be noted among the Remarks. The amount of Cloud is entered from a scale of 0 to 10; thus, when the sky overhead is free from Clouds it is entered 0, when half-covered by Clouds, 5, wholly covered, 10, and so on.

Observations of the Clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—Thus, in the column Velocity and Direction, 6, S. W.

——— will indicate that the upper strata of Clouds travel with
2, W.

extreme velocity from S.W., and those in the lower regions from W., with one-third the speed of the former. Again, in the second Cloud column, an entry of $\frac{\text{4, st.}}{\text{2, cu-st.}}$ will indicate that the higher regions are covered to the amount of 4-tenths with stratus Clouds; and that the sky is further obscured to the extent of 2-tenths by lower Clouds of the cumulo stratus kind.

Remarks on peculiar Clouds, accompanied with drawings, will assist materially in the development of a more exact nomenclature of Clouds, as well as throw light on the electrical, and other of the more obscure phenomena of Meteorology.

**Sunshine.** The approximate number of Hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

**Underground Thermometers.** As the germination and growth of crops and plants generally depend greatly on the temperature of the soil,—its amount and constancy,—the Council recommend that Observations in this interesting department be made at 9 A.M., by Thermometers permanently fixed in the soil, their bulbs being sunk to depths of 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames.

**Temperature of the Sea.** A knowledge of the Temperature of the Sea is not only in itself, but in its relations to that of our island, a most important branch of Meteorology. The Council therefore recommend that the Temperature of the Sea be carefully taken by a properly constructed apparatus, from boats, or, if this be impracticable, from the ends of piers and rocks round the coast, where it is not influenced by that of river water, and as little influenced as possible by currents sweeping along the coast, and thus acquiring the temperature of the land, either greatly heated by the sun or cooled by nocturnal radiation. At or near the time of high water, in cases where the observations cannot be taken daily, the observation may be made on the 5th, 15th, and 25th of each month. When convenient, extra Sea Observations might be taken for other and greater depths, noting always the Temperature of the Air, and the Hour of Observation. It is also very desirable that observations on the daily Maxima and Minima by Thermometers continuously immersed, be instituted at points along the coast, by the method proposed by Mr. T. Stevenson, and already commenced at Peterhead and Liverpool.

**Temperature of Wells.** The Temperature of the water at the bottom of Wells ought, when practicable, to be taken, both the depth of the Well and of the water being noted.

**Ozone.** Mention what Test-Papers are used, Schönbein's or Moffat's, etc. The Paper is affixed by a pin to a board in the Thermometer Box, and the indications registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus $3^{\frac{N.W.}{4}}$, as an Ozone entry in the schedule will indicate that the Ozone paper is tinted as 3 on the scale, that the wind is from the N.W., and that its force on the scale 0—5 is 4, or blowing fresh.

**Atmospheric Electricity.** Too much importance cannot be attached to the electric condition of the atmosphere in connection with terrestrial magnetism, barometrical, thermometrical, and meteorological phenomena generally. A proper Electrometer is, in truth, necessary to every complete meteorological observatory.

**Remarks.** The Remarks column is unavoidably too narrow. Some of the most valuable Observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are in general use is given at the foot of the column. Besides special and extraordinary Observations, great prominence ought to be given in this column to Prevalent Diseases, differences in character, colour, velocity, and direction between the Lower and Upper Strata of clouds, the Colour of the Sky, etc. Remarks ought to be made on the occurrence of Meteors, Auroræ Boreales, remarkable depressions, elevations, and fluctuations of the Barometer, Thunder-Storms, and remarkable falls of Snow, Hail, or Rain, the Hour of Storms of Wind commencing, attaining their maximum, and ending, as well as such Notes on Storms as have been hinted at above. When lofty hills are in the vicinity of a Station, the Height of Clouds and of the Snow-line in winter should be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. should be registered, either in two columns, otherwise unoccupied, or ruled off for the purpose, from the column of 'Remarks.'

**Observations in connection with the Periodic Return of the Seasons.** Observations in connection with the Periodic Return of the Seasons, possess not only great scientific value, but are of considerable importance in connection with Agriculture, Horticulture, and Natural History. The Council would direct the special attention of Observers to the registration of such phenomena, so that the published Summaries may fairly represent the whole of Scotland. Observations ought to be confined to individual trees and shrubs; to particular species of birds, and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm. The Annual Table, published yearly in the Society's Journal, will indicate the species of plants and animals to which special attention is more particularly directed.

The Council recommend Observers, before purchasing new instruments, and in repairing old ones, to communicate with the Meteorological Secretary, in order that every instrument may be examined and improved before being used; and they consider it necessary that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, *December* 1891.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

| FOREST TREES. | In Flower. | Leaf Buds first Appear. | In Leaf. | Divested of Leaves. |
|---|---|---|---|---|
| Alder, | | | | |
| Ash, | | | | |
| Beech, | | | | |
| Birch, | | | | |
| Elm, | | | | |
| Larch, | | | | |
| Lime, | | | | |
| Oak, | | | | |
| Sycamore or Plane, | | | | |

| SHRUBS, ETC. | First in Blossom. |
|---|---|
| Barberry, | |
| Bourtree or Elder, | |
| Broom, | |
| Hazel, | |
| Hawthorn, | |
| Holly, | |
| Laburnum, | |
| Lilac, | |
| Mezereon, | |
| Mountain Ash or Rowan, | |
| Red Flowering Currant, | |
| Rhododendron Ponticum, | |
| White, | |

| FRUITS. | First in Blossom. |
|---|---|
| Apple, | |
| Black Currant, | |
| Cherry, | |
| Gean, | |
| Gooseberry, | |
| Peach, | |
| Pear, | |
| Plum, | |
| Strawberry, | |

| CROPS, mentioning variety. | Sowing or Planting. | Appearing above Ground. | In Ear or Flower. | First Cut or Raised. |
|---|---|---|---|---|
| Barley, | | | | |
| Bere or Bigg, | | | | |
| Oats, | | | | |
| Wheat, | | | | |
| Beans, | | | | |
| Pease, | | | | |
| Potatoes, | | | | |
| Turnips, | | | | |
| Rye Grass, | | | | |

| Fruit Ripe, generally. |
|---|
| |

| MIGRATORY BIRDS. | First Arrival. | Departure. |
|---|---|---|
| Cuckoo, | | |
| Curlew, | | |
| House-Swallow, | | |
| Lapwing, | | |
| Plover, | | |
| Sand-Martin, | | |
| Starling, | | |
| Swan, | | |
| Rail or Corn Crake, | | |

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

Haddo House
March 1894

To the SECRETARY
Scottish Meteorological Society,
122 George Street,
EDINBURGH.

BOOK POST.

# SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Haddo House, County of Aberdeen, in Lat. 57°24', Long. 2°14', Distance from Sea 12 miles.

Height of Cistern of the Barometer above Mean Sea-Level 180 feet, above Ground 3 feet. During the MONTH of April 1894.

The Hours of Observation are of Greenwich Time.

| Days of Month. | BAROMETER. 9 h. A.M. * No. | Attached Thermometer | 9 h. P.M. No. | Attached Thermometer | SELF-REGISTERING THERMOMETERS, Read Daily, at 9 P.M. Protected in Shade, 4 feet above Ground. Max. No. | Min. No. | Exposed Black Bulbs. Max. in Sun's rays No. | Min. on Grass No. | HYGROMETER. Dry No. Wet No. 9 h. A.M. Dry bulb. | Wet bulb. | 9 h. P.M. Dry bulb. | Wet bulb. | Rain. No. of day in which it fell. | Amount in inches. No. | WIND. 9 h. A.M. Direction. | Force | 9 h. P.M. Direction. | Force | Readings of the H. Cup Anemometer. No. 9 h. A.M. | CLOUDS. 9 A.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | P.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | SUNSHINE. Hours. | THERMOMETERS under Ground. 9 h. A.M. No. 3 inches. | No. 12 inches. | No. 22 inches. | Temperature of WELL at depth of feet, No. | SEA. Temperature at 1 fathom, and Density. | OZONE. 0—10. 9 A.M. | 9 P.M. | GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. *Mention the hour at which Storms, including Thunder and Lightning, began and ended.* | Days of Month. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches. | ° | inches. | ° | ° | ° | ° | ° | ° | ° | ° | ° | | | | | | | | | | | | | | ° | ° | | | | | | | |
| 1 | 29·766 | 51 | 29·782 | 44 | 58 | 29 | 73 | 24 | 50 | 46 | 39·5 | 38·5 | + | | S.W | | S.W | | 7238 | | | | | | 42 | 43 | 42 | | | 7 | 7 | Thunder | 1 |
| 2 | 29·788 | 46 | 29·764 | 42 | 55 | 31 | 66 | 28 | 44 | 42·5 | 39 | 38·5 | | | S.E | | S.E | | 7451 | | | | | | 44 | 43 | 42 | | | 7 | 9 | Fog | 2 |
| 3 | 29·692 | 41 | 29·804 | 43 | 50·5 | 35 | 63 | 26 | 40 | 40 | 43 | 41 | | | S.E | | S.E | | 8120 | | | | | | 44 | 44 | 43 | | | 8 | 9 | Fog | 3 |
| 4 | 29·860 | 45 | 30·034 | 44 | 49 | 41 | 67 | 33 | 44 | 41 | 43 | 41·5 | | | S | | S.E | | 8935 | | | | | | 45 | 45 | 43 | | | 7 | 6 | | 4 |
| 5 | 30·050 | 45 | 30·152 | 41 | 51 | 39 | 64 | 38 | 44 | 42 | 40 | 38 | | | S.E | | E | | 9716 | | | | | | 45 | 45 | 43 | | | 8 | 8 | | 5 |
| 6 | 30·108 | 46·5 | 30·048 | 42 | 46 | 39 | 51 | 37 | 44 | 41 | 41 | 40 | + | | S.E | | E | | 0794 | | | | | | 45 | 45 | 43 | | | 8 | 8 | | 6 |
| 7 | 29·976 | 48 | 29·910 | 42 | 49 | 37 | 67 | 33 | 47 | 43·5 | 41 | 40 | | ·05 | S.E | | S.E | | 1817 | | | | | | 45 | 45 | 43 | | | 9 | 7 | | 7 |
| 8 | 29·812 | 45 | 29·708 | 43·5 | 47 | 40 | 51 | 32 | 47 | 46 | 42 | 41·5 | | | E | | S.E | | 3098 | | | | | | 44 | 45 | 43 | | | 10 | 10 | | 8 |
| 9 | 29·612 | 44 | 29·648 | 46 | 61 | 39 | 76 | 35 | 44·5 | 44 | 45 | 43·5 | | | S.E | | S.E | | 3847 | | | | | | 44 | 43 | 43 | | | 10 | 7 | | 9 |
| 10 | 29·768 | 54 | 29·768 | 47 | 55 | 36 | 68 | 32 | 52 | 48·5 | 45·5 | 43·5 | | | S.W | | S.W | | 4421 | | | | | | 46 | 45 | 44 | | | 8 | 6 | | 10 |
| 11 | 29·778 | 55 | 29·804 | 46 | 64·5 | 41 | 75 | 35 | 52 | 48·5 | 42 | 41·5 | | | S.E | | S.E | | 5040 | | | | | | 46 | 45 | 44 | | | 9 | 5 | | 11 |
| 12 | 29·768 | 55 | 29·782 | 44 | 53·5 | 32 | 64 | 27 | 50 | 47 | 41 | 40·5 | | | S.E | | E | | 5793 | | | | | | 46 | 46 | 44 | | | 9 | 6 | | 12 |
| 13 | 29·804 | 50 | 29·702 | 44 | 51 | 34 | 66 | 32 | 46 | 43 | 41·5 | 40 | | | S.E | | S.E | | 7661 | | | | | | 46 | 46 | 45 | | | 8 | 8 | | 13 |
| 14 | 29·600 | 46 | 29·452 | 43 | 47 | 31 | 68 | 24 | 44 | 41 | 42·5 | 41·5 | + | ·83 | S.E | | S.E | | 8985 | | | | | | 45 | 46 | 45 | | | 8 | 9 | | 14 |
| 15 | 29·470 | 53 | 29·422 | 46 | 58 | 42 | 73 | 37 | 49·5 | 47 | 44 | 43·5 | | | E | | S.E | | 0507 | | | | | | 47 | 46 | 45 | | | 9 | 10 | Fog | 15 |
| 16 | 29·372 | 46 | 29·246 | 46 | 57·5 | 42 | 70 | 40 | 44 | 43·5 | 42 | 41·5 | + | | E | | E | | 1507 | | | | | | 47 | 47 | 45 | | | 10 | 9 | Fog | 16 |
| 17 | 29·086 | 47 | 29·334 | 44 | 56 | 40 | 77 | 36 | 46 | 45 | 42 | 41·5 | + | | S.W | | S.W | | 2078 | | | | | | 48 | 47 | 45 | | | 10 | 9 | Fog | 17 |
| 18 | 29·496 | 47 | 29·782 | 44 | 53 | 38 | 64 | 33 | 47 | 46 | 41 | 40 | + | | N.W | | N.W | | 2387 | | | | | | 47 | 47 | 45 | | | 8 | 8 | | 18 |
| 19 | 29·936 | 54 | 29·958 | 44 | 58 | 32 | 81 | 26 | 50 | 45 | 42 | 40 | | | N.W | | E | | 2661 | | | | | | 47 | 47 | 46 | | | 9 | 5 | | 19 |
| 20 | 29·956 | 55 | 29·896 | 46 | 57 | 36 | 72 | 30 | 54 | 48 | 48 | 46 | | | N.E | | S.E | | 3059 | | | | | | 48 | 47 | 46 | | | 6 | 5 | | 20 |
| 21 | 29·846 | 46 | 29·878 | 42 | 52·5 | 39 | 55 | 35 | 44 | 42 | 40·5 | 39 | | ·42 | S.E | | E | | 3903 | | | | | | 48 | 47 | 46 | | | 10 | 8 | | 21 |
| 22 | 29·784 | 45 | 29·696 | 43 | 48 | 38 | 60 | 33 | 45 | 41 | 41·5 | 41 | + | | S.E | | E | | 5272 | | | | | | 46 | 47 | 46 | | | 9 | 9 | | 22 |
| 23 | 29·548 | 44·5 | 29·501 | 42 | 48 | 39 | 55 | 37 | 44 | 42 | 40 | 39 | | | E | | E | | 7223 | | | | | | 46 | 47 | 46 | | | 11 | 9 | | 23 |
| 24 | 29·452 | 47 | 29·350 | 45 | 51 | 39 | 51 | 36 | 44 | 42 | 44 | 43 | + | | S.E | | S.E | | 5541 | | | | | | 46 | 47 | 46 | | | 10 | 10 | | 24 |
| 25 | 29·414 | 52 | 29·338 | 45 | 53·5 | 37·5 | 70 | 32·5 | 50 | 46 | 44 | 41 | | | S.E | | S.E | | 9867 | | | | | | 46 | 46 | 46 | | | 9 | 6 | | 25 |
| 26 | 29·418 | 57 | 29·392 | 45 | 58·5 | 37·5 | 86 | 36 | 52 | 47 | 42·5 | 41·5 | | | S.E | | S.E | | 1058 | | | | | | 48 | 47 | 46 | | | 8 | 8 | | 26 |
| 27 | 29·368 | 58·5 | 29·526 | 47 | 58 | 42 | 73 | 40 | 46 | 44 | 45 | 43·5 | | | S.E | | N.E | | 1821 | | | | | | 49 | 48 | 46 | | | 9 | 6 | | 27 |
| 28 | 29·740 | 51 | 29·818 | 46·5 | 61 | 43·5 | 88 | 37 | 50 | 44·5 | 45 | 41·5 | | | S.W | | S.W | | 2046 | | | | | | 51 | 49 | 46 | | | 7 | 6 | | 28 |
| 29 | 29·728 | 53 | 29·808 | 50·5 | 61 | 43 | 79 | 37 | 54 | 51 | 49 | 48 | + | | S.W | | N.E | | 2534 | | | | | | 51 | 50 | 47 | | | 9 | 6 | | 29 |
| 30 | 30·028 | 57 | 30·112 | 47 | 57 | 42 | 84 | 36 | 52 | 45 | 43·5 | 41·5 | + | ·22 | N.W | | N.W | | 2900 | | | | | | 52 | 50 | 47 | | | 10 | 9 | | 30 |
| 31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 31 |
| Sums. | 891·024 | 484 | 891·355 | 1334 | 1637·5 | 1137·5 | 2060 | 997 | 1420 | 1333 | 1280 | 1246 | | ·72 | | | | | | | | | | | 1291 | 1285 | 1247 | | | 260 | 228 | | |
| Means. | 29·701 | 49·4 | 29·712 | 44·4 | 54·3 | 37·8 | 68·6 | 33·2 | 47·4 | 44·4 | 42·7 | 41·4 | 10 | ·72 | | | | | | | | | | | 43 | 42·8 | 41·5 | | | 8·7 | 7·6 | | |
| † Total Corrections for Instrumental Errors. | +035 | | +035 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ‡ Corrections for Diurnal Range. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "Corrected Means." | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. of Column. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | | |

NOTATION USED IN GENERAL REMARKS.

| | | | |
|---|---|---|---|
| a. | *denotes* aurora. | m. | *enotes* meteor. |
| ci. | ,, cirrus. | ms. | ,, meteors. |
| ci.-cu. | ,, cirro-cumulus. | n. | ,, nimbus. |
| ci.-s. | ,, cirro-stratus. | r. | ,, rain. |
| cu. | ,, cumulus. | h. r. | ,, heavy rain. |
| cu.-s. | ,, cumulo-stratus. | c. h. r. | ,, continued heavy rain. |
| d. | ,, dew. | s. | ,, stratus. |
| f. | ,, fog. | sc. | ,, scud. |
| fr. | ,, frost. | s. | ,, sleet. |
| h.-fr. | ,, hoar-frost. | s. | ,, snow. |
| h. | ,, haze. | so. ha. | ,, solar halo. |
| h. d. | ,, heavy dew. | sq. | ,, squall. |
| hl. | ,, hail. | sqs. | ,, squalls. |
| l. | ,, lightning. | t. | ,, thunder. |
| li. cl. | ,, light clouds. | t. s. | ,, thunder-storm. |
| li. sh. | ,, light showers. | w. | ,, wind. |
| lu. co. | ,, lunar corona. | g. | ,, gale of wind. |
| lu. ha. | ,, lunar halo. | | |

TABLE FOR ESTIMATING FORCE OF WIND.

| Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. |
|---|---|---|---|---|---|
| 0 | Calm | 1·5 | Light breeze | 4 | Blowing hard |
| 0·5 | Very light air | 2· | Fresh breeze | 5 | Blowing a gale |
| 1· | Light air | 3· | Very fresh | 6 | Violent gale |

**BAROMETER**, "corrected Mean" at 9 A.M., *minus* the Correction †† for Temp. (Col. 2), = 29·736 − 57 = 29·679

"Corrected Mean" of Barometer at 9 P.M., *minus* the Correction †† for Temp. (Col. 4), = 29·747 − 44 = 29·703

**Mean at Station, corrected, and at 32°**, = 29·691

Correction for height, feet above Mean Sea-level, = 199

**Mean, reduced to 32°, and Sea-level**, = 29·890

Highest Reading, corrected for Index error, on the 5 th, = 30·152

Lowest Do. Do., on the 17 th, = 29·086

Difference, or **Monthly Range**, = 1·066

**S.-R. THERMOMETER**, (in shade, etc.), **Highest in Month**, (corrected for Index Errors), on the 11 th, = 64·5

**Lowest in Month**, corrected for Index errors, on the 1 th, = 29·0

Difference, or **Monthly Range**, = 35·5

"Corrected **Mean**" **of all the Highest**, (Col. 5), = 54·3

"Corrected **Mean**" **of all the Lowest**, (Col. 6), = 37·8

Difference, or **Mean Daily Range**, = 16·5

** Calculated **Mean Temperature** of Month, = 46·0

**S.-R. THERMOMETER, Black Bulb in Sun, Highest**, (corrected for Index Errors), on the th, =

"Corrected **Mean**," (Col. 7), **of Black Bulb, Max. in Sun**, =

**Lowest at Night**, Black Bulb (corrected for Index errors), on the th, =

"Corrected **Mean**," (Col. 8), **of Black Bulb, Min.** on grass, =

Difference of above means or range ("exposed"), =

**HYGROMETER, Mean** (corrected) A.M. and P.M. Reading **of Dry Bulb**, (Cols. 9 and 11), = 45·0

**Mean** (corrected) A.M. and P.M. Reading **of Wet Bulb**, (Cols. 10 and 12), = 42·9

‡‡ Computed **Temperature of Dew-Point**, = 40·5

‡‡ Do. **Elastic Force of Vapour**, = ·251

‡‡ Do. **Weight of Vapour in a Cubic Foot of Air**, =

‡‡ **Relative Humidity** (**Saturation** = 100), = 84

**RAIN** fell on 10 **Days; Amount in Inches**, = 0·72

| WIND. Direction. | SUMMARY. N | NE | E | SE | S | SW | W | NW | Calm or Variable. | Mean Force. | Mean Velocity in miles per day. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. | | 1 | 4 | 16 | 1 | 5 | 0 | 3 | | | |
| P.M | | 2 | 8 | 14 | | 4 | | 2 | | | |
| Mean. | 0 | 2 | 6 | 15 | 1 | 4 | 0 | 2 | 0 | | |

* Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S."; and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.

† Embracing corrections for both capillarity and Index Errors

‡ The Diurnal Range for Scotland is as yet unknown.

†† *Practically*, though not *absolutely* a *minus* correction.

‡‡ These "Hygrometrical Deductions" are calculated from Glaisher's Hygrometrical Tables, Second Edition *only*.

** While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature."

Any observations not taken under the Conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. *See over.*

*Observations made and Return verified by* John Forrest

(*Signed*)

# INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS,

## WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the chief objects that the SCOTTISH METEOROLOGICAL SOCIETY proposed to itself when the Society was established in 1855, was to secure PERFECT UNIFORMITY in the system of observation pursued at all its Stations. Uniformity in the observations is absolutely necessary to justify the publication of Monthly Results from different observations, it being found that differences between the Returns from two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those who kindly furnish Reports to the Society will, by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

The Council recommend that Observations be made precisely at

**Hour of Observation.**

9 A.M. and 9 P.M. (Greenwich or Railway Time only), as specified in the following remarks, or at the top of the columns of the Schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading the time at which it was taken, if not at 9 A.M. or 9 P.M.

**Barometer.**

Weather-Glasses and Aneroids, though well suited to indicate roughly variations of atmospheric pressure, are not fitted for scientific purposes. No Barometer should be used for Meteorological Observation that is not supplied with some means of adjustment or compensation which will secure that the height of the mercury in the tube is accurately measured from the fluctuating surface of the mercury in the cistern.

The Barometer in which the error arising from the fluctuating surface of the mercury in the cistern is entirely got rid of is FORTIN'S Barometer, the arrangement consisting in applying pressure by means of a screw to the bottom of the cistern, which is made of flexible leather, thus raising or depressing the surface till it just meets the ivory point which forms the zero point of the fixed scale.

The Barometer originally constructed by Mr. Adie of London, and usually called the Board of Trade Barometer, has the great convenience of requiring no adjustment of the cistern. Its scale-inches are not true inches, but so much shorter as to compensate the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This is an excellent Barometer for ordinary Observers, inasmuch as it entirely eliminates the error of observation likely to arise in not a few cases in setting the instrument to the zero point of the fixed scale when the light is not good. To show the accuracy with which these Barometers are made, it may be stated, that one was compared, during a whole year, with the Society's Standard Barometer, particular care being given to make the comparison when atmospheric pressure was rising or falling very rapidly, with the result that none of the readings differed from those of the Standard more than 0·003 inch.

A modification of Fortin's Barometer is used at a number of the Society's Stations, by which the coincidence of the zero point with the surface of the mercury is indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the index-line on this little piston-rod is brought, by the adjusting screw, to form one straight line with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this preliminary setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the vernier.

It is absolutely necessary that the Barometer which is to be used shall have been compared with a Standard Barometer.

The Barometer should be suspended in as good a light as can be secured, and to facilitate the reading, a piece of white paper may be put behind the tube. It must be hung truly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire, and must not be hung against a wall heated by a flue. The object being to secure that the whole instrument, including the brass fittings, the contained mercury, and the attached Thermometer, shall be, when read, at one uniform temperature, it is evident that the best position is that which is least liable to sudden changes of temperature.

In taking an Observation, the Attached Thermometer is first noted: the tube must then be gently tapped, and the cistern-adjustment carefully made. The eye, by raising and lowering it, must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted so as to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will facilitate an accurate adjustment and reading of the Barometer. A mistake not unfrequently made by those beginning to observe, consisting in setting the edge of the vernier to the level of the clear surface of the mercury which is in direct contact with the glass tube, must be carefully avoided.

The errors most frequently made in reading the Barometer are errors of 1·000 inch, 0·500 inch, and 0·050 inch; that is to say, instead of 29·365 inches, either of the following is sometimes set down—viz. as 30·365 inches, 28·365 inches, 29·865 inches, or 29·815 inches. Experience having shown that even the very best Observers make these mistakes, particular attention is directed to the matter.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must first be screwed so as to form a tight plug to the cistern, thus preventing the escape of the mercury. Then screw up the mercury not quite to the top of the tube, but to within a quarter of an inch of it, and take down the instrument; it should then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case if, on inclining the instrument, a sharp tap is produced when the mercury strikes the top of the tube. If a dull tap is heard, there is air in the tube, which must be got rid of.

As Barometers are liable to be deranged by the introduction of air into their tubes, on removal from place to place, or in being roughly handled, it may be useful to Observers to know how the air may be expelled. First close up the cistern by screwing the ivory peg tight, so as to prevent the escape of mercury; then screw up the mercury to about half an inch from the top of the tube; and having slowly inverted the instrument, place the top of it on a yielding substance, such as the boot, and gently tap on the cistern with the palm of the hand, so as to induce the air to ascend through the column to the cistern, whence it may escape. Since there is the weight of two atmospheres—the pressure of the mercury in the Barometer, and the air outside—pressing on any air that may be inside the tube, it is usually a tedious operation to get it wholly expelled. After repeated trials, however, it is generally accomplished; and the clear metallic sound of the mercury, when gently struck against the top of the glass tube, will show when the whole of the air has been expelled. On hanging up the Barometer, care must be taken to screw down the mercury in the tube before unfastening the float of the cistern, for, if this be not attended to, the mercury will flow out, and the instrument be seriously damaged.

The Council of the Society recommend that the Self-Registering Thermometers, and the Dry and Wet Bulb Hygrometer, be kept in Stevenson's Louvre-boarded Box for Thermometers, painted white inside and outside, and screwed to four stout posts, also painted white, firmly fixed in the ground. The posts must be of such a length that when the Thermometers are hung in position the Bulbs of the Minimum Thermometer, and of the Dry and Wet Bulb Thermometers, will be exactly at the same height of FOUR FEET above the ground, the Maximum Thermometer being hung immediately above the Minimum Thermometer. The Thermometer Box is to be placed over a plot of grass, and in a free open space to which the sun's rays have free access during as much of the day as surrounding conditions enable the Observer to secure. The Thermometers are suspended on cross-laths in the centre of the Box, and face the door, which should open to the north.

**Protection and Position of Thermometers.**

The Council regard the question of UNIFORMITY OF HEIGHT ABOVE GROUND, AND METHOD IN PROTECTING THE THERMOMETERS, as vital in every system of Meteorological Observation, since without it Observations made at different Stations are incomparable, thus rendering it impossible to compare the Climates of places with each other as regards their most important features.

Professor Phillips, and Negretti and Zambra's Maximum Thermometers, and Rutherford's Minimum Thermometer, are recommended. It is recommended that these Thermometers be graduated on the glass stem. The Minimum Thermometer is liable to two derangements—viz., the column of spirit breaking, and part of the spirit distilling by high temperature and lodging at the top of the tube. This derangement is of occasional occurrence with protected Thermometers, but of frequent occurrence with exposed Thermometers. Hence a systematic examination of Minimum Thermometers ought to be a regular part of the work carried on by each Observer.

**Self-Registering Thermometers.**

Fortunately, Spirit Thermometers may be easily set right by any one, when the column of spirit chances to separate. Let the Thermometer be taken in the hand by the end farthest from the bulb, raised above the head, and then forcibly swung down towards the feet; the object being, on the principle of centrifugal force, to send down the detached portion of spirit till it unites with the column. A few throws, or swinging strokes, will generally be sufficient for the purpose; after which the Thermometer should be placed in a slanting position, to allow the rest of the spirit still adhering to the sides of the tube to drain down to the column. But another method must be adopted, if the portion of spirit in the top of the tube be small. Heat should be applied slowly and cautiously to the top end of the tube where the detached portion of spirit is, which, being turned into vapour by the heat, will condense on the surface of the unbroken column of spirit. Care must be taken that the heat is not applied too quickly; for, if this be done, the tube will break and the instrument be destroyed. The best way to apply the requisite amount of heat is by bringing the end of the tube slowly down towards a minute flame from a gas-burner; or, if gas be not at hand, a piece of heated metal will serve instead.

The bulbs of the Thermometers for registering the greatest heat from the sun's rays, and the least from radiation during night, have a black coating, which may easily be made, or mended, by the application of a mixture of lampblack and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind, The Maximum should be freely exposed to the sun, and the Minimum should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation. Black-bulbs enclosed in 'glass jackets' may also be used, being indeed preferable to the above. It must, however, be added, that the whole subject of the observation of Solar and Terrestrial Radiation is not yet in a sufficiently advanced state to warrant the exclusive recommendation of any one of these methods.

**Black-Bulb Thermometers.**

The Hygrometer in use at the Society's Stations consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved form of this apparatus seriously vitiate the Hygrometrical Observations, Observers are specially requested to attend to the following conditions:—The bulbs must hang down by at least an inch free from the scales and frame to which they are attached; the frame must be such as will bring the tubes forward by an inch from any board on which it may be suspended; the water-cup must be covered, and altogether placed to the side, and a little below the level of the wet bulb, but in no case under the bulbs; the muslin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the Observer that the muslin is always clean and moist, and the water pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

**Dry and Wet Bulb Hygrometer.**

In reading the Thermometer great care must be taken to bring the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or $40\frac{1}{2}°$, respectively. So also $40\frac{1}{4}°$, and $40\frac{3}{4}°$, more or less, must be registered 40°·2, or 40°·3, and 40°·7, or 40°·8 respectively. In reading Rutherford's Minimum Thermometer, the indication of that end of the index which is next the surface of the spirit is alone noted. On opening the Thermometer Box, the Dry and Wet Bulb Thermometers are to be first, and rapidly, read, inasmuch as they are readily affected by heat from the person of the Observer.

**Reading of the Thermometer.**

The Hygrometer is read at 9 A.M. and 9 P.M. The Self-Registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the Self-Registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 3d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

**Hour of observing Temperature.**

No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a standard Thermometer. When such Thermometers as are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being re-tested. The Self-Registering, especially the Minimum Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer, marked by a scratch on the tube, ought to be tested once a year, in snow or melting ice.

**Verification of Thermometers.**

In selecting instruments, the following points require attention:—The divisions of the vernier of Barometers in reference to their scales, and the perfect freedom of the Barometer from air; the correct numbering of the scale of every instrument; the rejection of Thermometers the frameworks of which are not likely to stand exposure to the weather, as shown in the past by repeated and annoying breakages of Thermometers of similar construction; and as regards Maximum Thermometers, either Negretti and Zambra's, or Phillip's, whether they will act at the highest temperatures they may be required to register. By the laws of the Society, Members and Observers have a right to have their instruments compared by the Secretary, and to advise with him regarding the purchase of instruments.

Very great care should be bestowed on the Observations of the Wind, the accuracy of which, both as regards Direction and Force, is so essential towards the right discussion of many of the more important problems of the science.

**Wind.**

A Wind-Vane ought to be elevated at least 12 feet above surrounding objects. When it oscillates incessantly, the mean direction should be taken. In all cases, but especially when the Vane is stationary, and when the wind is feeble, reference may be made to the direction of smoke, etc., in well-exposed situations. Careful observations are recommended to be made on the changes in the direction of the wind; and during storms, extra observations at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, is likely to give highly valuable and important results, particularly in connection with the system of thickly-planted Stations over a limited district round Edinburgh called STORM STATIONS, in the course of being established by the Society for the systematic investigation of the relation of the force of the wind to BAROMETRIC GRADIENTS, and other points connected with storms.

**1. As regards Direction.**

The Council would recommend the Hemispherical Cup Anemometer,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the mean Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, the Pressure Anemometers recently brought under the notice of the Society by Mr. T. Stevenson, the Honorary Secretary, and Mr. R. Ballingall, the Society's Observer at Eallabus, are recommended as likely to secure uniformity in making observations on the Force of the Wind.

**2. As regards Velocity and Pressure.**

Many causes conspire to produce anomalies in Rain Returns, arising partly from the difficulty of obtaining a perfectly unobjectionable situation for observation, and partly from the defective nature of the instruments used. The Rain Gauge should not be placed on a slope or terrace, but on a level piece of ground, in as open a situation as the Observer can secure for it. As it is often difficult to obtain a position as free and unobstructed by surrounding objects as is desirable, care should be taken to place it at some distance from shrubs, trees, buildings, or other obstructions, at least as many feet from their base as they are in height. The more important directions, towards which it is most desirable to have a free exposure, are, in the order of their importance, S.W., N.E., S.E., S., and W. The rim of the gauge must be perfectly level, and fixed so that it will remain level in all weathers, and be at a height of one foot above ground, over grass. In such gauges as Fleming's, which are furnished with a measuring-rod attached to a float, the rod ought to be fixed down, and the float rise to its height only at the time the instrument is read, it being found that a stem projecting above the rim of the gauge seriously interferes with the proper measurement of the Rainfall. When a measuring-glass is used, care should be taken to hold it quite perpendicular. The Rain Gauge ought to be read daily at 9 A.M., and the reading entered in the Returns of the previous day. If the Gauge is read once a month, the reading is to be made on the first of the month, and the amount entered for the previous month.

**Rain Gauges.**

Snow-falls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs, it should be noted in the 'Remarks,' and the letter S affixed to the depth of water received in Gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the Rain Gauge. For wind, rain, and snow, as indeed in every column, the Observer cannot be too careful to register observations only; and nothing that partakes of the nature of deduction or inference.

**Snow-falls.**

Convenient abbreviations for the nomenclature of Clouds will be found on the other side. The amount of Cloud ought to be estimated from the greater or less obscuration of the sky overhead (*i.e.* within 20° or 30° of the zenith). The strata of Clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the Clouds' column, though their appearance and changes may be noted among the Remarks. The amount of Cloud is entered from a scale of 0 to 10; thus, when the sky overhead is free from Clouds it is entered 0, when half-covered by Clouds, 5, wholly covered, 10, and so on.

**Clouds.**

Observations of the Clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—Thus, in the column Velocity and Direction, 6, S. W.

——— will indicate that the upper strata of Clouds travel with
2, W.

extreme velocity from S.W., and those in the lower regions from W., with one-third the speed of the former. Again, in the second
4, st.

Cloud column, an entry of ——— will indicate that the higher
2, cu-st.

regions are covered to the amount of 4-tenths with stratus Clouds; and that the sky is further obscured to the extent of 2-tenths by lower Clouds of the cumulo stratus kind.

Remarks on peculiar Clouds, accompanied with drawings, will assist materially in the development of a more exact nomenclature of Clouds, as well as throw light on the electrical, and other of the more obscure phenomena of Meteorology.

The approximate number of Hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

**Sunshine.**

As the germination and growth of crops and plants generally depend greatly on the temperature of the soil,—its amount and constancy,—the Council recommend that Observations in this interesting department be made at 9 A.M., by Thermometers permanently fixed in the soil, their bulbs being sunk to depths of 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames.

**Underground Thermometers.**

A knowledge of the Temperature of the Sea is not only in itself, but in its relations to that of our island, a most important branch of Meteorology. The Council therefore recommend that the Temperature of the Sea be carefully taken by a properly constructed apparatus, from boats, or, if this be impracticable, from the ends of piers and rocks round the coast, where it is not influenced by that of river water, and as little influenced as possible by currents sweeping along the coast, and thus acquiring the temperature of the land, either greatly heated by the sun or cooled by nocturnal radiation. At or near the time of high water, in cases where the observations cannot be taken daily, the observation may be made on the 5th, 15th, and 25th of each month. When convenient, extra Sea Observations might be taken for other and greater depths, noting always the Temperature of the Air, and the Hour of Observation. It is also very desirable that observations on the daily Maxima and Minima by Thermometers continuously immersed, be instituted at points along the coast, by the method proposed by Mr. T. Stevenson, and already commenced at Peterhead and Liverpool.

**Temperature of the Sea.**

The Temperature of the water at the bottom of Wells ought, when practicable, to be taken, both the depth of the Well and of the water being noted.

**Temperature of Wells.**

Mention what Test-Papers are used, Schönbein's or Moffat's, etc.

The Paper is affixed by a pin to a board in the Thermometer Box, and the indications registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus $3^{S.W.}_{4}$, as an Ozone entry in the schedule will indicate that the Ozone paper is tinted as 3 on the scale, that the wind is from the N.W., and that its force on the scale 0—5 is 4, or blowing fresh.

**Ozone.**

Too much importance cannot be attached to the electric condition of the atmosphere in connection with terrestrial magnetism, barometrical, thermometrical, and meteorological phenomena generally. A proper Electrometer is, in truth, necessary to every complete meteorological observatory.

**Atmospheric Electricity.**

The Remarks column is unavoidably too narrow. Some of the most valuable Observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are in general use is given at the foot of the column. Besides special and extraordinary Observations, great prominence ought to be given in this column to Prevalent Diseases, differences in character, colour, velocity, and direction between the Lower and Upper Strata of clouds, the Colour of the Sky, etc. Remarks ought to be made on the occurrence of Meteors, Auroræ Boreales, remarkable depressions, elevations, and fluctuations of the Barometer, Thunder-Storms, and remarkable falls of Snow, Hail, or Rain, the Hour of Storms of Wind commencing, attaining their maximum, and ending, as well as such Notes on Storms as have been hinted at above. When lofty hills are in the vicinity of a Station, the Height of Clouds and of the Snow-line in winter should be recorded.

**Remarks.**

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. should be registered, either in two columns, otherwise unoccupied, or ruled off for the purpose, from the column of 'Remarks.'

Observations in connection with the Periodic Return of the Seasons, possess not only great scientific value, but are of considerable importance in connection with Agriculture, Horticulture, and Natural History. The Council would direct the special attention of Observers to the registration of such phenomena, so that the published Summaries may fairly represent the whole of Scotland. Observations ought to be confined to individual trees and shrubs, to particular species of birds, and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm. The Annual Table, published yearly in the Society's Journal, will indicate the species of plants and animals to which special attention is more particularly directed.

**Observations in connection with the Periodic Return of the Seasons.**

The Council recommend Observers, before purchasing new instruments, and in repairing old ones, to communicate with the Meteorological Secretary, in order that every instrument may be examined and improved before being used; and they consider it necessary that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, *December* 1891.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

| FOREST TREES. | In Flower. | Leaf Buds first Appear. | In Leaf. | Divested of Leaves. |
|---|---|---|---|---|
| Alder, | | | | |
| Ash, | | | | |
| Beech, | | | | |
| Birch, | | | | |
| Elm, | | | | |
| Larch, | | | | |
| Lime, | | | | |
| Oak, | | | | |
| Sycamore or Plane, | | | | |

| SHRUBS, ETC. | First in Blossom. |
|---|---|
| Barberry, | |
| Bourtree or Elder, | |
| Broom, | |
| Hazel, | |
| Hawthorn, | |
| Holly, | |
| Laburnum, | |
| Lilac, | |
| Mezereon, | |
| Mountain Ash or Rowan, | |
| Red Flowering Currant, | |
| Rhododendron Pontieum, | |
| Whin, | |

| FRUITS. | First in Blossom. | Fruit Ripe, generally. |
|---|---|---|
| Apple, | | |
| Black Currant, | | |
| Cherry, | | |
| Gean, | | |
| Gooseberry, | | |
| Peach, | | |
| Pear, | | |
| Plum, | | |
| Strawberry, | | |

| CROPS, mentioning variety. | Sowing or Planting. | Appearing above Ground. | In Ear or Flower. | First Cut or Raised. |
|---|---|---|---|---|
| Barley, | | | | |
| Bere or Bigg, | | | | |
| Oats, | | | | |
| Wheat, | | | | |
| Beans, | | | | |
| Pease, | | | | |
| Potatoes, | | | | |
| Turnips, | | | | |
| Rye Grass, | | | | |

| MIGRATORY BIRDS. | First Arrival. | Departure. |
|---|---|---|
| Cuckoo, | | |
| Curlew, | | |
| House-Swallow, | | |
| Lapwing, | | |
| Plover, | | |
| Sand-Martin, | | |
| Starling, | | |
| Swan, | | |
| Rail or Corn Crake, | | |

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

Hand to Hand
April 1894

*To the SECRETARY*
*Scottish Meteorological Society,*
*122 George Street,*
*EDINBURGH.*

BOOK POST.

# SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Haddo House, County of Aberdeen, in Lat. 57°24', Long. 2°14', Distance from Sea 12 miles.

Height of Cistern of the Barometer above Mean Sea-Level 150 feet, above Ground 3 feet. During the MONTH of May 1894.

The Hours of Observation are of Greenwich Time.

| Days of Month. | BAROMETER. 9 h. A.M. * No. | Attached Thermometer | 9 h. P.M. Barometer. No. | Attached Thermometer | SELF-REGISTERING THERMOMETERS, Read Daily, at 9 P.M. Protected in Shade, 4 feet above Ground. Max. | Min. | Exposed Black Bulbs. Max. in Sun's rays No. | Min. on Grass. No. | HYGROMETER. Dry No. ___ Wet No. ___ 9 h. A.M. Dry bulb. | Wet bulb. | 9 h. P.M. Dry bulb. | Wet bulb. | Rain. No. of Days in which it fell. | Amount in inches. No. | WIND. 9 h. A.M. Direction. | Force | 9 h. P.M. Direction. | Force | Readings of the H. Cup Anemometer. No. 9 h. A.M. | CLOUDS. 9 A.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | P.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | SUNSHINE. Hours. | THERMOMETERS under Ground. 9 h. A.M. No. 3 inches. | No. 12 inches. | No. 22 inches. | Temperature of WELL at depth of ___ feet, No. | SEA. Temperature at Edinburgh, and Density. | OZONE. 0—10. 9 A.M. | 9 P.M. | GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. *Mention the hour at which Storms, including Thunder and Lightning, began and ended.* | Days of Month. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches. | ° | inches. | ° | ° | ° | ° | ° | ° | ° | ° | ° | | | | | | | | | | | | | | ° | ° | | | | | | |
| 1 | 30·158 | 35 | 30·108 | 47 | 52 | 41 | 64 | 35 | 52 | 47 | 46 | 43 | + | | N | | N.W | | 3727 | | | | | | 50 | 50 | 47 | | | 6 | 9 | | 1 |
| 2 | 29·786 | 47 | 29·700 | 50 | 55 | 32 | 56 | 26 | 45 | 43 | 37·5 | 50 | + | | S.W | | S.W | | 3974 | | | | | | 48 | 49 | 47 | | | 9 | 8 | | 2 |
| 3 | 29·340 | 51 | 29·342 | 42 | 53 | 36 | 73 | 32·5 | 46 | 43 | 37·5 | 34 | + | | N.W | | N.W | | 4790 | | | | | | 49 | 49 | 47 | | | 5 | 6 | | 3 |
| 4 | 29·348 | 39·5 | 29·502 | 47 | 53 | 32 | 65 | 27 | 38 | 36 | 36 | 37·5 | + | | N.W | | N.W | | 6353 | | | | | | 43 | 48 | 47 | | | 10 | 9 | Snow Showers | 4 |
| 5 | 29·608 | 47 | 29·372 | 44 | 53 | 37 | 74 | 32 | 46 | 41 | 43 | 41 | + | | N.W | | S.E | | 7718 | | | | | | 46 | 47 | 47 | | | 4 | 5 | | 5 |
| 6 | 29·290 | 58 | 29·362 | 45 | 59 | 34 | 84 | 29 | 51 | 45 | 41 | 39 | + | ·68 | N.W | | W | | 8480 | | | | | | 48 | 48 | 47 | | | 10 | 5 | | 6 |
| 7 | 29·356 | 60 | 29·512 | 46 | 53 | 34 | 70 | 27·5 | 50·5 | 45 | 42 | 40 | + | | W | | W | | 9223 | | | | | | 49 | 48 | 47 | | | 8 | 7 | | 7 |
| 8 | 29·550 | 51 | 29·426 | 50 | 53 | 32 | 68 | 28·5 | 49·5 | 45 | 49 | 37·5 | + | | S.E | | S.E | | 4710 | | | | | | 47 | 48 | 47 | | | 10 | 9 | | 8 |
| 9 | 29·452 | 57 | 29·360 | 45 | 51 | 41·5 | 79 | 32 | 52 | 46 | 43 | 41 | + | | S.E | | S.E | | 0385 | | | | | | 49 | 48 | 47 | | | 7 | 7 | | 9 |
| 10 | 29·296 | 51 | 29·286 | 47 | 56 | 31 | 70 | 24·5 | 48 | 44 | 45·5 | 43 | + | | S.E | | S.W | | 0962 | | | | | | 47 | 48 | 47 | | | 10 | 7 | | 10 |
| 11 | 29·422 | 57·5 | 29·580 | 49 | 60 | 36 | 87 | 30 | 52 | 47·5 | 47·5 | 45·5 | + | | S.W | | S.W | | 1826 | | | | | | 49 | 48 | 47 | | | 7 | 9 | | 11 |
| 12 | 29·760 | 55 | 29·892 | 47 | 59 | 40 | 83 | 35 | 52 | 48 | 44 | 43 | + | | S.W | | S.W | | 2180 | | | | | | 50 | 49 | 47 | | | 9 | 7 | | 12 |
| 13 | 29·936 | 64 | 29·888 | 46 | 56 | 33 | 82 | 27 | 55 | 49 | 42 | 41 | | ·76 | N.W | | S.E | | 2412 | | | | | | 50 | 50 | 47 | | | 9 | 8 | | 13 |
| 14 | 29·826 | 48 | 29·850 | 47 | 48 | 40 | 48 | 33 | 45·5 | 45 | 45·5 | 45 | + | | E | | E | | 2817 | | | | | | 49 | 50 | 47 | | | 8 | 10 | | 14 |
| 15 | 29·886 | 48 | 29·962 | 47 | 47·5 | 44 | 49 | 44 | 46·5 | 46 | 45·5 | 45 | + | | E | | E | | 3657 | | | | | | 49 | 49 | 47 | | | 12 | 11 | | 15 |
| 16 | 30·072 | 46 | 30·194 | 44 | 50 | 42 | 74 | 41 | 44·5 | 44 | 42·5 | 39·5 | + | | N.E | | N.E | | 4016 | | | | | | 48 | 49 | 48 | | | 10 | 5 | | 16 |
| 17 | 30·280 | 53 | 30·240 | 43 | 55 | 42 | 78 | 31 | 47 | 43·5 | 40 | 43 | | | N.E | | N | | 4596 | | | | | | 48 | 49 | 48 | | | 4 | 4 | | 17 |
| 18 | 30·250 | 54 | 30·270 | 43·5 | 55 | 30 | 82 | 24 | 49 | 44·5 | 41 | 38·5 | + | | N.E | | N | | 4833 | | | | | | 49 | 50 | 48 | | | 9 | 7 | | 18 |
| 19 | 30·176 | 42·5 | 29·968 | 37·5 | 56 | 33 | 72 | 30 | 40 | 36 | 34 | 33 | | | N | | N.W | | 5150 | | | | | | 47 | 49 | 48 | | | 5 | 7 | | 19 |
| 20 | 29·840 | 41·5 | 29·776 | 38 | 48·5 | 32 | 72 | 27 | 36·5 | 35 | 35·5 | 34·5 | + | ·35 | N.W | | W | | 5691 | | | | | | 48 | 48 | 48 | | | 9 | 5 | Snow Showers | 20 |
| 21 | 29·810 | 51 | 29·855 | 40 | 51 | 31 | 71 | 26 | 44 | 42 | 36 | 35 | + | | W | | N | | 6106 | | | | | | 45 | 48 | 48 | | | 12 | 4 | Snow Showers | 21 |
| 22 | 30·020 | 61 | 30·126 | 41·5 | 52 | 26 | 83 | 19 | 49 | 43 | 39 | 37 | | | S.E | | S.E | | 6249 | | | | | | 46 | 48 | 48 | | | 8 | 4 | | 22 |
| 23 | 30·268 | 66 | 30·280 | 43·5 | 55 | 28 | 76 | 20 | 52·5 | 46 | 40 | 38 | | | S | | S | | 6947 | | | | | | 48 | 49 | 48 | | | 9 | 5 | | 23 |
| 24 | 30·266 | 61 | 30·124 | 48·5 | 61 | 29 | 90 | 24 | 54 | 46·5 | 46 | 41 | | | S.E | | S.E | | 7901 | | | | | | 49 | 50 | 48 | | | 4 | 4 | | 24 |
| 25 | 29·968 | 54 | 29·784 | 45 | 58 | 39 | 89 | 33 | 51 | 48·5 | 42 | 40 | + | | N | | N | | 7935 | | | | | | 51 | 50 | 49 | | | 8 | 5 | | 25 |
| 26 | 29·750 | 45 | 29·814 | 43 | 48 | 34 | 89 | 35 | 45 | 43 | 41·5 | 39·5 | + | | N.W | | N | | 8608 | | | | | | 49 | 50 | 48 | | | 9 | 9 | | 26 |
| 27 | 29·646 | 47 | 29·448 | 44 | 50 | 36·5 | 70 | 31 | 45 | 42 | 43 | 42 | + | ·79 | N | | N | | 9073 | | | | | | 48 | 49 | 48 | | | 7 | 9 | | 27 |
| 28 | 29·400 | 46 | 29·376 | 45 | 51 | 42 | 63 | 40 | 45 | 44 | 44 | 43 | + | ·68 | N.E | | N.E | | 9360 | | | | | | 48 | 48 | 48 | | | 9 | 8 | | 28 |
| 29 | 29·468 | 50 | 29·524 | 46·5 | 54 | 42 | 77 | 37 | 49 | 46 | 45 | 44 | + | | E | | E | | 9703 | | | | | | 50 | 49 | 48 | | | 9 | 7 | | 29 |
| 30 | 29·496 | 50·5 | 29·504 | 47 | 58 | 35·5 | 72 | 29·5 | 49 | 46 | 46 | 45 | + | | N.E | | E | | 0280 | | | | | | 50 | 50 | 48 | | | 7 | 8 | | 30 |
| 31 | 29·492 | 51 | 29·568 | 45 | 55·5 | 35 | 86 | 30 | 49 | 46 | 41 | 40 | + | ·84 | E | | E | | 0839 | | | | | | 50 | 50 | 48 | | | 8 | 8 | Thunder | 31 |
| Sums. | 15 17 11 29·321 | 6 | 15 15 11 29·269 | 3 | 1388 | | 65·5 | 11 5·5 | 2302 | 940·5 | 1479·5 | 1366·5 | 1318·5 | 1278·5 | | 4·10 | | | | | | | | | 1496 | 1574 | 1474 | | | 253 | 216 | | |
| Means. | 29·749 | 51·8 | 29·732 | 44·7 | 53·4 | 35·8 | 74·2 | 30·3 | 47·7 | 44·1 | 42·5 | 40·6 | | | | | | | | | | | | | 48·2 | 48·8 | 47·6 | | | 8·2 | 7·0 | | |
| † Total Corrections for Instrumental Errors. | +035 | | +035 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ‡ Corrections for Diurnal Range. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "Corrected Means." | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. of Column. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | |

## NOTATION USED IN GENERAL REMARKS.

| | | | | | |
|---|---|---|---|---|---|
| a. | *denotes* aurora. | | m. | *enotes* meteor. | |
| ci. | ,, | cirrus. | ms. | ,, | meteors. |
| ci-cu. | ,, | cirro-cumulus. | n. | ,, | nimbus. |
| ci.-s. | ,, | cirro-stratus. | r. | ,, | rain. |
| cu. | ,, | cumulus. | h. r. | ,, | heavy rain. |
| cu.-s. | ,, | cumulo-stratus. | c. h. r. | ,, | continued heavy rain. |
| d. | ,, | dew. | s. | ,, | stratus. |
| f. | ,, | fog. | sc. | ,, | scud. |
| fr. | ,, | frost. | s. | ,, | sleet. |
| h.-fr. | ,, | hoar-frost. | s. | ,, | snow. |
| h. | ,, | haze. | so. ha. | ,, | solar halo. |
| h. d. | ,, | heavy dew. | sq. | ,, | squall. |
| hl. | ,, | hail. | sqs. | ,, | squalls. |
| l. | ,, | lightning. | t. | ,, | thunder. |
| li. cl. | ,, | light clouds. | t. s. | ,, | thunder-storm. |
| li. sh. | ,, | light showers. | w. | ,, | wind. |
| lu. co. | ,, | lunar corona. | g. | ,, | gale of wind. |
| lu. ha. | ,, | lunar halo. | | | |

## TABLE FOR ESTIMATING FORCE OF WIND.

| Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. |
|---|---|---|---|---|---|
| 0 | Calm | 1·5 | Light breeze | 4 | Blowing hard |
| 0·5 | Very light air | 2· | Fresh breeze | 5 | Blowing a gale |
| 1· | Light air | 3· | Very fresh | 6 | Violent gale |

**BAROMETER**, "corrected Mean" at 9 A.M., *minus* the Correction †† for Temp. (Col. 2), = 29·784 ..... (-) 61 = 29·723

"Corrected Mean" of Barometer at 9 P.M., *minus* the Correction †† for Temp. (Col. 4), = 29·767 ..... 51 = 29·716

**Mean at Station, corrected, and at 32°**, ..... = 29·720

Correction for height, ___ feet above Mean Sea-level, ..... = 200

**Mean, reduced to 32°, and Sea-level**, ..... = 29·920

Highest Reading, corrected for Index error, on the 17 th, ..... = 30·280

Lowest Do. Do., on the 10 th, ..... = 29·286

Difference, or **Monthly Range**, ..... = 0·994

* Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S."; and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.
† Embracing corrections for both capillarity and Index Errors
‡ The Diurnal Range for Scotland is as yet unknown.
†† *Practically*, though not *absolutely* a *minus* correction.
‡‡ These "Hygrometrical Deductions" are calculated from Glaisher's Hygrometrical Tables, Second Edition *only*.
** While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature." Any observations not taken under the Conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. *See over.*

**S.-R. THERMOMETER**, (in shade, etc.), **Highest in Month**, (corrected for Index Errors), on the 24 th, ..... = 61·0

**Lowest in Month**, corrected for Index errors, on the 22th, ..... = 26·0

Difference, or **Monthly Range**, ..... = 35·0

"Corrected **Mean**" **of all the Highest**, (Col. 5), ..... = 53·4

"Corrected **Mean**" **of all the Lowest**, (Col. 6), ..... = 35·7

Difference, or **Mean Daily Range**, ..... = 17·7

** Calculated **Mean Temperature** of Month, ..... = 44·6

**S.-R. THERMOMETER, Black Bulb in Sun, Highest**, (corrected for Index Errors), on the 24 th, ..... = 90·0

"Corrected **Mean**," (Col. 7), **of Black Bulb, Max. in Sun**, ..... = 74·2

**Lowest at Night**, Black Bulb (corrected for Index errors), on the 22 th, = 19·0

"Corrected **Mean**," (Col. 8), **of Black Bulb, Min.** on grass, ..... = 30·3

Difference of above means or range ("exposed"), ..... =

**HYGROMETER, Mean** (corrected) A.M. and P.M. Reading **of Dry Bulb**, (Cols. 9 and 11), ..... = 45·1

**Mean** (corrected) A.M. and P.M. Reading **of Wet Bulb**, (Cols. 10 and 12), ..... = 42·4

‡‡ Computed **Temperature of Dew-Point**, ..... = 39·3

‡‡ Do. **Elastic Force of Vapour**, ..... = ·240

‡‡ Do. **Weight of Vapour in a Cubic Foot of Air**, =

‡‡ **Relative Humidity** (**Saturation** = 100), ..... = 80

**RAIN** fell on 25 **Days**; **Amount in Inches**, ..... = 4·10 4-10

**WIND.** SUMMARY.

| Direction. | N | NE | E | SE | S | SW | W | NW | Calm or Variable. | Mean Force. | Mean Velocity in miles per day. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. | 4 | 5 | 4 | 5 | 1 | 3 | 2 | 7 | | | |
| P.M | 6 | 2 | 5 | 6 | 1 | 4 | 3 | 4 | | | |
| Mean. | 5 | 3 | 5 | 5 | 1 | 4 | 3 | 5 | 0 | | |

*Observations made and Return verified by* John Forrest

(*Signed*) ___

# INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS,

## WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the chief objects that the SCOTTISH METEOROLOGICAL SOCIETY proposed to itself when the Society was established in 1855, was to secure PERFECT UNIFORMITY in the system of observation pursued at all its Stations. Uniformity in the observations is absolutely necessary to justify the publication of Monthly Results from different observations, it being found that differences between the Returns from two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those who kindly furnish Reports to the Society will, by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

**Hour of Observation.**

The Council recommend that Observations be made precisely at 9 A.M. and 9 P.M. (Greenwich or Railway Time only), as specified in the following remarks, or at the top of the columns of the Schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading the time at which it was taken, if not at 9 A.M. or 9 P.M.

**Barometer.**

Weather-Glasses and Aneroids, though well suited to indicate roughly variations of atmospheric pressure, are not fitted for scientific purposes. No Barometer should be used for Meteorological Observation that is not supplied with some means of adjustment or compensation which will secure that the height of the mercury in the tube is accurately measured from the fluctuating surface of the mercury in the cistern.

The Barometer in which the error arising from the fluctuating surface of the mercury in the cistern is entirely got rid of is FORTIN'S Barometer, the arrangement consisting in applying pressure by means of a screw to the bottom of the cistern, which is made of flexible leather, thus raising or depressing the surface till it just meets the ivory point which forms the zero point of the fixed scale.

The Barometer originally constructed by Mr. Adie of London, and usually called the Board of Trade Barometer, has the great convenience of requiring no adjustment of the cistern. Its scale-inches are not true inches, but so much shorter as to compensate the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This is an excellent Barometer for ordinary Observers, inasmuch as it entirely eliminates the error of observation likely to arise in not a few cases in setting the instrument to the zero point of the fixed scale when the light is not good. To show the accuracy with which these Barometers are made, it may be stated, that one was compared, during a whole year, with the Society's Standard Barometer, particular care being given to make the comparison when atmospheric pressure was rising or falling very rapidly, with the result that none of the readings differed from those of the Standard more than 0·003 inch.

A modification of Fortin's Barometer is used at a number of the Society's Stations, by which the coincidence of the zero point with the surface of the mercury is indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the index-line on this little piston-rod is brought, by the adjusting screw, to form one straight line with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this preliminary setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the vernier.

It is absolutely necessary that the Barometer which is to be used shall have been compared with a Standard Barometer.

The Barometer should be suspended in as good a light as can be secured, and to facilitate the reading, a piece of white paper may be put behind the tube. It must be hung truly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire, and must not be hung against a wall heated by a flue. The object being to secure that the whole instrument, including the brass fittings, the contained mercury, and the attached Thermometer, shall be, when read, at one uniform temperature, it is evident that the best position is that which is least liable to sudden changes of temperature.

In taking an Observation, the Attached Thermometer is first noted: the tube must then be gently tapped, and the cistern-adjustment carefully made. The eye, by raising and lowering it, must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted so as to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will facilitate an accurate adjustment and reading of the Barometer. A mistake not unfrequently made by those beginning to observe, consisting in setting the edge of the vernier to the level of the clear surface of the mercury which is in direct contact with the glass tube, must be carefully avoided.

The errors most frequently made in reading the Barometer are errors of 1·000 inch, 0·500 inch, and 0·050 inch; that is to say, instead of 29·365 inches, either of the following is sometimes set down—viz. as 30·365 inches, 28·365 inches, 29·865 inches, or 29·815 inches. Experience having shown that even the very best Observers make these mistakes, particular attention is directed to the matter.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must first be screwed so as to form a tight plug to the cistern, thus preventing the escape of the mercury. Then screw up the mercury not quite to the top of the tube, but to within a quarter of an inch of it, and take down the instrument; it should then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case if, on inclining the instrument, a sharp tap is produced when the mercury strikes the top of the tube. If a dull tap is heard, there is air in the tube, which must be got rid of.

As Barometers are liable to be deranged by the introduction of air into their tubes, on removal from place to place, or in being roughly handled, it may be useful to Observers to know how the air may be expelled. First close up the cistern by screwing the ivory peg tight, so as to prevent the escape of mercury; then screw up the mercury to about half an inch from the top of the tube; and having slowly inverted the instrument, place the top of it on a yielding substance, such as the boot, and gently tap on the cistern with the palm of the hand, so as to induce the air to ascend through the column to the cistern, whence it may escape. Since there is the weight of two atmospheres—the pressure of the mercury in the Barometer, and the air outside—pressing on any air that may be inside the tube, it is usually a tedious operation to get it wholly expelled. After repeated trials, however, it is generally accomplished; and the clear metallic sound of the mercury, when gently struck against the top of the glass tube, will show when the whole of the air has been expelled. On hanging up the Barometer, care must be taken to screw down the mercury in the tube before unfastening the float of the cistern, for, if this be not attended to, the mercury will flow out, and the instrument be seriously damaged.

**Protection and Position of Thermometers.**

The Council of the Society recommend that the Self-Registering Thermometers, and the Dry and Wet Bulb Hygrometer, be kept in Stevenson's Louvre-boarded Box for Thermometers, painted white inside and outside, and screwed to four stout posts, also painted white, firmly fixed in the ground. The posts must be of such a length that when the Thermometers are hung in position the Bulbs of the Minimum Thermometer, and of the Dry and Wet Bulb Thermometers, will be exactly at the same height of FOUR FEET above the ground, the Maximum Thermometer being hung immediately above the Minimum Thermometer. The Thermometer Box is to be placed over a plot of grass, and in a free open space to which the sun's rays have free access during as much of the day as surrounding conditions enable the Observer to secure. The Thermometers are suspended on cross-laths in the centre of the Box, and face the door, which should open to the north.

The Council regard the question of UNIFORMITY OF HEIGHT ABOVE GROUND, AND METHOD IN PROTECTING THE THERMOMETERS, as vital in every system of Meteorological Observation, since without it Observations made at different Stations are incomparable, thus rendering it impossible to compare the Climates of places with each other as regards their most important features.

**Self-Registering Thermometers.**

Professor Phillips, and Negretti and Zambra's Maximum Thermometers, and Rutherford's Minimum Thermometer, are recommended. It is recommended that these Thermometers be graduated on the glass stem. The Minimum Thermometer is liable to two derangements—viz., the column of spirit breaking, and part of the spirit distilling by high temperature and lodging at the top of the tube. This derangement is of occasional occurrence with protected Thermometers, but of frequent occurrence with exposed Thermometers. Hence a systematic examination of Minimum Thermometers ought to be a regular part of the work carried on by each Observer.

Fortunately, Spirit Thermometers may be easily set right by any one, when the column of spirit chances to separate. Let the Thermometer be taken in the hand by the end farthest from the bulb, raised above the head, and then forcibly swung down towards the feet; the object being, on the principle of centrifugal force, to send down the detached portion of spirit till it unites with the column. A few throws, or swinging strokes, will generally be sufficient for the purpose; after which the Thermometer should be placed in a slanting position, to allow the rest of the spirit still adhering to the sides of the tube to drain down to the column. But another method must be adopted, if the portion of spirit in the top of the tube be small. Heat should be applied slowly and cautiously to the top end of the tube where the detached portion of spirit is, which, being turned into vapour by the heat, will condense on the surface of the unbroken column of spirit. Care must be taken that the heat is not applied too quickly; for, if this be done, the tube will break and the instrument be destroyed. The best way to apply the requisite amount of heat is by bringing the end of the tube slowly down towards a minute flame from a gas-burner; or, if gas be not at hand, a piece of heated metal will serve instead.

**Black-Bulb Thermometers.**

The bulbs of the Thermometers for registering the greatest heat from the sun's rays, and the least from radiation during night, have a black coating, which may easily be made, or mended, by the application of a mixture of lampblack and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind, The Maximum should be freely exposed to the sun, and the Minimum should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation. Black-bulbs enclosed in 'glass jackets' may also be used, being indeed preferable to the above. It must, however, be added, that the whole subject of the observation of Solar and Terrestrial Radiation is not yet in a sufficiently advanced state to warrant the exclusive recommendation of any one of these methods.

**Dry and Wet Bulb Hygrometer.**

The Hygrometer in use at the Society's Stations consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved form of this apparatus seriously vitiate the Hygrometrical Observations, Observers are specially requested to attend to the following conditions:—The bulbs must hang down by at least an inch free from the scales and frame to which they are attached; the frame must be such as will bring the tubes forward by an inch from any board on which it may be suspended; the water-cup must be covered, and altogether placed to the side, and a little below the level of the wet bulb, but in no case under the bulbs; the muslin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the Observer that the muslin is always clean and moist, and the water pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

**Reading of the Thermometer.**

In reading the Thermometer great care must be taken to bring the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40½°, respectively. So also 40½°, and 40¾°, more or less, must be registered 40°·2, or 40°·3, and 40°·7, or 40°·8 respectively. In reading Rutherford's Minimum Thermometer, the indication of that end of the index which is next the surface of the spirit is alone noted. On opening the Thermometer Box, the Dry and Wet Bulb Thermometers are to be first, and rapidly, read, inasmuch as they are readily affected by heat from the person of the Observer.

**Hour of observing Temperature.**

The Hygrometer is read at 9 A.M. and 9 P.M. The Self-Registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the Self-Registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 3d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

**Verification of Thermometers.**

No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a standard Thermometer. When such Thermometers as are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being re-tested. The Self-Registering, especially the Minimum Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer, marked by a scratch on the tube, ought to be tested once a year, in snow or melting ice.

In selecting instruments, the following points require attention:—The divisions of the vernier of Barometers in reference to their scales, and the perfect freedom of the Barometer from air; the correct numbering of the scale of every instrument; the rejection of Thermometers the frameworks of which are not likely to stand exposure to the weather, as shown in the past by repeated and annoying breakages of Thermometers of similar construction; and as regards Maximum Thermometers, either Negretti and Zambra's, or Phillip's, whether they will act at the highest temperatures they may be required to register. By the laws of the Society, Members and Observers have a right to have their instruments compared by the Secretary, and to advise with him regarding the purchase of instruments.

**Wind.**

Very great care should be bestowed on the Observations of the Wind, the accuracy of which, both as regards Direction and Force, is so essential towards the right discussion of many of the more important problems of the science.

**1. As regards Direction.**

A Wind-Vane ought to be elevated at least 12 feet above surrounding objects. When it oscillates incessantly, the mean direction should be taken. In all cases, but especially when the Vane is stationary, and when the wind is feeble, reference may be made to the direction of smoke, etc., in well-exposed situations. Careful observations are recommended to be made on the changes in the direction of the wind; and during storms, extra observations at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, is likely to give highly valuable and important results, particularly in connection with the system of thickly-planted Stations over a limited district round Edinburgh called STORM STATIONS, in the course of being established by the Society for the systematic investigation of the relation of the force of the wind to BAROMETRIC GRADIENTS, and other points connected with storms.

**2. As regards Velocity and Pressure.**

The Council would recommend the Hemispherical Cup Anemometer,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the mean Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, the Pressure Anemometers recently brought under the notice of the Society by Mr. T. Stevenson, the Honorary Secretary, and Mr. R. Ballingall, the Society's Observer at Eallabus, are recommended as likely to secure uniformity in making observations on the Force of the Wind.

**Rain Gauges.**

Many causes conspire to produce anomalies in Rain Returns, arising partly from the difficulty of obtaining a perfectly unobjectionable situation for observation, and partly from the defective nature of the instruments used. The Rain Gauge should not be placed on a slope or terrace, but on a level piece of ground, in as open a situation as the Observer can secure for it. As it is often difficult to obtain a position as free and unobstructed by surrounding objects as is desirable, care should be taken to place it at some distance from shrubs, trees, buildings, or other obstructions, at least as many feet from their base as they are in height. The more important directions, towards which it is most desirable to have a free exposure, are, in the order of their importance, S.W., N.E., S.E., S., and W. The rim of the gauge must be perfectly level, and fixed so that it will remain level in all weathers, and be at a height of one foot above ground, over grass. In such gauges as Fleming's, which are furnished with a measuring-rod attached to a float, the rod ought to be fixed down, and the float rise to its height only at the time the instrument is read, it being found that a stem projecting above the rim of the gauge seriously interferes with the proper measurement of the Rainfall. When a measuring-glass is used, care should be taken to hold it quite perpendicular. The Rain Gauge ought to be read daily at 9 A.M., and the reading entered in the Returns of the previous day. If the Gauge is read once a month, the reading is to be made on the first of the month, and the amount entered for the previous month.

**Snow-falls.**

Snow-falls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs, it should be noted in the 'Remarks,' and the letter S affixed to the depth of water received in Gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the Rain Gauge. For wind, rain, and snow, as indeed in every column, the Observer cannot be too careful to register observations only; and nothing that partakes of the nature of deduction or inference.

**Clouds.**

Convenient abbreviations for the nomenclature of Clouds will be found on the other side. The amount of Cloud ought to be estimated from the greater or less obscuration of the sky overhead (*i.e.* within 20° or 30° of the zenith). The strata of Clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the Clouds' column, though their appearance and changes may be noted among the Remarks. The amount of Cloud is entered from a scale of 0 to 10; thus, when the sky overhead is free from Clouds it is entered 0, when half-covered by Clouds, 5, wholly covered, 10, and so on.

Observations of the Clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—Thus, in the column Velocity and Direction, 6, S. W.

——— will indicate that the upper strata of Clouds travel with 2, W.

extreme velocity from S.W., and those in the lower regions from W., with one-third the speed of the former. Again, in the second 4, st.

Cloud column, an entry of ——— will indicate that the higher 2, cu-st.

regions are covered to the amount of 4-tenths with stratus Clouds; and that the sky is further obscured to the extent of 2-tenths by lower Clouds of the cumulo stratus kind.

Remarks on peculiar Clouds, accompanied with drawings, will assist materially in the development of a more exact nomenclature of Clouds, as well as throw light on the electrical, and other of the more obscure phenomena of Meteorology.

**Sunshine.**

The approximate number of Hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

**Underground Thermometers.**

As the germination and growth of crops and plants generally depend greatly on the temperature of the soil,—its amount and constancy,—the Council recommend that Observations in this interesting department be made at 9 A.M., by Thermometers permanently fixed in the soil, their bulbs being sunk to depths of 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames.

**Temperature of the Sea.**

A knowledge of the Temperature of the Sea is not only in itself, but in its relations to that of our island, a most important branch of Meteorology. The Council therefore recommend that the Temperature of the Sea be carefully taken by a properly constructed apparatus, from boats, or, if this be impracticable, from the ends of piers and rocks round the coast, where it is not influenced by that of river water, and as little influenced as possible by currents sweeping along the coast, and thus acquiring the temperature of the land, either greatly heated by the sun or cooled by nocturnal radiation. At or near the time of high water, in cases where the observations cannot be taken daily, the observation may be made on the 5th, 15th, and 25th of each month. When convenient, extra Sea Observations might be taken for other and greater depths, noting always the Temperature of the Air, and the Hour of Observation. It is also very desirable that observations on the daily Maxima and Minima by Thermometers continuously immersed, be instituted at points along the coast, by the method proposed by Mr. T. Stevenson, and already commenced at Peterhead and Liverpool.

**Temperature of Wells.**

The Temperature of the water at the bottom of Wells ought, when practicable, to be taken, both the depth of the Well and of the water being noted.

Mention what Test-Papers are used, Schönbein's or Moffat's, etc.

**Ozone.**

The Paper is affixed by a pin to a board in the Thermometer Box, and the indications registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus $3^{S.W.}_{4}$, as an Ozone entry in the schedule will indicate that the Ozone paper is tinted as 3 on the scale, that the wind is from the N.W., and that its force on the scale 0—5 is 4, or blowing fresh.

**Atmospheric Electricity.**

Too much importance cannot be attached to the electric condition of the atmosphere in connection with terrestrial magnetism, barometrical, thermometrical, and meteorological phenomena generally. A proper Electrometer is, in truth, necessary to every complete meteorological observatory.

**Remarks.**

The Remarks column is unavoidably too narrow. Some of the most valuable Observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are in general use is given at the foot of the column. Besides special and extraordinary Observations, great prominence ought to be given in this column to Prevalent Diseases, differences in character, colour, velocity, and direction between the Lower and Upper Strata of clouds, the Colour of the Sky, etc. Remarks ought to be made on the occurrence of Meteors, Auroræ Boreales, remarkable depressions, elevations, and fluctuations of the Barometer, Thunder-Storms, and remarkable falls of Snow, Hail, or Rain, the Hour of Storms of Wind commencing, attaining their maximum, and ending, as well as such Notes on Storms as have been hinted at above. When lofty hills are in the vicinity of a Station, the Height of Clouds and of the Snow-line in winter should be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. should be registered, either in two columns, otherwise unoccupied, or ruled off for the purpose, from the column of 'Remarks.'

**Observations in connection with the Periodic Return of the Seasons.**

Observations in connection with the Periodic Return of the Seasons, possess not only great scientific value, but are of considerable importance in connection with Agriculture, Horticulture, and Natural History. The Council would direct the special attention of Observers to the registration of such phenomena, so that the published Summaries may fairly represent the whole of Scotland. Observations ought to be confined to individual trees and shrubs; to particular species of birds, and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm. The Annual Table, published yearly in the Society's Journal, will indicate the species of plants and animals to which special attention is more particularly directed.

The Council recommend Observers, before purchasing new instruments, and in repairing old ones, to communicate with the Meteorological Secretary, in order that every instrument may be examined and improved before being used; and they consider it necessary that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, *December* 1891.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

| FOREST TREES. | In Flower. | Leaf Buds first Appear. | In Leaf. | Divested of Leaves. |
|---|---|---|---|---|
| Alder, | | | | |
| Ash, | | | | |
| Beech, | | | | |
| Birch, | | | | |
| Elm, | | | | |
| Larch, | | | | |
| Lime, | | | | |
| Oak, | | | | |
| Sycamore or Plane, | | | | |

| SHRUBS, ETC. | First in Blossom. |
|---|---|
| Barberry, | |
| Bourtree or Elder, | |
| Broom, | |
| Hazel, | |
| Hawthorn, | |
| Holly, | |
| Laburnum, | |
| Lilac, | |
| Mezereon, | |
| Mountain Ash or Rowan, | |
| Red Flowering Currant, | |
| Rhododendron Ponticum, | |
| Whin, | |

| FRUITS. | First in Blossom. | Fruit Ripe, generally. |
|---|---|---|
| Apple, | | |
| Black Currant, | | |
| Cherry, | | |
| Gean, | | |
| Gooseberry, | | |
| Peach, | | |
| Pear, | | |
| Plum, | | |
| Strawberry, | | |

| CROPS, mentioning variety: | Sowing or Planting. |
|---|---|
| Barley, | |
| Bere or Bigg, | |
| Oats, | |
| Wheat, | |
| Beans, | |
| Pease, | |
| Potatoes, | |
| Turnips, | |
| Rye Grass, | |

| MIGRATORY BIRDS. | Appearing above Ground. | In Ear or Flower. | First Cut or Teased. |
|---|---|---|---|
| Cuckoo, | | | |
| Curlew, | | | |
| House-Swallow, | | | |
| Lapwing, | | | |
| Plover, | | | |
| Sand-Martin, | | | |
| Starling, | | | |
| Swan, | | | |
| Rail or Corn Crake, | | | |

| First Arrival. | Departure. |
|---|---|
| | |

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

BOOK POST.

To the SECRETARY
Scottish Meteorological Society,
122 George Street,
EDINBURGH.

+ Haddo House
Jan 1892.

11

# SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Haddo House, County of Aberdeen, in Lat. 57°24', Long. 2°14', Distance from Sea 12 miles.

Height of Cistern of the Barometer above Mean Sea-Level 150 feet, above Ground 3 feet. During the MONTH of June 1894.

The Hours of Observation are of Greenwich Time.

| Days of Month. | BAROMETER. 9 h. A.M. Barometer. * No. | Attached Thermometer | 9 h. P.M. Barometer. No. | Attached Thermometer | SELF-REGISTERING THERMOMETERS, Read Daily, at 9 P.M. Protected in Shade, 4 feet above Ground. Max. | Min. | Exposed Black Bulbs. Max. in Sun's rays. No. | Min. on Grass. No. | HYGROMETER. Dry No. ___ Wet No. ___ 9 h. A.M. Dry bulb. | Wet bulb. | 9 h. P.M. Dry bulb. | Wet bulb. | Rain. No. of Hours in which it fell. | Amount in inches. No. | WIND. 9 h. A.M. Direction. | Force | 9 h. P.M. Direction. | Force | Readings of the H. Cup Anemometer. No. 9 h. A.M. | CLOUDS. 9 A.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | ___ P.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | SUNSHINE. Hours. | THERMOMETERS under Ground. 9 h. A.M. No. 3 inches. | No. 12 inches. | No. 22 inches. | Temperature of WELL at depth of ___ feet, No. | SEA. Temperature at 1 Fathom, and Density. | OZONE. 0—10. 9 A.M. | 9 P.M. | GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. *Mention the hour at which Storms, including Thunder and Lightning, began and ended.* | Days of Month. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches. | ° | inches. | ° | ° | ° | ° | ° | ° | ° | ° | ° | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 29.620 | 53 | 29.684 | 45 | 58 | 38 | 80 | 33 | 52 | 49 | 43 | 42 | + | | N.E | | E | | 0839 | | | | | | | | | | | | | | | | 1 |
| 2 | 29.636 | 53 | 29.626 | 49 | 58 | 36 | 75 | 30 | 54 | 50 | 46·5 | 45 | | | S.E | | E | | 1193 | | | | | | | | | | | | | | | | 2 |
| 3 | 29.780 | 56 | 29.892 | 50 | 57 | 41 | 77 | 35 | 54 | 49·5 | 48 | 46 | | | E | | S.E | | 1712 | | | | | | | | | | | | | | | | 3 |
| 4 | 29.862 | 58 | 29.708 | 50 | 57 | 37 | 72 | 33 | 52·5 | 49 | 47 | 46 | | | E | | S.E | | 2254 | | | | | | | | | | | | | | | | 4 |
| 5 | 29.630 | 51 | 29.622 | 49 | 54 | 45 | 65 | 42 | 50 | 48 | 46 | 43 | + | | E | | N.E | | 2904 | | | | | | | | | | | | | | | | 5 |
| 6 | 29.754 | 60 | 29.678 | 50 | 59·5 | 36·5 | 78 | 31 | 52 | 46 | 49 | 46·5 | + | | N | | N.W | | 3164 | | | | | | | | | | | | | | | | 6 |
| 7 | 29.626 | 53 | 29.648 | 50 | 61 | 44 | 84 | 39 | 53 | 51 | 46 | 44 | + | | N | | N | | 3348 | | | | | | | | | | | | | | | | 7 |
| 8 | 29.665 | 52 | 29.678 | 50 | 68 | 43 | 89 | 38 | 53 | 50 | 48 | 47 | | | N | | S.E | | 3654 | | | | | | | | | | | | | | | | 8 |
| 9 | 29.686 | 51 | 29.701 | 48·5 | 57 | 46 | 72 | 39 | 50 | 48·5 | 46 | 45 | + | | S.E | | S.E | | 4080 | | | | | | | | | | | | | | | | 9 |
| 10 | 29.596 | 61 | 29.410 | 50 | 57 | 38·5 | 73 | 33 | 54·5 | 50 | 49 | 48 | + | ·36 | S.E | | S.E | | 4464 | | | | | | | | | | | | | | | | 10 |
| 11 | 29.400 | 52 | 29.572 | 51 | 55 | 47 | 67 | 47 | 50 | 48 | 50 | 49·5 | + | | N.W | | N.W | | 5235 | | | | | | | | | | | | | | | | 11 |
| 12 | 29.638 | 55 | 29.672 | 49·5 | 58 | 44·5 | 77 | 39·5 | 53 | 49 | 48 | 46·5 | + | | N.W | | N.W | | 6507 | | | | | | | | | | | | | | | | 12 |
| 13 | 29.784 | 50 | 29.878 | 50 | 59 | 46 | 78·5 | 45·5 | 49 | 47 | 48·5 | 46 | + | | N.W | | N.W | | 6238 | | | | | | | | | | | | | | | | 13 |
| 14 | 29.868 | 55 | 29.824 | 51 | 63 | 44 | 90 | 42 | 54 | 49 | 50 | 47 | | | N.W | | S | | 6636 | | | | | | | | | | | | | | | | 14 |
| 15 | 29.636 | 55 | 29.772 | 51·5 | 63 | 42·5 | 67 | 37 | 57 | 55 | 50 | 47 | + | | S.W | | W | | 7046 | | | | | | | | | | | | | | | | 15 |
| 16 | 29.870 | 60·5 | 29.475 | 55 | 60·5 | 36 | 76 | 31·5 | 58 | 56 | 53 | 41 | | | W | | S.E | | 7467 | | | | | | | | | | | | | | | | 16 |
| 17 | 29.478 | 53·5 | 29.436 | 55 | 61·5 | 42·5 | 75 | 37·5 | 57 | 53·5 | 52 | 48 | + | ·42 | S.W | | W | | 8308 | | | | | | | | | | | | | | | | 17 |
| 18 | 29.512 | 63 | 29.580 | 51 | 64 | 34 | 92 | 28 | 58·5 | 56 | 46 | 45 | + | | S.W | | S.W | | 8707 | | | | | | | | | | | | | | | | 18 |
| 19 | 29.738 | 62 | 29.604 | 54 | 64 | 37 | 80 | 31 | 59 | 51 | 52 | 49 | + | | W | | S.W | | 8978 | | | | | | | | | | | | | | | | 19 |
| 20 | 29.676 | 59 | 29.784 | 52 | 64 | 34 | 81 | 34 | 58 | 53·5 | 48 | 45·5 | | | W | | N.W | | 9576 | | | | | | | | | | | | | | | | 20 |
| 21 | 29.910 | 64 | 29.826 | 58 | 64 | 37·5 | 77·5 | 31·5 | 58 | 52 | 57·5 | 53·5 | | | S.W | | S.W | | 9799 | | | | | | | | | | | | | | | | 21 |
| 22 | 29.762 | 63 | 29.688 | 57 | 65 | 42 | 81 | 35·5 | 61 | 55 | 52·5 | 49 | + | | S.E | | S.W | | 0361 | | | | | | | | | | | | | | | | 22 |
| 23 | 29.644 | 53·5 | 29.398 | 52 | 58 | 43·5 | 63 | 37 | 53 | 50 | 49 | 47 | + | | S | | N.W | | 0888 | | | | | | | | | | | | | | | | 23 |
| 24 | 29.538 | 60 | 29.688 | 53 | 61·5 | 40 | 92 | 32·5 | 53·5 | 47 | 49 | 45 | + | ·66 | N.W | | W | | 1540 | | | | | | | | | | | | | | | | 24 |
| 25 | 29.898 | 64·5 | 29.918 | 54 | 59·5 | 38 | 75 | 32 | 58 | 50 | 52 | 51 | | | W | | S.E | | 2559 | | | | | | | | | | | | | | | | 25 |
| 26 | 30.042 | 61 | 30.156 | 58·5 | 74 | 50 | 95 | 46·5 | 64 | 60 | 58·5 | 54 | | | W | | S.E | | 3024 | | | | | | | | | | | | | | | | 26 |
| 27 | 30.218 | 62 | 30.232 | 58 | 70 | 45 | 87 | 41 | 64 | 60 | 57 | 56 | | | S.E | | S.E | | 3216 | | | | | | | | | | | | | | | | 27 |
| 28 | 30.148 | 63 | 30.212 | 59 | 65 | 54·5 | 73 | 51 | 64 | 61·5 | 58 | 56·5 | | | S | | S.E | | 3595 | | | | | | | | | | | | | | | | 28 |
| 29 | 30.292 | 71 | 30.280 | 57 | 70 | 52 | 92 | 47 | 67 | 63 | 54 | 53 | | | S.E | | E | | 3769 | | | | | | | | | | | | | | | | 29 |
| 30 | 30.282 | 66 | 30.244 | 57 | 66 | 48 | 87·5 | 47 | 61 | 58·5 | 53 | 52·5 | | ·61 | E | | E | | 4392 | | | | | | | | | | | | | | | | 30 |
| 31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 31 |
| Sums. | 18·15·12 893·18 23 | 1742 | 18·15·73 892·26 23 | ·12 1581 | 1850·5 | 1263 | 2571·5 | 1131 | 1682 | 1564 | 1491·5 | 1434·5 | | | | | | | | | | | | | | | | | 1673 | 1642 | 1571 | | | 772 | 1745 | | |
| Means. | 29.767 | 58 | 29.747 | 52·7 | 61·7 | 42·1 | 76·7 | 37·7 | 56·4 | 52·1 | 49·7 | 47·8 | 16 | 1·45 | | | | | | | | | | | | | | | 55·7 | 54·7 | 52·3 | | | 7·4 | 5·8 | | |
| † Total Corrections for Instrumental Errors. | 773 +035 | | 768 +035 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 132 | 6·6 | | |
| ‡ Corrections for Diurnal Range. | +035 | | +035 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "Corrected Means." | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. of Column. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | | | |

## NOTATION USED IN GENERAL REMARKS.

| | | | |
|---|---|---|---|
| a. | *denotes* aurora. | m. | *denotes* meteor. |
| ci. | ,, cirrus. | ms. | ,, meteors. |
| ci.-cu. | ,, cirro-cumulus. | n. | ,, nimbus. |
| ci.-s. | ,, cirro-stratus. | r. | ,, rain. |
| cu. | ,, cumulus. | h. r. | ,, heavy rain. |
| cu.-s. | ,, cumulo-stratus. | c. h. r. | ,, continued heavy rain. |
| d. | ,, dew. | s. | ,, stratus. |
| f. | ,, fog. | sc. | ,, scud. |
| fr. | ,, frost. | s. | ,, sleet. |
| h.-fr. | ,, hoar-frost. | s. | ,, snow. |
| h. | ,, haze. | so. ha. | ,, solar halo. |
| h. d. | ,, heavy dew. | sq. | ,, squall. |
| hl. | ,, hail. | sqs. | ,, squalls. |
| l. | ,, lightning. | t. | ,, thunder. |
| li. cl. | ,, light clouds. | t. s. | ,, thunder-storm. |
| li. sh. | ,, light showers. | w. | ,, wind. |
| lu. co. | ,, lunar corona. | g. | ,, gale of wind. |
| lu. ha. | ,, lunar halo. | | |

## TABLE FOR ESTIMATING FORCE OF WIND.

| Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. |
|---|---|---|---|---|---|
| 0 | Calm | 1·5 | Light breeze | 4 | Blowing hard |
| 0·5 | Very light air | 2· | Fresh breeze | 5 | Blowing a gale |
| 1· | Light air | 3· | Very fresh | 6 | Violent gale |

**BAROMETER**, "corrected Mean" at 9 A.M., *minus* the Correction †† for Temp. (Col. 2), = 29·808 − 79 = 29·729

"Corrected Mean" of Barometer at 9 P.M., *minus* the Correction †† for Temp. (Col. 4), = 29·803 − 64 = 29·739

**Mean at Station, corrected, and at 32°**, ..... +020 = 29·754

Correction for height, feet above Mean Sea-level, ..... = 196

**Mean, reduced to 32°, and Sea-level**, ..... = 29·950

Highest Reading, corrected for Index error, on the 29 th, ..... = 30·292

Lowest Do. Do., on the 9 th, ..... = 29·410

Difference, or **Monthly Range**, ..... = 0·882

**S.-R. THERMOMETER**, (in shade, etc.) **Highest in Month**, (corrected for Index Errors), on the 26 th, ..... = 74·0

**Lowest in Month**, corrected for Index errors, on the 20 th, ..... = 34·0

Difference, or **Monthly Range**, ..... = 40·0

"Corrected **Mean**" **of all the Highest**, (Col. 5), ..... = 61·7

"Corrected **Mean**" **of all the Lowest**, (Col. 6), ..... = 42·1

Difference, or **Mean Daily Range**, ..... = 19·6

** Calculated **Mean Temperature** of Month, ..... = 51·9

**S.-R. THERMOMETER**, **Black Bulb in Sun, Highest**, (corrected for Index Errors), on the 26 th, ..... = 95·0

"Corrected **Mean**," (Col. 7), **of Black Bulb, Max. in Sun**, ..... = 76·4

**Lowest at Night**, Black Bulb (corrected for Index errors), on the 18 th, = 28·0

"Corrected **Mean**," (Col. 8), **of Black Bulb, Min.** on grass, ..... = 37·4

Difference of above means or range ("exposed"), ..... = 39·0

**HYGROMETER, Mean** (corrected) A.M. and P.M. Reading **of Dry Bulb**, (Cols. 9 and 11), ..... = 52·9

**Mean** (corrected) A.M. and P.M. Reading **of Wet Bulb**, (Cols. 10 and 12), ..... = 50·8

†† Computed **Temperature of Dew-Point**, ..... = 47·1

†† Do. **Elastic Force of Vapour**, ..... = ·323

†† Do. **Weight of Vapour in a Cubic Foot of Air**, =

†† **Relative Humidity** (**Saturation** = 100), ..... = 81

**RAIN** fell on 16 **Days; Amount in Inches**, ..... = 1·45

| WIND. SUMMARY. Direction. | N | NE | E | SE | S | SW | W | NW | Calm or Variable. | Mean Force. | Mean Velocity in miles per day. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. and | | | | | | | | | | | |
| P.M | 3 | 2 | 8 | 16 | 3 | 8 | 9 | 11 | | | |
| Mean. | 2 | 1 | 4 | 8 | 2 | 4 | 4 | 5 | | | |

Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S."; and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.

† Embracing corrections for both capillarity and Index Errors

‡ The Diurnal Range for Scotland is as yet unknown.

†† *Practically*, though not *absolutely* a *minus* correction.

‡‡ These "Hygrometrical Deductions" are calculated from Glaisher's Hygrometrical Tables, Second Edition *only*.

** While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature."

Any observations not taken under the Conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. *See over.*

*Observations made and Return verified by* { John Forrest

(*Signed*) _____

# INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS,

## WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the chief objects that the SCOTTISH METEOROLOGICAL SOCIETY proposed to itself when the Society was established in 1855, was to secure PERFECT UNIFORMITY in the system of observation pursued at all its Stations. Uniformity in the observations is absolutely necessary to justify the publication of Monthly Results from different observations, it being found that differences between the Returns from two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those who kindly furnish Reports to the Society will, by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

**Hour of Observation.**

The Council recommend that Observations be made precisely at 9 A.M. and 9 P.M. (Greenwich or Railway Time only), as specified in the following remarks, or at the top of the columns of the Schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading the time at which it was taken, if not at 9 A.M. or 9 P.M.

**Barometer.**

Weather-Glasses and Aneroids, though well suited to indicate roughly variations of atmospheric pressure, are not fitted for scientific purposes. No Barometer should be used for Meteorological Observation that is not supplied with some means of adjustment or compensation which will secure that the height of the mercury in the tube is accurately measured from the fluctuating surface of the mercury in the cistern.

The Barometer in which the error arising from the fluctuating surface of the mercury in the cistern is entirely got rid of is FORTIN'S Barometer, the arrangement consisting in applying pressure by means of a screw to the bottom of the cistern, which is made of flexible leather, thus raising or depressing the surface till it just meets the ivory point which forms the zero point of the fixed scale.

The Barometer originally constructed by Mr. Adie of London, and usually called the Board of Trade Barometer, has the great convenience of requiring no adjustment of the cistern. Its scale-inches are not true inches, but so much shorter as to compensate the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This is an excellent Barometer for ordinary Observers, inasmuch as it entirely eliminates the error of observation likely to arise in not a few cases in setting the instrument to the zero point of the fixed scale when the light is not good. To show the accuracy with which these Barometers are made, it may be stated, that one was compared, during a whole year, with the Society's Standard Barometer, particular care being given to make the comparison when atmospheric pressure was rising or falling very rapidly, with the result that none of the readings differed from those of the Standard more than 0·003 inch.

A modification of Fortin's Barometer is used at a number of the Society's Stations, by which the coincidence of the zero point with the surface of the mercury is indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the index-line on this little piston-rod is brought, by the adjusting screw, to form one straight line with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this preliminary setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the vernier.

It is absolutely necessary that the Barometer which is to be used shall have been compared with a Standard Barometer.

The Barometer should be suspended in as good a light as can be secured, and to facilitate the reading, a piece of white paper may be put behind the tube. It must be hung truly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire, and must not be hung against a wall heated by a flue. The object being to secure that the whole instrument, including the brass fittings, the contained mercury, and the attached Thermometer, shall be, when read, at one uniform temperature, it is evident that the best position is that which is least liable to sudden changes of temperature.

In taking an Observation, the Attached Thermometer is first noted: the tube must then be gently tapped, and the cistern-adjustment carefully made. The eye, by raising and lowering it, must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted so as to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will facilitate an accurate adjustment and reading of the Barometer. A mistake not unfrequently made by those beginning to observe, consisting in setting the edge of the vernier to the level of the clear surface of the mercury which is in direct contact with the glass tube, must be carefully avoided.

The errors most frequently made in reading the Barometer are errors of 1·000 inch, 0·500 inch, and 0·050 inch; that is to say, instead of 29·365 inches, either of the following is sometimes set down—viz. as 30·365 inches, 28·365 inches, 29·865 inches, or 29·815 inches. Experience having shown that even the very best Observers make these mistakes, particular attention is directed to the matter.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must first be screwed so as to form a tight plug to the cistern, thus preventing the escape of the mercury. Then screw up the mercury not quite to the top of the tube, but to within a quarter of an inch of it, and take down the instrument; it should then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case if, on inclining the instrument, a sharp tap is produced when the mercury strikes the top of the tube. If a dull tap is heard, there is air in the tube, which must be got rid of.

As Barometers are liable to be deranged by the introduction of air into their tubes, on removal from place to place, or in being roughly handled, it may be useful to Observers to know how the air may be expelled. First close up the cistern by screwing the ivory peg tight, so as to prevent the escape of mercury; then screw up the mercury to about half an inch from the top of the tube; and having slowly inverted the instrument, place the top of it on a yielding substance, such as the boot, and gently tap on the cistern with the palm of the hand, so as to induce the air to ascend through the column to the cistern, whence it may escape. Since there is the weight of two atmospheres—the pressure of the mercury in the Barometer, and the air outside—pressing on any air that may be inside the tube, it is usually a tedious operation to get it wholly expelled. After repeated trials, however, it is generally accomplished; and the clear metallic sound of the mercury, when gently struck against the top of the glass tube, will show when the whole of the air has been expelled. On hanging up the Barometer, care must be taken to screw down the mercury in the tube before unfastening the float of the cistern, for, if this be not attended to, the mercury will flow out, and the instrument be seriously damaged.

**Protection and Position of Thermometers.**

The Council of the Society recommend that the Self-Registering Thermometers, and the Dry and Wet Bulb Hygrometer, be kept in Stevenson's Louvre-boarded Box for Thermometers, painted white inside and outside, and screwed to four stout posts, also painted white, firmly fixed in the ground. The posts must be of such a length that when the Thermometers are hung in position the Bulbs of the Minimum Thermometer, and of the Dry and Wet Bulb Thermometers, will be exactly at the same height of FOUR FEET above the ground, the Maximum Thermometer being hung immediately above the Minimum Thermometer. The Thermometer Box is to be placed over a plot of grass, and in a free open space to which the sun's rays have free access during as much of the day as surrounding conditions enable the Observer to secure. The Thermometers are suspended on cross-laths in the centre of the Box, and face the door, which should open to the north.

The Council regard the question of UNIFORMITY OF HEIGHT ABOVE GROUND, AND METHOD IN PROTECTING THE THERMOMETERS, as vital in every system of Meteorological Observation, since without it Observations made at different Stations are incomparable, thus rendering it impossible to compare the Climates of places with each other as regards their most important features.

Professor Phillips, and Negretti and Zambra's Maximum Thermometers, and Rutherford's Minimum Thermometer,

**Self-Registering Thermometers.**

are recommended. It is recommended that these Thermometers be graduated on the glass stem. The Minimum Thermometer is liable to two derangements—viz., the column of spirit breaking, and part of the spirit distilling by high temperature and lodging at the top of the tube. This derangement is of occasional occurrence with protected Thermometers, but of frequent occurrence with exposed Thermometers. Hence a systematic examination of Minimum Thermometers ought to be a regular part of the work carried on by each Observer.

Fortunately, Spirit Thermometers may be easily set right by any one, when the column of spirit chances to separate. Let the Thermometer be taken in the hand by the end farthest from the Thermometer be taken in the hand by the end farthest from the feet; the object being, on the principle of centrifugal force, to send down the detached portion of spirit till it unites with the column. A few throws, or swinging strokes, will generally be sufficient for the purpose; after which the Thermometer should be placed in a slanting position, to allow the rest of the spirit still adhering to the sides of the tube to drain down to the column. But another method must be adopted, if the portion of spirit in the top of the tube be small. Heat should be applied slowly and cautiously to the top end of the tube where the detached portion of spirit is, which, being turned into vapour by the heat, will condense on the surface of the unbroken column of spirit. Care must be taken that the heat is not applied too quickly; for, if this be done, the tube will break and the instrument be destroyed. The best way to apply the requisite amount of heat is by bringing the end of the tube slowly down towards a minute flame from a gas-burner; or, if gas be not at hand, a piece of heated metal will serve instead.

**Black-Bulb Thermometers.**

The bulbs of the Thermometers for registering the greatest heat from the sun's rays, and the least from radiation during night, have a black coating, which may easily be made, or mended, by the application of a mixture of lampblack and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind, The Maximum should be freely exposed to the sun, and the Minimum should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation. Black-bulbs enclosed in 'glass jackets' may also be used, being indeed preferable to the above. It must, however, be added, that the whole subject of the observation of Solar and Terrestrial Radiation is not yet in a sufficiently advanced state to warrant the exclusive recommendation of any one of these methods.

**Dry and Wet Bulb Hygrometer.**

The Hygrometer in use at the Society's Stations consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved form of this apparatus seriously vitiate the Hygrometrical Observations, Observers are specially requested to attend to the following conditions:—The bulbs must hang down by at least an inch free from the scales and frame to which they are attached; the frame must be such as will bring the tubes forward by an inch from any board on which it may be suspended; the water-cup must be covered, and altogether placed to the side, and a little below the level of the wet bulb, but in no case under the bulbs; the muslin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the Observer that the muslin is always clean and moist, and the water pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

**Reading of the Thermometer.**

In reading the Thermometer great care must be taken to bring the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40½°, respectively. So also 40¼°, and 40¾°, more or less, must be registered 40°·2, or 40°·3, and 40°·7, or 40°·8 respectively. In reading Rutherford's Minimum Thermometer, the indication of that end of the index which is next the surface of the spirit is alone noted. On opening the Thermometer Box, the Dry and Wet Bulb Thermometers are to be first, and rapidly, read, inasmuch as they are readily affected by heat from the person of the Observer.

**Hour of observing Temperature.**

The Hygrometer is read at 9 A.M. and 9 P.M. The Self-Registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the Self-Registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 3d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

**Verification of Thermometers.**

No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a standard Thermometer. When such Thermometers as are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being re-tested. The Self-Registering, especially the Minimum Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer, marked by a scratch on the tube, ought to be tested once a year, in snow or melting ice.

In selecting instruments, the following points require attention:—The divisions of the vernier of Barometers in reference to their scales, and the perfect freedom of the Barometer from air; the correct numbering of the scale of every instrument; the rejection of Thermometers the frameworks of which are not likely to stand exposure to the weather, as shown in the past by repeated and annoying breakages of Thermometers of similar construction; and as regards Maximum Thermometers, either Negretti and Zambra's, or Phillip's, whether they will act at the highest temperatures they may be required to register. By the laws of the Society, Members and Observers have a right to have their instruments compared by the Secretary, and to advise with him regarding the purchase of instruments.

**Wind.**

Very great care should be bestowed on the Observations of the Wind, the accuracy of which, both as regards Direction and Force, is so essential towards the right discussion of many of the more important problems of the science.

**1. As regards Direction.**

A Wind-Vane ought to be elevated at least 12 feet above surrounding objects. When it oscillates incessantly, the mean direction should be taken. In all cases, but especially when the Vane is stationary, and when the wind is feeble, reference may be made to the direction of smoke, etc., in well-exposed situations. Careful observations are recommended to be made on the changes in the direction of the wind; and during storms, extra observations at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, is likely to give highly valuable and important results, particularly in connection with the system of thickly-planted Stations over a limited district round Edinburgh called STORM STATIONS, in the course of being established by the Society for the systematic investigation of the relation of the force of the wind to BAROMETRIC GRADIENTS, and other points connected with storms.

**2. As regards Velocity and Pressure.**

The Council would recommend the Hemispherical Cup Anemometer,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the mean Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, the Pressure Anemometers recently brought under the notice of the Society by Mr. T. Stevenson, the Honorary Secretary, and Mr. R. Ballingall, the Society's Observer at Eallabus, are recommended as likely to secure uniformity in making observations on the Force of the Wind.

**Rain Gauges.**

Many causes conspire to produce anomalies in Rain Returns, arising partly from the difficulty of obtaining a perfectly unobjectionable situation for observation, and partly from the defective nature of the instruments used. The Rain Gauge should not be placed on a slope or terrace, but on a level piece of ground, in as open a situation as the Observer can secure for it. As it is often difficult to obtain a position as free and unobstructed by surrounding objects as is desirable, care should be taken to place it at some distance from shrubs, trees, buildings, or other obstructions, at least as many feet from their base as they are in height. The more important directions, towards which it is most desirable to have a free exposure, are, in the order of their importance, S.W., N.E., S.E., S., and W. The rim of the gauge must be perfectly level, and fixed so that it will remain level in all weathers, and be at a height of one foot above ground, over grass. In such gauges as Fleming's, which are furnished with a measuring-rod attached to a float, the rod ought to be fixed down, and the float rise to its height only at the time the instrument is read, it being found that a stem projecting above the rim of the gauge seriously interferes with the proper measurement of the Rainfall. When a measuring-glass is used, care should be taken to hold it quite perpendicular. The Rain Gauge ought to be read daily at 9 A.M., and the reading entered in the Returns of the previous day. If the Gauge is read once a month, the reading is to be made on the first of the month, and the amount entered for the previous month.

**Snow-falls.**

Snow-falls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs, it should be noted in the 'Remarks,' and the letter S affixed to the depth of water received in Gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the Rain Gauge. For wind, rain, and snow, as indeed in every column, the Observer cannot be too careful to register observations only; and nothing that partakes of the nature of deduction or inference.

**Clouds.**

Convenient abbreviations for the nomenclature of Clouds will be found on the other side. The amount of Cloud ought to be estimated from the greater or less obscuration of the sky overhead (*i.e.* within 20° or 30° of the zenith). The strata of Clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the Clouds' column, though their appearance and changes may be noted among the Remarks. The amount of Cloud is entered from a scale of 0 to 10; thus, when the sky overhead is free from Clouds it is entered 0, when half-covered by Clouds, 5, wholly covered, 10, and so on.

Observations of the Clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—Thus, in the column Velocity and Direction, 6, S. W.

$\frac{\text{2, W.}}{\text{4, st.}}$ will indicate that the upper strata of Clouds travel with extreme velocity from S.W., and those in the lower regions from W., with one-third the speed of the former. Again, in the second Cloud column, an entry of $\frac{\text{4, st.}}{\text{2, cu-st.}}$ will indicate that the higher regions are covered to the amount of 4-tenths with stratus Clouds; and that the sky is further obscured to the extent of 2-tenths by lower Clouds of the cumulo stratus kind.

Remarks on peculiar Clouds, accompanied with drawings, will assist materially in the development of a more exact nomenclature of Clouds, as well as throw light on the electrical, and other of the more obscure phenomena of Meteorology.

**Sunshine.**

The approximate number of Hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

**Underground Thermometers.**

As the germination and growth of crops and plants generally depend greatly on the temperature of the soil,—its amount and constancy,—the Council recommend that Observations in this interesting department be made at 9 A.M., by Thermometers permanently fixed in the soil, their bulbs being sunk to depths of 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames.

**Temperature of the Sea.**

A knowledge of the Temperature of the Sea is not only in itself, but in its relations to that of our island, a most important branch of Meteorology. The Council therefore recommend that the Temperature of the Sea be carefully taken by a properly constructed apparatus, from boats, or, if this be impracticable, from the ends of piers and rocks round the coast, where it is not influenced by that of river water, and as little influenced as possible by currents sweeping along the coast, and thus acquiring the temperature of the land, either greatly heated by the sun or cooled by nocturnal radiation. At or near the time of high water, in cases where the observations cannot be taken daily, the observation may be made on the 5th, 15th, and 25th of each month. When convenient, extra Sea Observations might be taken for other and greater depths, noting always the Temperature of the Air, and the Hour of Observation. It is also very desirable that observations on the daily Maxima and Minima by Thermometers continuously immersed, be instituted at points along the coast, by the method proposed by Mr. T. Stevenson, and already commenced at Peterhead and Liverpool.

**Temperature of Wells.**

The Temperature of the water at the bottom of Wells ought, when practicable, to be taken, both the depth of the Well and of the water being noted.

Mention what Test-Papers are used, Schönbein's or Moffat's, etc.

**Ozone.**

The Paper is affixed by a pin to a board in the Thermometer Box, and the indications registered at 9 A.M. and 9 P.M. It is desired that those indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus $3^{S.W.}_{4}$, as an Ozone entry in the schedule will indicate that the Ozone paper is tinted as 3 on the scale, that the wind is from the N.W., and that its force on the scale 0—5 is 4, or blowing fresh.

**Atmospheric Electricity.**

Too much importance cannot be attached to the electric condition of the atmosphere in connection with terrestrial magnetism, barometrical, thermometrical, and meteorological phenomena generally. A proper Electrometer is, in truth, necessary to every complete meteorological observatory.

**Remarks.**

The Remarks column is unavoidably too narrow. Some of the most valuable Observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are in general use is given at the foot of the column. Besides special and extraordinary Observations, great prominence ought to be given in this column to Prevalent Diseases, differences in character, colour, velocity, and direction between the Lower and Upper Strata of clouds, the Colour of the Sky, etc. Remarks ought to be made on the occurrence of Meteors, Auroræ Boreales, remarkable depressions, elevations, and fluctuations of the Barometer, Thunder-Storms, and remarkable falls of Snow, Hail, or Rain, the Hour of Storms of Wind commencing, attaining their maximum, and ending, as well as such Notes on Storms as have been hinted at above. When lofty hills are in the vicinity of a Station, the Height of Clouds and of the Snow-line in winter should be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. should be registered, either in two columns, otherwise unoccupied, or ruled off for the purpose, from the column of 'Remarks.'

**Observations in connection with the Periodic Return of the Seasons.**

Observations in connection with the Periodic Return of the Seasons, possess not only great scientific value, but are of considerable importance in connection with Agriculture, Horticulture, and Natural History. The Council would direct the special attention of Observers to the registration of such phenomena, so that the published Summaries may fairly represent the whole of Scotland. Observations ought to be confined to individual trees and shrubs; to particular species of birds, and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm. The Annual Table, published yearly in the Society's Journal, will indicate the species of plants and animals to which special attention is more particularly directed.

The Council recommend Observers, before purchasing new instruments, and in repairing old ones, to communicate with the Meteorological Secretary, in order that every instrument may be examined and improved before being used; and they consider it necessary that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, *December* 1891.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

| FOREST TREES. | In Flower. | Leaf Buds first Appear. | In Leaf. | Dressed of Leaves. |
|---|---|---|---|---|
| Alder, | | | | |
| Ash, | | | | |
| Beech, | | | | |
| Birch, | | | | |
| Elm, | | | | |
| Larch, | | | | |
| Lime, | | | | |
| Oak, | | | | |
| Sycamore or Plane, | | | | |

| SHRUBS, ETC. | First in Blossom. |
|---|---|
| Barberry, | |
| Bourtree or Elder, | |
| Broom, | |
| Hazel, | |
| Hawthorn, | |
| Holly, | |
| Laburnum, | |
| Lilac, | |
| Mezereon, | |
| Mountain Ash or Rowan, | |
| Red Flowering Currant, | |
| Rhododendron Ponticum, | |
| Whin, | |

| FRUITS. | First in Blossom. | Fruit Ripe, generally. |
|---|---|---|
| Apple, | | |
| Black Currant, | | |
| Cherry, | | |
| Gean, | | |
| Gooseberry, | | |
| Peach, | | |
| Pear, | | |
| Plum, | | |
| Strawberry, | | |

| CROPS, mentioning variety. | Sowing or Planting. | Appearing above Ground. | In Ear or Flower. | First Cut or Raised. |
|---|---|---|---|---|
| Barley, | | | | |
| Bere or Bigg, | | | | |
| Oats, | | | | |
| Wheat, | | | | |
| Beans, | | | | |
| Pease, | | | | |
| Potatoes, | | | | |
| Turnips, | | | | |
| Rye Grass, | | | | |

| MIGRATORY BIRDS. | First Arrival. | Departure. |
|---|---|---|
| Cuckoo, | | |
| Curlew, | | |
| House-Swallow, | | |
| Lapwing, | | |
| Plover, | | |
| Sand-Martin, | | |
| Starlings, | | |
| Swan, | | |
| Rail or Corn Crake, | | |

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

# SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Hadlo House, County of Aberdeen, in Lat. 57° 4', Long. 2° 14', Distance from Sea 12 miles.

Height of Cistern of the Barometer above Mean Sea-Level 180 feet, above Ground 3 feet. During the MONTH of July 1894.

The Hours of Observation are of Greenwich Time.

| Days of Month. | BAROMETER. 9 h. A.M. * No. | Attached Thermometer | 9 h. P.M. No. | Attached Thermometer | SELF-REGISTERING THERMOMETERS, Read Daily, at 9 P.M. Protected in Shade, 4 feet above Ground. Max. No. | Min. No. | Exposed Black Bulbs. Max. in Sun's rays No. | Min. on Grass No. | HYGROMETER. Dry No. ___ Wet No. ___ 9 h. A.M. Dry bulb. | Wet bulb. | 9 h. P.M. Dry bulb. | Wet bulb. | Rain. No. of days in which it fell. | Amount in inches. No. ___ | WIND. 9 h. A.M. Direction. | Force | 9 h. P.M. Direction. | Force | Readings of the H. Cup Anemometer. No. ___ 9 h. A.M. | CLOUDS. 9 A.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | ___ P.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | SUNSHINE. Hours. | THERMOMETERS under Ground. 9 h. A.M. No. 3 inches. | No. 12 inches. | No. 22 inches. | Temperature of WELL at depth of feet. No. | SEA. Temperature at 1 fathom, and Density. | OZONE. 0—10. 9 A.M. | 9 P.M. | GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. *Mention the hour at which Storms, including Thunder and Lightning, began and ended.* | Days of Month. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches. | ° | inches. | ° | ° | ° | ° | ° | ° | ° | ° | ° | | | | | | | | | | | | | ° | ° | ° | ° | ° | | | | | |
| 1 | 30·238 | 74 | 30·082 | 60 | 71 | 46 | 88 | 44 | 66·5 | 62 | 54 | 55 | | | E | | E | | 5052 | | | | | | 63 | 60 | 56 | | | 6 | 5 | | 1 |
| 2 | 29·996 | 72 | 29·806 | 60 | 67 | 48 | 84 | 40·5 | 65 | 62 | 58 | 57 | | | E | | S.E. | | 5812 | | | | | | 63 | 61 | 54 | | | 5 | 7 | | 2 |
| 3 | 29·786 | 59 | 29·848 | 58 | 65·5 | 53·5 | 82 | 53 | 57 | 54 | 56 | 54 | X | | N.W. | | S.W. | | 6775 | | | | | | 61 | 61 | 54 | | | 9 | 5 | | 3 |
| 4 | 29·870 | 72 | 29·888 | 62 | 71·5 | 40 | 91 | 33 | 65 | 54 | 60 | 57·5 | | | W. | | S.W. | | 7043 | | | | | | 60 | 60 | 54 | | | 5 | 5 | | 4 |
| 5 | 29·872 | 68 | 29·896 | 69 | 70·5 | 51 | 95 | 44 | 65 | 60 | 58 | 57·5 | | | S.W | | S.W. | | 7595 | | | | | | 61 | 60 | 57 | | | 6 | 5 | | 5 |
| 6 | 29·862 | 71 | 29·740 | 59 | 68·5 | 50 | 85 | 41 | 66 | 62 | 57·5 | 56 | | | S.E | | S.E. | | 8011 | | | | | | 62 | 60 | 57 | | | 5 | 6 | | 6 |
| 7 | 29·608 | 69 | 29·626 | 57 | 70 | 49·5 | 94 | 40·5 | 65 | 61 | 54 | 51 | X | | S.W. | | S.E. | | 9315 | | | | | | 62 | 61 | 58 | | | 7 | 4 | | 7 |
| 8 | 29·648 | 71 | 29·636 | 56·5 | 70 | 45 | 100 | 34 | 63 | 55 | 54·5 | 53·5 | X | ·26 | S.W. | | S.W | | 9747 | | | | | | 61 | 61 | 54 | | | 5 | 7 | | 8 |
| 9 | 29·578 | 54 | 29·516 | 56 | 62·5 | 50 | 71 | 46 | 56 | 55 | 53·5 | 52·5 | X | | S.E. | | S.E. | | 9957 | | | | | | 60 | 60 | 54 | | | 7 | 7 | | 9 |
| 10 | 29·412 | 60 | 29·268 | 56·5 | 60·5 | 49 | 70 | 41 | 58 | 56 | 54·5 | 54 | X | | S.E. | | S.E. | | 0481 | | | | | | 60 | 60 | 54 | | | 9 | 10 | | 10 |
| 11 | 29·166 | 58 | 29·106 | 54 | 61·5 | 51 | 73 | 48 | 58 | 56·5 | 54·5 | 54 | X | | E | | E | | 1022 | | | | | | 60 | 59 | 54 | | | 9 | 10 | Thunder. | 11 |
| 12 | 28·988 | 54·5 | 28·998 | 56 | 60 | 51 | 72 | 48 | 55 | 54 | 55 | 54 | X | | N | | N | | 1373 | | | | | | 59 | 59 | 54 | | | 9 | 9 | | 12 |
| 13 | 29·018 | 60 | 29·208 | 58·5 | 66·5 | 52 | 91 | 48 | 60 | 55 | 57 | 55 | X | | W | | W | | 2927 | | | | | | 58 | 59 | 54 | | | 7 | 4 | | 13 |
| 14 | 29·350 | 59 | 29·468 | 57 | 59 | 52 | 63 | 52 | 58 | 56 | 55·5 | 55 | X | | W. | | W | | 3547 | | | | | | 60 | 59 | 54 | | | 7 | 8 | | 14 |
| 15 | 29·518 | 55 | 29·612 | 54·5 | 58 | 52 | 67 | 49·5 | 54 | 53 | 52 | 50 | X | 2·41 | N.W. | | N.W | | 4194 | | | | | | 58 | 59 | 54 | | | 9 | 8 | | 15 |
| 16 | 29·524 | 58 | 29·268 | 55 | 59 | 48 | 67 | 45 | 54 | 51·5 | 54·5 | 54 | X | | S.E. | | S.E. | | 4553 | | | | | | 58 | 59 | 54 | | | 7 | 8 | Fog. | 16 |
| 17 | 29·246 | 61 | 29·242 | 54 | 66·5 | 51 | 90 | 49·5 | 60 | 54 | 55 | 53 | X | | W | | N.W | | 5071 | | | | | | 58 | 59 | 54 | | | 7 | 7 | | 17 |
| 18 | 29·252 | 58·5 | 29·370 | 56 | 61·5 | 51 | 82 | 48 | 58 | 55 | 52 | 50·5 | X | | N. | | N.W | | 5374 | | | | | | 60 | 59 | 54 | | | 9 | 8 | | 18 |
| 19 | 29·434 | 54·5 | 29·516 | 54·5 | 61·5 | 48 | 78 | 41 | 52·5 | 49 | 48 | 47 | | | N.W | | N.E | | 6018 | | | | | | 58 | 59 | 54 | | | 8 | 4 | | 19 |
| 20 | 29·568 | 62·5 | 29·546 | 54·5 | 68·5 | 40 | 98 | 35 | 60·5 | 55 | 52 | 51 | X | | N.W | | W | | 6216 | | | | | | 58 | 59 | 58 | | | 5 | 6 | Thunder. | 20 |
| 21 | 29·616 | 68 | 29·508 | 50 | 66 | 43 | 88 | 38 | 63 | 54 | 54·5 | 53 | | | W | | S.E. | | 6527 | | | | | | 61 | 60 | 54 | | | 5 | 6 | | 21 |
| 22 | 29·588 | 58·5 | 29·696 | 56 | 68 | 43 | 91 | 44 | 58 | 54 | 53 | 52 | X | ·56 | W | | W | | 6977 | | | | | | 61 | 60 | 54 | | | 6 | 6 | Thunder. | 22 |
| 23 | 29·706 | 60 | 29·928 | 54 | 67 | 46 | 90 | 40 | 59 | 56 | 56 | 54 | | | N | | N. | | 7221 | | | | | | 61 | 61 | 58 | | | 5 | 6 | | 23 |
| 24 | ~~29·968~~ 30·168 | 65 | 30·148 | 56 | 67 | 44·5 | 89 | 40 | 61 | 56 | 53 | 51 | | | N.E. | | N.E. | | 7411 | | | | | | 63 | 61 | 58 | | | 7 | 6 | | 24 |
| 25 | 30·042 | 62 | 29·938 | 59 | 65 | 44 | 83 | 38 | 59 | 55 | 58 | 54 | X | | N.E. | | E. | | 7681 | | | | | | 63 | 61 | 58 | | | 7 | 8 | | 25 |
| 26 | 29·822 | 60 | 29·828 | 60·5 | 67 | 48 | 82 | 42 | 60 | 58·5 | 59 | 58 | X | | S.E | | S.E. | | 8797 | | | | | | 63 | 61 | 58 | | | 9 | 9 | | 26 |
| 27 | 29·840 | 61 | 29·888 | 60 | 66 | 51 | 81 | 41·5 | 59 | 58 | 54·5 | 54 | | | S.E. | | E. | | 9290 | | | | | | 63 | 62 | 59 | | | 10 | 8 | Fog. | 27 |
| 28 | 29·924 | 61 | 29·994 | 60 | 72 | 46 | 86·5 | 41 | 64 | 61 | 54·5 | 54 | | | S.E | | S.E | | 9743 | | | | | | 63 | 62 | 59 | | | 8 | 9 | Fog. | 28 |
| 29 | 29·998 | 64·5 | 29·984 | 58 | 72 | 48 | 86 | 43 | 65·5 | 61·5 | 54·5 | 54 | | ·19 | S.E | | S.E | | 0247 | | | | | | 64 | 63 | 59 | | | 8 | 7 | Fog. | 29 |
| 30 | 29·932 | 61 | 29·864 | 59 | 68·5 | 53 | 83 | 52 | 65 | 60 | 57 | 54 | | | N.E. | | N.E. | | 0601 | | | | | | 65 | 64 | 60 | | | 9 | 8 | | 30 |
| 31 | 29·750 | 57 | 29·704 | 59 | 65 | 52 | 80 | 50 | 59 | 54·5 | 56 | 54 | | | N.E. | | S.E. | | 0797 | | | | | | 64 | 64 | 60 | | | 8 | 5 | | 31 |
| Sums. | 449·310 | 1935 | 449·180 | 1778·5 | 2042·5 | 1496·5 | 2583·5 | 1333·5 | 1869·0 | 1757·5 | 1744·5 | 1612·5 | | 3·42 | | | | | | | | | | | 1891 | 1843 | 1784 | | | | | | |
| Means. | 29·655 | 62·4 | 29·651 | 57·3 | 65·9 | 48·3 | 83·3 | 43·6 | 60·3 | 56·7 | 55·3 | 53·9 | | | | | | | | | | | | | 61·0 | 60·4 | 57·5 | | | 7·2 | 6·8 | | |
| † Total Corrections for Instrumental Errors. | +055 | | +055 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ‡ Corrections for Diurnal Range. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "Corrected Means." | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. of Column. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | | |

NOTATION USED IN GENERAL REMARKS.

| | | | | | |
|---|---|---|---|---|---|
| a. | *denotes* aurora. | | m. | *enotes* meteor. | |
| ci. | ,, | cirrus. | ms. | ,, | meteors. |
| ci.-cu. | ,, | cirro-cumulus. | n. | ,, | nimbus. |
| ci.-s. | ,, | cirro-stratus. | r. | ,, | rain. |
| cu. | ,, | cumulus. | h. r. | ,, | heavy rain. |
| cu.-s. | ,, | cumulo-stratus. | c. h. r. | ,, | continued heavy rain. |
| d. | ,, | dew. | s. | ,, | stratus. |
| f. | ,, | fog. | sc. | ,, | scud. |
| fr. | ,, | frost. | s. | ,, | sleet. |
| h.-fr. | ,, | hoar-frost. | s. | ,, | snow. |
| h. | ,, | haze. | so. ha. | ,, | solar halo. |
| h. d. | ,, | heavy dew. | sq. | ,, | squall. |
| hl. | ,, | hail. | sqs. | ,, | squalls. |
| l. | ,, | lightning. | t. | ,, | thunder. |
| li. cl. | ,, | light clouds. | t. s. | ,, | thunder-storm. |
| li. sh. | ,, | light showers. | w. | ,, | wind. |
| lu. co. | ,, | lunar corona. | g. | ,, | gale of wind. |
| lu. ha. | ,, | lunar halo. | | | |

TABLE FOR ESTIMATING FORCE OF WIND.

| Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. |
|---|---|---|---|---|---|
| 0 | Calm | 1·5 | Light breeze | 4 | Blowing hard |
| 0·5 | Very light air | 2· | Fresh breeze | 5 | Blowing a gale |
| 1· | Light air | 3· | Very fresh | 6 | Violent gale |

**BARometer**, "corrected Mean" at 9 A.M., *minus* the Correction †† for Temp. (Col. 2), = 29·710 − 90 = 29·620

"Corrected Mean" of Barometer at 9 P.M., *minus* the Correction †† for Temp. (Col. 4), = 29·706 − 76 = 29·630

**Mean at Station, corrected, and at 32°**, = 29·625

Correction for height, feet above Mean Sea-level, = 195

**Mean, reduced to 32°, and Sea-level**, = 29·820

Highest Reading, corrected for Index error, on the 1 th, = 30·238

Lowest Do. Do., on the 12th, = 28·986

Difference, or **Monthly Range**, = 1·250

**S.-R. THERMOMETER**, (in shade, etc.), **Highest in Month**, (corrected for Index Errors), on the 28th, = 72·0

**Lowest in Month**, corrected for Index errors, on the 20th, = 40·0

Difference, or **Monthly Range**, = 32·0

"Corrected **Mean**" of all the **Highest**, (Col. 5), = 65·9

"Corrected **Mean**" of all the **Lowest**, (Col. 6), = 48·3

Difference, or **Mean Daily Range**, = 17·6

** Calculated **Mean Temperature** of Month, = 57·1

**S.-R. THERMOMETER, Black Bulb in Sun, Highest**, (corrected for Index Errors), on the 6 th, = 100·0

"Corrected **Mean**," (Col. 7), **of Black Bulb, Max. in Sun**, = 83·3

**Lowest at Night**, Black Bulb (corrected for Index errors), on the 4 th, = 33·0

"Corrected **Mean**," (Col. 8), **of Black Bulb, Min.** on grass, = 43·6

Difference of above means or range ("exposed"), = ___

**HYGROMETER, Mean** (corrected) A.M. and P.M. Reading **of Dry Bulb**, (Cols. 9 and 11), = 57·8

**Mean** (corrected) A.M. and P.M. Reading **of Wet Bulb**, (Cols. 10 and 12), = 55·3

†† Computed **Temperature of Dew-Point**, = 53·1

†† Do. **Elastic Force of Vapour**, = ·404

†† Do. **Weight of Vapour in a Cubic Foot of Air**, = ___

†† **Relative Humidity** (Saturation = 100), = 84

**RAIN** fell on 17 **Days; Amount in Inches**, = 3·42

| WIND. SUMMARY. Direction. | N | NE | E | SE | S | SW | W | NW | Calm or Variable. | Mean Force. | Mean Velocity in miles per day. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. | 3 | 4 | 3 | 8 | | 3 | 6 | 4 | | | |
| P.M | 2 | 3 | 4 | 11 | | 4 | 4 | 3 | | | |
| Mean. | 3 | 3 | 4 | 9 | 0 | 4 | 5 | 3 | 0 | | |

* Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S."; and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.
† Embracing corrections for both capillarity and Index Errors
‡ The Diurnal Range for Scotland is as yet unknown.
†† *Practically*, though not *absolutely* a *minus* correction.
‡‡ These "Hygrometrical Deductions" are calculated from Glaisher's Hygrometrical Tables, Second Edition *only*.
** While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature." Any observations not taken under the Conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. *See over.*

*Observations made and Return verified by* John Forrest

(*Signed*) ___

# INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS,

## WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the chief objects that the SCOTTISH METEOROLOGICAL SOCIETY proposed to itself when the Society was established in 1855, was to secure PERFECT UNIFORMITY in the system of observation pursued at all its Stations. Uniformity in the observations is absolutely necessary to justify the publication of Monthly Results from different observations, it being found that differences between the Returns from two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those who kindly furnish Reports to the Society will, by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

**Hour of Observation.** The Council recommend that Observations be made precisely at 9 A.M. and 9 P.M. (Greenwich or Railway Time only), as specified in the following remarks, or at the top of the columns of the Schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading the time at which it was taken, if not at 9 A.M. or 9 P.M.

**Barometer.** Weather-Glasses and Aneroids, though well suited to indicate roughly variations of atmospheric pressure, are not fitted for scientific purposes. No Barometer should be used for Meteorological Observation that is not supplied with some means of adjustment or compensation which will secure that the height of the mercury in the tube is accurately measured from the fluctuating surface of the mercury in the cistern.

The Barometer in which the error arising from the fluctuating surface of the mercury in the cistern is entirely got rid of is FORTIN'S Barometer, the arrangement consisting in applying pressure by means of a screw to the bottom of the cistern, which is made of flexible leather, thus raising or depressing the surface till it just meets the ivory point which forms the zero point of the fixed scale.

The Barometer originally constructed by Mr. Adie of London, and usually called the Board of Trade Barometer, has the great convenience of requiring no adjustment of the cistern. Its scale-inches are not true inches, but so much shorter as to compensate the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This is an excellent Barometer for ordinary Observers, inasmuch as it entirely eliminates the error of observation likely to arise in not a few cases in setting the instrument to the zero point of the fixed scale when the light is not good. To show the accuracy with which these Barometers are made, it may be stated, that one was compared, during a whole year, with the Society's Standard Barometer, particular care being given to make the comparison when atmospheric pressure was rising or falling very rapidly, with the result that none of the readings differed from those of the Standard more than 0·003 inch.

A modification of Fortin's Barometer is used at a number of the Society's Stations, by which the coincidence of the zero point with the surface of the mercury is indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the index-line on this little piston-rod is brought, by the adjusting screw, to form one straight line with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this preliminary setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the vernier.

It is absolutely necessary that the Barometer which is to be used shall have been compared with a Standard Barometer.

The Barometer should be suspended in as good a light as can be secured, and to facilitate the reading, a piece of white paper may be put behind the tube. It must be hung truly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire, and must not be hung against a wall heated by a flue. The object being to secure that the whole instrument, including the brass fittings, the contained mercury, and the attached Thermometer, shall be, when read, at one uniform temperature, it is evident that the best position is that which is least liable to sudden changes of temperature.

In taking an Observation, the Attached Thermometer is first noted: the tube must then be gently tapped, and the cistern-adjustment carefully made. The eye, by raising and lowering it, must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted so as to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will facilitate an accurate adjustment and reading of the Barometer. A mistake not unfrequently made by those beginning to observe, consisting in setting the edge of the vernier to the level of the clear surface of the mercury which is in direct contact with the glass tube, must be carefully avoided.

The errors most frequently made in reading the Barometer are errors of 1·000 inch, 0·500 inch, and 0·050 inch; that is to say, instead of 29·365 inches, either of the following is sometimes set down—viz. as 30·365 inches, 28·365 inches, 29·865 inches, or 29·815 inches. Experience having shown that even the very best Observers make these mistakes, particular attention is directed to the matter.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must first be screwed so as to form a tight plug to the cistern, thus preventing the escape of the mercury. Then screw up the mercury not quite to the top of the tube, but to within a quarter of an inch of it, and take down the instrument; it should then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case if, on inclining the instrument, a sharp tap is produced when the mercury strikes the top of the tube. If a dull tap is heard, there is air in the tube, which must be got rid of.

As Barometers are liable to be deranged by the introduction of air into their tubes, on removal from place to place, or in being roughly handled, it may be useful to Observers to know how the air may be expelled. First close up the cistern by screwing the ivory peg tight, so as to prevent the escape of mercury; then screw up the mercury to about half an inch from the top of the tube; and having slowly inverted the instrument, place the top of it on a yielding substance, such as the boot, and gently tap on the cistern with the palm of the hand, so as to induce the air to ascend through the column to the cistern, whence it may escape. Since there is the weight of two atmospheres—the pressure of the mercury in the Barometer, and the air outside—pressing on any air that may be inside the tube, it is usually a tedious operation to get it wholly expelled. After repeated trials, however, it is generally accomplished; and the clear metallic sound of the mercury, when gently struck against the top of the glass tube, will show when the whole of the air has been expelled. On hanging up the Barometer, care must be taken to screw down the mercury in the tube before unfastening the float of the cistern, for, if this be not attended to, the mercury will flow out, and the instrument be seriously damaged.

**Protection and Position of Thermometers.** The Council of the Society recommend that the Self-Registering Thermometers, and the Dry and Wet Bulb Hygrometer, be kept in Stevenson's Louvre-boarded Box for Thermometers, painted white inside and outside, and screwed to four stout posts, also painted white, firmly fixed in the ground. The posts must be of such a length that when the Thermometers are hung in position the Bulbs of the Minimum Thermometer, and of the Dry and Wet Bulb Thermometers, will be exactly at the same height of FOUR FEET above the ground, the Maximum Thermometer being hung immediately above the Minimum Thermometer. The Thermometer Box is to be placed over a plot of grass, and in a free open space to which the sun's rays have free access during as much of the day as surrounding conditions enable the Observer to secure. The Thermometers are suspended on cross-laths in the centre of the Box, and face the door, which should open to the north.

The Council regard the question of UNIFORMITY OF HEIGHT ABOVE GROUND, AND METHOD IN PROTECTING THE THERMOMETERS, as vital in every system of Meteorological Observation, since without Observations made at different Stations are incomparable, thus rendering it impossible to compare the Climates of places with each other as regards their most important features.

**Self-Registering Thermometers.** Professor Phillips, and Negretti and Zambra's Maximum Thermometers, and Rutherford's Minimum Thermometer, are recommended. It is recommended that these Thermometers be graduated on the glass stem. The Minimum Thermometer is liable to two derangements—viz., the column of spirit breaking, and part of the spirit distilling by high temperature and lodging at the top of the tube. This derangement is of occasional occurrence with protected Thermometers, but of frequent occurrence with exposed Thermometers. Hence a systematic examination of Minimum Thermometers ought to be a regular part of the work carried on by each Observer.

Fortunately, Spirit Thermometers may be easily set right by any one, when the column of spirit chances to separate. Let the Thermometer be taken in the hand by the end farthest from the bulb, raised above the head, and then forcibly swung down towards the feet; the object being, on the principle of centrifugal force, to send down the detached portion of spirit till it unites with the column. A few throws, or swinging strokes, will generally be sufficient for the purpose; after which the Thermometer should be placed in a slanting position, to allow the rest of the spirit still adhering to the sides of the tube to drain down to the column. But another method must be adopted, if the portion of spirit in the top of the tube be small. Heat should be applied slowly and cautiously to the top end of the tube where the detached portion of spirit is, which, being turned into vapour by the heat, will condense on the surface of the unbroken column of spirit. Care must be taken that the heat is not applied too quickly; for, if this be done, the tube will break and the instrument be destroyed. The best way to apply the requisite amount of heat is by bringing the end of the tube slowly down towards a minute flame from a gas-burner; or, if gas be not at hand, a piece of heated metal will serve instead.

**Black-Bulb Thermometers.** The bulbs of the Thermometers for registering the greatest heat from the sun's rays, and the least from radiation during night, have a black coating, which may easily be made, or mended, by the application of a mixture of lampblack and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind, The Maximum should be freely exposed to the sun, and the Minimum should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation. Black-bulbs enclosed in 'glass jackets' may also be used, being indeed preferable to the above. It must, however, be added, that the whole subject of the observation of Solar and Terrestrial Radiation is not yet in a sufficiently advanced state to warrant the exclusive recommendation of any one of these methods.

**Dry and Wet Bulb Hygrometer.** The Hygrometer in use at the Society's Stations consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved form of this apparatus seriously vitiate the Hygrometrical Observations, Observers are specially requested to attend to the following conditions:—The bulbs must hang down by at least an inch free from the scales and frame to which they are attached; the frame must be such as will bring the tubes forward by an inch from any board on which it may be suspended; the water-cup must be covered, and altogether placed to the side, and a little below the level of the wet bulb, but in no case under the bulbs; the muslin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the Observer that the muslin is always clean and moist, and the water pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

**Reading of the Thermometer.** In reading the Thermometer great care must be taken to bring the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40½°, respectively. So also 40¼°, and 40¾°, more or less, must be registered 40°·2, or 40°·3, and 40°·7, or 40°·8 respectively. In reading Rutherford's Minimum Thermometer, the indication of that end of the index which is next the surface of the spirit is alone noted. On opening the Thermometer Box, the Dry and Wet Bulb Thermometers are to be first, and rapidly, read, inasmuch as they are readily affected by heat from the person of the Observer.

**Hour of observing Temperature.** The Hygrometer is read at 9 A.M. and 9 P.M. The Self-Registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the Self-Registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 3d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

**Verification of Thermometers.** No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a standard Thermometer. When such Thermometers as are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being re-tested. The Self-Registering, especially the Minimum Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer, marked by a scratch on the tube, ought to be tested once a year, in snow or melting ice.

In selecting instruments, the following points require attention:—The divisions of the vernier of Barometers in reference to their scales, and the perfect freedom of the Barometer from air; the correct numbering of the scale of every instrument; the rejection of Thermometers the frameworks of which are not likely to stand exposure to the weather, as shown in the past by repeated and annoying breakages of Thermometers of similar construction; and as regards Maximum Thermometers, either Negretti and Zambra's, or Phillip's, whether they will act at the highest temperatures they may be required to register. By the laws of the Society, Members and Observers have a right to have their instruments compared by the Secretary, and to advise with him regarding the purchase of instruments.

**Wind.** Very great care should be bestowed on the Observations of the Wind, the accuracy of which, both as regards Direction and Force, is so essential towards the right discussion of many of the more important problems of the science.

**1. As regards Direction.** A Wind-Vane ought to be elevated at least 12 feet above surrounding objects. When it oscillates incessantly, the mean direction should be taken. In all cases, but especially when the Vane is stationary, and when the wind is feeble, reference may be made to the direction of smoke, etc., in well-exposed situations. Careful observations are recommended to be made on the changes in the direction of the wind; and during storms, extra observations at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, is likely to give highly valuable and important results, particularly in connection with the system of thickly-planted Stations over a limited district round Edinburgh called STORM STATIONS, in the course of being established by the Society for the systematic investigation of the relation of the force of the wind to BAROMETRIC GRADIENTS, and other points connected with storms.

**2. As regards Velocity and Pressure.** The Council would recommend the Hemispherical Cup Anemometer,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the mean Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, the Pressure Anemometers recently brought under the notice of the Society by Mr. T. Stevenson, the Honorary Secretary, and Mr. R. Ballingall, the Society's Observer at Eallabus, are recommended as likely to secure uniformity in making observations on the Force of the Wind.

**Rain Gauges.** Many causes conspire to produce anomalies in Rain Returns, arising partly from the difficulty of obtaining a perfectly unobjectionable situation for observation, and partly from the defective nature of the instruments used. The Rain Gauge should not be placed on a slope or terrace, but on a level piece of ground, in as open a situation as the Observer can secure for it. As it is often difficult to obtain a position as free and unobstructed by surrounding objects as is desirable, care should be taken to place it at some distance from shrubs, trees, buildings, or other obstructions, at least as many feet from their base as they are in height. The more important directions, towards which it is most desirable to have a free exposure, are, in the order of their importance, S.W., N.E., S.E., S., and W. The rim of the gauge must be perfectly level, and fixed so that it will remain level in all weathers, and be at a height of one foot above ground, over grass. In such gauges as Fleming's, which are furnished with a measuring-rod attached to a float, the rod ought to be fixed down, and the float rise to its height only at the time the instrument is read, it being found that a stem projecting above the rim of the gauge seriously interferes with the proper measurement of the Rain-fall. When a measuring-glass is used, care should be taken to hold it quite perpendicular. The Rain Gauge ought to be read daily at 9 A.M., and the reading entered in the Returns of the previous day. If the Gauge is read once a month, the reading is to be made on the first of the month, and the amount entered for the previous month.

**Snow-falls.** Snow-falls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs, it should be noted in the 'Remarks,' and the letter S affixed to the depth of water received in Gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the Rain Gauge. For wind, rain, and snow, as indeed in every column, the Observer cannot be too careful to register observations only; and nothing that partakes of the nature of deduction or inference.

**Clouds.** Convenient abbreviations for the nomenclature of Clouds will be found on the other side. The amount of Cloud ought to be estimated from the greater or less obscuration of the sky overhead (*i.e.* within 20° or 30° of the zenith). The strata of Clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the Clouds' column, though their appearance and changes may be noted among the Remarks. The amount of Cloud is entered from a scale of 0 to 10; thus, when the sky overhead is free from Clouds it is entered 0, when half-covered by Clouds, 5, wholly covered, 10, and so on.

Observations of the Clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—Thus, in the column Velocity and Direction, 6, S. W.

——— will indicate that the upper strata of Clouds travel with 2, W.

extreme velocity from S.W., and those in the lower regions from W., with one-third the speed of the former. Again, in the second 4, st.

Cloud column, an entry of ——— will indicate that the higher 2, cu-st.

regions are covered to the amount of 4-tenths with stratus Clouds; and that the sky is further obscured to the extent of 2-tenths by lower Clouds of the cumulo stratus kind.

Remarks on peculiar Clouds, accompanied with drawings, will assist materially in the development of a more exact nomenclature of Clouds, as well as throw light on the electrical, and other of the more obscure phenomena of Meteorology.

**Sunshine.** The approximate number of Hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

**Underground Thermometers.** As the germination and growth of crops and plants generally depend greatly on the temperature of the soil,—its amount and constancy,—the Council recommend that Observations in this interesting department be made at 9 A.M., by Thermometers permanently fixed in the soil, their bulbs being sunk to depths of 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames.

**Temperature of the Sea.** A knowledge of the Temperature of the Sea is not only in itself, but in its relations to that of our island, a most important branch of Meteorology. The Council therefore recommend that the Temperature of the Sea be carefully taken by a properly constructed apparatus, from boats, or, if this be impracticable, from the ends of piers and rocks round the coast, where it is not influenced by that of river water, and as little influenced as possible by currents sweeping along the coast, and thus acquiring the temperature of the land, either greatly heated by the sun or cooled by nocturnal radiation. At or near the time of high water, in cases where the observations cannot be taken daily, the observation may be made on the 5th, 15th, and 25th of each month. When convenient, extra Sea Observations might be taken for other and greater depths, noting always the Temperature of the Air, and the Hour of Observation. It is also very desirable that observations on the daily Maxima and Minima by Thermometers continuously immersed, be instituted at points along the coast, by the method proposed by Mr. T. Stevenson, and already commenced at Peterhead and Liverpool.

**Temperature of Wells.** The Temperature of the water at the bottom of Wells ought, when practicable, to be taken, both the depth of the Well and of the water being noted.

**Ozone.** Mention what Test-Papers are used, Schönbein's or Moffat's, etc. The Paper is affixed by a pin to a board in the Thermometer Box, and the indications registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus $3^{N.W.}_{4}$, as an Ozone entry in the schedule will indicate that the Ozone paper is tinted as 3 on the scale, that the wind is from the N.W., and that its force on the scale 0—5 is 4, or blowing fresh.

**Atmospheric Electricity.** Too much importance cannot be attached to the electric condition of the atmosphere in connection with terrestrial magnetism, barometrical, thermometrical, and meteorological phenomena generally. A proper Electrometer is, in truth, necessary to every complete meteorological observatory.

**Remarks.** The Remarks column is unavoidably too narrow. Some of the most valuable Observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are in general use is given at the foot of the column. Besides special and extraordinary Observations, great prominence ought to be given in this column to Prevalent Diseases, differences in character, colour, velocity, and direction between the Lower and Upper Strata of clouds, the Colour of the Sky, etc. Remarks ought to be made on the occurrence of Meteors, Aurora Borealis, remarkable depressions, elevations, and fluctuations of the Barometer, Thunder-Storms, and remarkable falls of Snow, Hail, or Rain, the Hour of Storms of Wind commencing, attaining their maximum, and ending, as well as such Notes on Storms as have been hinted at above. When lofty hills are in the vicinity of a Station, the Height of Clouds and of the Snow-line in winter should be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. should be registered, either in two columns, otherwise unoccupied, or ruled off for the purpose, from the column of 'Remarks.'

**Observations in connection with the Periodic Return of the Seasons.** Observations in connection with the Periodic Return of the Seasons, possess not only great scientific value, but are of considerable importance in connection with Agriculture, Horticulture, and Natural History. The Council would direct the special attention of Observers to the registration of such phenomena, so that the published Summaries may fairly represent the whole of Scotland. Observations ought to be confined to individual trees and shrubs; to particular species of birds, and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm. The Annual Table, published yearly in the Society's Journal, will indicate the species of plants and animals to which special attention is more particularly directed.

The Council recommend Observers, before purchasing new instruments, and in repairing old ones, to communicate with the Meteorological Secretary, in order that every instrument may be examined and improved before being used; and they consider it necessary that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, *December* 1891.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

| FOREST TREES. | In Flower. | Leaf Buds first Appear. | In Leaf. | Divested of Leaves. |
|---|---|---|---|---|
| Alder, | | | | |
| Ash, | | | | |
| Beech, | | | | |
| Birch, | | | | |
| Elm, | | | | |
| Larch, | | | | |
| Lime, | | | | |
| Oak, | | | | |
| Sycamore or Plane, | | | | |

| SHRUBS, ETC. | First in Blossom. |
|---|---|
| Barberry, | |
| Bourtree or Elder, | |
| Broom, | |
| Hazel, | |
| Hawthorn, | |
| Holly, | |
| Laburnum, | |
| Lilac, | |
| Mezereon, | |
| Mountain Ash or Rowan, | |
| Red Flowering Currant, | |
| Rhododendron Ponticum, | |
| Whin, | |

| FRUITS. | First in Blossom. | Fruit Ripe, generally. |
|---|---|---|
| Apple, | | |
| Black Currant, | | |
| Cherry, | | |
| Gean, | | |
| Gooseberry, | | |
| Peach, | | |
| Pear, | | |
| Plum, | | |
| Strawberry, | | |

| CROPS, mentioning variety. | Sowing or Planting. |
|---|---|
| Barley, | |
| Bere or Figgy, | |
| Oats, | |
| Wheat, | |
| Beans, | |
| Pease, | |
| Potatoes, | |
| Turnips, | |
| Rye Grass, | |

| MIGRATORY BIRDS. | First Arrival. | Departure. |
|---|---|---|
| Cuckoo, | | |
| Curlew, | | |
| House-Swallow, | | |
| Lapwing, | | |
| Plover, | | |
| Sand-Martin, | | |
| Starling, | | |
| Swan, | | |
| Rail or Corn Crake, | | |

| Appearing above Ground. | In Ear or Flower. | First Cut or Bleed. |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

Addo House
July 1894.

BOOK POST.

To the SECRETARY
Scottish Meteorological Society,
122 George Street,
EDINBURGH.

# SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Haddo House, County of Aberdeen, in Lat. 57° 24′, Long. 2° 14′, Distance from Sea 12 miles.

Height of Cistern of the Barometer above Mean Sea-Level 180 feet, above Ground 3 feet. During the MONTH of August 1894.

The Hours of Observation are of Greenwich Time.

| Days of Month. | BAROMETER. 9 h. A.M. * No. | Attached Thermometer | 9 h. P.M. No. | Attached Thermometer | SELF-REGISTERING THERMOMETERS, Read Daily, at 9 P.M. Protected in Shade, 4 feet above Ground. Max. No. | Min. No. | Exposed Black Bulbs. Max. in Sun's rays No. | Min. on Grass No. | HYGROMETER. Dry No. Wet No. 9 h. A.M. Dry bulb. | Wet bulb. | 9 h. P.M. Dry bulb. | Wet bulb. | Rain. No. of day in which it fell. | Amount in inches. No. | WIND. 9 h. A.M. Direction. | Force | 9 h. P.M. Direction. | Force | Readings of the H. Cup Anemometer. No. 9 h. A.M. | CLOUDS. 9 A.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | P.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | SUNSHINE. Hours. | THERMOMETERS under Ground. 9 h. A.M. No. 3 inches. | No. 12 inches. | No. 22 inches. | Temperature of WELL at depth of feet, No. | SEA. Temperature at 1 Fathom, and Density. | OZONE. 0—10. 9 A.M. | 9 P.M. | GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. *Mention the hour at which Storms, including Thunder and Lightning, began and ended.* | Days of Month. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches. | ° | inches. | ° | ° | ° | ° | ° | ° | ° | ° | ° | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 29·578 | 60 | 29·482 | 60 | 65·5 | 55 | 77 | 54 | 59 | 57·5 | 59·5 | 58·5 | + | | S·E | | S·W | | 1140 | | | | | | 64 | 64 | 60 | | | 9 | 8 | | 1 |
| 2 | 29·332 | 61 | 29·258 | 59 | 63 | 52 | 72·5 | 51 | 62 | 58 | 58 | 56·5 | + | | W | | N·E | | 1513 | | | | | | 64 | 63 | 60 | | | 7 | 9 | Thunder | 2 |
| 3 | 29·181 | 59 | 29·322 | 59·5 | 69 | 53·5 | 86 | 54 | 59 | 57 | 58·5 | 57·5 | + | ·442 | N·E | | N | | 1790 | | | | | | 60 | 61 | 60 | | | 10 | 8 | Thunder | 3 |
| 4 | 29·338 | 59·5 | 29·328 | 60 | 67 | 57 | 83 | 52 | 62 | 58 | 57 | 56·5 | | | W | | W | | 2030 | | | | | | 64 | 62 | 60 | | | 9 | 5 | | 4 |
| 5 | 29·420 | 62 | 29·456 | 57 | 67 | 47 | 88 | 40 | 61 | 54 | 54·5 | 52·5 | + | | W | | W | | 2522 | | | | | | 62 | 62 | 60 | | | 5 | 4 | | 5 |
| 6 | 29·388 | 60 | 29·400 | 56·5 | 66 | 48 | 86 | 36·5 | 58 | 53 | 54 | 50 | | | W | | W | | 3018 | | | | | | 60 | 62 | 60 | | | 7 | 4 | | 6 |
| 7 | 29·456 | 60 | 29·472 | 57 | 67 | 47 | 93 | 39 | 60 | 54 | 54 | 52 | + | | W | | W | | 3878 | | | | | | 60 | 61 | 60 | | | 7 | 5 | | 7 |
| 8 | 29·434 | 59 | 29·386 | 57 | 68 | 49 | 87 | 45 | 59·5 | 57 | 56 | 55 | + | | W | | N·W | | 4037 | | | | | | 60 | 61 | 60 | | | 7 | 8 | Thunder | 8 |
| 9 | 29·462 | 60 | 29·502 | 58 | 67 | 49·5 | 88 | 44 | 61 | 58 | 56·5 | 55 | | | N·W | | N | | 4899 | | | | | | 61 | 61 | 60 | | | 8 | 6 | | 9 |
| 10 | 29·698 | 58·5 | 29·772 | 55 | 65 | 49 | 82 | 43 | 57 | 54 | 52·5 | 51 | + | | N | | N | | 4640 | | | | | | 61 | 61 | 60 | | | 9 | 6 | | 10 |
| 11 | 29·774 | 57·5 | 29·722 | 56 | 63 | 45 | 85 | 38 | 58·5 | 54 | 54 | 52 | + | ·79 | W | | W | | 5267 | | | | | | 60 | 61 | 60 | | | 9 | 7 | | 11 |
| 12 | 29·500 | 58·5 | 29·440 | 56 | 65 | 47 | 73 | 48 | 61 | 57 | 54 | 53 | + | | W | | N·W | | 5710 | | | | | | 60 | 61 | 59 | | | 8 | 8 | | 12 |
| 13 | 29·476 | 57 | 29·618 | 54 | 63·5 | 48 | 80 | 44 | 55 | 52 | 55 | 54 | + | | N·W | | S·W | | 7101 | | | | | | 58 | 61 | 59 | | | 8 | 6 | | 13 |
| 14 | 29·190 | 58 | 29·024 | 55 | 65 | 43 | 84 | 45 | 54·5 | 53·5 | 53 | 52 | + | | S | | S·W | | 7714 | | | | | | 58 | 60 | 59 | | | 8 | 7 | | 14 |
| 15 | 28·958 | 56 | 29·152 | 54 | 64 | 43 | 75 | 37 | 56 | 54 | 53·5 | 52·5 | + | | N | | N | | 7879 | | | | | | 58 | 60 | 59 | | | 5 | 9 | | 15 |
| 16 | 29·392 | 53 | 29·598 | 51 | 59 | 46 | 75 | 33 | 52 | 51 | 47 | 45 | + | | N·W | | N·W | | 8548 | | | | | | 57 | 60 | 59 | | | 10 | 7 | | 16 |
| 17 | 29·668 | 56 | 29·780 | 53·5 | 62 | 42 | 81 | 35 | 58 | 53 | 52·5 | 51 | + | | W | | W | | 9512 | | | | | | 57 | 59 | 59 | | | 9 | 5 | | 17 |
| 18 | 29·782 | 55 | 29·796 | 55 | 65 | 50 | 87 | 48 | 56 | 53 | 53·5 | 52 | + | 1·13 | W | | W | | 9826 | | | | | | 58 | 59 | 59 | | | 8 | 6 | | 18 |
| 19 | 29·632 | 54·5 | 29·422 | 56 | 61 | 47 | 73 | 43 | 53·5 | 51·5 | 53 | 54 | + | | W | | S | | 9965 | | | | | | 58 | 59 | 59 | | | 7 | 7 | | 19 |
| 20 | 29·442 | 54 | 29·566 | 54 | 58 | 48 | 64 | 37 | 52·5 | 52 | 53 | 51·5 | + | | N·W | | W | | 0774 | | | | | | 57 | 59 | 59 | | | 10 | 7 | | 20 |
| 21 | 29·544 | 55 | 29·506 | 49 | 60 | 44 | 79 | 35 | 58 | 57 | 44 | 43·5 | + | | N·E | | S·W | | 1084 | | | | | | 57 | 59 | 59 | | | 8 | 7 | | 21 |
| 22 | 29·508 | 53 | 29·644 | 54·5 | 64 | 36 | 88 | 32 | 54 | 51 | 53 | 52 | + | | W | | N·W | | 1417 | | | | | | 55 | 58 | 58 | | | 6 | 5 | | 22 |
| 23 | 29·766 | 53 | 29·858 | 50·5 | 63 | 46 | 79 | 37 | 55 | 53·5 | 47 | 45·5 | + | | N·W | | N·W | | 2016 | | | | | | 57 | 58 | 58 | | | 9 | 8 | | 23 |
| 24 | 29·932 | 54 | 30·054 | 52 | 61 | 44 | 80 | 36·5 | 53·5 | 51 | 49 | 47·5 | + | | N | | N | | 2223 | | | | | | 57 | 59 | 58 | | | 9 | 6 | | 24 |
| 25 | 30·064 | 53 | 30·054 | 50 | 60 | 41 | 76 | 35 | 53 | 48 | 45·5 | 44·5 | | ·85 | W | | N·W | | 2413 | | | | | | 57 | 58 | 58 | | | 8 | 6 | | 25 |
| 26 | 29·896 | 51 | 29·898 | 50 | 57·5 | 34 | 72 | 29 | 52·5 | 49·5 | 47·5 | 46 | | | S·W | | N | | 2448 | | | | | | 54 | 58 | 58 | | | 6 | 6 | | 26 |
| 27 | 29·854 | 55 | 29·924 | 53 | 57·5 | 45·5 | 73·5 | 40 | 56 | 52 | 51 | 50 | | | N | | N·W | | 2633 | | | | | | 57 | 58 | 58 | | | 7 | 6 | | 27 |
| 28 | 29·932 | 54 | 29·988 | 56 | 60 | 50 | 68 | 47 | 54 | 51 | 56·5 | 54 | + | | W | | W | | 2777 | | | | | | 56 | 58 | 58 | | | 5 | 6 | | 28 |
| 29 | 29·928 | 56 | 29·948 | 56 | 67 | 45 | 81 | 39 | 56·5 | 52 | 55 | 53 | | | W | | W | | 3464 | | | | | | 56 | 58 | 58 | | | 9 | 6 | | 29 |
| 30 | 29·918 | 57 | 29·926 | 58 | 67 | 47·5 | 89 | 42 | 58·5 | 54 | 57 | 55 | | | W | | N·W | | 3653 | | | | | | 57 | 58 | 57 | | | 7 | 6 | | 30 |
| 31 | 29·856 | 56 | 29·862 | 55 | 57·5 | 49 | 65·5 | 44 | 57 | 55 | 54 | 53·5 | + | ·64 | N·W | | S·W | | 3950 | | | | | | 58 | 58 | 57 | | | 7 | 7 | | 31 |
| Sums. | 918·279 | 1736·5 | 918·078 | 1713·5 | 1961·5 | 1462·0 | 2460·5 | 1280 | 1763·5 | 1673·5 | 1640·5 | 1566·0 | 23 | 7·23 | | | | | | | | | | | 1818 | 1857 | 1828 | | | 241 | 196 | | |
| Means. | 29·621 | 56·6 | 29·615 | 55·2 | 63·4 | 47·2 | 79·3 | 41·3 | 56·9 | 53·7 | 53·2 | 51·8 | | | | | | | | | | | | | 58·6 | 59·8 | 58·9 | | | 7·8 | 6·3 | | |
| + Total Corrections for Instrumental Errors. | ~~·590~~ +·035 | | +·035 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ‡ Corrections for Diurnal Range. | +·055 | | +·055 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "Corrected Means." | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. of Column. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | | |

## NOTATION USED IN GENERAL REMARKS.

| | | | | | |
|---|---|---|---|---|---|
| a. | *denotes* aurora. | | m. | *enotes* meteor. | |
| ci. | ,, | cirrus. | ms. | ,, | meteors. |
| ci-cu. | ,, | cirro-cumulus. | n. | ,, | nimbus. |
| ci.-s. | ,, | cirro-stratus. | r. | ,, | rain. |
| cu. | ,, | cumulus. | h. r. | ,, | heavy rain. |
| cu.-s. | ,, | cumulo-stratus. | c. h. r. | ,, | continued heavy rain. |
| d. | ,, | dew. | s. | ,, | stratus. |
| f. | ,, | fog. | sc. | ,, | scud. |
| fr. | ,, | frost. | s. | ,, | sleet. |
| h.-fr. | ,, | hoar-frost. | s. | ,, | snow. |
| h. | ,, | haze. | so. ha. | ,, | solar halo. |
| h. d. | ,, | heavy dew. | sq. | ,, | squall. |
| hl. | ,, | hail. | sqs. | ,, | squalls. |
| l. | ,, | lightning. | t. | ,, | thunder. |
| li. cl. | ,, | light clouds. | t. s. | ,, | thunder-storm. |
| li. sh. | ,, | light showers. | w. | ,, | wind. |
| lu. co. | ,, | lunar corona. | g. | ,, | gale of wind. |
| lu. ha. | ,, | lunar halo. | | | |

## TABLE FOR ESTIMATING FORCE OF WIND.

| Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. |
|---|---|---|---|---|---|
| 0 | Calm | 1·5 | Light breeze | 4 | Blowing hard |
| 0·5 | Very light air | 2· | Fresh breeze | 5 | Blowing a gale |
| 1· | Light air | 3· | Very fresh | 6 | Violent gale |

**BAROMETER**, "corrected Mean" at 9 A.M., *minus* the Correction †† for Temp. (Col. 2), = 29·625 ~~29·551~~ ..... 74 = 29·551

"Corrected Mean" of Barometer at 9 P.M., *minus* the Correction †† for Temp. (Col. 4), = 29·650 ..... 71 = 29·579

**Mean at Station, corrected, and at 32°**, ..... = +·000 29·580

Correction for height, feet above Mean Sea-level, ..... = ·197

**Mean, reduced to 32°, and Sea-level**, ..... = 29·777

Highest Reading, corrected for Index error, on the 25th, ..... = 30·064

Lowest Do. Do., on the 15th, ..... = 28·958

Difference, or **Monthly Range**, ..... = 1·106

**S.-R. THERMOMETER**, (in shade, etc.), **Highest in Month**, (corrected for Index Errors), on the 3 th, ..... = 69·0

**Lowest in Month**, corrected for Index errors, on the 26 th, ..... = 34·0

Difference, or **Monthly Range**, ..... = 35·0

"Corrected **Mean**" **of all the Highest**, (Col. 5), ..... = 63·4

"Corrected **Mean**" **of all the Lowest**, (Col. 6), ..... = 46·8

Difference, or **Mean Daily Range**, ..... = 16·6

** Calculated **Mean Temperature** of Month, ..... = 55·1

**S.-R. THERMOMETER, Black Bulb in Sun, Highest**, (corrected for Index Errors), on the 7 th, ..... = 93·0

"Corrected **Mean**," (Col. 7), **of Black Bulb, Max. in Sun**, ..... = 79·3

**Lowest at Night**, Black Bulb (corrected for Index errors), on the 26th, = 29·0

"Corrected **Mean**," (Col. 8), **of Black Bulb, Min.** on grass, ..... = 41·3

Difference of above means or range ("exposed"), ..... =

**HYGROMETER, Mean** (corrected) A.M. and P.M. Reading **of Dry Bulb**, (Cols. 9 and 11), ..... = 55·0

**Mean** (corrected) A.M. and P.M. Reading **of Wet Bulb**, (Cols. 10 and 12), ..... = 52·8

‡‡ Computed **Temperature of Dew-Point**, ..... = 50·7

‡‡ Do. **Elastic Force of Vapour**, ..... = ·370

‡‡ Do. **Weight of Vapour in a Cubic Foot of Air**, =

‡‡ **Relative Humidity** (**Saturation** = 100), ..... = 86

**RAIN** fell on 23 **Days; Amount in Inches**, ..... = 7·23 inches

| WIND. Direction. | SUMMARY. N | NE | E | SE | S | SW | W | NW | Calm or Variable. | Mean Force. | Mean Velocity in miles per day. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. | 4 | 2 | | 1 | 1 | 1 | 16 | 6 | | | |
| P.M | 7 | 2 | | | 1 | 4 | 9 | 8 | | | |
| Mean. | 5· | 2 | 0 | 1 | 1 | 3 | 12 | 7 | 0 | | |

* Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S."; and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.
† Embracing corrections for both capillarity and Index Errors
‡ The Diurnal Range for Scotland is as yet unknown.
†† *Practically*, though not *absolutely* a *minus* correction.
‡‡ These "Hygrometrical Deductions" are calculated from Glaisher's Hygrometrical Tables, Second Edition *only*.
** While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature."
Any observations not taken under the Conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. *See over.*

*Observations made and Return verified by* John Forrat

(*Signed*)

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# INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS,

## WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the chief objects that the SCOTTISH METEOROLOGICAL SOCIETY proposed to itself when the Society was established in 1855, was to secure PERFECT UNIFORMITY in the system of observation pursued at all its Stations. Uniformity in the observations is absolutely necessary to justify the publication of Monthly Results from different observations, it being found that differences between the Returns from two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those who kindly furnish Reports to the Society will, by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

The Council recommend that Observations be made precisely at 9 A.M. and 9 P.M. (Greenwich or Railway Time only),

**Hour of Observation.**

as specified in the following remarks, or at the top of the columns of the Schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading the time at which it was taken, if not at 9 A.M. or 9 P.M.

**Barometer.**

Weather-Glasses and Aneroids, though well suited to indicate roughly variations of atmospheric pressure, are not fitted for scientific purposes. No Barometer should be used for Meteorological Observation that is not supplied with some means of adjustment or compensation which will secure that the height of the mercury in the tube is accurately measured from the fluctuating surface of the mercury in the cistern.

The Barometer in which the error arising from the fluctuating surface of the mercury in the cistern is entirely got rid of is FORTIN'S Barometer, the arrangement consisting in applying pressure by means of a screw to the bottom of the cistern, which is made of flexible leather, thus raising or depressing the surface till it just meets the ivory point which forms the zero point of the fixed scale.

The Barometer originally constructed by Mr. Adie of London, and usually called the Board of Trade Barometer, has the great convenience of requiring no adjustment of the cistern. Its scale-inches are not true inches, but so much shorter as to compensate the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This is an excellent Barometer for ordinary Observers, inasmuch as it entirely eliminates the error of observation likely to arise in not a few cases in setting the instrument to the zero point of the fixed scale when the light is not good. To show the accuracy with which these Barometers are made, it may be stated, that one was compared, during a whole year, with the Society's Standard Barometer, particular care being given to make the comparison when atmospheric pressure was rising or falling very rapidly, with the result that none of the readings differed from those of the Standard more than 0·003 inch.

A modification of Fortin's Barometer is used at a number of the Society's Stations, by which the coincidence of the zero point with the surface of the mercury is indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the index-line on this little piston-rod is brought, by the adjusting screw, to form one straight line with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this preliminary setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the vernier.

It is absolutely necessary that the Barometer which is to be used shall have been compared with a Standard Barometer.

The Barometer should be suspended in as good a light as can be secured, and to facilitate the reading, a piece of white paper may be put behind the tube. It must be hung truly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire, and must not be hung against a wall heated by a flue. The object being to secure that the whole instrument, including the brass fittings, the contained mercury, and the attached Thermometer, shall be, when read, at one uniform temperature, it is evident that the best position is that which is least liable to sudden changes of temperature.

In taking an Observation, the Attached Thermometer is first noted: the tube must then be gently tapped, and the cistern-adjustment carefully made. The eye, by raising and lowering it, must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted so as to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will facilitate an accurate adjustment and reading of the Barometer. A mistake not unfrequently made by those beginning to observe, consisting in setting the edge of the vernier to the level of the clear surface of the mercury which is in direct contact with the glass tube, must be carefully avoided.

The errors most frequently made in reading the Barometer are errors of 1·000 inch, 0·500 inch, and 0·050 inch; that is to say, instead of 29·365 inches, either of the following is sometimes set down—viz. as 30·365 inches, 28·365 inches, 29·865 inches, or 29·815 inches. Experience having shown that even the very best Observers make these mistakes, particular attention is directed to the matter.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must first be screwed so as to form a tight plug to the cistern, thus preventing the escape of the mercury. Then screw up the mercury not quite to the top of the tube, but to within a quarter of an inch of it, and take down the instrument; it should then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case if, on inclining the instrument, a sharp tap is produced when the mercury strikes the top of the tube. If a dull tap is heard, there is air in the tube, which must be got rid of.

As Barometers are liable to be deranged by the introduction of air into their tubes, on removal from place to place, or in being roughly handled, it may be useful to Observers to know how the air may be expelled. First close up the cistern by screwing the ivory peg tight, so as to prevent the escape of mercury; then screw up the mercury to about half an inch from the top of the tube; and having slowly inverted the instrument, place the top of it on a yielding substance, such as the boot, and gently tap on the cistern with the palm of the hand, so as to induce the air to ascend through the column to the cistern, whence it may escape. Since there is the weight of two atmospheres—the pressure of the mercury in the Barometer, and the air outside—pressing on any air that may be inside the tube, it is usually a tedious operation to get it wholly expelled. After repeated trials, however, it is generally accomplished; and the clear metallic sound of the mercury, when gently struck against the top of the glass tube, will show when the whole of the air has been expelled. On hanging up the Barometer, care must be taken to screw down the mercury in the tube before unfastening the float of the cistern, for, if this be not attended to, the mercury will flow out, and the instrument be seriously damaged.

**Protection and Position of Thermometers.**

The Council of the Society recommend that the Self-Registering Thermometers, and the Dry and Wet Bulb Hygrometer, be kept in Stevenson's Louvre-boarded Box for Thermometers, painted white inside and outside, and screwed to four stout posts, also painted white, firmly fixed in the ground. The posts must be of such a length that when the Thermometers are hung in position the Bulbs of the Minimum Thermometer, and of the Dry and Wet Bulb Thermometers, will be exactly at the same height of FOUR FEET above the ground, the Maximum Thermometer being hung immediately above the Minimum Thermometer. The Thermometer Box is to be placed over a plot of grass, and in a free open space to which the sun's rays have free access during as much of the day as surrounding conditions enable the Observer to secure. The Thermometers are suspended on cross-laths in the centre of the Box, and face the door, which should open to the north.

The Council regard the question of UNIFORMITY OF HEIGHT ABOVE GROUND, AND METHOD IN PROTECTING THE THERMOMETERS, as vital in every system of Meteorological Observation, since without it Observations made at different Stations are incomparable, thus rendering it impossible to compare the Climates of places with each other as regards their most important features.

**Self-Registering Thermometers.**

Professor Phillips, and Negretti and Zambra's Maximum Thermometers, and Rutherford's Minimum Thermometer, are recommended. It is recommended that these Thermometers be graduated on the glass stem. The Minimum Thermometer is liable to two derangements—viz., the column of spirit breaking, and part of the spirit distilling by high temperature and lodging at the top of the tube. This derangement is of occasional occurrence with protected Thermometers, but of frequent occurrence with exposed Thermometers. Hence a systematic examination of Minimum Thermometers ought to be a regular part of the work carried on by each Observer.

Fortunately, Spirit Thermometers may be easily set right by any one, when the column of spirit chances to separate. Let the Thermometer be taken in the hand by the end farthest from the bulb, raised above the head, and then forcibly swung down towards the feet; the object being, on the principle of centrifugal force, to send down the detached portion of spirit till it unites with the column. A few throws, or swinging strokes, will generally be sufficient for the purpose; after which the Thermometer should be placed in a slanting position, to allow the rest of the spirit still adhering to the sides of the tube to drain down to the column. But another method must be adopted, if the portion of spirit in the top of the tube be small. Heat should be applied slowly and cautiously to the top end of the tube where the detached portion of spirit is, which, being turned into vapour by the heat, will condense on the surface of the unbroken column of spirit. Care must be taken that the heat is not applied too quickly; for, if this be done, the tube will break and the instrument be destroyed. The best way to apply the requisite amount of heat is by bringing the end of the tube slowly down towards a minute flame from a gas-burner; or, if gas be not at hand, a piece of heated metal will serve instead.

**Black-Bulb Thermometers.**

The bulbs of the Thermometers for registering the greatest heat from the sun's rays, and the least from radiation during night, have a black coating, which may easily be made, or mended, by the application of a mixture of lampblack and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind, The Maximum should be freely exposed to the sun, and the Minimum should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation. Black-bulbs enclosed in 'glass jackets' may also be used, being indeed preferable to the above. It must, however, be added, that the whole subject of the observation of Solar and Terrestrial Radiation is not yet in a sufficiently advanced state to warrant the exclusive recommendation of any one of these methods.

**Dry and Wet Bulb Hygrometer.**

The Hygrometer in use at the Society's Stations consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved form of this apparatus seriously vitiate the Hygrometrical Observations, Observers are specially requested to attend to the following conditions:—The bulbs must hang down by at least an inch free from the scales and frame to which they are attached; the frame must be such as will bring the tubes forward by an inch from any board on which it may be suspended; the water-cup must be covered, and altogether placed to the side, and a little below the level of the wet bulb, but in no case under the bulbs; the muslin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the Observer that the muslin is always clean and moist, and the water pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

**Reading of the Thermometer.**

In reading the Thermometer great care must be taken to bring the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40½°, respectively. So also 40¼°, and 40¾°, more or less, must be registered 40°·2, or 40°·3, and 40°·7, or 40°·8 respectively. In reading Rutherford's Minimum Thermometer, the indication of that end of the index which is next the surface of the spirit is alone noted. On opening the Thermometer Box, the Dry and Wet Bulb Thermometers are to be first, and rapidly, read, inasmuch as they are readily affected by heat from the person of the Observer.

**Hour of observing Temperature.**

The Hygrometer is read at 9 A.M. and 9 P.M. The Self-Registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the Self-Registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 3d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

**Verification of Thermometers.**

No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a standard Thermometer. When such Thermometers as are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being re-tested. The Self-Registering, especially the Minimum Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer, marked by a scratch on the tube, ought to be tested once a year, in snow or melting ice.

In selecting instruments, the following points require attention:—The divisions of the vernier of Barometers in reference to their scales, and the perfect freedom of the Barometer from air; the correct numbering of the scale of every instrument; the rejection of Thermometers the frameworks of which are not likely to stand exposure to the weather, as shown in the past by repeated and annoying breakages of Thermometers of similar construction; and as regards Maximum Thermometers, either Negretti and Zambra's, or Phillip's, whether they will act at the highest temperatures they may be required to register. By the laws of the Society, Members and Observers have a right to have their instruments compared by the Secretary, and to advise with him regarding the purchase of instruments.

**Wind.**

Very great care should be bestowed on the Observations of the Wind, the accuracy of which, both as regards Direction and Force, is so essential towards the right discussion of many of the more important problems of the science.

**1. As regards Direction.**

A Wind-Vane ought to be elevated at least 12 feet above surrounding objects. When it oscillates incessantly, the mean direction should be taken. In all cases, but especially when the Vane is stationary, and when the wind is feeble, reference may be made to the direction of smoke, etc., in well-exposed situations. Careful observations are recommended to be made on the changes in the direction of the wind; and during storms, extra observations at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, is likely to give highly valuable and important results, particularly in connection with the system of thickly-planted Stations over a limited district round Edinburgh called STORM STATIONS, in the course of being established by the Society for the systematic investigation of the relation of the force of the wind to BAROMETRIC GRADIENTS, and other points connected with storms.

**2. As regards Velocity and Pressure.**

The Council would recommend the Hemispherical Cup Anemometer,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the mean Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, the Pressure Anemometers recently brought under the notice of the Society by Mr. T. Stevenson, the Honorary Secretary, and Mr. R. Ballingall, the Society's Observer at Eallabus, are recommended as likely to secure uniformity in making observations on the Force of the Wind.

**Rain Gauges.**

Many causes conspire to produce anomalies in Rain Returns, arising partly from the difficulty of obtaining a perfectly unobjectionable situation for observation, and partly from the defective nature of the instruments used. The Rain Gauge should not be placed on a slope or terrace, but on a level piece of ground, in as open a situation as the Observer can secure for it. As it is often difficult to obtain a position as free and unobstructed by surrounding objects as is desirable, care should be taken to place it at some distance from shrubs, trees, buildings, or other obstructions, at least as many feet from their base as they are in height. The more important directions, towards which it is most desirable to have a free exposure, are, in the order of their importance, S.W., N.E., S.E., S., and W. The rim of the gauge must be perfectly level, and fixed so that it will remain level in all weathers, and be at a height of one foot above ground, over grass. In such gauges as Fleming's, which are furnished with a measuring-rod attached to a float, the rod ought to be fixed down, and the float rise to its height only at the time the instrument is read, it being found that a stem projecting above the rim of the gauge seriously interferes with the proper measurement of the Rainfall. When a measuring-glass is used, care should be taken to hold it quite perpendicular. The Rain Gauge ought to be read daily at 9 A.M., and the reading entered in the Returns of the previous day. If the Gauge is read once a month, the reading is to be made on the first of the month, and the amount entered for the previous month.

**Snow-falls.**

Snow-falls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs, it should be noted in the 'Remarks,' and the letter S affixed to the depth of water received in Gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the Rain Gauge. For wind, rain, and snow, as indeed in every column, the Observer cannot be too careful to register observations only; and nothing that partakes of the nature of deduction or inference.

**Clouds.**

Convenient abbreviations for the nomenclature of Clouds will be found on the other side. The amount of Cloud ought to be estimated from the greater or less obscuration of the sky overhead (*i.e.* within 20° or 30° of the zenith). The strata of Clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the Clouds' column, though their appearance and changes may be noted among the Remarks. The amount of Cloud is entered from a scale of 0 to 10; thus, when the sky overhead is free from Clouds it is entered 0, when half-covered by Clouds, 5, wholly covered, 10, and so on.

Observations of the Clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—Thus, in the column Velocity and Direction, 6, S. W.

——— will indicate that the upper strata of Clouds travel with 2, W.

extreme velocity from S.W., and those in the lower regions from W., with one-third the speed of the former. Again, in the second 4, st.

Cloud column, an entry of ——— will indicate that the higher 2, cu-st.

regions are covered to the amount of 4-tenths with stratus Clouds; and that the sky is further obscured to the extent of 2-tenths by lower Clouds of the cumulo stratus kind.

Remarks on peculiar Clouds, accompanied with drawings, will assist materially in the development of a more exact nomenclature of Clouds, as well as throw light on the electrical, and other of the more obscure phenomena of Meteorology.

**Sunshine.**

The approximate number of Hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

**Underground Thermometers.**

As the germination and growth of crops and plants generally depend greatly on the temperature of the soil,—its amount and constancy,—the Council recommend that Observations in this interesting department be made at 9 A.M., by Thermometers permanently fixed in the soil, their bulbs being sunk to depths of 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames.

**Temperature of the Sea.**

A knowledge of the Temperature of the Sea is not only in itself, but in its relations to that of our island, a most important branch of Meteorology. The Council therefore recommend that the Temperature of the Sea be carefully taken by a properly constructed apparatus, from boats, or, if this be impracticable, from the ends of piers and rocks round the coast, where it is not influenced by that of river water, and as little influenced as possible by currents sweeping along the coast, and thus acquiring the temperature of the land, either greatly heated by the sun or cooled by nocturnal radiation. At or near the time of high water, in cases where the observations cannot be taken daily, the observation may be made on the 5th, 15th, and 25th of each month. When convenient, extra Sea Observations might be taken for other and greater depths, noting always the Temperature of the Air, and the Hour of Observation. It is also very desirable that observations on the daily Maxima and Minima by Thermometers continuously immersed, be instituted at points along the coast, by the method proposed by Mr. T. Stevenson, and already commenced at Peterhead and Liverpool.

**Temperature of Wells.**

The Temperature of the water at the bottom of Wells ought, when practicable, to be taken, both the depth of the Well and of the water being noted.

Mention what Test-Papers are used, Schönbein's or Moffat's, etc.

**Ozone.**

The Paper is affixed by a pin to a board in the Thermometer Box, and the indications registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus $3^{S.W.}_{4}$, as an Ozone entry in the schedule will indicate that the Ozone paper is tinted as 3 on the scale, that the wind is from the N.W., and that its force on the scale 0—5 is 4, or blowing fresh.

**Atmospheric Electricity.**

Too much importance cannot be attached to the electric condition of the atmosphere in connection with terrestrial magnetism, barometrical, thermometrical, and meteorological phenomena generally. A proper Electrometer is, in truth, necessary to every complete meteorological observatory.

**Remarks.**

The Remarks column is unavoidably too narrow. Some of the most valuable Observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are in general use is given at the foot of the column. Besides special and extraordinary Observations, great prominence ought to be given in this column to Prevalent Diseases, differences in character, colour, velocity, and direction between the Lower and Upper Strata of clouds, the Colour of the Sky, etc. Remarks ought to be made on the occurrence of Meteors, Auroræ Boreales, remarkable depressions, elevations, and fluctuations of the Barometer, Thunder-Storms, and remarkable falls of Snow, Hail, or Rain, the Hour of Storms of Wind commencing, attaining their maximum, and ending, as well as such Notes on Storms as have been hinted at above. When lofty hills are in the vicinity of a Station, the Height of Clouds and of the Snow-line in winter should be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. should be registered, either in two columns, otherwise unoccupied, or ruled off for the purpose, from the column of 'Remarks.'

**Observations in connection with the Periodic Return of the Seasons.**

Observations in connection with the Periodic Return of the Seasons, possess not only great scientific value, but are of considerable importance in connection with Agriculture, Horticulture, and Natural History. The Council would direct the special attention of Observers to the registration of such phenomena, so that the published Summaries may fairly represent the whole of Scotland. Observations ought to be confined to individual trees and shrubs; to particular species of birds, and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm. The Annual Table, published yearly in the Society's Journal, will indicate the species of plants and animals to which special attention is more particularly directed.

The Council recommend Observers, before purchasing new instruments, and in repairing old ones, to communicate with the Meteorological Secretary, in order that every instrument may be examined and improved before being used; and they consider it necessary that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, *December* 1891.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

| FOREST TREES. | In Flower. | Leaf Buds first Appear. | In Leaf. | Divested of Leaves. |
|---|---|---|---|---|
| Alder, | | | | |
| Ash, | | | | |
| Beech, | | | | |
| Birch, | | | | |
| Elm, | | | | |
| Larch, | | | | |
| Lime, | | | | |
| Oak, | | | | |
| Sycamore or Plane, | | | | |

| SHRUBS, ETC. | First in Blossom. |
|---|---|
| Barberry, | |
| Bourtree or Elder, | |
| Broom, | |
| Hazel, | |
| Hawthorn, | |
| Holly, | |
| Laburnum, | |
| Lilac, | |
| Mezereon, | |
| Mountain Ash or Rowan, | |
| Red Flowering Currant, | |
| Rhododendron Ponticum, | |
| Whin, | |

| FRUITS. | First in Blossom. | Fruit Ripe, generally. |
|---|---|---|
| Apple, | | |
| Black Currant, | | |
| Cherry, | | |
| Gean, | | |
| Gooseberry, | | |
| Peach, | | |
| Pear, | | |
| Plum, | | |
| Strawberry, | | |

| CROPS, mentioning variety. | Sowing or Planting. | Appearing above Ground. | In Ear or Flower. | First Cut or Raised. |
|---|---|---|---|---|
| Barley, | | | | |
| Bere or Bigg, | | | | |
| Oats, | | | | |
| Wheat, | | | | |
| Beans, | | | | |
| Pease, | | | | |
| Potatoes, | | | | |
| Turnips, | | | | |
| Rye Grass, | | | | |

| MIGRATORY BIRDS. | First Arrival. | Departure. |
|---|---|---|
| Cuckoo, | | |
| Curlew, | | |
| House-Swallow, | | |
| Lapwing, | | |
| Plover, | | |
| Sand-Martin, | | |
| Starling, | | |
| Swan, | | |
| Rail or Corn Crake, | | |

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

Raddo Ho
Augt 1894

To the SECRETARY
Scottish Meteorological Society,
122 George Street,
EDINBURGH.

BOOK POST.

# SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Haddo House, County of Aberdeen, in Lat. 57°24′, Long. 2°14′, Distance from Sea 12 miles.

Height of Cistern of the Barometer above Mean Sea-Level 180 feet, above Ground 3 feet. During the MONTH of Septembes 1894.

The Hours of Observation are of Greenwich Time.

| Days of Month. | BAROMETER. 9 h. A.M. Barometer. * No. | Attached Thermometer | 9 h. P.M. Barometer. No. | Attached Thermometer | SELF-REGISTERING THERMOMETERS, Read Daily, at 9 P.M. Protected in Shade, 4 feet above Ground. Max. No. | Min. No. | Exposed Black Bulbs. Max. in Sun's rays No. | Min. on Grass No. | HYGROMETER. Dry No. ___ Wet No. ___ 9 h. A.M. Dry bulb. | Wet bulb. | 9 h. P.M. Dry bulb. | Wet bulb. | Rain. No. of hours in which it fell. | Amount in inches. No. | WIND. 9 h. A.M. Direction. | Force | 9 h. P.M. Direction. | Force | Readings of the H. Cup Anemometer. No. 9 h. A.M. | CLOUDS. 9 A.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | P.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | SUNSHINE. Hours. | THERMOMETERS under Ground. 9 h. A.M. No. 3 inches. | No. 12 inches. | No. 22 inches. | Temperature of Well at depth of ___ feet, No. | SEA. Temperature at 1 fathom, and Density. | OZONE. 0—10. 9 A.M. | 9 P.M. | GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. *Mention the hour at which Storms, including Thunder and Lightning, began and ended.* | Days of Month. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches. | ° | inches. | ° | ° | ° | ° | ° | ° | ° | ° | ° | + | | | | | | | | | | | | ° | ° | | | | | | | | |
| 1 | 29·880 | 55 | 29·900 | 48 | 58 | 42 | 81 | 34 | 53 | 50 | 42·5 | 41 | + | | NW | | NW | | 4242 | | | | | 56 | 58 | 57 | | | 8 | 6 | | 1 |
| 2 | 29·928 | 50 | 29·926 | 45 | 57 | 39 | 76 | 32 | 52 | 49 | 40 | 39 | + | | N | | N | | 4723 | | | | | 54 | 57 | 57 | | | 9 | 7 | | 2 |
| 3 | 29·894 | 49 | 29·889 | 49 | 58 | 38 | 81 | 33 | 49 | 48 | 47 | 46 | + | | N | | N | | 5385 | | | | | 53 | 57 | 57 | | | 9 | 8 | | 3 |
| 4 | 29·842 | 50 | 29·864 | 50 | 58·5 | 41 | 77 | 36 | 51 | 49 | 48·5 | 47·5 | + | | N | | N | | 5936 | | | | | 53 | 56 | 56 | | | 8 | 8 | | 4 |
| 5 | 29·902 | 52 | 30·002 | 50 | 59·5 | 44 | 73·5 | 37 | 52 | 51 | 47 | 46 | + | | NE | | NE | | 6260 | | | | | 54 | 56 | 56 | | | 9 | 8 | | 5 |
| 6 | 29·976 | 50 | 29·884 | 51 | 57 | 42 | 86 | 38 | 51 | 48·5 | 48 | 46·5 | + | | W | | NW | | 6435 | | | | | 54 | 56 | 56 | | | 9 | 7 | | 6 |
| 7 | 29·742 | 52·5 | 29·732 | 49 | 58 | 44 | 75 | 38 | 53 | 49 | 47·5 | 46 | + | | N | | N | | 7311 | | | | | 54 | 56 | 56 | | | 9 | 6 | | 7 |
| 8 | 29·732 | 50 | 29·962 | 51 | 57 | 45 | 75 | 37 | 49 | 47 | 50 | 48 | + | ·65 | NE | | N | | 7815 | | | | | 53 | 56 | 56 | | | 5 | 6 | | 8 |
| 9 | 30·128 | 53 | 30·212 | 48 | 59 | 41·5 | 81 | 35 | 54·5 | 51 | 42 | 41 | | | NW | | NW | | 8186 | | | | | 54 | 55 | 56 | | | 5 | 6 | | 9 |
| 10 | 30·130 | 47·5 | 29·988 | 48 | 64 | 31 | 86 | 27 | 48·5 | 48 | 45 | 44 | | | W | | SE | | 8307 | | | | | 50 | 55 | 55 | | | 4 | 6 | | 10 |
| 11 | 29·866 | 56 | 30·052 | 53 | 67 | 41 | 85 | 35 | 60·5 | 57 | 53 | 50 | | | W | | W | | 8608 | | | | | 54 | 55 | 55 | | | 7 | 5 | | 11 |
| 12 | 30·176 | 52 | 30·232 | 50 | 60 | 44 | 82 | 40 | 53 | 48 | 48· | 46·5 | | | W | | W | | 9659 | | | | | 53 | 55 | 55 | | | 5 | 5 | | 12 |
| 13 | 30·198 | 54·5 | 30·216 | 54 | 63 | 43 | 82 | 37 | 58 | 53 | 52 | 51 | + | | NW | | W | | 9847 | | | | | 55 | 56 | 55 | | | 7 | 6 | | 13 |
| 14 | 30·122 | 55 | 30·128 | 55 | 63 | 44 | 80 | 40 | 61 | 56·5 | 56 | 55 | + | | W | | W | | 0168 | | | | | 55 | 56 | 56 | | | 7 | 8 | | 14 |
| 15 | 30·198 | 56 | 30·218 | 54 | 58 | 52 | 64 | 51 | 56·5 | 53 | 52·5 | 50·5 | | | NW | | W | | 0756 | | | | | 56 | 56 | 56 | | | 9 | 6 | | 15 |
| 16 | 30·212 | 54 | 30·206 | 50 | 60·5 | 43·5 | 73 | 37 | 57·5 | 52 | 48 | 47·5 | | | E | | SE | | 0930 | | | | | 55 | 57 | 56 | | | 7 | 8 | | 16 |
| 17 | 30·162 | 49 | 30·184 | 49 | 65 | 34 | 78 | 32 | 55 | 52·5 | 47 | 46 | | | SE | | SE | | 1242 | | | | | 53 | 56 | 56 | | | 5 | 8 | | 17 |
| 18 | 30·166 | 53 | 30·150 | 52 | 56 | 46 | 67 | 39 | 53 | 50 | 50·5 | 48 | | | SE | | SE | | 1634 | | | | | 55 | 56 | 56 | | | 8 | 5 | | 18 |
| 19 | 30·064 | 53 | 30·048 | 51·5 | 55 | 49 | 66 | 49 | 54 | 51 | 51 | 50 | | | SE | | SE | | 1993 | | | | | 55 | 56 | 56 | | | 8 | 7 | | 19 |
| 20 | 30·018 | 53 | 29·996 | 52·5 | 62 | 47 | 81 | 47 | 53 | 50 | 51 | 50 | | | SE | | E | | 2133 | | | | | 55 | 56 | 56 | | | 5 | 8 | | 20 |
| 21 | 29·912 | 53 | 29·920 | 48 | 57 | 41 | 63 | 37 | 54 | 50·5 | 41·5 | 41 | + | | E | | E | | 2223 | | | | | 55 | 56 | 56 | | | 9 | 9 | | 21 |
| 22 | 29·856 | 50 | 29·794 | 50 | 55 | 38 | 57 | 34 | 50 | 49 | 47 | 46 | + | | NE | | NE | | 2445 | | | | | 54 | 55 | 55 | | | 6 | 6 | | 22 |
| 23 | 29·706 | 50·5 | 29·724 | 47 | 54 | 44 | 75 | 36 | 50 | 48 | 43·5 | 42·5 | | ·03 | E | | W | | 2484 | | | | | 53 | 55 | 53 | | | 8 | 4 | | 23 |
| 24 | 29·726 | 49 | 29·758 | 47 | 62 | 41 | 77 | 36 | 53 | 49 | 44 | 43 | + | | W | | NW | | 2682 | | | | | 52 | 55 | 55 | | | 4 | 6 | | 24 |
| 25 | 29·690 | 50 | 29·608 | 48 | 64 | 41 | 81 | 37 | 55·5 | 52 | 52 | 45·5 | + | | W | | SW | | 2770 | | | | | 52 | 55 | 55 | | | 4 | 6 | | 25 |
| 26 | 29·664 | 48·5 | 29·806 | 46 | 56 | 36 | 72 | 29 | 50 | 47·5 | 44 | 42 | + | | W | | N | | 2987 | | | | | 51 | 55 | 55 | | | 9 | 7 | | 26 |
| 27 | 29·948 | 48 | 30·084 | 47 | 53 | 38 | 64 | 34 | 51 | 48·5 | 45 | 43 | + | | N | | N | | 3416 | | | | | 50 | 54 | 54 | | | 9 | 6 | | 27 |
| 28 | 30·186 | 47·5 | 30·208 | 48 | 55 | 43·5 | 69 | 40 | 48 | 45 | 48 | 47 | + | | NE | | NE | | 3618 | | | | | 50 | 53 | 54 | | | 6 | 7 | | 28 |
| 29 | 30·236 | 49·5 | 30·294 | 48 | 55 | 43 | 67 | 42 | 50 | 48·5 | 47 | 46 | + | | NE | | NE | | 3747 | | | | | 51 | 53 | 54 | | | 10 | 8 | | 29 |
| 30 | 30·302 | 49 | 30·320 | 48 | 52 | 42·5 | 54 | 39 | 49 | 47 | 47 | 46 | + | ·34 | NE | | NE | | 3890 | | | | | 51 | 53 | 54 | | | 6 | 6 | | 30 |
| 31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 31 |
| Sums. | 909·582 | | 910·405 | | 1487·0 | | 1763·5 | | 1259·5 | | 1408·5 | | | 1·02 | | | | | | | | | | 1600 | 1665 | 1664 | | | 214 | 193 | | |
| Means. | 29·985 | | 30·014 | | 49·6 | | 58·8 | | 42·0 | | 74·3 | | 3·73 | | 52·8 | | 50·0 | | 47·5 | | 46·0 | | 1·9 | 1·02 | 53·3 | 55·5 | 55·4 | | | 7·1 | 6·6 | | |
| † Total Corrections for Instrumental Errors. | +·055 | | +·055 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ‡ Corrections for Diurnal Range. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "Corrected Means." | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. of Column. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | | | |

## NOTATION USED IN GENERAL REMARKS.

| | | | | | |
|---|---|---|---|---|---|
| a. | *denotes* aurora. | | m. | *denotes* meteor. | |
| ci. | ,, | cirrus. | ms. | ,, | meteors. |
| ci.-cu. | ,, | cirro-cumulus. | n. | ,, | nimbus. |
| ci.-s. | ,, | cirro-stratus. | r. | ,, | rain. |
| cu. | ,, | cumulus. | h. r. | ,, | heavy rain. |
| cu.-s. | ,, | cumulo-stratus. | c. h. r. | ,, | continued heavy rain. |
| d. | ,, | dew. | s. | ,, | stratus. |
| f. | ,, | fog. | sc. | ,, | scud. |
| fr. | ,, | frost. | s. | ,, | sleet. |
| h.-fr. | ,, | hoar-frost. | s. | ,, | snow. |
| h. | ,, | haze. | so. ha. | ,, | solar halo. |
| h. d. | ,, | heavy dew. | sq. | ,, | squall. |
| hl. | ,, | hail. | sqs. | ,, | squalls. |
| l. | ,, | lightning. | t. | ,, | thunder. |
| li. cl. | ,, | light clouds. | t. s. | ,, | thunder-storm. |
| li. sh. | ,, | light showers. | w. | ,, | wind. |
| lu. co. | ,, | lunar corona. | g. | ,, | gale of wind. |
| lu. ha. | ,, | lunar halo. | | | |

## TABLE FOR ESTIMATING FORCE OF WIND.

| Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. |
|---|---|---|---|---|---|
| 0 | Calm | 1·5 | Light breeze | 4 | Blowing hard |
| 0·5 | Very light air | 2· | Fresh breeze | 5 | Blowing a gale |
| 1· | Light air | 3· | Very fresh | 6 | Violent gale |

**BAROMETER**, "corrected Mean" at 9 A.M., *minus* the Correction †† for Temp. (Col. 2), = 30·040 − ·061 = 29·979

"Corrected Mean" of Barometer at 9 P.M., *minus* the Correction †† for Temp. (Col. 4), = 30·069 − ·057 = 30·012

**Mean at Station, corrected, and at 32°**, = 29·996

Correction for height, feet above Mean Sea-level, = ·198

**Mean, reduced to 32°, and Sea-level**, = 30·194

Highest Reading, corrected for Index error, on the 30 th, = 30·320

Lowest Do. Do., on the 25 th, = 29·608

Difference, or **Monthly Range**, = 0·712

**S.-R. THERMOMETER**, (in shade, etc.), **Highest in Month**, (corrected for Index Errors), on the 11 th, = 67·0

**Lowest in Month**, corrected for Index errors, on the 10 th, = 31·0

Difference, or **Monthly Range**, = 36·0

"Corrected **Mean**" **of all the Highest**, (Col. 5), = 58·8

"Corrected **Mean**" **of all the Lowest**, (Col. 6), = 42·0

Difference, or **Mean Daily Range**, = 16·8

** Calculated **Mean Temperature** of Month, = 50·4

**S.-R. THERMOMETER, Black Bulb in Sun, Highest**, (corrected for Index Errors), on the 10 th, = 86·0

"Corrected **Mean**," (Col. 7), **of Black Bulb, Max. in Sun**, = 74·3

**Lowest at Night**, Black Bulb (corrected for Index errors), on the 10 th, = 27·0

"Corrected **Mean**," (Col. 8), **of Black Bulb, Min.** on grass, = 37·3

Difference of above means or range ("exposed"), =

**HYGROMETER, Mean** (corrected) A.M. and P.M. Reading **of Dry Bulb**, (Cols. 9 and 11), = 50·2

**Mean** (corrected) A.M. and P.M. Reading **of Wet Bulb**, (Cols. 10 and 12), = 48·0

‡‡ Computed **Temperature of Dew-Point**, = 45·7

‡‡ Do. **Elastic Force of Vapour**, = ·307

‡‡ Do. **Weight of Vapour in a Cubic Foot of Air**, =

‡‡ **Relative Humidity** (**Saturation** = 100), = 83·

**RAIN** fell on 19 **Days; Amount in Inches**, = 1·02

| WIND. SUMMARY. Direction. | N | NE | E | SE | S | SW | W | NW | Calm or Variable. | Mean Force. | Mean Velocity in miles per day. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. | 5 | 6 | 3 | 4 | | | 8 | 4 | | | |
| P.M | 7 | 5 | 2 | 5 | | 1 | 6 | 4 | | | |
| Mean. | 6 | 5 | 3 | 4 | 0 | 1 | 7 | 4 | 0 | | |

* Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S."; and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.
† Embracing corrections for both capillarity and Index Errors
‡ The Diurnal Range for Scotland is as yet unknown.
†† *Practically*, though not *absolutely* a *minus* correction.
‡‡ These "Hygrometrical Deductions" are calculated from Glaisher's Hygrometrical Tables, Second Edition *only*.
** While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature."
Any observations not taken under the Conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. *See over.*

*Observations made and Return verified by* John Forrest

(*Signed*)

# INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS,

## WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the chief objects that the SCOTTISH METEOROLOGICAL SOCIETY proposed to itself when the Society was established in 1855, was to secure PERFECT UNIFORMITY in the system of observation pursued at all its Stations. Uniformity in the observations is absolutely necessary to justify the publication of Monthly Results from different observations, it being found that differences between the Returns from two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those who kindly furnish Reports to the Society will, by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

**Hour of Observation.**

The Council recommend that Observations be made precisely at 9 A.M. and 9 P.M. (Greenwich or Railway Time only), as specified in the following remarks, or at the top of the columns of the Schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading the time at which it was taken, if not at 9 A.M. or 9 P.M.

**Barometer.**

Weather-Glasses and Aneroids, though well suited to indicate roughly variations of atmospheric pressure, are not fitted for scientific purposes. No Barometer should be used for Meteorological Observation that is not supplied with some means of adjustment or compensation which will secure that the height of the mercury in the tube is accurately measured from the fluctuating surface of the mercury in the cistern.

The Barometer in which the error arising from the fluctuating surface of the mercury in the cistern is entirely got rid of is FORTIN'S Barometer, the arrangement consisting in applying pressure by means of a screw to the bottom of the cistern, which is made of flexible leather, thus raising or depressing the surface till it just meets the ivory point which forms the zero point of the fixed scale.

The Barometer originally constructed by Mr. Adie of London, and usually called the Board of Trade Barometer, has the great convenience of requiring no adjustment of the cistern. Its scale-inches are not true inches, but so much shorter as to compensate the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This is an excellent Barometer for ordinary Observers, inasmuch as it entirely eliminates the error of observation likely to arise in not a few cases in setting the instrument to the zero point of the fixed scale when the light is not good. To show the accuracy with which these Barometers are made, it may be stated, that one was compared, during a whole year, with the Society's Standard Barometer, particular care being given to make the comparison when atmospheric pressure was rising or falling very rapidly, with the result that none of the readings differed from those of the Standard more than 0·003 inch.

A modification of Fortin's Barometer is used at a number of the Society's Stations, by which the coincidence of the zero point with the surface of the mercury is indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the index-line on this little piston-rod is brought, by the adjusting screw, to form one straight line with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this preliminary setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the vernier.

It is absolutely necessary that the Barometer which is to be used shall have been compared with a Standard Barometer.

The Barometer should be suspended in as good a light as can be secured, and to facilitate the reading, a piece of white paper may be put behind the tube. It must be hung truly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire, and must not be hung against a wall heated by a flue. The object being to secure that the whole instrument, including the brass fittings, the contained mercury, and the attached Thermometer, shall be, when read, at one uniform temperature, it is evident that the best position is that which is least liable to sudden changes of temperature.

In taking an Observation, the Attached Thermometer is first noted: the tube must then be gently tapped, and the cistern-adjustment carefully made. The eye, by raising and lowering it, must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted so as to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will facilitate an accurate adjustment and reading of the Barometer. A mistake not unfrequently made by those beginning to observe, consisting in setting the edge of the vernier to the level of the clear surface of the mercury which is in direct contact with the glass tube, must be carefully avoided.

The errors most frequently made in reading the Barometer are errors of 1·000 inch, 0·500 inch, and 0·050 inch; that is to say, instead of 29·365 inches, either of the following is sometimes set down—viz. as 30·365 inches, 28·365 inches, 29·865 inches, or 29·815 inches. Experience having shown that even the very best Observers make these mistakes, particular attention is directed to the matter.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must first be screwed so as to form a tight plug to the cistern, thus preventing the escape of the mercury. Then screw up the mercury not quite to the top of the tube, but to within a quarter of an inch of it, and take down the instrument; it should then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case if, on inclining the instrument, a sharp tap is produced when the mercury strikes the top of the tube. If a dull tap is heard, there is air in the tube, which must be got rid of.

As Barometers are liable to be deranged by the introduction of air into their tubes, on removal from place to place, or in being roughly handled, it may be useful to Observers to know how the air may be expelled. First close up the cistern by screwing the ivory peg tight, so as to prevent the escape of mercury; then screw up the mercury to about half an inch from the top of the tube; and having slowly inverted the instrument, place the top of it on a yielding substance, such as the boot, and gently tap on the cistern with the palm of the hand, so as to induce the air to ascend through the column to the cistern, whence it may escape. Since there is the weight of two atmospheres—the pressure of the mercury in the Barometer, and the air outside—pressing on any air that may be inside the tube, it is usually a tedious operation to get it wholly expelled. After repeated trials, however, it is generally accomplished; and the clear metallic sound of the mercury, when gently struck against the top of the glass tube, will show when the whole of the air has been expelled. On hanging up the Barometer, care must be taken to screw down the mercury in the tube before unfastening the float of the cistern, for, if this be not attended to, the mercury will flow out, and the instrument be seriously damaged.

**Protection and Position of Thermometers.**

The Council of the Society recommend that the Self-Registering Thermometers, and the Dry and Wet Bulb Hygrometer, be kept in Stevenson's Louvre-boarded Box for Thermometers, painted white inside and outside, and screwed to four stout posts, also painted white, firmly fixed in the ground. The posts must be of such a length that when the Thermometers are hung in position the Bulbs of the Minimum Thermometer, and of the Dry and Wet Bulb Thermometers, will be exactly at the same height of FOUR FEET above the ground, the Maximum Thermometer being hung immediately above the Minimum Thermometer. The Thermometer Box is to be placed over a plot of grass, and in a free open space to which the sun's rays have free access during as much of the day as surrounding conditions enable the Observer to secure. The Thermometers are suspended on cross-laths in the centre of the Box, and face the door, which should open to the north.

The Council regard the question of UNIFORMITY OF HEIGHT ABOVE GROUND, AND METHOD IN PROTECTING THE THERMOMETERS, as vital in every system of Meteorological Observation, since without it Observations made at different Stations are incomparable, thus rendering it impossible to compare the Climates of places with each other as regards their most important features.

**Self-Registering Thermometers.**

Professor Phillips, and Negretti and Zambra's Maximum Thermometers, and Rutherford's Minimum Thermometer, are recommended. It is recommended that these Thermometers be graduated on the glass stem. The Minimum Thermometer is liable to two derangements—viz., the column of spirit breaking, and part of the spirit distilling by high temperature and lodging at the top of the tube. This derangement is of occasional occurrence with protected Thermometers, but of frequent occurrence with exposed Thermometers. Hence a systematic examination of Minimum Thermometers ought to be a regular part of the work carried on by each Observer.

Fortunately, Spirit Thermometers may be easily set right by any one, when the column of spirit chances to separate. Let the Thermometer be taken in the hand by the end farthest from the bulb, raised above the head, and then forcibly swung down towards the feet; the object being, on the principle of centrifugal force, to send down the detached portion of spirit till it unites with the column. A few throws, or swinging strokes, will generally be sufficient for the purpose; after which the Thermometer should be placed in a slanting position, to allow the rest of the spirit still adhering to the sides of the tube to drain down to the column. But another method must be adopted, if the portion of spirit in the top of the tube be small. Heat should be applied slowly and cautiously to the top end of the tube where the detached portion of spirit is, which, being turned into vapour by the heat, will condense on the surface of the unbroken column of spirit. Care must be taken that the heat is not applied too quickly; for, if this be done, the tube will break and the instrument be destroyed. The best way to apply the requisite amount of heat is by bringing the end of the tube slowly down towards a minute flame from a gas-burner; or, if gas be not at hand, a piece of heated metal will serve instead.

**Black-Bulb Thermometers.**

The bulbs of the Thermometers for registering the greatest heat from the sun's rays, and the least from radiation during night, have a black coating, which may easily be made, or mended, by the application of a mixture of lampblack and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind, The Maximum should be freely exposed to the sun, and the Minimum should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation. Black-bulbs enclosed in 'glass jackets' may also be used, being indeed preferable to the above. It must, however, be added, that the whole subject of the observation of Solar and Terrestrial Radiation is not yet in a sufficiently advanced state to warrant the exclusive recommendation of any one of these methods.

**Dry and Wet Bulb Hygrometer.**

The Hygrometer in use at the Society's Stations consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved form of this apparatus seriously vitiate the Hygrometrical Observations, Observers are specially requested to attend to the following conditions:—The bulbs must hang down by at least an inch free from the scales and frame to which they are attached; the frame must be such as will bring the tubes forward by an inch from any board on which it may be suspended; the water-cup must be covered, and altogether placed to the side, and a little below the level of the wet bulb, but in no case under the bulbs; the muslin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the Observer that the muslin is always clean and moist, and the water pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

**Reading of the Thermometer.**

In reading the Thermometer great care must be taken to bring the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40$\frac{1}{2}$°; respectively. So also 40$\frac{1}{2}$°, and 40$\frac{3}{4}$°, more or less, must be registered 40°·2, or 40°·3, and 40°·7, or 40°·8 respectively. In reading Rutherford's Minimum Thermometer, the indication of that end of the index which is next the surface of the spirit is alone noted. On opening the Thermometer Box, the Dry and Wet Bulb Thermometers are to be first, and rapidly, read, inasmuch as they are readily affected by heat from the person of the Observer.

**Hour of observing Temperature.**

The Hygrometer is read at 9 A.M. and 9 P.M. The Self-Registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the Self-Registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 3d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

**Verification of Thermometers.**

No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a standard Thermometer. When such Thermometers as are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being re-tested. The Self-Registering, especially the Minimum Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer, marked by a scratch on the tube, ought to be tested once a year, in snow or melting ice.

In selecting instruments, the following points require attention:—The divisions of the vernier of Barometers in reference to their scales, and the perfect freedom of the Barometer from air; the correct numbering of the scale of every instrument; the rejection of Thermometers the frameworks of which are not likely to stand exposure to the weather, as shown in the past by repeated and annoying breakages of Thermometers of similar construction; and as regards Maximum Thermometers, either Negretti and Zambra's, or Phillip's, whether they will act at the highest temperatures they may be required to register. By the laws of the Society, Members and Observers have a right to have their instruments compared by the Secretary, and to advise with him regarding the purchase of instruments.

**Wind.**

Very great care should be bestowed on the Observations of the Wind, the accuracy of which, both as regards Direction and Force, is so essential towards the right discussion of many of the more important problems of the science.

**1. As regards Direction.**

A Wind-Vane ought to be elevated at least 12 feet above surrounding objects. When it oscillates incessantly, the mean direction should be taken. In all cases, but especially when the Vane is stationary, and when the wind is feeble, reference may be made to the direction of smoke, etc., in well-exposed situations. Careful observations are recommended to be made on the changes in the direction of the wind; and during storms, extra observations at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, is likely to give highly valuable and important results, particularly in connection with the system of thickly-planted Stations over a limited district round Edinburgh called STORM STATIONS, in the course of being established by the Society for the systematic investigation of the relation of the force of the wind to BAROMETRIC GRADIENTS, and other points connected with storms.

**2. As regards Velocity and Pressure.**

The Council would recommend the Hemispherical Cup Anemometer,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the mean Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, the Pressure Anemometers recently brought under the notice of the Society by Mr. T. Stevenson, the Honorary Secretary, and Mr. R. Ballingall, the Society's Observer at Eallabus, are recommended as likely to secure uniformity in making observations on the Force of the Wind.

**Rain Gauges.**

Many causes conspire to produce anomalies in Rain Returns, arising partly from the difficulty of obtaining a perfectly unobjectionable situation for observation, and partly from the defective nature of the instruments used. The Rain Gauge should not be placed on a slope or terrace, but on a level piece of ground, in as open a situation as the Observer can secure for it. As it is often difficult to obtain a position as free and unobstructed by surrounding objects as is desirable, care should be taken to place it at some distance from shrubs, trees, buildings, or other obstructions, at least as many feet from their base as they are in height. The more important directions, towards which it is most desirable to have a free exposure, are, in the order of their importance, S.W., N.E., S.E., S., and W. The rim of the gauge must be perfectly level, and fixed so that it will remain level in all weathers, and be at a height of one foot above ground, over grass. In such gauges as Fleming's, which are furnished with a measuring-rod attached to a float, the rod ought to be fixed down, and the float rise to its height only at the time the instrument is read, it being found that a stem projecting above the rim of the gauge seriously interferes with the proper measurement of the Rainfall. When a measuring-glass is used, care should be taken to hold it quite perpendicular. The Rain Gauge ought to be read daily at 9 A.M., and the reading entered in the Returns of the previous day. If the Gauge is read once a month, the reading is to be made on the first of the month, and the amount entered for the previous month.

**Snow-falls.**

Snow-falls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs, it should be noted in the 'Remarks,' and the letter S affixed to the depth of water received in Gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the Rain Gauge. For wind, rain, and snow, as indeed in every column, the Observer cannot be too careful to register observations only; and nothing that partakes of the nature of deduction or inference.

**Clouds.**

Convenient abbreviations for the nomenclature of Clouds will be found on the other side. The amount of Cloud ought to be estimated from the greater or less obscuration of the sky overhead (*i.e.* within 20° or 30° of the zenith). The strata of Clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the Clouds' column, though their appearance and changes may be noted among the Remarks. The amount of Cloud is entered from a scale of 0 to 10; thus, when the sky overhead is free from Clouds it is entered 0, when half-covered by Clouds, 5, wholly covered, 10, and so on.

Observations of the Clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—Thus, in the column Velocity and Direction, 6, S. W.

——— will indicate that the upper strata of Clouds travel with
2, W.

extreme velocity from S.W., and those in the lower regions from W., with one-third the speed of the former. Again, in the second
4, st.

Cloud column, an entry of ——— will indicate that the higher
2, cu-st.

regions are covered to the amount of 4-tenths with stratus Clouds; and that the sky is further obscured to the extent of 2-tenths by lower Clouds of the cumulo stratus kind.

Remarks on peculiar Clouds, accompanied with drawings, will assist materially in the development of a more exact nomenclature of Clouds, as well as throw light on the electrical, and other of the more obscure phenomena of Meteorology.

**Sunshine.**

The approximate number of Hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

**Underground Thermometers.**

As the germination and growth of crops and plants generally depend greatly on the temperature of the soil,—its amount and constancy,—the Council recommend that Observations in this interesting department be made at 9 A.M., by Thermometers permanently fixed in the soil, their bulbs being sunk to depths of 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames.

**Temperature of the Sea.**

A knowledge of the Temperature of the Sea is not only in itself, but in its relations to that of our island, a most important branch of Meteorology. The Council therefore recommend that the Temperature of the Sea be carefully taken by a properly constructed apparatus, from boats, or, if this be impracticable, from the ends of piers and rocks round the coast, where it is not influenced by that of river water, and as little influenced as possible by currents sweeping along the coast, and thus acquiring the temperature of the land, either greatly heated by the sun or cooled by nocturnal radiation. At or near the time of high water, in cases where the observations cannot be taken daily, the observation may be made on the 5th, 15th, and 25th of each month. When convenient, extra Sea Observations might be taken for other and greater depths, noting always the Temperature of the Air, and the Hour of Observation. It is also very desirable that observations on the daily Maxima and Minima by Thermometers continuously immersed, be instituted at points along the coast, by the method proposed by Mr. T. Stevenson, and already commenced at Peterhead and Liverpool.

**Temperature of Wells.**

The Temperature of the water at the bottom of Wells ought, when practicable, to be taken, both the depth of the Well and of the water being noted.

Mention what Test-Papers are used, Schönbein's or Moffat's, etc.

**Ozone.**

The Paper is affixed by a pin to a board in the Thermometer Box, and the indications registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus $3^{N.W.}_{1}$, as an Ozone entry in the schedule will indicate that the Ozone paper is tinted as 3 on the scale, that the wind is from the N.W., and that its force on the scale 0—5 is 4, or blowing fresh.

**Atmospheric Electricity.**

Too much importance cannot be attached to the electric condition of the atmosphere in connection with terrestrial magnetism, barometrical, thermometrical, and meteorological phenomena generally. A proper Electrometer is, in truth, necessary to every complete meteorological observatory.

**Remarks.**

The Remarks column is unavoidably too narrow. Some of the most valuable Observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are in general use is given at the foot of the column. Besides special and extraordinary Observations, great prominence ought to be given in this column to Prevalent Diseases, differences in character, colour, velocity, and direction between the Lower and Upper Strata of clouds, the Colour of the Sky, etc. Remarks ought to be made on the occurrence of Meteors, Auroræ Boreales, remarkable depressions, elevations, and fluctuations of the Barometer, Thunder-Storms, and remarkable falls of Snow, Hail, or Rain, the Hour of Storms of Wind commencing, attaining their maximum, and ending, as well as such Notes on Storms as have been hinted at above. When lofty hills are in the vicinity of a Station, the Height of Clouds and of the Snow-line in winter should be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. should be registered, either in two columns, otherwise unoccupied, or ruled off for the purpose, from the column of 'Remarks.'

**Observations in connection with the Periodic Return of the Seasons.**

Observations in connection with the Periodic Return of the Seasons, possess not only great scientific value, but are of considerable importance in connection with Agriculture, Horticulture, and Natural History. The Council would direct the special attention of Observers to the registration of such phenomena, so that the published Summaries may fairly represent the whole of Scotland. Observations ought to be confined to individual trees and shrubs; to particular species of birds, and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm. The Annual Table, published yearly in the Society's Journal, will indicate the species of plants and animals to which special attention is more particularly directed.

The Council recommend Observers, before purchasing new instruments, and in repairing old ones, to communicate with the Meteorological Secretary, in order that every instrument may be examined and improved before being used; and they consider it necessary that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, *December* 1891.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

| FOREST TREES. | In Flower. | Leaf Buds first Appear. | In Leaf. | Directed of Leaves. |
|---|---|---|---|---|
| Alder, | | | | |
| Ash, | | | | |
| Beech, | | | | |
| Birch, | | | | |
| Elm, | | | | |
| Larch, | | | | |
| Lime, | | | | |
| Oak, | | | | |
| Sycamore or Plane, | | | | |

| SHRUBS, ETC. | First in Blossom. |
|---|---|
| Barberry, | |
| Bourtree or Elder, | |
| Broom, | |
| Hazel, | |
| Hawthorn, | |
| Holly, | |
| Laburnum, | |
| Lilac, | |
| Mezereon, | |
| Mountain Ash or Rowan, | |
| Red Flowering Currant, | |
| Rhododendron Ponticum, | |
| Whin, | |

| FRUITS. | First in Blossom. | Fruit Ripe, generally. |
|---|---|---|
| Apple, | | |
| Black Currant, | | |
| Cherry, | | |
| Gean, | | |
| Gooseberry, | | |
| Peach, | | |
| Pear, | | |
| Plum, | | |
| Strawberry, | | |

| CROPS, mentioning variety. | Sowing or Planting. | Appearing above Ground. | In Ear or Flower. | First Cut or Raised. |
|---|---|---|---|---|
| Barley, | | | | |
| Bere or Bigg, | | | | |
| Oats, | | | | |
| Wheat, | | | | |
| Beans, | | | | |
| Peas, | | | | |
| Potatoes, | | | | |
| Turnips, | | | | |
| Rye Grass, | | | | |

| MIGRATORY BIRDS. | First Arrival. | Departure. |
|---|---|---|
| Cuckoo, | | |
| Curlew, | | |
| House-Swallow, | | |
| Lapwing, | | |
| Plover, | | |
| Sand-Martin, | | |
| Starling, | | |
| Swan, | | |
| Rail or Corn Crake, | | |

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

To the SECRETARY
Scottish Meteorological Society,
122 George Street,
EDINBURGH.

BOOK POST.

Radio Ho
Sept 1894

# SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Hadds House, County of Aberdeen, in Lat. 57°24', Long. 2°14', Distance from Sea 12 miles.

Height of Cistern of the Barometer above Mean Sea-Level 180 feet, above Ground 3 feet. During the MONTH of October 1894.

The Hours of Observation are of Greenwich Time.

| Days of Month. | BAROMETER. 9 h. A.M. Barometer. * No. | Attached Thermometer | 9 h. P.M. Barometer. No. | Attached Thermometer | SELF-REGISTERING THERMOMETERS, Read Daily, at 9 P.M. Protected in Shade, 4 feet above Ground. Max. No. | Min. No. | Exposed Black Bulbs. Max. in Sun's rays No. | Min. on Grass. No. | HYGROMETER. Dry No. Wet No. 9 h. A.M. Dry bulb. | Wet bulb. | 9 h. P.M. Dry bulb. | Wet bulb. | Rain. No. of days in which it fell. | Amount in inches. No. | WIND. 9 h. A.M. Direction. | Force | 9 h. P.M. Direction. | Force | Readings of the H. Cup Anemometer. No. 9 h. A.M. | CLOUDS. 9 A.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | P.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | SUNSHINE. Hours. | THERMOMETERS under Ground. 9 h. A.M. No. 3 inches. | No. 12 inches. | No. 22 inches. | Temperature of WELL at depth of feet, No. | SEA. Temperature at 1 fathom, and Density. | OZONE. 0—10. 9 A.M. | 9 P.M. | GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. *Mention the hour at which Storms, including Thunder and Lightning, began and ended.* | Days of Month. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELECTRICITY. | inches. | ° | inches. | ° | ° | ° | ° | ° | ° | ° | ° | ° | | | | | | | | | | | | | | ° | ° | | | | | | | |
| 1 | 30.244 | 50 | 30.168 | 47.5 | 56 | 43 | 72 | 39 | 50 | 45 | 45 | 43 | | | S | | S.E | | 3943 | | | | | | 49 | 53 | 53 | | | 5 | 4 | | 1 |
| 2 | 30.116 | 45 | 30.132 | 45 | 65 | 38.5 | 78 | 34 | 48.5 | 43 | 39 | 38.5 | | | S.E | | W | | 4211 | | | | | | 48 | 52 | 53 | | | 4 | 5 | | 2 |
| 3 | 30.114 | 42.5 | 30.108 | 48 | 62 | 33.5 | 73 | 29 | 41 | 40 | 49 | 48 | | | N.W | | N.E | | 4254 | | | | | | 46 | 52 | 53 | | | 5 | 6 | | 3 |
| 4 | 30.048 | 49 | 30.110 | 50 | 53 | 46 | 64 | 40 | 50.5 | 49 | 50 | 49.5 | + | | N.E | | E | | 4450 | | | | | | 51 | 53 | 53 | | | 9 | 8 | Fog | 4 |
| 5 | 30.028 | 50 | 30.034 | 50 | 53 | 48 | 65 | 48 | 50.5 | 50 | 49 | 48 | + | | E | | E | | 4468 | | | | | | 52 | 53 | 53 | | | 7 | 8 | Fog | 5 |
| 6 | 29.976 | 50 | 29.982 | 49.5 | 56 | 47 | 67 | 47 | 50 | 49 | 49 | 48 | + | | E | | S | | 4579 | | | | | | 52 | 53 | 53 | | | 8 | 9 | Fog | 6 |
| 7 | 29.862 | 49 | 29.878 | 50.5 | 56 | 44 | 67.5 | 39 | 48 | 47.5 | 50 | 49 | + | .22 | S.E | | S.W | | 4763 | | | | | | 52 | 53 | 53 | | | 7 | 8 | Fog | 7 |
| 8 | 29.930 | 50 | 29.876 | 51 | 58 | 46 | 67 | 44 | 53 | 51 | 52 | 51 | | | S.W | | S | | 4800 | | | | | | 52 | 53 | 53 | | | 5 | 6 | | 8 |
| 9 | 29.830 | 53 | 29.796 | 53 | 57 | 47 | 65 | 43 | 58 | 51 | 52 | 51 | + | | S | | S.E | | 5452 | | | | | | 52 | 53 | 53 | | | 9 | 8 | | 9 |
| 10 | 29.752 | 53 | 29.844 | 53 | 64 | 45 | 75 | 39 | 57 | 54.5 | 48 | 47 | | | W | | S.W | | 5921 | | | | | | 53 | 53 | 53 | | | 5 | 6 | | 10 |
| 11 | 29.976 | 49 | 30.042 | 43 | 60.5 | 43 | 72 | 38 | 44 | 42 | 39 | 38.5 | | | W | | S.E | | 5980 | | | | | | 51 | 53 | 53 | | | 4 | 8 | Fog | 11 |
| 12 | 29.956 | 48 | 29.920 | 50 | 67 | 34.5 | 64 | 32 | 51 | 50 | 52 | 50.5 | + | | S.W | | S.W | | 6079 | | | | | | 49 | 53 | 53 | | | 6 | 6 | | 12 |
| 13 | 29.858 | 53 | 29.918 | 46.5 | 58 | 41 | 65 | 37 | 56 | 55 | 43 | 41 | + | | W | | N.E | | 6263 | | | | | | 52 | 53 | 53 | | | 7 | 9 | | 13 |
| 14 | 29.940 | 43.5 | 30.038 | 44 | 50 | 38 | 60 | 32 | 45.5 | 43 | 42.5 | 40 | + | .46 | N.E | | N | | 6506 | | | | | | 47 | 51 | 53 | | | 5 | 5 | Hail | 14 |
| 15 | 30.038 | 45.5 | 30.066 | 44 | 57 | 39 | 58 | 34 | 45.5 | 42.5 | 42 | 41 | + | | N | | N | | 6820 | | | | | | 47 | 51 | 52 | | | 6 | 9 | | 15 |
| 16 | 30.046 | 45 | 30.000 | 43 | 50 | 40.5 | 62.5 | 36 | 46 | 44 | 48 | 42 | + | | N | | N | | 7004 | | | | | | 47 | 50 | 52 | | | 8 | 9 | | 16 |
| 17 | 29.814 | 45 | 29.706 | 43 | 51 | 39 | 60 | 35 | 45 | 44 | 40.5 | 40 | + | | N.W | | N | | 7646 | | | | | | 47 | 50 | 51 | | | 9 | 9 | | 17 |
| 18 | 29.651 | 41 | 29.560 | 37 | 47 | 31 | 57 | 36 | 39 | 37 | 35 | 34 | + | | N | | N | | 7895 | | | | | | 44 | 49 | 51 | | | 9 | 8 | Hail | 18 |
| 19 | 29.516 | 36 | 29.598 | 37.5 | 46.5 | 28 | 62 | 22.5 | 37 | 33.5 | 35 | 34 | + | | N.E | | N.E | | 8493 | | | | | | 42 | 48 | 50 | | | 5 | 8 | Snow | 19 |
| 20 | 29.540 | 39 | 29.620 | 40.5 | 44 | 29 | 62 | 24 | 38 | 37.5 | 40.5 | 38 | + | | N.E | | E | | 8595 | | | | | | 42 | 47 | 50 | | | 5 | 8 | | 20 |
| 21 | 29.596 | 40 | 29.540 | 37 | 48.5 | 33 | 60 | 30 | 41 | 38 | 34 | 33.5 | + | .59 | N.E | | W | | 9478 | | | | | | 43 | 46 | 49 | | | 5 | 8 | | 21 |
| 22 | 29.532 | 38 | 29.618 | 34 | 49 | 29.5 | 60 | 24 | 41 | 38 | 29 | 28.5 | | | W | | W | | 0085 | | | | | | 41 | 46 | 48 | | | 9 | 5 | | 22 |
| 23 | 29.742 | 32 | 29.676 | 42.5 | 49 | 23 | 67 | 20 | 36 | 32 | 45.5 | 42 | + | | W | | S.E | | 0463 | | | | | | 38 | 45 | 48 | | | 6 | 5 | | 23 |
| 24 | 29.148 | 46 | 28.618 | 51 | 52 | 42.5 | 52 | 40 | 49 | 48.5 | 51 | 50.5 | + | | S.E | | S.E | | 1794 | | | | | | 44 | 45 | 47 | | | 6 | 9 | | 24 |
| 25 | 28.432 | 48 | 28.766 | 40 | 51 | 41 | 62 | 41 | 48.5 | 48 | 42 | 41 | + | | N.E | | N.E | | 2745 | | | | | | 47 | 46 | 47 | | | 7 | 9 | | 25 |
| 26 | 29.126 | 40 | 29.226 | 37 | 47 | 33 | 57 | 28 | 40 | 38.5 | 33 | 32.5 | + | | N.E | | N.W | | 3077 | | | | | | 43 | 47 | 47 | | | 8 | 5 | | 26 |
| 27 | 29.132 | 36.5 | 29.294 | 34 | 50 | 28.5 | 61 | 24 | 34.5 | 33.5 | 30 | 29.5 | + | | N | | N | | 3255 | | | | | | 41 | 46 | 47 | | | 6 | 5 | | 27 |
| 28 | 29.362 | 38 | 29.350 | 44 | 48 | 26 | 56 | 23 | 40 | 38.5 | 45 | 44 | + | 1.34 | S | | S.E | | 3326 | | | | | | 41 | 45 | 47 | | | 5 | 6 | | 28 |
| 29 | 29.026 | 46.5 | 29.042 | 37 | 53 | 31 | 63 | 26.5 | 45.5 | 44 | 31 | 30.5 | + | | S.E | | S.W | | 5029 | | | | | | 44 | 45 | 47 | | | 6 | 6 | | 29 |
| 30 | 29.332 | 43.5 | 29.609 | 34 | 53.5 | 25 | 64 | 22 | 33.5 | 31.5 | 29 | 28.5 | | | N.W | | N.W | | 5178 | | | | | | 39 | 45 | 46 | | | 6 | 4 | | 30 |
| 31 | 29.668 | 45 | 29.514 | 48 | 51 | 24 | 62 | 22 | 48 | 44.5 | 51 | 50.5 | + | .78 | S | | S.E | | 5487 | | | | | | 42 | 44 | 46 | | | 6 | 6 | | 31 |
| Sums. | 15 13 12 912.326 | 13 3 3.00 | 14 13 13 920.649 | 12 3 13 44.5 | 13 2 1647 | 13 3 1135.5 | 12 1 1960 | 13 1 1084 | 13 4 1394.5 | 14 5 1363.5 | 14 2 1316 | 13 6 1283 | | 22 3.39 | | | | | | | | | | | 12 1438 | 12 1533 | 12 1557 | | | 266 | 285 | | |
| Means. | 21 29.[illegible] | 15 44.8 | 21 29.698 | 12 44.0 | 10 53.5 | 20 36.7 | 10 63.2 | 4 33.2 | 16 45.3 | 10 43.3 | 42.5 | 41.4 | | | | | | | | | | | | | 19 46.1 | 29 49.4 | 1 50.6 | | | 6.6 | 6.9 | | |
| † Total Corrections for Instrumental Errors. | 6 8 +070 | | +070 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ‡ Corrections for Diurnal Range. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "Corrected Means." | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. of Column. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | | |

## NOTATION USED IN GENERAL REMARKS.

| | | | | | |
|---|---|---|---|---|---|
| a. | *denotes* aurora. | | m. | *denotes* meteor. | |
| ci. | ,, | cirrus. | ms. | ,, | meteors. |
| ci.-cu. | ,, | cirro-cumulus. | n. | ,, | nimbus. |
| ci.-s. | ,, | cirro-stratus. | r. | ,, | rain. |
| cu. | ,, | cumulus. | h. r. | ,, | heavy rain. |
| cu.-s. | ,, | cumulo-stratus. | c. h. r. | ,, | continued heavy rain. |
| d. | ,, | dew. | s. | ,, | stratus. |
| f. | ,, | fog. | sc. | ,, | scud. |
| fr. | ,, | frost. | s. | ,, | sleet. |
| h.-fr. | ,, | hoar-frost. | s. | ,, | snow. |
| h. | ,, | haze. | so. ha. | ,, | solar halo. |
| h. d. | ,, | heavy dew. | sq. | ,, | squall. |
| hl. | ,, | hail. | sqs. | ,, | squalls. |
| l. | ,, | lightning. | t. | ,, | thunder. |
| li. cl. | ,, | light clouds. | t. s. | ,, | thunder-storm. |
| li. sh. | ,, | light showers. | w. | ,, | wind. |
| lu. co. | ,, | lunar corona. | g. | ,, | gale of wind. |
| lu. ha. | ,, | lunar halo. | | | |

## TABLE FOR ESTIMATING FORCE OF WIND.

| Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. |
|---|---|---|---|---|---|
| 0 | Calm | 1·5 | Light breeze | 4 | Blowing hard |
| 0·5 | Very light air | 2· | Fresh breeze | 5 | Blowing a gale |
| 1· | Light air | 3· | Very fresh | 6 | Violent gale |

**BAROMETER**, "corrected Mean" at 9 A.M., *minus* the Correction †† for Temp. (Col. 2), = 29.688 − 43 = 29.645

"Corrected Mean" of Barometer at 9 P.M., *minus* the Correction †† for Temp. (Col. 4), = 29.698 − 41 = 29.657

**Mean at Station, corrected, and at 32°**, = 29.721 +055 = 29.776

Correction for height, feet above Mean Sea-level, = 200

**Mean, reduced to 32°, and Sea-level**, = 29.921

Highest Reading, corrected for Index error, on the 1 th, = 30.244

Lowest Do. Do., on the 25th, = 28.432

Difference, or **Monthly Range**, = 1.812

**S.-R. THERMOMETER**, (in shade, etc.), **Highest in Month**, (corrected for Index Errors), on the 2th, = 65.0

**Lowest in Month**, corrected for Index errors, on the 23th, = 23.0

Difference, or **Monthly Range**, = 42.0

"Corrected **Mean**" **of all the Highest**, (Col. 5), = 53.5

"Corrected **Mean**" **of all the Lowest**, (Col. 6), = 36.7

Difference, or **Mean Daily Range**, = 16.8

** Calculated **Mean Temperature** of Month, = 45.1

**S.-R. THERMOMETER, Black Bulb in Sun, Highest**, (corrected for Index Errors), on the 2 th, = 78.0

"Corrected **Mean**," (Col. 7), **of Black Bulb, Max. in Sun**, = 53.2

**Lowest at Night**, Black Bulb (corrected for Index errors), on the 3th, = 20.0

"Corrected **Mean**," (Col. 8), **of Black Bulb, Min.** on grass, = 33.2

Difference of above means or range ("exposed"), =

**HYGROMETER, Mean** (corrected) A.M. and P.M. Reading **of Dry Bulb**, (Cols. 9 and 11), = 43.9

**Mean** (corrected) A.M. and P.M. Reading **of Wet Bulb**, (Cols. 10 and 12), = 42.4

‡‡ Computed **Temperature of Dew-Point**, = 40.6

‡‡ Do. **Elastic Force of Vapour**, = .254

‡‡ Do. **Weight of Vapour in a Cubic Foot of Air**, =

‡‡ **Relative Humidity** (Saturation = 100), = 88

**RAIN** fell on 23 **Days; Amount in Inches**, = 3.39

| WIND. SUMMARY. Direction. | N | NE | E | SE | S | SW | W | NW | Calm or Variable. | Mean Force. | Mean Velocity in miles per day. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. | 4 | 7 | 2 | 4 | 4 | 2 | 5 | 3 | | | |
| P.M | 6 | 4 | 3 | 7 | 2 | 4 | 3 | 2 | | | |
| Mean. | 5 | 5 | 3 | 5 | 3 | 3 | 4 | 3 | 0 | | |

* Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S."; and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.
† Embracing corrections for both capillarity and Index Errors
‡ The Diurnal Range for Scotland is as yet unknown.
†† *Practically*, though not *absolutely* a *minus* correction.
‡‡ These "Hygrometrical Deductions" are calculated from Glaisher's Hygrometrical Tables, Second Edition *only*.
** While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature." Any observations not taken under the Conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. *See over.*

*Observations made and Return verified by* John Forrest

(*Signed*)

# INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS,

## WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the chief objects that the SCOTTISH METEOROLOGICAL SOCIETY proposed to itself when the Society was established in 1855, was to secure PERFECT UNIFORMITY in the system of observation pursued at all its Stations. Uniformity in the observations is absolutely necessary to justify the publication of Monthly Results from different observations, it being found that differences between the Returns from two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those who kindly furnish Reports to the Society will, by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

The Council recommend that Observations be made precisely at 9 A.M. and 9 P.M. (Greenwich or Railway Time only),

**Hour of Observation.** as specified in the following remarks, or at the top of the columns of the Schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading the time at which it was taken, if not at 9 A.M. or 9 P.M.

**Barometer.** Weather-Glasses and Aneroids, though well suited to indicate roughly variations of atmospheric pressure, are not fitted for scientific purposes. No Barometer should be used for Meteorological Observation that is not supplied with some means of adjustment or compensation which will secure that the height of the mercury in the tube is accurately measured from the fluctuating surface of the mercury in the cistern.

The Barometer in which the error arising from the fluctuating surface of the mercury in the cistern is entirely got rid of is FORTIN'S Barometer, the arrangement consisting in applying pressure by means of a screw to the bottom of the cistern, which is made of flexible leather, thus raising or depressing the surface till it just meets the ivory point which forms the zero point of the fixed scale.

The Barometer originally constructed by Mr. Adie of London, and usually called the Board of Trade Barometer, has the great convenience of requiring no adjustment of the cistern. Its scale-inches are not true inches, but so much shorter as to compensate the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This is an excellent Barometer for ordinary Observers, inasmuch as it entirely eliminates the error of observation likely to arise in not a few cases in setting the instrument to the zero point of the fixed scale when the light is not good. To show the accuracy with which these Barometers are made, it may be stated, that one was compared, during a whole year, with the Society's Standard Barometer, particular care being given to make the comparison when atmospheric pressure was rising or falling very rapidly, with the result that none of the readings differed from those of the Standard more than 0·003 inch.

A modification of Fortin's Barometer is used at a number of the Society's Stations, by which the coincidence of the zero point with the surface of the mercury is indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the index-line on this little piston-rod is brought, by the adjusting screw, to form one straight line with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this preliminary setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the vernier.

It is absolutely necessary that the Barometer which is to be used shall have been compared with a Standard Barometer.

The Barometer should be suspended in as good a light as can be secured, and to facilitate the reading, a piece of white paper may be put behind the tube. It must be hung truly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire, and must not be hung against a wall heated by a flue. The object being to secure that the whole instrument, including the brass fittings, the contained mercury, and the attached Thermometer, shall be, when read, at one uniform temperature, it is evident that the best position is that which is least liable to sudden changes of temperature.

In taking an Observation, the Attached Thermometer is first noted: the tube must then be gently tapped, and the cistern-adjustment carefully made. The eye, by raising and lowering it, must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted so as to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will facilitate an accurate adjustment and reading of the Barometer. A mistake not unfrequently made by those beginning to observe, consisting in setting the edge of the vernier to the level of the clear surface of the mercury which is in direct contact with the glass tube, must be carefully avoided.

The errors most frequently made in reading the Barometer are errors of 1·000 inch, 0·500 inch, and 0·050 inch; that is to say, instead of 29·365 inches, either of the following is sometimes set down—viz. as 30·365 inches, 28·365 inches, 29·865 inches, or 29·815 inches. Experience having shown that even the very best Observers make these mistakes, particular attention is directed to the matter.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must first be screwed so as to form a tight plug to the cistern, thus preventing the escape of the mercury. Then screw up the mercury not quite to the top of the tube, but to within a quarter of an inch of it, and take down the instrument; it should then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case if, on inclining the instrument, a sharp tap is produced when the mercury strikes the top of the tube. If a dull tap is heard, there is air in the tube, which must be got rid of.

As Barometers are liable to be deranged by the introduction of air into their tubes, on removal from place to place, or in being roughly handled, it may be useful to Observers to know how the air may be expelled. First close up the cistern by screwing the ivory peg tight, so as to prevent the escape of mercury; then screw up the mercury to about half an inch from the top of the tube; and having slowly inverted the instrument, place the top of it on a yielding substance, such as the boot, and gently tap on the cistern with the palm of the hand, so as to induce the air to ascend through the column to the cistern, whence it may escape. Since there is the weight of two atmospheres—the pressure of the mercury in the Barometer, and the air outside—pressing on any air that may be inside the tube, it is usually a tedious operation to get it wholly expelled. After repeated trials, however, it is generally accomplished; and the clear metallic sound of the mercury, when gently struck against the top of the glass tube, will show when the whole of the air has been expelled. On hanging up the Barometer, care must be taken to screw down the mercury in the tube before unfastening the float of the cistern, for, if this be not attended to, the mercury will flow out, and the instrument be seriously damaged.

The Council of the Society recommend that the Self-Registering Thermometers, and the Dry and Wet Bulb Hygrometer, be kept in Stevenson's Louvre-boarded Box for

**Protection and Position of Thermometers.** Thermometers, painted white inside and outside, and screwed to four stout posts, also painted white, firmly fixed in the ground. The posts must be of such a length that when the Thermometers are hung in position the Bulbs of the Minimum Thermometer, and of the Dry and Wet Bulb Thermometers, will be exactly at the same height of FOUR FEET above the ground, the Maximum Thermometer being hung immediately above the Minimum Thermometer. The Thermometer Box is to be placed over a plot of grass, and in a free open space to which the sun's rays have free access during as much of the day as surrounding conditions enable the Observer to secure. The Thermometers are suspended on cross-laths in the centre of the Box, and face the door, which should open to the north.

The Council regard the question of UNIFORMITY OF HEIGHT ABOVE GROUND, AND METHOD IN PROTECTING THE THERMOMETERS, as vital in every system of Meteorological Observation, since without it Observations made at different Stations are incomparable, thus rendering it impossible to compare the Climates of places with each other as regards their most important features.

Professor Phillips, and Negretti and Zambra's Maximum Ther-

**Self-Registering Thermometers.** mometers, and Rutherford's Minimum Thermometer, are recommended. It is recommended that these Thermometers be graduated on the glass stem. The Minimum Thermometer is liable to two derangements—viz., the column of spirit breaking, and part of the spirit distilling by high temperature and lodging at the top of the tube. This derangement is of occasional occurrence with protected Thermometers, but of frequent occurrence with exposed Thermometers. Hence a systematic examination of Minimum Thermometers ought to be a regular part of the work carried on by each Observer.

Fortunately, Spirit Thermometers may be easily set right by any one, when the column of spirit chances to separate. Let the Thermometer be taken in the hand by the end farthest from the bulb, raised above the head, and then forcibly swung down towards the feet; the object being, on the principle of centrifugal force, to send down the detached portion of spirit till it unites with the column. A few throws, or swinging strokes, will generally be sufficient for the purpose; after which the Thermometer should be placed in a slanting position, to allow the rest of the spirit still adhering to the sides of the tube to drain down to the column. But another method must be adopted, if the portion of spirit in the top of the tube be small. Heat should be applied slowly and cautiously to the top end of the tube where the detached portion of spirit is, which, being turned into vapour by the heat, will condense on the surface of the unbroken column of spirit. Care must be taken that the heat is not applied too quickly; for, if this be done, the tube will break and the instrument be destroyed. The best way to apply the requisite amount of heat is by bringing the end of the tube slowly down towards a minute flame from a gas-burner; or, if gas be not at hand, a piece of heated metal will serve instead.

The bulbs of the Thermometers for registering the greatest heat from the sun's rays, and the least from radiation

**Black-Bulb Thermometers.** during night, have a black coating, which may easily be made, or mended, by the application of a mixture of lampblack and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind, The Maximum should be freely exposed to the sun, and the Minimum should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation. Black-bulbs enclosed in 'glass jackets' may also be used, being indeed preferable to the above. It must, however, be added, that the whole subject of the observation of Solar and Terrestrial Radiation is not yet in a sufficiently advanced state to warrant the exclusive recommendation of any one of these methods.

The Hygrometer in use at the Society's Stations consists of two Thermometers usually, but not necessarily, mounted

**Dry and Wet Bulb Hygrometer.** on one frame. As apparently slight deviations from the approved form of this apparatus seriously vitiate the Hygrometrical Observations, Observers are specially requested to attend to the following conditions:—The bulbs must hang down by at least an inch free from the scales and frame to which they are attached; the frame must be such as will bring the tubes forward by an inch from any board on which it may be suspended; the water-cup must be covered, and altogether placed to the side, and a little below the level of the wet bulb, but in no case under the bulbs; the muslin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the Observer that the muslin is always clean and moist, and the water pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

In reading the Thermometer great care must be taken to bring

**Reading of the Thermometer.** the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or $40\frac{1}{4}°$, respectively. So also $40\frac{1}{4}°$, and $40\frac{3}{4}°$, more or less, must be registered 40°·2, or 40°·3, and 40°·7, or 40°·8 respectively. In reading Rutherford's Minimum Thermometer, the indication of that end of the index which is next the surface of the spirit is alone noted. On opening the Thermometer Box, the Dry and Wet Bulb Thermometers are to be first, and rapidly, read, inasmuch as they are readily affected by heat from the person of the Observer.

The Hygrometer is read at 9 A.M. and 9 P.M. The Self-Register-

**Hour of observing Temperature.** ing Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the Self-Registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 3d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

No instrument ought to be used for Meteorological purposes

**Verification of Thermometers.** till it has been carefully tested by comparison with a standard Thermometer. When such Thermometers as are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being re-tested. The Self-Registering, especially the Minimum Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer, marked by a scratch on the tube, ought to be tested once a year, in snow or melting ice.

In selecting instruments, the following points require attention:—The divisions of the vernier of Barometers in reference to their scales, and the perfect freedom of the Barometer from air; the correct numbering of the scale of every instrument; the rejection of Thermometers the frameworks of which are not likely to stand exposure to the weather, as shown in the past by repeated and annoying breakages of Thermometers of similar construction; and as regards Maximum Thermometers, either Negretti and Zambra's, or Phillip's, whether they will act at the highest temperatures they may be required to register. By the laws of the Society, Members and Observers have a right to have their instruments compared by the Secretary, and to advise with him regarding the purchase of instruments.

Very great care should be bestowed on the Observations of the

**Wind.** Wind, the accuracy of which, both as regards Direction and Force, is so essential towards the right discussion of many of the more important problems of the science.

A Wind-Vane ought to be elevated at least 12 feet above sur-

**1. As regards Direction.** rounding objects. When it oscillates incessantly, the mean direction should be taken. In all cases, but especially when the Vane is stationary, and when the wind is feeble, reference may be made to the direction of smoke, etc., in well-exposed situations. Careful observations are recommended to be made on the changes in the direction of the wind; and during storms, extra observations at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, is likely to give highly valuable and important results, particularly in connection with the system of thickly-planted Stations over a limited district round Edinburgh called STORM STATIONS, in the course of being established by the Society for the systematic investigation of the relation of the force of the wind to BAROMETRIC GRADIENTS, and other points connected with storms.

The Council would recommend the Hemispherical Cup Anemo-

**2. As regards Velocity and Pressure.** meter,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the mean Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, the Pressure Anemometers recently brought under the notice of the Society by Mr. T. Stevenson, the Honorary Secretary, and Mr. R. Ballingall, the Society's Observer at Eallabus, are recommended as likely to secure uniformity in making observations on the Force of the Wind.

Many causes conspire to produce anomalies in Rain Returns,

**Rain Gauges.** arising partly from the difficulty of obtaining a perfectly unobjectionable situation for observation, and partly from the defective nature of the instruments used. The Rain Gauge should not be placed on a slope or terrace, but on a level piece of ground, in as open a situation as the Observer can secure for it. As it is often difficult to obtain a position as free and unobstructed by surrounding objects as is desirable, care should be taken to place it at some distance from shrubs, trees, buildings, or other obstructions, at least as many feet from their base as they are in height. The more important directions, towards which it is most desirable to have a free exposure, are, in the order of their importance, S.W., N.E., S.E., S., and W. The rim of the gauge must be perfectly level, and fixed so that it will remain level in all weathers, and be at a height of one foot above ground, over grass. In such gauges as Fleming's, which are furnished with a measuring-rod attached to a float, the rod ought to be fixed down, and the float rise to its height only at the time the instrument is read, it being found that a stem projecting above the rim of the gauge seriously interferes with the proper measurement of the Rainfall. When a measuring-glass is used, care should be taken to hold it quite perpendicular. The Rain Gauge ought to be read daily at 9 A.M., and the reading entered in the Returns of the previous day. If the Gauge is read once a month, the reading is to be made on the first of the month, and the amount entered for the previous month.

Snow-falls may, for convenience, be registered in the rain columns,

**Snow-falls.** under the following conditions:—When a Snow shower occurs, it should be noted in the 'Remarks,' and the letter S affixed to the depth of water received in Gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the Rain Gauge. For wind, rain, and snow, as indeed in every column, the Observer cannot be too careful to register observations only; and nothing that partakes of the nature of deduction or inference.

Convenient abbreviations for the nomenclature of Clouds will be

**Clouds.** found on the other side. The amount of Cloud ought to be estimated from the greater or less obscuration of the sky overhead (*i.e.* within 20° or 30° of the zenith). The strata of Clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the Clouds' column, though their appearance and changes may be noted among the Remarks. The amount of Cloud is entered from a scale of 0 to 10; thus, when the sky overhead is free from Clouds it is entered 0, when half-covered by Clouds, 5, wholly covered, 10, and so on.

Observations of the Clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—Thus, in the column Velocity and Direction, 6, S. W.

——— will indicate that the upper strata of Clouds travel with 2, W.

extreme velocity from S.W., and those in the lower regions from W., with one-third the speed of the former. Again, in the second 4, st.

Cloud column, an entry of ——— will indicate that the higher 2, cu-st.

regions are covered to the amount of 4-tenths with stratus Clouds; and that the sky is further obscured to the extent of 2-tenths by lower Clouds of the cumulo stratus kind.

Remarks on peculiar Clouds, accompanied with drawings, will assist materially in the development of a more exact nomenclature of Clouds, as well as throw light on the electrical, and other of the more obscure phenomena of Meteorology.

The approximate number of Hours in which objects in the sun's

**Sunshine.** rays cast shadows, should be entered in the proper column.

As the germination and growth of crops and plants generally

**Underground Thermometers.** depend greatly on the temperature of the soil,—its amount and constancy,—the Council recommend that Observations in this interesting department be made at 9 A.M., by Thermometers permanently fixed in the soil, their bulbs being sunk to depths of 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames.

A knowledge of the Temperature of the Sea is not only in itself,

**Temperature of the Sea.** but in its relations to that of our island, a most important branch of Meteorology. The Council therefore recommend that the Temperature of the Sea be carefully taken by a properly constructed apparatus, from boats, or, if this be impracticable, from the ends of piers and rocks round the coast, where it is not influenced by that of river water, and as little influenced as possible by currents sweeping along the coast, and thus acquiring the temperature of the land, either greatly heated by the sun or cooled by nocturnal radiation. At or near the time of high water, in cases where the observations cannot be taken daily, the observation may be made on the 5th, 15th, and 25th of each month. When convenient, extra Sea Observations might be taken for other and greater depths, noting always the Temperature of the Air, and the Hour of Observation. It is also very desirable that observations on the daily Maxima and Minima by Thermometers continuously immersed, be instituted at points along the coast, by the method proposed by Mr. T. Stevenson, and already commenced at Peterhead and Liverpool.

The Temperature of the water at the bottom of Wells ought,

**Temperature of Wells.** when practicable, to be taken, both the depth of the Well and of the water being noted.

Mention what Test-Papers are used, Schönbein's or Moffat's, etc.

**Ozone.** The Paper is affixed by a pin to a board in the Thermometer Box, and the indications registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus $3^{2}_{3}{}^{W.}$, as an Ozone entry in the schedule will indicate that the Ozone paper is tinted as 3 on the scale, that the wind is from the N.W., and that its force on the scale 0—5 is 4, or blowing fresh.

Too much importance cannot be attached to the electric condi-

**Atmospheric Electricity.** tion of the atmosphere in connection with terrestrial magnetism, barometrical, thermometrical, and meteorological phenomena generally. A proper Electrometer is, in truth, necessary to every complete meteorological observatory.

The Remarks column is unavoidably too narrow. Some of the

**Remarks.** most valuable Observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are in general use is given at the foot of the column. Besides special and extraordinary Observations, great prominence ought to be given in this column to Prevalent Diseases, differences in character, colour, velocity, and direction between the Lower and Upper Strata of clouds, the Colour of the Sky, etc. Remarks ought to be made on the occurrence of Meteors, Auroræ Boreales, remarkable depressions, elevations, and fluctuations of the Barometer, Thunder-Storms, and remarkable falls of Snow, Hail, or Rain, the Hour of Storms of Wind commencing, attaining their maximum, and ending, as well as such Notes on Storms as have been hinted at above. When lofty hills are in the vicinity of a Station, the Height of Clouds and of the Snow-line in winter should be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. should be registered, either in two columns, otherwise unoccupied, or ruled off for the purpose, from the column of 'Remarks.'

Observations in connection with the Periodic Return of the

**Observations in connection with the Periodic Return of the Seasons.** Seasons, possess not only great scientific value, but are of considerable importance in connection with Agriculture, Horticulture, and Natural History. The Council would direct the special attention of Observers to the registration of such phenomena, so that the published Summaries may fairly represent the whole of Scotland. Observations ought to be confined to individual trees and shrubs; to particular species of birds, and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm. The Annual Table, published yearly in the Society's Journal, will indicate the species of plants and animals to which special attention is more particularly directed.

The Council recommend Observers, before purchasing new instruments, and in repairing old ones, to communicate with the Meteorological Secretary, in order that every instrument may be examined and improved before being used; and they consider it necessary that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, *December* 1891.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

| FOREST TREES. | In Flower. | Leaf Buds first Appear. | In Leaf. | Divested of Leaves. |
|---|---|---|---|---|
| Alder, | | | | |
| Ash, | | | | |
| Beech, | | | | |
| Birch, | | | | |
| Elm, | | | | |
| Larch, | | | | |
| Lime, | | | | |
| Oak, | | | | |
| Sycamore or Plane, | | | | |

| SHRUBS, ETC. | First in Blossom. |
|---|---|
| Barberry, | |
| Bourtree or Elder, | |
| Broom, | |
| Hazel, | |
| Hawthorn, | |
| Holly, | |
| Laburnum, | |
| Lilac, | |
| Mezereon, | |
| Mountain Ash or Rowan, | |
| Red Flowering Currant, | |
| Rhododendron Ponticum, | |
| Whin, | |

| FRUITS. | First in Blossom. | Fruit Ripe, generally. |
|---|---|---|
| Apple, | | |
| Black Currant, | | |
| Cherry, | | |
| Gean, | | |
| Gooseberry, | | |
| Peach, | | |
| Pear, | | |
| Plum, | | |
| Strawberry, | | |

| CROPS, mentioning variety. | Sowing or Planting. | Appearing above Ground. | In Ear or Flower. | First Cut or Reaped. |
|---|---|---|---|---|
| Barley, | | | | |
| Bere or Bigg. | | | | |
| Oats, | | | | |
| Wheat, | | | | |
| Beans, | | | | |
| Pease, | | | | |
| Potatoes, | | | | |
| Turnips, | | | | |
| Rye Grass, | | | | |

| MIGRATORY BIRDS. | First Arrival. | Departure. |
|---|---|---|
| Cuckoo, | | |
| Curlew, | | |
| House-Swallow, | | |
| Lapwing, | | |
| Plover, | | |
| Sand-Martin, | | |
| Starling, | | |
| Swan, | | |
| Rail or Corn Crake, | | |

* Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

To the SECRETARY,
Scottish Meteorological Society,
122 George Street,
EDINBURGH.

BOOK POST.

F

# SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Haelde House, County of Aberdeen, in Lat. 57°24′, Long. 2°14′, Distance from Sea 12 miles.

Height of Cistern of the Barometer above Mean Sea-Level 180 feet, above Ground 3 feet. During the MONTH of November 1894.

The Hours of Observation are of Greenwich Time.

| Days of Month | BAROMETER. 9 h. A.M. * No. | Attached Thermometer | 9 h. P.M. Barometer. No. | Attached Thermometer | SELF-REGISTERING THERMOMETERS, Read Daily, at 9 P.M. Protected in Shade, 4 feet above Ground. Max. No. | Min. No. | Exposed Black Bulbs. Max. in Sun's rays No. | Min. on Grass No. | HYGROMETER. Dry No. Wet No. 9 h. A.M. Dry bulb. | Wet bulb. | 9 h. P.M. Dry bulb. | Wet bulb. | Rain. No. of Hours in which it fell. | Amount in inches. No. | WIND. 9 h. A.M. Direction. | Force | 9 h. P.M. Direction. | Force | Readings of the H. Cup Anemometer. No. 9 h. A.M. | CLOUDS. 9 A.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | P.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | SUNSHINE. Hours. | THERMOMETERS under Ground. 9 h. A.M. No. 3 inches. | No. 12 inches. | No. 22 inches. | Temperature of WELL at depth of feet. No. | SEA. Temperature at 1 fathom, and Density. | OZONE. 0—10. 9 A.M. | 9 P.M. | GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. *Mention the hour at which Storms, including Thunder and Lightning, began and ended.* | Days of Month |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches. | ° | inches. | ° | ° | ° | ° | ° | ° | ° | ° | ° | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 29·344 | 38 | 29·322 | 52 | 56 | 50 | 56 | 48 | 52 | 51 | 52·5 | 52 | + | | S.W | | S | | 6579 | | | | | | 47 | 44 | 46 | | | 6 | 6 | | 1 |
| 2 | 29·202 | 51·5 | 29·400 | 51 | 61·5 | 47 | 71 | 39 | 54 | 52 | 50 | 48 | | | S.W | | S.W | | 6854 | | | | | | 47 | 46 | 46 | | | 7 | 5 | | 2 |
| 3 | 29·392 | 51 | 29·198 | 50 | 53 | 45 | 54 | 41 | 50·5 | 50 | 50 | 48·5 | + | | S | | S.W | | 7522 | | | | | | 47 | 47 | 47 | | | 6 | 8 | | 3 |
| 4 | 29·188 | 49·5 | 29·340 | 48 | 54 | 46 | 61 | 40 | 47 | 45 | 48·5 | 45·5 | + | ·07 | S.W | | S.W | | 8610 | | | | | | 46 | 47 | 47 | | | 5 | 5 | | 4 |
| 5 | 29·152 | 47 | 29·418 | 46 | 57 | 43 | 67 | 37 | 50 | 49 | 44 | 40 | + | | W | | W | | 9283 | | | | | | 46 | 47 | 47 | | | 6 | 7 | | 5 |
| 6 | 29·588 | 45 | 29·536 | 47 | 51 | 40 | 50 | 34 | 45 | 43·5 | 47 | 45 | | | S.W | | S.W | | 0462 | | | | | | 46 | 47 | 47 | | | 6 | 6 | | 6 |
| 7 | 29·312 | 50 | 29·052 | 48 | 53 | 46 | 55 | 40 | 50 | 48·5 | 48 | 47 | + | | S.W | | S.W | | 1199 | | | | | | 47 | 47 | 47 | | | 5 | 5 | | 7 |
| 8 | 29·014 | 44 | 29·106 | 45 | 50 | 36 | 55 | 30 | 43·5 | 41·5 | 44 | 43 | + | | N.W | | N.W | | 1561 | | | | | | 44 | 47 | 47 | | | 6 | 6 | | 8 |
| 9 | 29·196 | 41 | 29·034 | 43 | 47 | 36 | 57 | 31 | 41·5 | 40 | 42 | 40·5 | + | | N.W | | N.W | | 2342 | | | | | | 43 | 46 | 47 | | | 7 | 6 | | 9 |
| 10 | 28·996 | 40 | 28·944 | 34 | 51 | 32 | 59 | 27 | 41 | 39 | 32·5 | 32 | | | W | | W | | 2902 | | | | | | 42 | 45 | 46 | | | 6 | 7 | | 10 |
| 11 | 28·892 | 35 | 28·862 | 39 | 47 | 27·5 | 52 | 24 | 32 | 31·5 | 38 | 37 | | ·32 | N.W | | S.W | | 3142 | | | | | | 39 | 44 | 46 | | | 6 | 6 | | 11 |
| 12 | 28·780 | 37·5 | 28·944 | 40·5 | 47 | 34 | 52 | 28 | 38·5 | 38 | 41 | 40 | + | | S.W | | N.W | | 3233 | | | | | | 39 | 43 | 45 | | | 6 | 5 | | 12 |
| 13 | 29·124 | 39·5 | 28·725 | 43 | 45 | 35 | 52 | 30 | 38 | 36 | 48 | 42 | + | | N | | S | | 3722 | | | | | | 41 | 42 | 45 | | | 7 | 6 | | 13 |
| 14 | 28·508 | 39 | 28·564 | 37·5 | 49 | 32 | 59 | 25 | 37·5 | 36·5 | 35·5 | 34 | | | W | | S.W | | 4723 | | | | | | 41 | 42 | 45 | | | 6 | 5 | | 14 |
| 15 | 28·804 | 36 | 28·980 | 36 | 45 | 30 | 48 | 22·5 | 38 | 36 | 35 | 33·5 | | | S | | S.W | | 5071 | | | | | | 37 | 41 | 44 | | | 5 | 6 | | 15 |
| 16 | 29·254 | 37·5 | 29·464 | 39 | 46 | 30 | 57 | 25 | 39 | 37 | 39 | 37·5 | | | S | | S | | 5546 | | | | | | 37 | 41 | 44 | | | 6 | 5 | | 16 |
| 17 | 29·528 | 45 | 29·682 | 48 | 50 | 37 | 49 | 31 | 47 | 44·5 | 50 | 47·5 | | | S | | S | | 6241 | | | | | | 42 | 41 | 44 | | | 6 | 7 | | 17 |
| 18 | 29·816 | 46 | 29·748 | 46 | 50 | 44 | 49 | 38 | 46 | 44 | 46·5 | 45 | + | ·27 | S.W | | S.W | | 7375 | | | | | | 42 | 41 | 43 | | | 4 | 7 | | 18 |
| 19 | 29·748 | 43 | 29·744 | 45 | 49·5 | 40 | 60 | 33 | 43·5 | 43·5 | 45 | 44 | | | S.W | | S.W | | 7440 | | | | | | 43 | 43 | 43 | | | 6 | 5 | | 19 |
| 20 | 29·534 | 48 | 29·692 | 38 | 57 | 34 | 54 | 27 | 49 | 48 | 35 | 33·5 | + | | S.W | | W | | 8469 | | | | | | 43 | 43 | 43 | | | 5 | 7 | | 20 |
| 21 | 29·886 | 38 | 29·770 | 43 | 44·5 | 31 | 43 | 24 | 37 | 35 | 44·5 | 42 | + | | W | | S.W | | 9062 | | | | | | 39 | 43 | 43 | | | 6 | 8 | | 21 |
| 22 | 29·696 | 48 | 29·818 | 44 | 53 | 41 | 51 | 32 | 50 | 47 | 45 | 41·5 | | | S.W | | S.W | | 9799 | | | | | | 43 | 42 | 43 | | | 5 | 5 | | 22 |
| 23 | 29·916 | 37·5 | 30·116 | 35 | 49 | 28 | 50 | 22 | 34 | 33 | 29·5 | 29·5 | | | N.E | | E | | 6530 | | | | | | 39 | 42 | 43 | | | 6 | 5 | Fog. Great display of Aurora from 6.30 to 9.30 P.M. | 23 |
| 24 | 30·260 | 32 | 30·266 | 32 | 41·5 | 25 | 39 | 19·5 | 27·5 | 27 | 28·5 | 28·5 | | | W | | S.W | | 0554 | | | | | | 36 | 42 | 43 | | | 6 | 4 | Fog | 24 |
| 25 | 30·240 | 33·5 | 30·228 | 40 | 42·5 | 26 | 41 | 23 | 32 | 31·5 | 42 | 41 | | ·38 | S.W | | S.E | | 0565 | | | | | | 35 | 41 | 43 | | | 4 | 5 | | 25 |
| 26 | 30·196 | 43 | 30·232 | 35 | 44 | 30 | 44·5 | 24 | 43 | 41·5 | 30·5 | 30 | | | S | | S | | 0657 | | | | | | 39 | 40 | 42 | | | 4 | 6 | | 26 |
| 27 | 30·170 | 32 | 30·024 | 38 | 41 | 23 | 39·5 | 19 | 30 | 29·5 | 33 | 32 | | | S | | S.W | | 0763 | | | | | | 35 | 40 | 42 | | | 4 | 5 | | 27 |
| 28 | 30·004 | 39·5 | 29·862 | 45 | 50 | 36 | 49 | 32 | 40 | 39 | 47·5 | 45 | | | S.W | | W | | 0887 | | | | | | 37 | 39 | 42 | | | 6 | 5 | | 28 |
| 29 | 29·778 | 46 | 29·986 | 42 | 52 | 40 | 51 | 33 | 47 | 45 | 42 | 38·5 | | | W | | N.W | | 1661 | | | | | | 41 | 41 | 42 | | | 5 | 5 | | 29 |
| 30 | 30·174 | 43 | 30·186 | 34 | 46·5 | 31 | 48 | 25 | 42 | 40·5 | 33 | 32·5 | | | N.W | | W | | 3012 | | | | | | 41 | 41 | 42 | | | 5 | 5 | | 30 |
| 31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 31 |
| Sums. | 884·892 | 1268·6 | 885·243 | 1266·9 | 1487·27 | 1077·16 | 1567·6 | 934·0 | 1265·6 | 1223·2 | 1242·4 | 1196·28 | | 1·04 | | | | | | | | | | | 1244·11 | 1295·9 | 1334·13 | | | 168·5·6 | 173·5·8 | | |
| Means. | 29·490 | 42·3 | 29·508 | 42·2 | 49·3 | 35·6 | 52·2 | 30·1 | 42·2 | 40·8 | 41·4 | 39·5 | 12 | 1·04 | | | | | | | | | | | 41·5 | 43·2 | 44·5 | | | | | | | |
| † Total Corrections for Instrumental Errors. | +·070 | | +·070 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ‡ Corrections for Diurnal Range. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "Corrected Means." | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. of Column. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | | |

## NOTATION USED IN GENERAL REMARKS.

| | | | |
|---|---|---|---|
| a. | *denotes* aurora. | m. | *enotes* meteor. |
| ci. | ,, cirrus. | ms. | ,, meteors. |
| ci.-cu. | ,, cirro-cumulus. | n. | ,, nimbus. |
| ci.-s. | ,, cirro-stratus. | r. | ,, rain. |
| cu. | ,, cumulus. | h. r. | ,, heavy rain. |
| cu.-s. | ,, cumulo-stratus. | c. h. r. | ,, continued heavy rain. |
| d. | ,, dew. | s. | ,, stratus. |
| f. | ,, fog. | sc. | ,, scud. |
| fr. | ,, frost. | s. | ,, sleet. |
| h.-fr. | ,, hoar-frost. | s. | ,, snow. |
| h. | ,, haze. | so. ha. | ,, solar halo. |
| h. d. | ,, heavy dew. | sq. | ,, squall. |
| hl. | ,, hail. | sqs. | ,, squalls. |
| l. | ,, lightning. | t. | ,, thunder. |
| li. cl. | ,, light clouds. | t. s. | ,, thunder-storm. |
| li. sh. | ,, light showers. | w. | ,, wind. |
| lu. co. | ,, lunar corona. | g. | ,, gale of wind. |
| lu. ha. | ,, lunar halo. | | |

## TABLE FOR ESTIMATING FORCE OF WIND.

| Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. |
|---|---|---|---|---|---|
| 0 | Calm | 1·5 | Light breeze | 4 | Blowing hard |
| 0·5 | Very light air | 2· | Fresh breeze | 5 | Blowing a gale |
| 1· | Light air | 3· | Very fresh | 6 | Violent gale |

**BAROMETER**, "corrected Mean" at 9 A.M., *minus* the Correction †† for Temp. (Col. 2), = 29·490 − 36 = 29·454

"Corrected Mean" of Barometer at 9 P.M., *minus* the Correction †† for Temp. (Col. 4), = 29·508 − 36 = 29·472

**Mean at Station, corrected, and at 32°**, ..... = 29·533 (+·070)

Correction for height, 200 feet above Mean Sea-level, ..... = 29·733

**Mean, reduced to 32°, and Sea-level**, ..... = 29·733

Highest Reading, corrected for Index error, on the 24 th, ..... = 30·266

Lowest Do. Do., on the 14 th, ..... = 28·508

Difference, or **Monthly Range**, ..... = 1·758

* Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S."; and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.
† Embracing corrections for both capillarity and Index Errors
‡ The Diurnal Range for Scotland is as yet unknown.
†† *Practically*, though not *absolutely* a *minus* correction.
‡‡ These "Hygrometrical Deductions" are calculated from Glaisher's Hygrometrical Tables, Second Edition *only*.
** While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature."
Any observations not taken under the Conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. *See over.*

**S.-R. THERMOMETER**, (in shade, etc.), **Highest in Month**, (corrected for Index Errors), on the 2 th, ..... = 61·5

**Lowest in Month**, corrected for Index errors, on the 24 th, ..... = 25·0

Difference, or **Monthly Range**, ..... = 36·5

"Corrected **Mean**" **of all the Highest**, (Col. 5), ..... = 49·3

"Corrected **Mean**" **of all the Lowest**, (Col. 6), ..... = 35·6

Difference, or **Mean Daily Range**, ..... = 13·7

** Calculated **Mean Temperature** of Month, ..... = 42·5

**S.-R. THERMOMETER, Black Bulb in Sun, Highest**, (corrected for Index Errors), on the 2 th, ..... = 71·0

"Corrected **Mean**," (Col. 7), **of Black Bulb, Max. in Sun**, ..... = 49·3

**Lowest at Night**, Black Bulb (corrected for Index errors), on the 27 th, = 19·0

"Corrected **Mean**," (Col. 8), **of Black Bulb, Min.** on grass, ..... = 35·6

Difference of above means or range ("exposed"), ..... =

**HYGROMETER, Mean** (corrected) A.M. and P.M. Reading **of Dry Bulb**, (Cols. 9 and 11), ..... = 41·8

**Mean** (corrected) A.M. and P.M. Reading **of Wet Bulb**, (Cols. 10 and 12), ..... = 40·2

‡‡ Computed **Temperature of Dew-Point**, ..... = 38·2

‡‡ Do. **Elastic Force of Vapour**, ..... = 231

‡‡ Do. **Weight of Vapour in a Cubic Foot of Air**, =

‡‡ **Relative Humidity** (Saturation = 100), ..... = 88

**RAIN** fell on 12 **Days; Amount in Inches**, ..... = 1·04

**WIND.** SUMMARY.

| Direction. | N | NE | E | SE | S | SW | W | NW | Calm or Variable. | Mean Force. | Mean Velocity in miles per day. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. | 1 | 1 | | | 6 | 12 | 6 | 4 | | | |
| P.M | | | 1 | 1 | 5 | 14 | 5 | 4 | | | |
| Mean. | 0 | 1 | 1 | 1 | 5 | 13 | 5 | 4 | 6 | | |

*Observations made and Return verified by* John Forrest

(*Signed*) .....

# INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS,

## WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the chief objects that the SCOTTISH METEOROLOGICAL SOCIETY proposed to itself when the Society was established in 1855, was to secure PERFECT UNIFORMITY in the system of observation pursued at all its Stations. Uniformity in the observations is absolutely necessary to justify the publication of Monthly Results from different observations, it being found that differences between the Returns from two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those who kindly furnish Reports to the Society will, by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

**Hour of Observation.**

The Council recommend that Observations be made precisely at 9 A.M. and 9 P.M. (Greenwich or Railway Time only), as specified in the following remarks, or at the top of the columns of the Schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading the time at which it was taken, if not at 9 A.M. or 9 P.M.

**Barometer.**

Weather-Glasses and Aneroids, though well suited to indicate roughly variations of atmospheric pressure, are not fitted for scientific purposes. No Barometer should be used for Meteorological Observation that is not supplied with some means of adjustment or compensation which will secure that the height of the mercury in the tube is accurately measured from the fluctuating surface of the mercury in the cistern.

The Barometer in which the error arising from the fluctuating surface of the mercury in the cistern is entirely got rid of is FORTIN'S Barometer, the arrangement consisting in applying pressure by means of a screw to the bottom of the cistern, which is made of flexible leather, thus raising or depressing the surface till it just meets the ivory point which forms the zero point of the fixed scale.

The Barometer originally constructed by Mr. Adie of London, and usually called the Board of Trade Barometer, has the great convenience of requiring no adjustment of the cistern. Its scale-inches are not true inches, but so much shorter as to compensate the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This is an excellent Barometer for ordinary Observers, inasmuch as it entirely eliminates the error of observation likely to arise in not a few cases in setting the instrument to the zero point of the fixed scale when the light is not good. To show the accuracy with which these Barometers are made, it may be stated, that one was compared, during a whole year, with the Society's Standard Barometer, particular care being given to make the comparison when atmospheric pressure was rising or falling very rapidly, with the result that none of the readings differed from those of the Standard more than 0·003 inch.

A modification of Fortin's Barometer is used at a number of the Society's Stations, by which the coincidence of the zero point with the surface of the mercury is indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the index-line on this little piston-rod is brought, by the adjusting screw, to form one straight line with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this preliminary setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the vernier.

It is absolutely necessary that the Barometer which is to be used shall have been compared with a Standard Barometer.

The Barometer should be suspended in as good a light as can be secured, and to facilitate the reading, a piece of white paper may be put behind the tube. It must be hung truly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire, and must not be hung against a wall heated by a flue. The object being to secure that the whole instrument, including the brass fittings, the contained mercury, and the attached Thermometer, shall be, when read, at one uniform temperature, it is evident that the best position is that which is least liable to sudden changes of temperature.

In taking an Observation, the Attached Thermometer is first noted: the tube must then be gently tapped, and the cistern-adjustment carefully made. The eye, by raising and lowering it, must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted so as to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will facilitate an accurate adjustment and reading of the Barometer. A mistake not unfrequently made by those beginning to observe, consisting in setting the edge of the vernier to the level of the clear surface of the mercury which is in direct contact with the glass tube, must be carefully avoided.

The errors most frequently made in reading the Barometer are errors of 1·000 inch, 0·500 inch, and 0·050 inch; that is to say, instead of 29·365 inches, either of the following is sometimes set down—viz. as 30·365 inches, 28·365 inches, 29·865 inches, or 29·815 inches. Experience having shown that even the very best Observers make these mistakes, particular attention is directed to the matter.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must first be screwed so as to form a tight plug to the cistern, thus preventing the escape of the mercury. Then screw up the mercury not quite to the top of the tube, but to within a quarter of an inch of it, and take down the instrument; it should then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case if, on inclining the instrument, a sharp tap is produced when the mercury strikes the top of the tube. If a dull tap is heard, there is air in the tube, which must be got rid of.

As Barometers are liable to be deranged by the introduction of air into their tubes, on removal from place to place, or in being roughly handled, it may be useful to Observers to know how the air may be expelled. First close up the cistern by screwing the ivory peg tight, so as to prevent the escape of mercury; then screw up the mercury to about half an inch from the top of the tube; and having slowly inverted the instrument, place the top of it on a yielding substance, such as the boot, and gently tap on the cistern with the palm of the hand, so as to induce the air to ascend through the column to the cistern, whence it may escape. Since there is the weight of two atmospheres—the pressure of the mercury in the Barometer, and the air outside—pressing on any air that may be inside the tube, it is usually a tedious operation to get it wholly expelled. After repeated trials, however, it is generally accomplished; and the clear metallic sound of the mercury, when gently struck against the top of the glass tube, will show when the whole of the air has been expelled. On hanging up the Barometer, care must be taken to screw down the mercury in the tube before unfastening the float of the cistern, for, if this be not attended to, the mercury will flow out, and the instrument be seriously damaged.

**Protection and Position of Thermometers.**

The Council of the Society recommend that the Self-Registering Thermometers, and the Dry and Wet Bulb Hygrometer, be kept in Stevenson's Louvre-boarded Box for Thermometers, painted white inside and outside, and screwed to four stout posts, also painted white, firmly fixed in the ground. The posts must be of such a length that when the Thermometers are hung in position the Bulbs of the Minimum Thermometer, and of the Dry and Wet Bulb Thermometers, will be exactly at the same height of FOUR FEET above the ground, the Maximum Thermometer being hung immediately above the Minimum Thermometer. The Thermometer Box is to be placed over a plot of grass, and in a free open space to which the sun's rays have free access during as much of the day as surrounding conditions enable the Observer to secure. The Thermometers are suspended on cross-laths in the centre of the Box, and face the door, which should open to the north.

The Council regard the question of UNIFORMITY OF HEIGHT ABOVE GROUND, AND METHOD IN PROTECTING THE THERMOMETERS, as vital in every system of Meteorological Observation, since without it Observations made at different Stations are incomparable, thus rendering it impossible to compare the Climates of places with each other as regards their most important features.

**Self-Registering Thermometers.**

Professor Phillips, and Negretti and Zambra's Maximum Thermometers, and Rutherford's Minimum Thermometer, are recommended. It is recommended that these Thermometers be graduated on the glass stem. The Minimum Thermometer is liable to two derangements—viz., the column of spirit breaking, and part of the spirit distilling by high temperature and lodging at the top of the tube. This derangement is of occasional occurrence with protected Thermometers, but of frequent occurrence with exposed Thermometers. Hence a systematic examination of Minimum Thermometers ought to be a regular part of the work carried on by each Observer.

Fortunately, Spirit Thermometers may be easily set right by any one, when the column of spirit chances to separate. Let the Thermometer be taken in the hand by the end farthest from the bulb, raised above the head, and then forcibly swung down towards the feet; the object being, on the principle of centrifugal force, to send down the detached portion of spirit till it unites with the column. A few throws, or swinging strokes, will generally be sufficient for the purpose; after which the Thermometer should be placed in a slanting position, to allow the rest of the spirit still adhering to the sides of the tube to drain down to the column. But another method must be adopted, if the portion of spirit in the top of the tube be small. Heat should be applied slowly and cautiously to the top end of the tube where the detached portion of spirit is, which, being turned into vapour by the heat, will condense on the surface of the unbroken column of spirit. Care must be taken that the heat is not applied too quickly; for, if this be done, the tube will break and the instrument be destroyed. The best way to apply the requisite amount of heat is by bringing the end of the tube slowly down towards a minute flame from a gas-burner; or, if gas be not at hand, a piece of heated metal will serve instead.

**Black-Bulb Thermometers.**

The bulbs of the Thermometers for registering the greatest heat from the sun's rays, and the least from radiation during night, have a black coating, which may easily be made, or mended, by the application of a mixture of lampblack and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind, The Maximum should be freely exposed to the sun, and the Minimum should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation. Black-bulbs enclosed in 'glass jackets' may also be used, being indeed preferable to the above. It must, however, be added, that the whole subject of the observation of Solar and Terrestrial Radiation is not yet in a sufficiently advanced state to warrant the exclusive recommendation of any one of these methods.

**Dry and Wet Bulb Hygrometer.**

The Hygrometer in use at the Society's Stations consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved form of this apparatus seriously vitiate the Hygrometrical Observations, Observers are specially requested to attend to the following conditions:—The bulbs must hang down by at least an inch free from the scales and frame to which they are attached; the frame must be such as will bring the tubes forward by an inch from any board on which it may be suspended; the water-cup must be covered, and altogether placed to the side, and a little below the level of the wet bulb, but in no case under the bulbs; the muslin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the Observer that the muslin is always clean and moist, and the water pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

**Reading of the Thermometer.**

In reading the Thermometer great care must be taken to bring the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40$\frac{1}{4}$°, respectively. So also 40$\frac{1}{2}$°; and 40$\frac{3}{4}$°, more or less, must be registered 40°·2, or 40°·3, and 40°·7, or 40°·8 respectively. In reading Rutherford's Minimum Thermometer, the indication of that end of the index which is next the surface of the spirit is alone noted. On opening the Thermometer Box, the Dry and Wet Bulb Thermometers are to be first, and rapidly, read, inasmuch as they are readily affected by heat from the person of the Observer.

**Hour of observing Temperature.**

The Hygrometer is read at 9 A.M. and 9 P.M. The Self-Registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the Self-Registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 3d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

**Verification of Thermometers.**

No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a standard Thermometer. When such Thermometers as are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being re-tested. The Self-Registering, especially the Minimum Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer, marked by a scratch on the tube, ought to be tested once a year, in snow or melting ice.

In selecting instruments, the following points require attention:—The divisions of the vernier of Barometers in reference to their scales, and the perfect freedom of the Barometer from air; the correct numbering of the scale of every instrument; the rejection of Thermometers the frameworks of which are not likely to stand exposure to the weather, as shown in the past by repeated and annoying breakages of Thermometers of similar construction; and as regards Maximum Thermometers, either Negretti and Zambra's, or Phillip's, whether they will act at the highest temperatures they may be required to register. By the laws of the Society, Members and Observers have a right to have their instruments compared by the Secretary, and to advise with him regarding the purchase of instruments.

**Wind.**

Very great care should be bestowed on the Observations of the Wind, the accuracy of which, both as regards Direction and Force, is so essential towards the right discussion of many of the more important problems of the science.

**1. As regards Direction.**

A Wind-Vane ought to be elevated at least 12 feet above surrounding objects. When it oscillates incessantly, the mean direction should be taken. In all cases, but especially when the Vane is stationary, and when the wind is feeble, reference may be made to the direction of smoke, etc., in well-exposed situations. Careful observations are recommended to be made on the changes in the direction of the wind; and during storms, extra observations at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, is likely to give highly valuable and important results, particularly in connection with the system of thickly-planted Stations over a limited district round Edinburgh called STORM STATIONS, in the course of being established by the Society for the systematic investigation of the relation of the force of the wind to BAROMETRIC GRADIENTS, and other points connected with storms.

**2. As regards Velocity and Pressure.**

The Council would recommend the Hemispherical Cup Anemometer,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the mean Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, the Pressure Anemometers recently brought under the notice of the Society by Mr. T. Stevenson, the Honorary Secretary, and Mr. R. Ballingall, the Society's Observer at Eallabus, are recommended as likely to secure uniformity in making observations on the Force of the Wind.

**Rain Gauges.**

Many causes conspire to produce anomalies in Rain Returns, arising partly from the difficulty of obtaining a perfectly unobjectionable situation for observation, and partly from the defective nature of the instruments used. The Rain Gauge should not be placed on a slope or terrace, but on a level piece of ground, in as open a situation as the Observer can secure for it. As it is often difficult to obtain a position as free and unobstructed by surrounding objects as is desirable, care should be taken to place it at some distance from shrubs, trees, buildings, or other obstructions, at least as many feet from their base as they are in height. The more important directions, towards which it is most desirable to have a free exposure, are, in the order of their importance, S.W., N.E., S.E., S., and W. The rim of the gauge must be perfectly level, and fixed so that it will remain level in all weathers, and be at a height of one foot above ground, over grass. In such gauges as Fleming's, which are furnished with a measuring-rod attached to a float, the rod ought to be fixed down, and the float rise to its height only at the time the instrument is read, it being found that a stem projecting above the rim of the gauge seriously interferes with the proper measurement of the Rainfall. When a measuring-glass is used, care should be taken to hold it quite perpendicular. The Rain Gauge ought to be read daily at 9 A.M., and the reading entered in the Returns of the previous day. If the Gauge is read once a month, the reading is to be made on the first of the month, and the amount entered for the previous month.

**Snow-falls.**

Snow-falls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs, it should be noted in the 'Remarks,' and the letter S affixed to the depth of water received in Gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the Rain Gauge. For wind, rain, and snow, as indeed in every column, the Observer cannot be too careful to register observations only; and nothing that partakes of the nature of deduction or inference.

**Clouds.**

Convenient abbreviations for the nomenclature of Clouds will be found on the other side. The amount of Cloud ought to be estimated from the greater or less obscuration of the sky overhead (*i.e.* within 20° or 30° of the zenith). The strata of Clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the Clouds' column, though their appearance and changes may be noted among the Remarks. The amount of Cloud is entered from a scale of 0 to 10; thus, when the sky overhead is free from Clouds it is entered 0, when half-covered by Clouds, 5, wholly covered, 10, and so on.

Observations of the Clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—Thus, in the column Velocity and Direction, 6, S. W.

——— will indicate that the upper strata of Clouds travel with
2, W.

extreme velocity from S.W., and those in the lower regions from W., with one-third the speed of the former. Again, in the second

4, st.
column, an entry of ——— will indicate that the higher
2, cu-st.

regions are covered to the amount of 4-tenths with stratus Clouds; and that the sky is further obscured to the extent of 2-tenths by lower Clouds of the cumulo stratus kind.

Remarks on peculiar Clouds, accompanied with drawings, will assist materially in the development of a more exact nomenclature of Clouds, as well as throw light on the electrical, and other of the more obscure phenomena of Meteorology.

**Sunshine.**

The approximate number of Hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

**Underground Thermometers.**

As the germination and growth of crops and plants generally depend greatly on the temperature of the soil,—its amount and constancy,—the Council recommend that Observations in this interesting department be made at 9 A.M., by Thermometers permanently fixed in the soil, their bulbs being sunk to depths of 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames.

**Temperature of the Sea.**

A knowledge of the Temperature of the Sea is not only in itself, but in its relations to that of our island, a most important branch of Meteorology. The Council therefore recommend that the Temperature of the Sea be carefully taken by a properly constructed apparatus, from boats, or, if this be impracticable, from the ends of piers and rocks round the coast, where it is not influenced by that of river water, and as little influenced as possible by currents sweeping along the coast, and thus acquiring the temperature of the land, either greatly heated by the sun or cooled by nocturnal radiation. At or near the time of high water, in cases where the observations cannot be taken daily, the observation may be made on the 5th, 15th, and 25th of each month. When convenient, extra Sea Observations might be taken for other and greater depths, noting always the Temperature of the Air, and the Hour of Observation. It is also very desirable that observations on the daily Maxima and Minima by Thermometers continuously immersed, be instituted at points along the coast, by the method proposed by Mr. T. Stevenson, and already commenced at Peterhead and Liverpool.

**Temperature of Wells.**

The Temperature of the water at the bottom of Wells ought, when practicable, to be taken, both the depth of the Well and of the water being noted.

**Ozone.**

Mention what Test-Papers are used, Schönbein's or Moffat's, etc. The Paper is affixed by a pin to a board in the Thermometer Box, and the indications registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus $3^{N.W.}_{\frac{1}{2}}$, as an Ozone entry in the schedule will indicate that the Ozone paper is tinted as 3 on the scale, that the wind is from the N.W., and that its force on the scale 0—5 is 4, or blowing fresh.

**Atmospheric Electricity.**

Too much importance cannot be attached to the electric condition of the atmosphere in connection with terrestrial magnetism, barometrical, thermometrical, and meteorological phenomena generally. A proper Electrometer is, in truth, necessary to every complete meteorological observatory.

**Remarks.**

The Remarks column is unavoidably too narrow. Some of the most valuable Observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are in general use is given at the foot of the column. Besides special and extraordinary Observations, great prominence ought to be given in this column to Prevalent Diseases, differences in character, colour, velocity, and direction between the Lower and Upper Strata of clouds, the Colour of the Sky, etc. Remarks ought to be made on the occurrence of Meteors, Auroræ Boreales, remarkable depressions, elevations, and fluctuations of the Barometer, Thunder-Storms, and remarkable falls of Snow, Hail, or Rain, the Hour of Storms of Wind commencing, attaining their maximum, and ending, as well as such Notes on Storms as have been hinted at above. When lofty hills are in the vicinity of a Station, the Height of Clouds and of the Snow-line in winter should be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. should be registered, either in two columns, otherwise unoccupied, or ruled off for the purpose, from the column of 'Remarks.'

**Observations in connection with the Periodic Return of the Seasons.**

Observations in connection with the Periodic Return of the Seasons, possess not only great scientific value, but are of considerable importance in connection with Agriculture, Horticulture, and Natural History. The Council would direct the special attention of Observers to the registration of such phenomena, so that the published Summaries may fairly represent the whole of Scotland. Observations ought to be confined to individual trees and shrubs; to particular species of birds, and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm. The Annual Table, published yearly in the Society's Journal, will indicate the species of plants and animals to which special attention is more particularly directed.

The Council recommend Observers, before purchasing new instruments, and in repairing old ones, to communicate with the Meteorological Secretary, in order that every instrument may be examined and improved before being used; and they consider it necessary that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, *December* 1891.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

| FOREST TREES. | In Flower. | Leaf Buds first Appear. | In Leaf. | Directed of Leaves. |
|---|---|---|---|---|
| Alder, | | | | |
| Ash, | | | | |
| Beech, | | | | |
| Birch, | | | | |
| Elm, | | | | |
| Larch, | | | | |
| Lime, | | | | |
| Oak, | | | | |
| Sycamore or Plane, | | | | |

| SHRUBS, ETC. | First in Blossom. |
|---|---|
| Barberry, | |
| Bourtree or Elder, | |
| Broom, | |
| Hazel, | |
| Hawthorn, | |
| Holly, | |
| Laburnum, | |
| Lilac, | |
| Mezereon, | |
| Mountain Ash or Rowan, | |
| Red Flowering Currant, | |
| Rhododendron Ponticum, | |
| Whin, | |

| FRUITS. | First in Blossom. | Fruit Ripe, generally. |
|---|---|---|
| Apple, | | |
| Black Currant, | | |
| Cherry, | | |
| Gean, | | |
| Gooseberry, | | |
| Peach, | | |
| Pear, | | |
| Plum, | | |
| Strawberry, | | |

| CROPS, mentioning variety. | Sowing or Planting. | Appearing above Ground. | In Ear or Flower. | First Cut or Raised. |
|---|---|---|---|---|
| Barley, | | | | |
| Bere or Bigg, | | | | |
| Oats, | | | | |
| Wheat, | | | | |
| Beans, | | | | |
| Peas, | | | | |
| Potatoes, | | | | |
| Turnips, | | | | |
| Rye Grass, | | | | |

| MIGRATORY BIRDS. | First Arrival. | Departure. |
|---|---|---|
| Cuckoo, | | |
| Curlew, | | |
| House-Swallow, | | |
| Lapwing, | | |
| Plover, | | |
| Sand-Martin, | | |
| Starling, | | |
| Swan, | | |
| Rail or Corn Crake, | | |

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

To the SECRETARY
Scottish Meteorological Society,
122 George Street,
EDINBURGH.

BOOK POST.

Haddo House
Nov 1894

# SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Haddo House, County of Aberdeen, in Lat. 57° 24', Long. 2° 14', Distance from Sea 12 miles.

Height of Cistern of the Barometer above Mean Sea-Level 180 feet, above Ground 3 feet. During the MONTH of December 1894.

The Hours of Observation are of Greenwich Time.

× Note Mc Forrest explains that the sun never reaches the thermometer during the months of December and January owing to high trees on south side. Gill. 1.1.95.

† Owing to its situation the anemometer is not reliable

| Days of Month. | BAROMETER. 9 h. A.M. Barometer. No. | Attached Thermometer | 9 h. P.M. Barometer. No. | Attached Thermometer | SELF-REGISTERING THERMOMETERS, Read Daily, at 9 P.M. Protected in Shade, 4 feet above Ground. Max. No. | Min. No. | Exposed Black Bulbs. Max. in Sun's rays × No. | Min. on Grass. No. | HYGROMETER. Dry No.___ Wet No.___ 9 h. A.M. Dry bulb. | Wet bulb. | 9 h. P.M. Dry bulb. | Wet bulb. | Rain. No. of days in which it fell. | Amount in inches. No. | WIND. 9 h. A.M. Direction. | Force | 9 h. P.M. Direction. | Force | Readings of the H. Cup Anemometer. No. 9 h. A.M. † | CLOUDS. 9 A.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | P.M. Velocity (0—6) and Direction. | Amount (0—10), and Species. | SUNSHINE. Hours. | THERMOMETERS under Ground. 9 h. A.M. No. 3 inches. | No. 12 inches. | No. 22 inches. | Temperature of WELL at depth of feet, No. | SEA. Temperature at 1 fathom, and Density. | OZONE. 0—10. 9 A.M. | 9 P.M. | GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. *Mention the hour at which Storms, including Thunder and Lightning, began and ended.* | Days of Month. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | inches. | ° | inches. | ° | ° | ° | ° | ° | ° | ° | ° | ° | | | | | | | | | | | | | | | ° | ° | | | | | | |
| 1 | 30·134 | 33 | 30·116 | 37 | 42·5 | 26 | 38 | 22 | 29 | 32 | 38 | 36·5 | | | W | | W | | 3242 | | | | | | 35 | 40 | 42 | | | 5 | 6 | | 1 |
| 2 | 30·066 | 30 | 29·988 | 30 | 39 | 24 | 35 | 19 | 25 | 25 | 26 | 25·5 | | | W | | W | | 3480 | | | | | | 34 | 39 | 42 | | | 6 | 4 | | 2 |
| 3 | 29·856 | 38 | 29·748 | 38·5 | 40 | 25·5 | 39 | 19 | 38 | 38 | 40 | 29·5 | | | S | | S | | 3542 | | | | | | 36 | 38 | 42 | | | 5 | 5 | Fog | 3 |
| 4 | 29·658 | 42 | 29·606 | 42 | 43 | 39 | 42 | 37·5 | 42 | 40 | 43 | 41·5 | | | S | | S | | 3898 | | | | | | 39 | 38 | 41 | | | 6 | 5 | | 4 |
| 5 | 29·636 | 39 | 29·664 | 39 | 43 | 37 | 41 | 33 | 36 | 35·5 | 37 | 37 | × | | S | | S.W | | 4110 | | | | | | 39 | 39 | 41 | | | 6 | 5 | Fog | 5 |
| 6 | 29·614 | 34 | 29·538 | 34 | 35 | 29 | 43 | 24·5 | 30 | 32 | 31 | 30·5 | | | S.W | | W | | 4127 | | | | | | 37 | 39 | 41 | | | 5 | 4 | Fog | 6 |
| 7 | 29·436 | 32 | 29·298 | 38 | 44 | 24 | 42 | 21 | 32·5 | 31·5 | 37 | 36·5 | × | | S | | S.W | | 4128 | | | | | | 34 | 39 | 41 | | | 6 | 6 | | 7 |
| 8 | 29·588 | 37·5 | 29·752 | 33 | 41 | 28 | 44 | 20 | 36·5 | 35 | 28·5 | 28 | | | W | | W | | 4742 | | | | | | 37 | 39 | 41 | | | 5 | 5 | | 8 |
| 9 | 29·776 | 31 | 29·646 | 39·5 | 42 | 22 | 39·5 | 18 | 27 | 26·5 | 42 | 40 | × | 1·18 | S.W | | S | | 4956 | | | | | | 34 | 38 | 41 | | | 6 | 6 | | 9 |
| 10 | 29·458 | 44 | 29·624 | 45 | 50 | 38 | 48·5 | 30 | 47 | 46 | 45 | 44·5 | × | | S | | S.W | | 5824 | | | | | | 39 | 38 | 41 | | | 5 | 6 | | 10 |
| 11 | 29·568 | 46 | 29·558 | 47 | 50 | 32 | 50 | 27 | 48 | 47 | 47 | 45·5 | × | | S | | S | | 6187 | | | | | | 42 | 39 | 41 | | | 6 | 6 | Fog | 11 |
| 12 | 29·484 | 38·5 | 29·446 | 47 | 50 | 37 | 48 | 33 | 36 | 35 | 49·5 | 46·5 | × | | W | | S | | 6444 | | | | | | 39 | 40 | 41 | | | 5 | 6 | | 12 |
| 13 | 29·252 | 50·5 | 29·166 | 48·5 | 55 | 44 | 51 | 41 | 52·5 | 49·5 | 50 | 44 | | | S.W | | S.W | | 7438 | | | | | | 43 | 40 | 41 | | | 4 | 3 | | 13 |
| 14 | 29·588 | 41 | 29·528 | 33 | 49·5 | 25·5 | 47 | 20·5 | 38·5 | 36 | 28 | 27·5 | | | S.W | | S.W | | 0452 | | | | | | 40 | 41 | 41 | | | 5 | 6 | | 14 |
| 15 | 29·310 | 40 | 29·614 | 35 | 44 | 26 | 43 | 22 | 36·5 | 35 | 32 | 31 | | | W | | W | | 0990 | | | | | | 39 | 40 | 41 | | | 5 | 5 | | 15 |
| 16 | 29·720 | 36 | 29·864 | 33 | 35 | 29 | 34 | 23 | 34 | 32·5 | 30 | 29 | × | | N.W | | N.W | | 1832 | | | | | | 36 | 39 | 41 | | | 6 | 5 | | 16 |
| 17 | 29·488 | 36 | 29·336 | 39 | 41·5 | 37·5 | 38 | 23 | 35·5 | 35 | 41·5 | 39 | × | | S | | S.W | | 2190 | | | | | | 35 | 38 | 40 | | | 6 | 6 | | 17 |
| 18 | 28·724 | 43 | 28·734 | 37·5 | 44·5 | 34 | 44 | 29·5 | 42·5 | 41 | 37 | 34·5 | × | | S | | N.W | | 2740 | | | | | | 38 | 39 | 40 | | | 5 | 6 | | 18 |
| 19 | 28·886 | 39 | 29·336 | 41·5 | 44 | 34·5 | 44 | 29 | 39 | 37·5 | 41 | 38·5 | × | | N.W | | N.W | | 4510 | | | | | | 36 | 38 | 40 | | | 6 | 7 | | 19 |
| 20 | 29·764 | 41 | 29·698 | 34 | 43 | 29 | 41 | 23 | 40 | 38 | 32 | 31 | × | | N.W | | W | | 5205 | | | | | | 38 | 38 | 40 | | | 6 | 6 | | 20 |
| 21 | 29·528 | 39 | 29·066 | 40 | 43 | 28 | 40 | 21 | 37 | 36 | 41 | 40 | × | | W | | S.E. | | 5439 | | | | | | 36 | 38 | 40 | | | 6 | 6 | | 21 |
| 22 | 29·934 | 40·5 | 29·398 | 37·5 | 40 | 35 | 40 | 31 | 41 | 39·5 | 37 | 33 | × | | N.W | | N.W | | 6269 | | | | | | 39 | 38 | 40 | | | 6 | 8 | Hurricane | 22 |
| 23 | 29·572 | 37·5 | 29·654 | 35 | 43 | 32 | 40 | 25 | 39 | 36·5 | 33·5 | 32·5 | | 1·27 | W | | W | | 7385 | | | | | | 36 | 38 | 40 | | | 6 | 5 | | 23 |
| 24 | 29·832 | 36 | 29·946 | 34 | 37 | 29 | 37 | 24 | 35·5 | 34 | 32 | 31·5 | | | S.W | | W | | 7493 | | | | | | 35 | 38 | 40 | | | 6 | 5 | | 24 |
| 25 | 29·976 | 32·5 | 29·958 | 37 | 47 | 25 | 46·5 | 22 | 32 | 32 | 35 | 34 | | | W | | W | | 7652 | | | | | | 33 | 37 | 39 | | | 6 | 5 | | 25 |
| 26 | 30·028 | 41 | 30·134 | 38 | 42 | 33 | 41 | 29 | 42 | 40 | 37 | 35 | × | | N.W | | N.W | | 8007 | | | | | | 37 | 37 | 39 | | | 5 | 5 | | 26 |
| 27 | 30·206 | 38 | 30·300 | 35 | 40 | 32 | 37 | 25 | 39 | 37 | 32·5 | 31·5 | × | | N.W | | N.W | | 9392 | | | | | | 36 | 37 | 39 | | | 5 | 5 | | 27 |
| 28 | 29·444 | 42 | 29·788 | 34 | 50 | 36 | 46 | 33 | 42·5 | 39 | 32 | 31·5 | × | | S.W | | N.W | | 9794 | | | | | | 35 | 37 | 39 | | | 6 | 7 | | 28 |
| 29 | 28·442 | 33 | 28·796 | 32 | 36 | 29 | 34 | 35 | 32 | 31·5 | 30 | 31·5 | × | | N.W | | N | | 2387 | | | | | | 35 | 37 | 39 | | | 7 | 6 | | 29 |
| 30 | 29·042 | 33·5 | 29·328 | 31 | 36 | 28 | 35 | 25 | 29 | 31·5 | 31 | 30 | × | | N. | | N | | 3940 | | | | | | 35 | 37 | 38 | | | 6 | 6 | | 30 |
| 31 | 29·454 | 33 | 29·608 | 32 | 35 | 28 | 32 | 27 | 33 | 33 | 30·5 | 30·5 | × | 2·43 | N. | | N | | 4641 | | | | | | 35 | 37 | 38 | | | 6 | 6 | | 31 |
| Sums. | 914·454 | 1177·5 | 906·254 | 1164·0 | 1325·0 | 946·0 | 1270·5 | 802·0 | 1147·5 | 1118·0 | 1127·0 | 1087·0 | 9 | 1 | | | | | | | | | | | 1142 | 1290 | 1250 | | | 174 | 172 | | |
| Means. | 29·498 | 38·0 | 29·230 5·57 | 37·3 | 42·7 | 30·8 | 41·3 | 26·2 | 37·0 | 36·1 | 36·4 | 35·0 34·7 | | 3·88 | | | | | | | | | | | 36·8 | 41·6 | 40·3 | | | 5·6 | 5·5 | | |
| † Total Corrections for Instrumental Errors. | ×070 | | ×070 | | | | | | | | | | | | | | | | | | | | | | | | | | | 3·6 | | | |
| ‡ Corrections for Diurnal Range. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| "Corrected Means." | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. of Column. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | | | |

### NOTATION USED IN GENERAL REMARKS.

| | | | | | |
|---|---|---|---|---|---|
| a. | *denotes* aurora. | | m. | *enotes* meteor. | |
| ci. | ,, | cirrus. | ms. | ,, | meteors. |
| ci-cu. | ,, | cirro-cumulus. | n. | ,, | nimbus. |
| ci.-s. | ,, | cirro-stratus. | r. | ,, | rain. |
| cu. | ,, | cumulus. | h. r. | ,, | heavy rain. |
| cu.-s. | ,, | cumulo-stratus. | c. h. r. | ,, | continued heavy rain. |
| d. | ,, | dew. | s. | ,, | stratus. |
| f. | ,, | fog. | sc. | ,, | scud. |
| fr. | ,, | frost. | s. | ,, | sleet. |
| h.-fr. | ,, | hoar-frost. | s. | ,, | snow. |
| h. | ,, | haze. | so. ha. | ,, | solar halo. |
| h. d. | ,, | heavy dew. | sq. | ,, | squall. |
| hl. | ,, | hail. | sqs. | ,, | squalls. |
| l. | ,, | lightning. | t. | ,, | thunder. |
| li. cl. | ,, | light clouds. | t. s. | ,, | thunder-storm. |
| li. sh. | ,, | light showers. | w. | ,, | wind. |
| lu. co. | ,, | lunar corona. | g. | ,, | gale of wind. |
| lu. ha. | ,, | lunar halo. | | | |

### TABLE FOR ESTIMATING FORCE OF WIND.

| Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. | Estimated Force, 0—6. | Common Designation. |
|---|---|---|---|---|---|
| 0 | Calm | 1·5 | Light breeze | 4 | Blowing hard |
| 0·5 | Very light air | 2· | Fresh breeze | 5 | Blowing a gale |
| 1· | Light air | 3· | Very fresh | 6 | Violent gale |

**BAROMETER**, "corrected Mean" at 9 A.M., *minus* the Correction †† for Temp. (Col. 2), = 29·568 − 2·5 = 29·543

"Corrected Mean" of Barometer at 9 P.M., *minus* the Correction †† for Temp. (Col. 4), = 29·627 − 2·3 = 29·604

**Mean at Station, corrected, and at 32°**, = 29·574

Correction for height, feet above Mean Sea-level, = 203

**Mean, reduced to 32°, and Sea-level**, = 29·727

Highest Reading, corrected for Index error, on the 27th, = 30·370

Lowest Do. Do., on the 22th, = 28·004

Difference, or **Monthly Range**, = 2·366

**S.-R. THERMOMETER**, (in shade, etc.), **Highest in Month**, (corrected for Index Errors), on the 13th, = 55·0

**Lowest in Month**, corrected for Index errors, on the 9th, = 22·0

Difference, or **Monthly Range**, = 33·0

"Corrected **Mean**" of all the **Highest**, (Col. 5), = 42·7

"Corrected **Mean**" of all the **Lowest**, (Col. 6), = 30·8

Difference, or **Mean Daily Range**, = 11·9

** Calculated **Mean Temperature** of Month, = 36·8

**S.-R. THERMOMETER, Black Bulb in Sun, Highest**, (corrected for Index Errors), on the 13th, = 51·0

"Corrected **Mean**," (Col. 7), **of Black Bulb, Max. in Sun**, = 41·3

**Lowest at Night**, Black Bulb (corrected for Index errors), on the 9th, = 18·0

"Corrected **Mean**," (Col. 8), **of Black Bulb, Min.** on grass, = 26·2

Difference of above means or range ("exposed"), =

**HYGROMETER, Mean** (corrected) A.M. and P.M. Reading **of Dry Bulb**, (Cols. 9 and 11), = 36·7

**Mean** (corrected) A.M. and P.M. Reading **of Wet Bulb**, (Cols. 10 and 12), = 35·4

‡‡ Computed **Temperature of Dew-Point**, = 33·6

‡‡ Do. **Elastic Force of Vapour**, = ·193

‡‡ Do. **Weight of Vapour in a Cubic Foot of Air**, =

‡‡ **Relative Humidity (Saturation = 100)**, = 89

**RAIN** fell on 19 **Days; Amount in Inches**, = 3·88

| WIND. Direction. | SUMMARY. N | NE | E | SE | S | SW | W | NW | Calm or Variable. | Mean Force. | Mean Velocity in miles per day. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A.M. | 2 | | | | 8 | 6 | 8 | 7 | | | |
| P.M | 3 | | 1 | 1 | 5 | 6 | 8 | 7 | | | |
| Mean. | 2 | 0 | 1 | 1 | 6 | 6 | 8 | 7 | | | |

* Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S."; and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.
†† Embracing corrections for both capillarity and Index Errors
‡ The Diurnal Range for Scotland is as yet unknown.
‡‡ *Practically*, though not *absolutely* a *minus* correction.
‡‡ These "Hygrometrical Deductions" are calculated from Glaisher's Hygrometrical Tables, Second Edition *only*.
** While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature."
Any observations not taken under the Conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. *See over.*

*Observations made and Return verified by* John Forrest

(*Signed*)

# INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS,

## WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the chief objects that the SCOTTISH METEOROLOGICAL SOCIETY proposed to itself when the Society was established in 1855, was to secure PERFECT UNIFORMITY in the system of observation pursued at all its Stations. Uniformity in the observations is absolutely necessary to justify the publication of Monthly Results from different observations, it being found that differences between the Returns from two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those who kindly furnish Reports to the Society will, by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

**Hour of Observation.**

The Council recommend that Observations be made precisely at 9 A.M. and 9 P.M. (Greenwich or Railway Time only), as specified in the following remarks, or at the top of the columns of the Schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading the time at which it was taken, if not at 9 A.M. or 9 P.M.

**Barometer.**

Weather-Glasses and Aneroids, though well suited to indicate roughly variations of atmospheric pressure, are not fitted for scientific purposes. No Barometer should be used for Meteorological Observation that is not supplied with some means of adjustment or compensation which will secure that the height of the mercury in the tube is accurately measured from the fluctuating surface of the mercury in the cistern.

The Barometer in which the error arising from the fluctuating surface of the mercury in the cistern is entirely got rid of is FORTIN'S Barometer, the arrangement consisting in applying pressure by means of a screw to the bottom of the cistern, which is made of flexible leather, thus raising or depressing the surface till it just meets the ivory point which forms the zero point of the fixed scale.

The Barometer originally constructed by Mr. Adie of London, and usually called the Board of Trade Barometer, has the great convenience of requiring no adjustment of the cistern. Its scale-inches are not true inches, but so much shorter as to compensate the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This is an excellent Barometer for ordinary Observers, inasmuch as it entirely eliminates the error of observation likely to arise in not a few cases in setting the instrument to the zero point of the fixed scale when the light is not good. To show the accuracy with which these Barometers are made, it may be stated, that one was compared, during a whole year, with the Society's Standard Barometer, particular care being given to make the comparison when atmospheric pressure was rising or falling very rapidly, with the result that none of the readings differed from those of the Standard more than 0·003 inch.

A modification of Fortin's Barometer is used at a number of the Society's Stations, by which the coincidence of the zero point with the surface of the mercury is indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the index-line on this little piston-rod is brought, by the adjusting screw, to form one straight line with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this preliminary setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the vernier.

It is absolutely necessary that the Barometer which is to be used shall have been compared with a Standard Barometer.

The Barometer should be suspended in as good a light as can be secured, and to facilitate the reading, a piece of white paper may be put behind the tube. It must be hung truly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire, and must not be hung against a wall heated by a flue. The object being to secure that the whole instrument, including the brass fittings, the contained mercury, and the attached Thermometer, shall be, when read, at one uniform temperature, it is evident that the best position is that which is least liable to sudden changes of temperature.

In taking an Observation, the Attached Thermometer is first noted: the tube must then be gently tapped, and the cistern-adjustment carefully made. The eye, by raising and lowering it, must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted so as to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will facilitate an accurate adjustment and reading of the Barometer. A mistake not unfrequently made by those beginning to observe, consisting in setting the edge of the vernier to the level of the clear surface of the mercury which is in direct contact with the glass tube, must be carefully avoided.

The errors most frequently made in reading the Barometer are errors of 1·000 inch, 0·500 inch, and 0·050 inch; that is to say, instead of 29·365 inches, either of the following is sometimes set down—viz. as 30·365 inches, 28·365 inches, 29·865 inches, or 29·815 inches. Experience having shown that even the very best Observers make these mistakes, particular attention is directed to the matter.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must first be screwed so as to form a tight plug to the cistern, thus preventing the escape of the mercury. Then screw up the mercury not quite to the top of the tube, but to within a quarter of an inch of it, and take down the instrument; it should then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case if, on inclining the instrument, a sharp tap is produced when the mercury strikes the top of the tube. If a dull tap is heard, there is air in the tube, which must be got rid of.

As Barometers are liable to be deranged by the introduction of air into their tubes, on removal from place to place, or in being roughly handled, it may be useful to Observers to know how the air may be expelled. First close up the cistern by screwing the ivory peg tight, so as to prevent the escape of mercury; then screw up the mercury to about half an inch from the top of the tube; and having slowly inverted the instrument, place the top of it on a yielding substance, such as the boot, and gently tap on the cistern with the palm of the hand, so as to induce the air to ascend through the column to the cistern, whence it may escape. Since there is the weight of two atmospheres—the pressure of the mercury in the Barometer, and the air outside—pressing on any air that may be inside the tube, it is usually a tedious operation to get it wholly expelled. After repeated trials, however, it is generally accomplished; and the clear metallic sound of the mercury, when gently struck against the top of the glass tube, will show when the whole of the air has been expelled. On hanging up the Barometer, care must be taken to screw down the mercury in the tube before unfastening the float of the cistern, for, if this be not attended to, the mercury will flow out, and the instrument be seriously damaged.

**Protection and Position of Thermometers.**

The Council of the Society recommend that the Self-Registering Thermometers, and the Dry and Wet Bulb Hygrometer, be kept in Stevenson's Louvre-boarded Box for Thermometers, painted white inside and outside, and screwed to four stout posts, also painted white, firmly fixed in the ground. The posts must be of such a length that when the Thermometers are hung in position the Bulbs of the Minimum Thermometer, and of the Dry and Wet Bulb Thermometers, will be exactly at the same height of FOUR FEET above the ground, the Maximum Thermometer being hung immediately above the Minimum Thermometer. The Thermometer Box is to be placed over a plot of grass, and in a free open space to which the sun's rays have free access during as much of the day as surrounding conditions enable the Observer to secure. The Thermometers are suspended on cross-laths in the centre of the Box, and face the door, which should open to the north.

The Council regard the question of UNIFORMITY OF HEIGHT ABOVE GROUND, AND METHOD IN PROTECTING THE THERMOMETERS, as vital in every system of Meteorological Observation, since without it Observations made at different Stations are incomparable, thus rendering it impossible to compare the Climates of places with each other as regards their most important features.

**Self-Registering Thermometers.**

Professor Phillips, and Negretti and Zambra's Maximum Thermometers, and Rutherford's Minimum Thermometer, are recommended. It is recommended that these Thermometers be graduated on the glass stem. The Minimum Thermometer is liable to two derangements—viz., the column of spirit breaking, and part of the spirit distilling by high temperature and lodging at the top of the tube. This derangement is of occasional occurrence with protected Thermometers, but of frequent occurrence with exposed Thermometers. Hence a systematic examination of Minimum Thermometers ought to be a regular part of the work carried on by each Observer.

Fortunately, Spirit Thermometers may be easily set right by any one, when the column of spirit chances to separate. Let the Thermometer be taken in the hand by the end farthest from the bulb, raised above the head, and then forcibly swung down towards the feet; the object being, on the principle of centrifugal force, to send down the detached portion of spirit till it unites with the column. A few throws, or swinging strokes, will generally be sufficient for the purpose; after which the Thermometer should be placed in a slanting position, to allow the rest of the spirit still adhering to the sides of the tube to drain down to the column. But another method must be adopted, if the portion of spirit in the top of the tube be small. Heat should be applied slowly and cautiously to the top end of the tube where the detached portion of spirit is, which, being turned into vapour by the heat, will condense on the surface of the unbroken column of spirit. Care must be taken that the heat is not applied too quickly; for, if this be done, the tube will break and the instrument be destroyed. The best way to apply the requisite amount of heat is by bringing the end of the tube slowly down towards a minute flame from a gas-burner; or, if gas be not at hand, a piece of heated metal will serve instead.

**Black-Bulb Thermometers.**

The bulbs of the Thermometers for registering the greatest heat from the sun's rays, and the least from radiation during night, have a black coating, which may easily be made, or mended, by the application of a mixture of lampblack and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind, The Maximum should be freely exposed to the sun, and the Minimum should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation. Black-bulbs enclosed in 'glass jackets' may also be used, being indeed preferable to the above. It must, however, be added, that the whole subject of the observation of Solar and Terrestrial Radiation is not yet in a sufficiently advanced state to warrant the exclusive recommendation of any one of these methods.

**Dry and Wet Bulb Hygrometer.**

The Hygrometer in use at the Society's Stations consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved form of this apparatus seriously vitiate the Hygrometrical Observations, Observers are specially requested to attend to the following conditions:—The bulbs must hang down by at least an inch free from the scales and frame to which they are attached; the frame must be such as will bring the tubes forward by an inch from any board on which it may be suspended; the water-cup must be covered, and altogether placed to the side, and a little below the level of the wet bulb, but in no case under the bulbs; the muslin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the Observer that the muslin is always clean and moist, and the water pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

**Reading of the Thermometer.**

In reading the Thermometer great care must be taken to bring the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or $40\frac{1}{2}°$, respectively. So also $40\frac{1}{4}°$, and $40\frac{3}{4}°$, more or less, must be registered 40°·2, or 40°·3, and 40°·7, or 40°·8 respectively. In reading Rutherford's Minimum Thermometer, the indication of that end of the index which is next the surface of the spirit is alone noted. On opening the Thermometer Box, the Dry and Wet Bulb Thermometers are to be first, and rapidly, read, inasmuch as they are readily affected by heat from the person of the Observer.

**Hour of observing Temperature.**

The Hygrometer is read at 9 A.M. and 9 P.M. The Self-Registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the Self-Registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 3d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

**Verification of Thermometers.**

No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a standard Thermometer. When such Thermometers as are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being re-tested. The Self-Registering, especially the Minimum Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer, marked by a scratch on the tube, ought to be tested once a year, in snow or melting ice.

In selecting instruments, the following points require attention:—The divisions of the vernier of Barometers in reference to their scales, and the perfect freedom of the Barometer from air; the correct numbering of the scale of every instrument; the rejection of Thermometers the frameworks of which are not likely to stand exposure to the weather, as shown in the past by repeated and annoying breakages of Thermometers of similar construction; and as regards Maximum Thermometers, either Negretti and Zambra's, or Phillip's, whether they will act at the highest temperatures they may be required to register. By the laws of the Society, Members and Observers have a right to have their instruments compared by the Secretary, and to advise with him regarding the purchase of instruments.

**Wind.**

Very great care should be bestowed on the Observations of the Wind, the accuracy of which, both as regards Direction and Force, is so essential towards the right discussion of many of the more important problems of the science.

**1. As regards Direction.**

A Wind-Vane ought to be elevated at least 12 feet above surrounding objects. When it oscillates incessantly, the mean direction should be taken. In all cases, but especially when the Vane is stationary, and when the wind is feeble, reference may be made to the direction of smoke, etc., in well-exposed situations. Careful observations are recommended to be made on the changes in the direction of the wind; and during storms, extra observations at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, is likely to give highly valuable and important results, particularly in connection with the system of thickly-planted Stations over a limited district round Edinburgh called STORM STATIONS, in the course of being established by the Society for the systematic investigation of the relation of the force of the wind to BAROMETRIC GRADIENTS, and other points connected with storms.

**2. As regards Velocity and Pressure.**

The Council would recommend the Hemispherical Cup Anemometer,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the mean Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, the Pressure Anemometers recently brought under the notice of the Society by Mr. T. Stevenson, the Honorary Secretary, and Mr. R. Ballingall, the Society's Observer at Eallabus, are recommended as likely to secure uniformity in making observations on the Force of the Wind.

**Rain Gauges.**

Many causes conspire to produce anomalies in Rain Returns, arising partly from the difficulty of obtaining a perfectly unobjectionable situation for observation, and partly from the defective nature of the instruments used. The Rain Gauge should not be placed on a slope or terrace, but on a level piece of ground, in as open a situation as the Observer can secure for it. As it is often difficult to obtain a position as free and unobstructed by surrounding objects as is desirable, care should be taken to place it at some distance from shrubs, trees, buildings, or other obstructions, at least as many feet from their base as they are in height. The more important directions, towards which it is most desirable to have a free exposure, are, in the order of their importance, S.W., N.E., S.E., S., and W. The rim of the gauge must be perfectly level, and fixed so that it will remain level in all weathers, and be at a height of one foot above ground, over grass. In such gauges as Fleming's, which are furnished with a measuring-rod attached to a float, the rod ought to be fixed down, and the float rise to its height only at the time the instrument is read, it being found that a stem projecting above the rim of the gauge seriously interferes with the proper measurement of the Rainfall. When a measuring-glass is used, care should be taken to hold it quite perpendicular. The Rain Gauge ought to be read daily at 9 A.M., and the reading entered in the Returns of the previous day. If the Gauge is read once a month, the reading is to be made on the first of the month, and the amount entered for the previous month.

**Snow-falls.**

Snow-falls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs, it should be noted in the 'Remarks,' and the letter S affixed to the depth of water received in Gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the Rain Gauge. For wind, rain, and snow, as indeed in every column, the Observer cannot be too careful to register observations only; and nothing that partakes of the nature of deduction or inference.

**Clouds.**

Convenient abbreviations for the nomenclature of Clouds will be found on the other side. The amount of Cloud ought to be estimated from the greater or less obscuration of the sky overhead (*i.e.* within 20° or 30° of the zenith). The strata of Clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the Clouds' column, though their appearance and changes may be noted among the Remarks. The amount of Cloud is entered from a scale of 0 to 10; thus, when the sky overhead is free from Clouds it is entered 0, when half-covered by Clouds, 5, wholly covered, 10, and so on.

Observations of the Clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—Thus, in the column Velocity and Direction, 6, S. W.

$\frac{\text{2, W.}}{\text{————}}$ will indicate that the upper strata of Clouds travel with extreme velocity from S.W., and those in the lower regions from W., with one-third the speed of the former. Again, in the second Cloud column, an entry of $\frac{\text{4, st.}}{\text{2, cu-st.}}$ will indicate that the higher regions are covered to the amount of 4-tenths with stratus Clouds; and that the sky is further obscured to the extent of 2-tenths by lower Clouds of the cumulo stratus kind.

Remarks on peculiar Clouds, accompanied with drawings, will assist materially in the development of a more exact nomenclature of Clouds, as well as throw light on the electrical, and other of the more obscure phenomena of Meteorology.

**Sunshine.**

The approximate number of Hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

**Underground Thermometers.**

As the germination and growth of crops and plants generally depend greatly on the temperature of the soil,—its amount and constancy,—the Council recommend that Observations in this interesting department be made at 9 A.M., by Thermometers permanently fixed in the soil, their bulbs being sunk to depths of 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames.

**Temperature of the Sea.**

A knowledge of the Temperature of the Sea is not only in itself, but in its relations to that of our island, a most important branch of Meteorology. The Council therefore recommend that the Temperature of the Sea be carefully taken by a properly constructed apparatus, from boats, or, if this be impracticable, from the ends of piers and rocks round the coast, where it is not influenced by that of river water, and as little influenced as possible by currents sweeping along the coast, and thus acquiring the temperature of the land, either greatly heated by the sun or cooled by nocturnal radiation. At or near the time of high water, in cases where the observations cannot be taken daily, the observation may be made on the 5th, 15th, and 25th of each month. When convenient, extra Sea Observations might be taken for other and greater depths, noting always the Temperature of the Air, and the Hour of Observation. It is also very desirable that observations on the daily Maxima and Minima by Thermometers continuously immersed, be instituted at points along the coast, by the method proposed by Mr. T. Stevenson, and already commenced at Peterhead and Liverpool.

**Temperature of Wells.**

The Temperature of the water at the bottom of Wells ought, when practicable, to be taken, both the depth of the Well and of the water being noted.

**Ozone.**

Mention what Test-Papers are used, Schönbein's or Moffat's, etc. The Paper is affixed by a pin to a board in the Thermometer Box, and the indications registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus $3^{\frac{S.W.}{4}}$, as an Ozone entry in the schedule will indicate that the Ozone paper is tinted as 3 on the scale, that the wind is from the N.W., and that its force on the scale 0—5 is 4, or blowing fresh.

**Atmospheric Electricity.**

Too much importance cannot be attached to the electric condition of the atmosphere in connection with terrestrial magnetism, barometrical, thermometrical, and meteorological phenomena generally. A proper Electrometer is, in truth, necessary to every complete meteorological observatory.

**Remarks.**

The Remarks column is unavoidably too narrow. Some of the most valuable Observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are in general use is given at the foot of the column. Besides special and extraordinary Observations, great prominence ought to be given in this column to Prevalent Diseases, differences in character, colour, velocity, and direction between the Lower and Upper Strata of clouds, the Colour of the Sky, etc. Remarks ought to be made on the occurrence of Meteors, Auroræ Boreales, remarkable depressions, elevations, and fluctuations of the Barometer, Thunder-Storms, and remarkable falls of Snow, Hail, or Rain, the Hour of Storms of Wind commencing, attaining their maximum, and ending, as well as such Notes on Storms as have been hinted at above. When lofty hills are in the vicinity of a Station, the Height of Clouds and of the Snow-line in winter should be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. should be registered, either in two columns, otherwise unoccupied, or ruled off for the purpose, from the column of 'Remarks.'

**Observations in connection with the Periodic Return of the Seasons.**

Observations in connection with the Periodic Return of the Seasons, possess not only great scientific value, but are of considerable importance in connection with Agriculture, Horticulture, and Natural History. The Council would direct the special attention of Observers to the registration of such phenomena, so that the published Summaries may fairly represent the whole of Scotland. Observations ought to be confined to individual trees and shrubs; to particular species of birds, and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm. The Annual Table, published yearly in the Society's Journal, will indicate the species of plants and animals to which special attention is more particularly directed.

The Council recommend Observers, before purchasing new instruments, and in repairing old ones, to communicate with the Meteorological Secretary, in order that every instrument may be examined and improved before being used; and they consider it necessary that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, *December* 1891.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

| FOREST TREES. | In Flower. | Leaf Buds first Appear. | In Leaf. | Divested of Leaves. |
|---|---|---|---|---|
| Alder, | | | | |
| Ash, | | | | |
| Beech, | | | | |
| Birch, | | | | |
| Elm, | | | | |
| Larch, | | | | |
| Lime, | | | | |
| Oak, | | | | |
| Sycamore or Plane, | | | | |

| SHRUBS, ETC. | First in Blossom. |
|---|---|
| Barberry, | |
| Bourtree or Elder, | |
| Broom, | |
| Hazel, | |
| Hawthorn, | |
| Holly, | |
| Laburnum, | |
| Lilac, | |
| Mezereon, | |
| Mountain Ash or Rowan, | |
| Red Flowering Currant, | |
| Rhododendron Ponticum, | |
| White, | |

| FRUITS. | First in Blossom. | Fruit Ripe, generally. |
|---|---|---|
| Apple, | | |
| Black Currant, | | |
| Cherry, | | |
| Gean, | | |
| Gooseberry, | | |
| Peach, | | |
| Pear, | | |
| Plum, | | |
| Strawberry, | | |

| CROPS, mentioning variety. | Sowing or Planting. | Appearing above Ground. | In Ear or Flower. | First Cut or Thrashd. |
|---|---|---|---|---|
| Barley, | | | | |
| Bere or Bigg, | | | | |
| Oats, | | | | |
| Wheat, | | | | |
| Beans, | | | | |
| Pease, | | | | |
| Potatoes, | | | | |
| Turnips, | | | | |
| Rye Grass, | | | | |

| MIGRATORY BIRDS. | First Arrival. | Departure. |
|---|---|---|
| Cuckoo, | | |
| Curlew, | | |
| House-Swallow, | | |
| Lapwing, | | |
| Plover, | | |
| Sand-Martin, | | |
| Starling, | | |
| Swan, | | |
| Rail or Corn Crake, | | |

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

X Haddo House
Dec 1891.

To the SECRETARY
Scottish Meteorological Society,
122 George Street,
EDINBURGH.

BOOK POST.