

21/ M.O. 2

INSTRUCTIONS
FOR
METEOROLOGICAL TELEGRAPHY.
IN ACCORDANCE WITH THE INTERNATIONAL CODE.

ADOPTED AT
UTRECHT, SEPTEMBER, 1874.

[REVISED 1906.]

Issued under the Authority of the Meteorological Committee.

FOR THE USE OF OBSERVERS EXCLUSIVELY.



LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
By DARLING & SON, LTD., 34-40, BACON STREET, E.

1906.

Instructions for Meteorological Telegraphy.

The official hours of observation have been changed since this book was printed. They are now

| | | |
|--------|------------|---------|
| 7 a.m. | instead of | 8 a.m. |
| 1 p.m. | " | 2 p.m. |
| 9 p.m. | " | 10 p.m. |

The text requires correction accordingly.

~~ADD~~ ADD, on page 32:

Additional observations for climatological purposes.

In order to complete the series of observations for a full climatological table, the barometer and wet and dry bulb thermometers should be read at 9 p.m., and the wind and amount of cloud estimated.

The readings should be entered in the pocket register and transcribed in the monthly sheet for transmission to the Meteorological Office. The barometer reading at 9 p.m. should be included in the 7 a.m. telegram, see page 19.

INSTRUCTIONS
FOR
METEOROLOGICAL TELEGRAPHY.

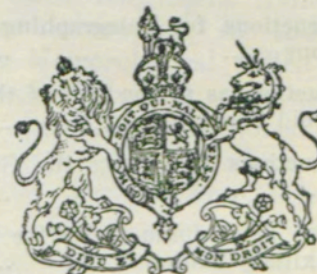
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Meteorological Telegrams.

THE reports forwarded daily, by telegraph, to the Meteorological Office consist of two parts, figures for certain observations and words.

The figures are arranged in groups of five each, in accordance with the Code approved by the International Meteorological Congress at Utrecht, in September 1874.

The words, sometimes with additional figures or letters in groups, are intended to give information which cannot properly be represented by the figures in the ordinary groups.*

The pages of this pamphlet contain detailed instructions as to the preparation of these reports; but the following general notes are of such importance that they are given at once, in order to secure from observers the utmost possible attention.

1. The observations *must* be made *punctually* and the reports sent off immediately.

2. The *time* referred to is always *Greenwich time*.

3. While *too much* time should not be occupied in "reading" the instruments, especially the thermometers, anything like hurry should be still more discouraged.

4. Any remarkable or unusual phenomena observed during the day, or any marked change of weather, should be noted briefly in words in the next report, and further details may be sent by an early post. Instructions as to the sending of special reports will be found at p. 9.

5. If from any cause telegraphic communication with London should be interrupted, so that the messages cannot arrive at the Meteorological Office by 8 p.m., they should be transmitted by the next post, *not* by wire.

6. Observers are particularly cautioned against making mistakes (*a*) of five hundredths of an inch in reading their barometers, and (*b*) of five degrees in reading their thermometers. These errors are easily made, very difficult to verify, and cause great trouble at the central Office.

7. The occurrence of very sudden changes in the barometer, thermometer, wind, or weather should always be remarked on briefly, in case they should be of a very local character, when they are liable to be looked upon as mere telegraphic errors at the central Office.

* Specimens of complete reports are given on p. 31.

8. The numbers of all the instruments in use should be carefully noted in the observer's note-book, and on the monthly schedules; and any changes in them should be immediately reported to the Meteorological Office.

The telegrams are to be addressed simply to "WEATHER LONDON." No stops of any kind are to be inserted in them.

The careful attention of *all* the observers is called to the matter on pages 27 to 32, which has been extensively revised; those who are able to make detailed observations of the movements of the Upper Clouds should study Appendix A., p. 33, while those who have a self-registering Aneroid or Sunshine Recorder should read attentively the Appendices B. and C. (pp. 36 and 39).

PART I.

Composition of the Groups in the Daily Weather Telegrams for the British Isles.

8 a.m. Reports.

The telegrams transmitted at 8 a.m. daily consist of six groups, containing five figures each, the groups being arranged in accordance with the following rules.

FIRST GROUP.

To contain the reading of the barometer, reduced to 32° F. and the mean sea level,* for 6 p.m. on the previous day, and the direction of the wind (*true*, not magnetic) at the same hour. The first figure of the barometrical reading and all decimal points are omitted, so that 29·76 is telegraphed as 976, and 30·44 as 044.

Example I.

| | | |
|------------------------|-----------|----------------|
| Barometer at 6 p.m. | = 29·76 | } Group 97622. |
| Wind direction, 6 p.m. | = W.S.W.† | |

Example II.

| | | |
|--------------------------|-----------|----------------|
| Barometer at 6 p.m. | = 30·44 | } Group 04402. |
| Wind direction at 6 p.m. | = N.N.E.† | |

* A card is supplied giving the necessary tables and instructions for performing this operation as soon as the instrument is properly fixed and its height above the *Mean Sea Level* (Ordnance Survey Datum) has been reported to the Meteorological Office.

† The scale used for telegraphing Wind Direction will be found at p. 10.

SECOND GROUP.

Force of the Wind at 6 p.m. on the previous day (by Beaufort scale*), the Weather,* and Temperature of air at the same hour.

Example I.

| | | |
|-------------------------|------------|----------------|
| Force of wind at 6 p.m. | = 9 | } Group 09549. |
| Weather | " " = Rain | |
| Temperature by dry bulb | = 49° | |

Example II.

| | | |
|-------------------------|----------------|----------------|
| Force of wind at 6 p.m. | = 11 | } Group 11409. |
| Weather | " " = Overcast | |
| Temperature by dry bulb | = 9° | |

It will be observed that in cases where, on some occasions one, and at other times two figures are required, spaces are given for two figures. When only one is needed, a cipher is to be inserted in the first place in order to maintain uniformity in the groups. Thus, it will be seen by the scale for the direction of wind on p. 10, that N.E. (*true*) = 4; this will be reported "04" in the groups, while S = 16 will be reported as 16. Again, force 2 is to be reported as "02," but force 11 as "11." The same principle runs through all the groups.

THIRD GROUP.

Reading of the barometer at 8 a.m., reduced to 32° F. and mean sea level.

Direction of wind at 8 a.m.

Example I.

| | | |
|--------------------------|---------|----------------|
| Reading of the barometer | = 29·62 | } Group 96228. |
| Direction of wind | = N.W. | |

Example II.

| | | |
|--------------------------|---------|----------------|
| Reading of the barometer | = 28·42 | } Group 84232. |
| Direction of wind | = N. | |

* For the Beaufort scale of wind force, see pages 10 and 11, and for Scale of Weather, see p. 12.

FOURTH GROUP.

Wind force at 8 a.m. : Weather at the same hour.
 Temperature of air by dry-bulb thermometer, at same hour.

Example I.

Wind force - - - = 6
 Weather - - - = half clouded
 Temperature of air by dry-bulb thermometer - - - = 53° } Group 06253.

Example II.

Wind force - - - = calm
 Weather - - - = quite clear sky
 Temperature of air by dry-bulb thermometer - - - = 27° } Group 00027.

When a dead calm prevails both the Direction and Force of the wind should be represented by ciphers.

FIFTH GROUP.

Reading of the Wet-bulb Thermometer at 8 a.m.
 Amount of Rainfall (including melted snow and hail*) during last 24 hours, in inches, tenths, and hundredths, omitting the decimal point.

Example I.

Reading of wet-bulb thermometer at 8 a.m. - - - = 50°
 Rainfall in last 24 hours, measured at 8 a.m. - - - = 0.46 in. } Group 50046.

Example II.

Reading of wet-bulb thermometer 25°
 Rainfall in last 24 hours = 2.36 ins. } Group 25236.†

SIXTH GROUP.

Maximum and Minimum Temperatures in the last 24 hours.

Amount of Sea Disturbance at 8 a.m.‡

* See p. 25.

† See p. 26.—*Special note.*

‡ For scale of Sea Disturbance, see p. 12. At inland stations the last figure is of course 0.

Example I.

Maximum temperature - - - = 64°
 Minimum " - - - = 48°
 Sea disturbance (rather rough) - - - = 5 } Group 64485

Example II.

Maximum temperature - - - = 38°
 Minimum " - - - = 4
 Sea disturbance (dead calm) - - - = 0 } Group 38040.

SPECIMEN of the SIX GROUPS in an 8 A.M. TELEGRAM, with explanation.

For 6 p.m. on previous day.

| | |
|--|------------------------|
| 97622 | 09549 |
| Bar. reduced to 32° F. and mean sea level. { 3 Figs. | Force of Wind. 2 Figs. |
| Direction of Wind. 2 Figs. | Weather. 1 Fig. |
| | Temp. of Air. 2 Figs. |

For 8 a.m.

| | | | |
|--|-----------------------------------|--|--------------------------------------|
| 96228 | 06253 | 50046 | 64485 |
| Bar. reduced to 32° F. and mean sea level. { 3 Figs. | Force of Wind. 2 Figs. | Reading of Wet Bulb. 2 Figs. | Max. temp. in past 24 hours. 2 Figs. |
| Direction of Wind. 2 Figs. | Weather. 1 Fig. | Rainfall in past 24 hours (measured at 8 a.m.) { 3 Figs. | Min. temp. in past 24 hours. 2 Figs. |
| | Temp. of Air by Dry Bulb. 2 Figs. | | Sea Disturbance at 8 a.m. 1 Fig. |

2 p.m. Reports.

Certain selected stations send additional reports at 2 p.m. daily, consisting of the readings of the Barometer, two Thermometers (dry and wet bulbs), with the Wind, Weather, and Sea Disturbance.

Such reports consist of three groups only, corresponding almost exactly with the third, fourth, and fifth groups in the 8 a.m. report.

FIRST GROUP.

Reading of the Barometer at 2 p.m., reduced to 32° F. and mean sea level.

Direction of the Wind.

Example.

Reading of the barometer, 29.48 }
Direction of the wind = S.E. } Group 94812.*

SECOND GROUP.

Force of wind at 2 p.m.; Weather at the same hour;
Temperature by dry-bulb thermometer.

Force of wind - - = 3 }
Weather - - - = hazy }
Temperature of air by dry-bulb }
thermometer - - = 62° } Group 03762.

THIRD GROUP.

Temperature by wet-bulb thermometer.

Sea disturbance.

Two ciphers (for uniformity).

Example.

Reading of wet bulb = 51° }
Sea disturbance - = 4 }
Ciphers - - = 00 } Group 51400.

SPECIMEN of GROUPS of FIGURES in a COMPLETE REPORT for
2 p.m., with explanation.

| 94812 | 03762 | 51400 |
|---|--|--|
| Barometer reduced to 32° F. and mean sea level. { 3 Figs. | Force of Wind. 2 Figs. | Reading of wet-bulb thermometer. 2 Figs. |
| Direction of Wind. 2 Figs. | Weather. 1 Fig. | Sea Disturbance. 1 Fig. |
| | Reading of dry-bulb thermometer. 2 Figs. | Ciphers, to maintain uniformity. 2 Figs. |

* For Wind Direction Scale, see p. 10.

6 p.m. Reports.

Some stations send reports daily at 6 p.m. These are to be prepared in a form similar to that given for the 2 p.m. reports; but the fourth and fifth figures of the third group are to be utilized for reporting the maximum temperature which has been recorded *since* 8 a.m.

Special Reports.

Special reports, whether sent at the discretion of the observer, or in accordance with the directions given in the next paragraph, or in reply to a telegraphic message from the Meteorological Office, should *always* be drawn up in the form given for 2 p.m. reports; but the observer should add any remarks which he may deem of importance.

Whenever the level of the mercury in the barometer has fallen half a tenth of an inch or more, in any one hour; or the wind, being strong, has suddenly changed its direction, or has increased to a gale or serious squall; or the sea has suddenly become rough, although the wind has not increased; or whenever the sky assumes an unusually threatening appearance, *an immediate report should be sent to London*, words being added so as to describe as nearly as possible the appearance observed.

Such telegrams are looked upon as extra Intelligence, and the next regular report to the Meteorological Office should be prepared as though no such special report had been forwarded.

Repetitions.

Whenever a repetition of any message is asked for, the observer is requested to look carefully at his register and his instruments in order to see whether he might not have made an error either in copying the report from his register, or in "reading off" and reducing the observation.

Scales in Use.

The following scales are used in drawing up the telegrams:—

WIND SCALES.

1. *Direction.*

The different points of the compass are supposed to be numbered, beginning with 01 = N. by E. and 02 = N.N.E. (*true bearings*), to 08 corresponding with East, 16 with South, 24 with West, and 32 with North.

A table of the approximate equivalents (for the United Kingdom) for compass bearings in true bearings, with the corresponding numbers, is here annexed.

| | | | | | | | | | | | | | | | | | | | |
|--|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|--|--|
| Compass bearings } N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW | | | | | | | | | | | | | | | | | | | |
| True bearings } NNW N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW | | | | | | | | | | | | | | | | | | | |
| Figures - | 30 | 32 | 02 | 04 | 06 | 08 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | | | |

2. *Force.*

This is estimated in accordance with the following scale, being a modification of that known ordinarily as the "Beaufort Scale," from its having been drawn up by Admiral Beaufort for use on board ship. Rules for the correct estimation of wind force are included, for the guidance of observers both at coast and at inland stations. Added to the Table are two lists, showing respectively for each force the equivalent pressure in pounds on the square foot and the equivalent mean velocity in miles per hour.

SCALE OF WIND FORCE, PRESSURE AND VELOCITY.

| Beaufort Number. | General description of Wind. | Specification of Scale. | | Equivalent pressure in lbs. per square foot. | Equivalent mean velocity in miles per hour. |
|------------------|------------------------------|--|--|--|---|
| | | For guidance of observers on coast. | For guidance of observers on land. | | |
| 0 | Calm | Calm | Calm ; smoke rises vertically. | 0 | 0 |
| 1 | Light air | Fishing smack just has steerage way. | Direction of wind shown by smoke drift, but not by wind vanes. | ·01 | 2 |
| 2 | Light breeze. | Wind fills the sails of smacks, which then move at about 1-2 miles per hour. | Wind felt on face; leaves rustle; ordinary vane moved by wind. | ·08 | 5 |

Scale of Wind Force, Pressure and Velocity—*continued.*

| Beaufort Number. | General description of Wind. | Specification of Scale. | | Equivalent pressure in lbs. per square foot. | Equivalent mean velocity in miles per hour. |
|------------------|------------------------------|---|---|--|---|
| | | For guidance of observers on coast. | For guidance of observers on land. | | |
| 3 | Gentle breeze. | Smacks begin to careen, and travel about 3-4 miles per hour. | Leaves and small twigs in constant motion; wind extends light flag. | ·28 | 10 |
| 4 | Moderate breeze. | Good working breeze; smacks carry all canvas, with good list. White crest on waves. | Raises dust and loose paper; small branches are moved. | ·67 | 15 |
| 5 | Fresh breeze. | Smacks shorten sail ... | Small trees in leaf begin to sway; wavelets form on inland waters. | 1·31 | 21 |
| 6 | Strong breeze. | Smacks have double reef in main sail. Care required when fishing. | Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty. | 2·3 | 27 |
| 7 | High wind. | Smacks remain in harbour, and those at sea lie to. | Whole trees in motion; inconvenience felt when walking against wind; umbrellas discarded in exposed places. | 3·6 | 35 |
| 8 | Gale. | All smacks make for harbour, if near. | Breaks twigs off trees; generally impedes progress. | 5·4 | 42 |
| 9 | Strong gale. | — | Slight structural damage occurs (chimney pots and slates removed). | 7·7 | 50 |
| 10 | Whole gale. | — | Seldom experienced inland; trees uprooted; considerable structural damage occurs. | 10·5 | 59 |
| 11 | Storm | — | Very rarely experienced; accompanied by wide-spread damage. | 14·0 | 68 |
| 12 | Hurricane | — | — | above 17·0 | above 75 |

Note.—The attention of observers is directed to the fact that storms in these islands are rarely, if ever, so violent as those in tropical latitudes.

Accordingly, great caution should be used in the insertion of extreme figures in the telegraphic reports such as 12 for the wind and 9 for the sea (see Scale below).

WEATHER SCALES.

Scale 1.—For use in composition of groups, showing weather at time of observation.

| | |
|-------------------------------|-------------------------------|
| 0 = sky quite clear. | 5 = rain falling. |
| 1 = „ a quarter clouded. | 6 = snow „ |
| 2 = „ half clouded. | 7 = haze, light fog, or mist. |
| 3 = „ three-quarters clouded. | 8 = fog. |
| 4 = „ entirely overcast. | 9 = thunderstorm. |

It will be observed that the values 0 to 4 refer entirely to the *extent* of sky covered, *not to the density* of the cloud, which may be described in words added to the telegram when necessary.

Scale 2.—For use in reporting sequence of weather in previous 24 hours. (See p. 29.)

| | |
|--|--|
| b = blue sky, <i>i.e.</i> sky quite clear, or not more than a quarter clouded. | t = thunder. |
| bc = sky half clouded. | l = lightning. |
| c = sky three parts clouded. | tl = thunderstorm. |
| o = sky entirely overcast. | tlr = thunderstorm, accompanied by rain. |
| g = gloomy. | q = squally. |
| m = mist. | u = ugly (a threatening appearance of the sky). |
| f = fog. | v = visibility, <i>i.e.</i> great transparency, or clearness, of the air, rendering distant objects unusually visible. |
| r = rain. | w = unusually heavy dew. |
| d = drizzling rain. | x = hoar frost. |
| e = wet air, without rain falling. | z = dust—haze, or smoke. |
| p = passing showers. | |
| h = hail. | |
| s = snow. | |

SCALE FOR SEA DISTURBANCE.

| | | |
|------------------|-------------------|-----------------|
| 0 = dead calm. | 4 = moderate. | 7 = high. |
| 1 = very smooth. | 5 = rather rough. | 8 = very high. |
| 2 = smooth. | 6 = rough. | 9 = tremendous. |
| 3 = slight. | | |

See also p. 31.

TIME SCALE.

| | |
|------------------|-------------|
| 00 } = Midnight. | 12 = Noon. |
| or 24 } | 13 = 1 p.m. |
| 01 = 1 a.m. | 14 = 2 „ |
| 02 = 2 „ | 15 = 3 „ |
| 03 = 3 „ | 16 = 4 „ |
| 04 = 4 „ | 17 = 5 „ |
| 05 = 5 „ | 18 = 6 „ |
| 06 = 6 „ | 19 = 7 „ |
| 07 = 7 „ | 20 = 8 „ |
| 08 = 8 „ | 21 = 9 „ |
| 09 = 9 „ | 22 = 10 „ |
| 10 = 10 „ | 23 = 11 „ |
| 11 = 11 „ | |

PART II.

Instructions as to the Handling, Mounting, and Reading of the Instruments, the Observing of Wind and Weather, and Preparation of Additional Notes to the Telegrams.

BAROMETER.

In handling barometers it should always be remembered that they are delicate and expensive instruments. The result of rough treatment is breakage; and for scientific purposes, observations from an instrument repaired and *not verified* are useless.

The barometer should be fixed in a good light for observing, but out of the reach of sunshine or the occasional heat of a fire or lamp. As it is sometimes necessary to have a fire where the barometer is hung, it should be remembered that the ill effects of artificial heat are nearly entirely removed by taking a careful reading of the attached thermometer. It is, therefore, hardly necessary to remark that the attached thermometer should be read at *every* observation of the barometer. The barometer should hang where it can swing freely, out of the reach of persons passing near it, and be in every way carefully protected from injury. A bracket and screws for suspending the instrument will be found in the box.

To suspend the barometer screw up the bracket where the instrument is to hang. Then lift the instrument carefully out of its box, bend back the hinged part of the suspension arm, and slip it into the bracket.* The mercury will then fall gradually, and the instrument will usually be ready for observation in about an hour; but as local temperature affects the mercury in the tube slowly, it may be well not to record observations from it for *some hours* after first fixing it.

In a well-boiled tube the mercury sometimes remains immovable, and will not readily quit the top of the tube. If, after an hour or so, it has not descended to its proper

* The holding screws should not be driven quite "home" until the instrument is in position.

level, tap the cistern end rather sharply with the hand, or make the instrument swing a little in its gimbals. If this method does not succeed, the force of the tap must be slightly increased, but violence should never be used. The box should be safely stowed away.

Whenever it may be necessary to take down a barometer and stow it in its box, *the vernier should be brought down to the bottom of the scale*. Then, having lifted the instrument out of the bracket, place or hold it in an *inclined* position for a few minutes, so as to allow the mercury to flow *very gently* up to the top of the glass tube. It should then be taken lengthwise and laid in its box. It is now portable, without any other adjustment whatever, and must be carried with the *cistern end upwards* or *lying flat*; it must not be subjected to jars or concussions.

Experience shows that it is advisable to give some directions as to the *packing* of barometers. The instrument having been taken down and placed in its box, as directed, if it is to be sent by rail or other conveyance, where it will probably have to be handled by persons unacquainted with its delicate and peculiar construction, should be placed in a packing case with two or three inches of soft elastic packing all round it, such as hay, straw, shavings, tow, or paper-cuttings. The lid of the case should *never be nailed down*, but always fastened with screws. The address label should be *pasted* or nailed on the lid *before* the lid is put on, and must be placed on or near to the end of the case which is next the cistern, or lower end of the barometer, and it should be marked "Glass and fragile instruments. Keep this box lying flat, or carry it this end upwards." Of course if two or more barometers are packed together, the cisterns should all be placed at this marked end of the case. Barometers should be transmitted by passenger train, and, in short, always by that route or conveyance which affords the most easy transit. Transshipment or change of conveyance should be avoided as much as possible.

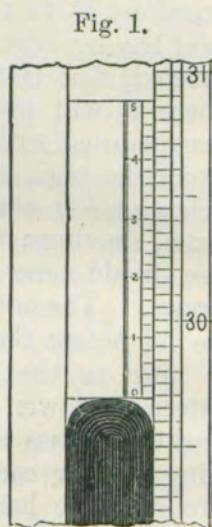
Reading the Barometer.

In order to facilitate the taking of accurate readings of the barometer, a small movable scale, called a "vernier," is attached to the instrument.

The general principle of this movable dividing scale is, that a given length, containing a certain number of divisions of the fixed scale is divided into one more or less than that number of divisions on the vernier. In standard barometers the twenty-five spaces in the vernier are equal to any twenty-four spaces of the scale, each of which is half a tenth, or five hundredths of an inch; therefore a space on the scale is larger than a space on the vernier by the twenty-fifth part of $\cdot 05$, which is $\cdot 002$ inch, consequently the vernier exhibits differences of $\cdot 002$ of an inch.

| | | | |
|-----------------|--------------------------------|---------------------------------|-----------------------------|
| Every long line | { cut on the barometer scale } | a tenth | ($\cdot 100$) of an inch. |
| " short " | " " " " " " | five hundredths ($\cdot 050$) | " |
| Every long line | { cut on the vernier scale } | one hundredth ($\cdot 010$) | " |
| " short " | " " " " " " | two thousandths ($\cdot 002$) | " |

The vernier is moved by a rack and pinion. Turn the mill-head of the pinion so as to bring the lower edge of the vernier *exactly* on a level with the top of the mercurial column, and taking great care not to push the instrument out of the perpendicular. When set properly, the front edge of the vernier, the top of the mercury, and the back edge of the vernier should be in the line of sight, which line will thus just touch the *middle* and *uppermost* point of the column. Great care should be taken to acquire the habit of reading with the eye exactly on a level with the top of the mercury, that is, with the line of sight at right angles to the scale.

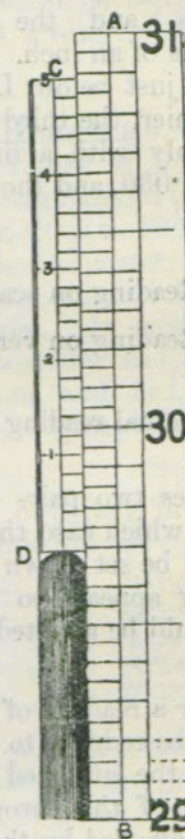
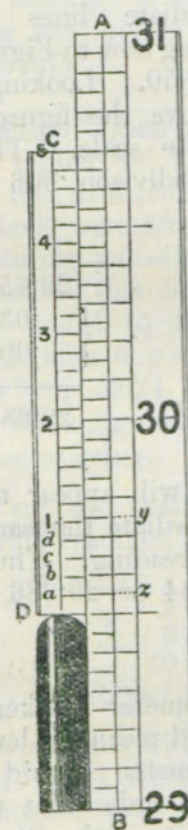


A piece of white paper placed behind the tube, so as to reflect the light, assists in setting the vernier accurately. A small bull's-eye lamp held so as to throw a strong light on the paper behind the instrument, enables the observer to get a correct setting at night. When setting the barometer, it should hang *freely*, not being inclined by holding or even by a touch, because any inclination will cause the column of mercury to rise in the tube.

The mode of reading off may be learned from a study of the following diagrams, in which A B represents part of the scale, and C D the vernier, the lower edge D denoting the top of the mercurial column. The scale is readily understood; B is 29.000 inches; the first line above B is 29.050; the second line 29.100, and so on. The first thing is to note the scale line just below D.

Fig. 2.

Fig. 3.



and the next is to find out the line of the vernier which is in one and the same direction with a line of the scale. In Figure 2, the lower edge of the vernier, D, is represented in exact coincidence with scale line 29.5; the barometer therefore reads 29.500 inches. Studying

B

it attentively in this position it will be perceived that the vernier line *a* is .002 inch below the next line of the scale. If, therefore, the vernier be moved so as to place *a* in a line with *z* the edge *D* would read 29.502. In like manner it is seen that *b* is .004 inch away from the line next above it *on the scale*; *c*, .006 inch apart from that next above it; *d*, .008 inch from that next above it; and 1, on the vernier, is .010 below *y*. Hence, if 1 be moved into line with *y*, *D* would read 29.510. Thus the numbers 1, 2, 3, 4, 5, on the vernier, indicate hundredths, and the intermediate lines the even thousandths of an inch. Referring now to Figure (3), the scale line just below *D* is 29.650. Looking carefully up the vernier, the third line above the figure 3 is seen to lie evenly with a line on the scale. The number 3 indicates .030, and the third subdivision .006; and thus we get—

| | | | |
|--------------------|---|---|----------------|
| Reading on scale | - | - | 29.650 |
| Reading on vernier | - | { | .030 |
| | | | .006 |
| Actual reading | - | - | 29.686 inches. |

Sometimes two pairs of lines will appear to be coincident; in which case the intermediate thousandth of an inch should be set down as the reading. Thus, suppose the reading appears to be 29.684 or 29.686, the mean 29.685 should be adopted.

Whenever a reading of the barometer is taken the reading should be reduced to 32° F. and mean sea level.* The reading of the attached thermometer should be taken before that of the barometer, in order that the former may not be affected by the proximity of the Observer.

The reading of the barometer should be taken, corrected, reduced, and registered to three places of decimals; but in reporting by wire the first two places only are requisite. Care must be used, however, to

* See note at foot of p. 4.

report to the nearest hundredth, *i.e.*, if the third decimal be less than "5" it is merely to be omitted thus—

$$29.874 \text{ or } 29.871 = 29.87;$$

but should it be 5 or more than 5, the second figure is to be increased by 1: thus—

$$29.875 \text{ or } 29.877 = 29.88.$$

Care must be taken to guard against the error of reporting the barometer reading to thousandths of an inch. A reading of 28.877 should be reported in the telegram as 888, not as 877, and a reading of 29.905 as 991, not as 905.

"Extreme" Barometer Readings.—These may be either higher or lower than that at 8 a.m.; thus, supposing that at 6 p.m. the reading reduced to 32° F. and mean sea level were 29.43, and at 10 p.m. 29.24, but that at 8 a.m. on the following day the barometer had risen to 29.40; then on this latter day the words "Bar. 22924" should be added to the message. It would thus be evident that after 6 p.m. the barometer had fallen to an "extreme" of 29.24 at 10 p.m. and had since risen briskly. These figures are often of great value, especially in unsettled weather.

Again, suppose that on any day (say in November) the following readings were recorded in the register:—

| | | | |
|-------------------|---|---|--------|
| Nov. 10th, 8 a.m. | - | - | 30.193 |
| " 2 p.m. | - | - | 30.392 |
| " 6 p.m. | - | - | 30.241 |
| " 10 p.m. | - | - | 30.230 |
| Nov. 11th, 8 a.m. | - | - | 30.214 |

Then at stations which send only one report daily, the report on the 11th should contain the words, "Bar. 14039," the two first figures showing the hour of observation and the others the reading of the barometer.

It is very desirable that those of the observers who have their barometers near at hand should give regularly in their 8 a.m. reports a reading taken at a late hour on the previous night, the most convenient time for such a reading being usually recognised as 10 p.m. In the same way those who send 2 p.m. reports might add a reading taken at noon: thus—"Bar. 12974."

The error to which observers are the most liable in reading a barometer is one of five hundredths ($\cdot 050$) of an inch; thus reading 29.926 for 29.976 and *vice versa*. This error occurs so frequently that observers are asked to take special precautions in order to avoid it. The result of such a slip at outlying stations is liable to be very serious. Great care is requisite in counting the tenths also.

Special Notes.—A word or two should be added to the telegram whenever:—

1. In cases where the barometer has been rising but has just begun to fall again, especially if the formation of cirrus clouds (mares' tails) occur simultaneously in the sky; or if the barometer has been falling and is just beginning to rise, especially if accompanied by a shift of wind and rain.

2. If the barometer begins to fall rapidly after having done so slowly or at a moderate rate.

Some stations are supplied with self-recording aneroids, to enable the observers to report "extreme" readings, and the movement of the barometer at the time of observation, with more minute accuracy. Special instruction for these observers will be found in Appendix "B," p. 36.

THERMOMETERS.

It is not at all an easy matter to obtain a record of temperature which shall be altogether unexceptionable. A double louver-boarded case, or screen, commonly known as a "Stevenson's screen," is supplied to contain the thermometers.

The engraving on the next page (Fig. 4) shows the form of this screen used for exposing the dry-bulb, wet-bulb, maximum, and minimum thermometers to a free circulation of the air, while protecting them as much as possible from the direct rays of the sun, and from rain, snow, &c. It should be fixed in as open a space as possible in the free air, with the bulbs of the dry and wet-bulb thermometers at about four feet from the ground. The screen should be fully exposed to the sun, but not subject to any artificial heat from the windows of rooms, doorways, or to radiation from any heated surfaces.

Two thermometers should be fitted up in a vertical position in the screen, one to give the temperature of the air and the other that of evaporation. The latter is to be mounted in the following way.

Fig. 4.

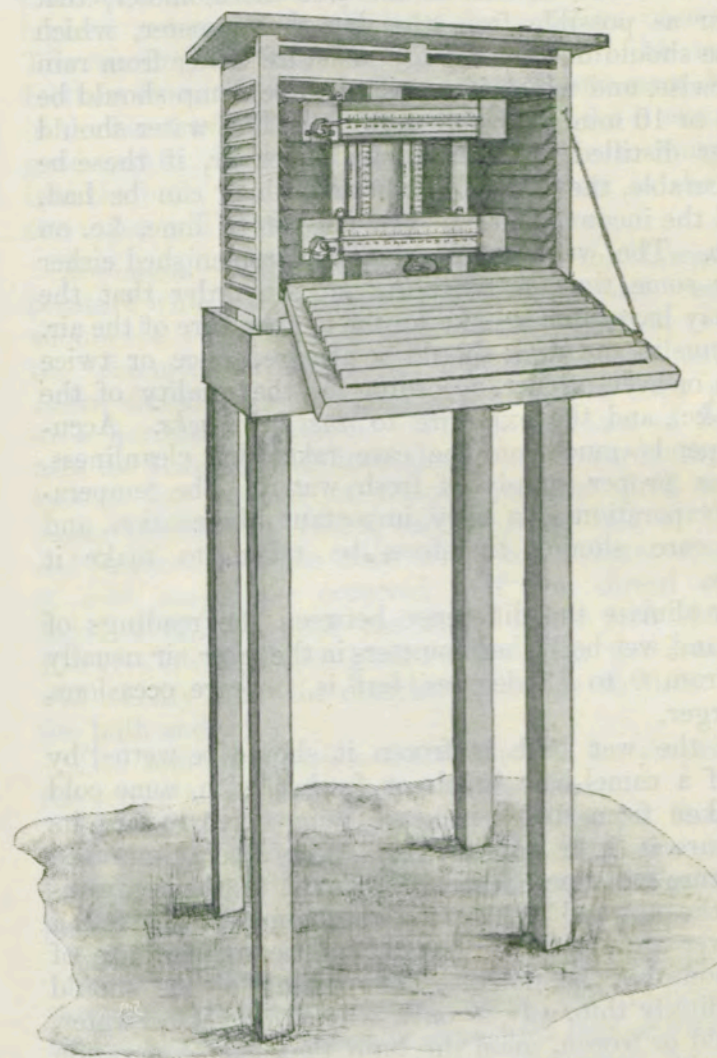


Fig. 5.



A piece of the finest muslin or cambric should be tied tightly round the bulb of one thermometer, and a few threads of cotton wick passed round the glass stem close to the bulb (see *a*, fig. 5), touching the muslin, and long enough to reach two or three inches away from the

lowest part of the bulb; these should be carried down so as to dip into, and remain in a small vessel of water. By this arrangement the water is slowly conducted, by capillary attraction, to the bulb and evaporated there.

The cup, glass, or other small holder of water should be placed on the off-side of the wet thermometer, that is, as far as possible from the dry thermometer, which of course should not receive any moisture either from rain or otherwise, and which if supposed to be damp should be wiped 5 or 10 minutes before reading. The water should be either distilled, or filtered rain water, or, if these be not procurable, the softest fresh water which can be had, to avoid the inconvenience of the deposit of lime, &c. on the bulb. The water vessel should be replenished either *after*, or some time *before*, observing, in order that the water may have time to take up the temperature of the air.

The muslin and wick should be changed once or twice a month or even oftener, according to the quality of the muslin, &c., and the exposure to *dust* or *blacks*. Accuracy depends much on the care taken for cleanliness, and for a proper supply of fresh water. The temperature of evaporation is a very important observation, and especial care should therefore be taken to make it correctly.

In our climate the difference between the readings of the dry and wet bulb thermometers in the *outer* air usually ranges from 0 to 15 degrees, but is, on rare occasions, much larger.

When the wet bulb is frozen it should be wetted by means of a camel-hair brush or feather with some cold water taken from under ice, care being taken to raise its temperature as little as possible. After several minutes, the moisture will freeze, then cool down to the temperature of the air, and finally the thermometer will fall a little lower than the dry one, when the temperature of evaporation may be noted. The coating of ice should be exceedingly thin. It is only when there is no water, either fluid or frozen, upon the bulb that the observation fails in cold weather.

DIRECTIONS FOR MAXIMUM AND MINIMUM THERMOMETERS.

Maximum.—This instrument records the highest temperature which has been reached since the time when it

was last “set.” It should be suspended in a horizontal position. On an increase of temperature the mercury will expand and a portion, which subsequently forms the Index, will be pushed forward along the tube. On a decrease of temperature the mercury in the bulb will contract, but leave the portion in the tube to show the highest temperature, till reset for a future observation. The reading is taken from the end of the mercury furthest from the bulb. To set the instrument, hold it in the hand *with the bulb downward* and give it one or two good jerks. This will force part of the mercury back into the bulb, till the existing temperature is shown by the *upper* end of the mercury.

Minimum.—This instrument shows the lowest temperature which has occurred since it was last “set.” It should be suspended in a horizontal position. To set the thermometer, hold it *bulb uppermost* until the *Index* descends to the end of the spirit, then place it in a horizontal position. With a decrease of temperature the alcohol will draw the Index towards the bulb; but on an increase of temperature the fluid will advance beyond the Index, leaving it behind, so that the end furthest from the bulb will show whatever extreme of cold may have occurred. If the thread of spirit becomes broken, hold the thermometer *bulb downward* and give it one or two good swings with the arm. This will usually cause the detached portions to flow towards the bulb and unite.

The minimum thermometer should be suspended in the screen a few inches *below* the maximum.

In reading a thermometer the principal liability to error is that of taking the reading 5° too high or too low, as the case may be; and thus reporting, say, 57° for 52°, and *vice versa*.

Special Notes.—(a) When the maximum and minimum thermometers are set in the morning the readings shown by each instrument should agree with that shown by the dry bulb thermometer. *If the difference between the readings of the three instruments amounts at any time to more than one degree, the fact should be immediately reported to the Office.* (b) If the minimum temperature has been very low in the night, but the thermometer has since risen suddenly, the change should be referred to in

the morning telegram, especially in winter time, and in such cases great care should be used in estimating the wind direction at 8 a.m.

(c) Exceptionally large or sudden changes should always be referred to in order that they may not be mistaken for telegraphic errors.

(d) If the *maximum* temperature has occurred in the night-time, or the *minimum* during the daytime, a note to that effect should be added.

RAIN GAUGE.

The lower part of the gauge should be sunk into the ground to such a depth that the upper rim of the gauge stands 1 foot above the level of the ground; this will prevent the gauge from being upset, and aid in securing uniformity of exposure. Gauges must be in a position exposed to a free fall of rain, snow, or hail, where no houses, walls, or trees shelter them from the wind or cause eddies. The gauge should not be nearer to a wall or house than a distance equal to the height of that object, nor nearer to a growing shrub or tree than a distance equal to twice that height.

The accuracy of rain gauges depends upon the perfect form of the circular opening of the funnel and upon the correct graduation of the measuring glass, the latter being carefully tested and the glass verified before issue. In the gauge supplied by this Office the diameter of the rim is eight inches. If the circular opening gets bent or knocked out of shape, the indications of the gauge are no longer correct. *Such defects should be reported as soon as they are discovered. The funnel should be kept clean and free from any accumulation of dust, leaves, &c.*

The funnel of the rain gauge is made to lift on and off the cylinder. A can for receiving the rain from the funnel is placed inside the cylinder.

When rain is to be measured, remove the funnel, take out the can, and pour the rain collected into the glass measure, which is graduated to hundredths of an artificial inch, up to 0.50 (or half) an inch. Place the glass upon a table or other horizontal surface for support and steadiness, and read off with the eye on a level with the surface of the water.

Should more than half an inch of rain have been collected successive measurements will be necessary. For instance, having measured half an inch (0.50), empty the glass, fill up again from the collecting can, and add the result of this second measurement to the half inch measured previously; should the second reading be 0.34, the two readings added together will give for the total rainfall 0.84 of an inch.

• From day to day, in the morning, the quantity of water from rain (snow, or hail melted) should be measured very regularly and carefully, and recorded.

THE GAUGE SHOULD BE EXAMINED EVERY DAY, EVEN IN FINE WEATHER, SO THAT NO SHOWER MAY ESCAPE NOTICE.

The gauge should not, as a rule, be opened more than once a day. The glass measure should be used with great care, because, if broken, some delay may occur in replacing it. It should not be left in the gauge, especially in winter, when it would be liable to be broken by frost.

Measurement of Snow and Hail.—The measurement of snow or hail is effected by thawing the quantity collected in the gauge, and measuring the water which results therefrom. The following method, though not quite satisfactory, appears to be the best for practical purposes; it is—to add a *measured quantity* of warm water to the snow in the gauge, and after subtracting this quantity from the resulting volume of water found in the collecting can, to report the remainder as the “rainfall” for the day.

When snow is light, and drifting with wind, it is found that, with ordinary gauges, the flakes are liable to be blown out of the funnel; in the gauges supplied by this Office the funnel is provided with a high rim, so as to reduce the possibility of loss from this cause to a minimum. If, however, the observer is of opinion that the snow collected in the gauge does not represent fairly the *average* fall in his neighbourhood, he should take the upper (funnel) portion of his gauge, and invert it over snow lying level (*not drifted*) where its depth seems to be about the average amount, collect the cylinder of snow thus cast off, and melt it with warm water, as directed above. This proceeding ought to give the

quantity of snow-water which would have been collected by the gauge if the snow had not been blown out of it; the results are not absolutely satisfactory, but approximate very nearly to the true values.

Special Note.—In cases of exceptionally large quantities of rain falling a note should always be added to the telegram, confirming the measurement, or those in London may doubt its accuracy, especially if the fall should be local. Thus:—Supposing that heavy rain fell during the night, and that the amount measured next morning was as much as 1.06 inch, the words “heavy rain night” should be added. Or supposing that heavy rain fell throughout the entire 24 hours and that the amount measured was as much as 2.34 inches, the remark should be added “continuous heavy rain, more than two inches.” Some remark of the kind should be made whenever the amount measured exceeds an inch.

WIND.

If there be no well-exposed vane near the observer the direction of the wind may be estimated best by observing smoke drifting from tall chimneys, or from ordinary chimneys in clear places, or from the motion of *very low* clouds, if there be any. Clouds, unless they are very low, frequently move in a direction different from that of the air at the earth's surface, and are consequently not safe guides as to the direction of the surface wind.

Every possible care should be taken that the wind reported is the true wind which prevails in the observer's neighbourhood, and not a mere local eddy caused by buildings or other local obstructions to the general current.

If a vane be used to give the direction, care should be taken that it is set to true, not to compass, bearings* and that it works freely. Rules for the guidance of observers in estimating the *force* of the wind will be found in the table on pages 10 and 11.

Special Notes.—If the wind should be shifting its direction while blowing strongly, let it be stated in the

* The equivalent “true” bearings as distinct from these shown by the compass are given on p. 10.

telegram which way it is shifting, and what weather accompanies the change.

A careful look-out should be kept for the strongest wind occurring in the 24 hours, in order, if it has reached force 6 or more, to report an accurate “extreme” in the next day's report: such extremes may be reported thus: Extreme 20070 at twenty,” meaning that the extreme force of 7 from S.W. occurred at about 8 p.m.

Whenever the force of the wind reaches 8 or upwards, the hour at which the gale (counted as Force 8 or more) commenced or ended and the extreme force which it attained, should be reported, thus: “Gale 04165 18100”: this will mean “gale from 4 a.m. to 4 p.m. with rain, extreme force “10, from S.S.W.”

WEATHER.

The Amount of Cloud is to be reported as one of the conditions of Weather. It is that proportion of the sky which is covered with clouds, and is estimated in fourths.

When the cloud is exceptionally dense, or exceptionally thin, a word or two at the end of the message will explain this.

Whenever the observer notices that the clouds are moving in a direction different from that of the wind at the surface of the earth, or that the clouds are travelling at a rate very different from what might be expected for the force of the wind prevailing at the time; or that the *upper* clouds are moving in a direction different from that of the *lower* clouds, he is to report the direction from which that motion takes place, and *whether it is fast or slow*.

The general *appearance* of the sky is important to note, and the gradual rising of a bank of cloud from the horizon, especially if its appearance be wild and threatening, should always be reported, and a word or two be added explaining its general features, as to density, smoothness, or raggedness of edge, &c., its bearing, and the direction from which it appears to be moving.

Full instructions for making observations of the upper (*cirrus*) clouds will be found in Appendix A., p. 33.

Lunar and solar halos should be carefully noted; so also should coronæ (coloured rings), which must be carefully distinguished from halos and mere ill-defined burrs.

Halos are, speaking roughly, large rings of light which appear round, but, at a distance from the sun, or moon; coronæ are coloured rings which appear close to the moon, or sun, while simple burrs are merely circular, white, hazy masses of light, appearing close round the sun or moon, and are usually formed in clouds of a type much lower than those which produce halos. Solar are much more difficult to observe than lunar halos, owing to the intensity of the sun's rays, but both are of great importance as indications of coming weather, and should be reported in the first telegram which is sent after, or during, their occurrence.

Auroræ, *unusually* heavy dews, thick hoar frost, hail and thunderstorms, &c. should be reported whenever they occur, and when the weather is squally, the word "squally" should always be added.

When mist or fog* is prevalent, so that the amount of cloud above it cannot be directly ascertained, the *weather* must be reported by one of the figures in the Scale (see Weather Scale 1, page 12) using, as may be, the figures 7 or 8. When there is mist or haze, but not sufficient to obscure the sky, the state of the sky should

* The terms "mist" and "fog" both refer properly to surface cloud; in either case there will be little or no difference between the readings of the dry bulb and wet bulb thermometers. In smoky districts the term "fog" is employed unless the cloud is unusually white. In country districts either word is used. A slight fog or mist is sometimes called haze, but it is better to restrict the use of the word haze to the obscurity due to mist or smoke or other cause when the air is dry, and there is a considerable difference between the dry bulb and wet bulb readings. In London and other cities the word "fog" is also used to describe the smoky surface cloud which persists when the air is calm and dry. The term "thick haze" would be more in accordance with the definitions given here, but the word fog is too commonly used for it to be replaced in that special case.

be given as the *weather* in the group, and the word "misty" or "hazy" be added to the report. When mist or fog is reported the word "light," "moderate" or "thick" should be added at discretion.

As an aid to the observer in the correct definition of these terms the following Scale has been drawn up:—

| | <i>On Land.</i> | <i>On Sea.</i> | <i>On River.</i> |
|-----------------------|-------------------------------|---|--|
| Light Fog or mist. | Street traffic unhindered. | Distant objects obscured, but traffic unim- peded. | Traffic practic- able with mod- erate caution. |
| Moderate Fog. | Street traffic difficult. | Traffic difficult | Traffic practic- able with ex- treme caution. |
| Thick Fog | Street traffic impossible. | Traffic very dangerous. | Traffic impos- sible. |

On some occasions fog or mist occurs which, in addition to obstructing the view, deposits moisture on out-door buildings, pavements, &c., and causes moisture to drop from trees, without there being any definite particles of rain traceable in the air; these are termed "wet" fogs (or mists), and should be reported as such.

INSTRUCTIONS FOR REPORTING ADDITIONAL WEATHER OBSERVATIONS.

In reports supplied at the usual hours of observation and in all special reports a word or two may often be added giving particulars of phenomena not shown by the figure in the group. Such additional information should always be placed after the last group in the message. Thus the figure 4 may appear in the group, showing that the weather at the time of observation was overcast; any words placed after the last group such as "rainy," "showery," "squally," etc., will convey further information as to the prevailing weather.

In the 8 a.m. report the sequence of the weather

during the previous 24 hours should be given in all cases *before* the ordinary group of figures, and should be indicated by three words or three groups of letters.* The first of these should indicate the weather prevailing on the morning of the previous day, *i.e.*, between 8 a.m. and noon; the second, the weather prevailing in the afternoon, *i.e.*, between noon and 6 p.m.; the third, the weather prevailing in the evening and at night, *i.e.*, between 6 p.m. of the previous day and 8 a.m. of the day on which the report is dispatched.

Whenever possible the character of the weather at any of these times should be indicated by one word, such as fine, cloudy, dull, etc. When more than one kind of weather prevails, the combination should be shown by a group of letters, thus:—c h p, cloudy, with hail showers; o r s, dull with rain and snow; b c p, showery, but with fine intervals. The group should never consist of more than 5 letters.

In writing out the telegram each group of letters must be placed quite separately in one of the five divisions shown on the telegraph form. In the case of combinations of letters great care must be taken to see that they are very clearly written, so that there may be no error in the telegraphed message.

The following are a few examples of the words and groups that may often be added:—

Example 1. fine | c p r h | foggy

Showing that the weather was fine in the morning, but that showers of rain and hail were experienced in the afternoon, and that the evening and night were foggy.

Example 2. o d p | cloudy | o m d

Showing that in the morning the weather was dull, with showers of drizzling rain, the afternoon was cloudy, and the evening and night dull, with mist and drizzling rain.

Example 3. dull | o t l r | b w

Showing that the morning was dull, and that a

* See Weather Scale, No. 2, p. 12.

thunderstorm, with rain, prevailed in the afternoon, but that the night was clear, with unusually heavy dew.

Example 4. rainy | fine | c p l

Showing that the morning was rainy, but the afternoon fine. The evening and night were cloudy and showery, and lightning was observed.

SEA DISTURBANCE.

The value of the reports will be greatly increased if the observers will say when the seas are longer, deeper, and heavier than appears to be accounted for by the wind at the time. The setting in of a "ground swell," too, should always be noted, with the directions from which it is rolling in.

SPECIMENS OF COMPLETE TELEGRAPHIC REPORTS.

The following are specimens of complete telegraphic reports, drawn up in accordance with the foregoing instructions.

1. Specimens of 8 a.m. Reports.

(Specimen a.)—Dull ogqs, bc 93728, 09434, 95932, 05436, 34014, 40294, snow still falling, Bar. 22986, gale 16066, 24110.

(Specimen b.)—Showery, fine, tlhr 00410, 01473, 01622, 03265, 60130, 79580. Thunderstorm 7 to 9 p.m., over inch rain, showery now, Bar. 22998.

(Specimen c.)—Behp dull, bx 03216, 02454, 04722, 04240, 38001, 57362, Bar 22042, ground swell from West.

2. Specimens of 2 p.m. Reports.

(Specimen a.)—Thunderstorm 11 a.m. to noon, 02628, 01465, 60300, showery.

(Specimen *b.*)—Snow showers, morning, 01232, 06438, 36020, force 8 in squalls.

(Specimen *c.*)—03000, 00846, 43000, fog commenced about noon.

3. Specimens of 6 p.m. Reports.

(Specimen *a.*)—00824, 05456, 52300, 01226, 03354, 49360, showery all day, thunder at 3 p.m., Bar. 16006.

(Specimen *b.*)—96832, 05336, 35500, 94704, 07632, 31638, snow commenced 4 p.m., Bar. still falling.

(Specimen *c.*)—05100, 00281, 72000, 05620, 01477, 71384, air close, appearance threatening.

APPENDIX A.

Instructions for Telegraphing Cirrus Observations.

Note.—Instructions for observing clouds are given in detail in the Observers' Handbook, pp. 43–47.

In telegraphing to the Meteorological Office information as to the appearance, quantity, and motion of cirrus clouds the following rules should be observed:—

Firstly, the time of observation.

Secondly, the precise form of cloud seen, the observer using at his discretion the terms "feathery," "thin," "thready," "hair," "very lofty," &c. as required, and distinguishing carefully (as directed further on) between *true cirrus*, "*sheet cirrus*," the highest forms of *cirro-cumulus*, and *cirrus-haze*. It is also desirable to say whether the cloud is (*a.*) in detached patches; (*b.*) in a mass (or bank); or (*c.*) spread tolerably uniformly over the sky, and (*d.*) whether it is increasing or decreasing in quantity or density.

Thirdly, the *amount* of sky covered by the cirrus.

Fourthly, the direction whence it is moving, and, as nearly as practicable, its rate of motion.

Fifthly, the point of the compass whence the clouds radiate, herein called the "*r.-point*."

Sixthly, the bearing of the centre and the density of the bank of cirrus, if there be a bank at all; and

Lastly, the direction and force of the surface wind, and the weather prevailing at the time of observation. (See Scale E., below, and Scale 2, p. 10).

These details are to be transmitted by a telegraphic code.

There is no fixed hour for taking the observations, but it will be useless to *transmit* a message by wire before 8 a.m. or later than 7 p.m. It is very convenient that the reports should be despatched so as to reach London about 9.30 a.m., 3 p.m., or 7 p.m., but should the observer consider the appearance threatening he should not hesitate to telegraph immediately his observation has been taken.

CODE.

The observations should be telegraphed by means of a code consisting of three groups, each group containing five figures. In preparing them the following scales will be used.

SCALE A.

FORM OF CLOUD.

- 1 = True cirrus.
- 2 = Sheet cirrus.
- 3 = High cirro-cumulus.
- 4 = Cirrus haze.

SCALE B.

AMOUNT OF CLOUD.

- 0 = Very slight indeed.
- 1 = $\frac{1}{4}$ of sky covered.
- 2 = $\frac{1}{2}$ " "
- 3 = $\frac{3}{4}$ " "
- 4 = All " "
- 9 = Amount doubtful.

SCALE C.

TRUE BEARINGS, FOR DIRECTION OF MOTION AND BEARING OF R.-POINT
AND OF BANK OF THE CLOUDS FOR WIND, &C.

| | | | |
|-------------------|-------------|----------------|-------------|
| 00 = Zero (Calm). | 10 = E.S.E. | 18 = S.S.W. | 26 = W.N.W. |
| 02 = N.N.E. | 12 = S.E. | 20 = S.W. | 28 = N.W. |
| 04 = N.E. | 14 = S.S.E. | 22 = W.S.W. | 30 = N.N.W. |
| 06 = E.N.E. | 16 = South. | 24 = West. | 32 = North. |
| 08 = East. | | 99 = Doubtful. | |

SCALE D.

VELOCITY OF MOTION OF CLOUDS OF THE CIRRUS TYPE.

| |
|-------------------------|
| 0 = Motionless. |
| 1 = Very slight motion. |
| 2 = Moderate " |
| 3 = Rapid " |
| 4 = Very rapid. |
| 9 = Doubtful. |

SCALE E.

(Beaufort's Scale.)*

FOR FORCE OF WIND.

| Force. | Force. |
|----------------------|------------------|
| 00. Calm. | 07. High wind. |
| 01. Light air. | 08. Fresh gale. |
| 02. Light breeze. | 09. Strong gale. |
| 03. Gentle breeze. | 10. Whole gale. |
| 04. Moderate breeze. | 11. Storm. |
| 05. Fresh breeze. | 12. Hurricane. |
| 06. Strong breeze. | |

SCALE F.

FOR DENSITY OF CIRRUS BANK, WHEN VISIBLE.

| |
|----------------------------------|
| 0 = Very thin and ill-defined. |
| 1 = Thin, but definitely formed. |
| 2 = Rather heavy. |
| 3 = Heavy. |
| 4 = Very heavy and angry. |
| 9 = Doubtful. |

SCALE G.

FOR WEATHER.

| |
|---|
| 0 = Sky clear. |
| 1 = $\frac{1}{4}$ covered with clouds of all kinds (i.e., upper and lower). |
| 2 = $\frac{1}{2}$ " |
| 3 = $\frac{3}{4}$ " |
| 4 = Entirely " " |
| 5 = Raining " " |
| 6 = Snow falling. |
| 7 = Hazy. |
| 8 = Foggy. |
| 9 = Thunder storm. |

* An amplification of this Scale will be found on pp. 10 and 11.

The following are a few examples of messages, with explanations :—

EXAMPLE 1.

Two p.m. 11232 26220 20067

MEANING OF ABOVE.

| Two p.m. | 1 | 1 | 28 | 2 | 26 | 22 | 0 | 20 | 06 | 7 |
|----------------------|-------------------------------|-----------------------------|-------------------------------------|--------------------------------|-------------------------------------|---|-----------------------------|--|---------------------------|--|
| Time of observation. | Form of cloud (see Scale A.). | Amount of cloud (Scale B.). | Direction whence moving (Scale C.). | Velocity of motion (Scale D.). | Direction of "R.-point" (Scale C.). | Direction of centre of bank (Scale C.). | Density of bank (Scale F.). | Direction of wind at earth's surface (Scale C.). | Force of wind (Scale E.). | Weather at time of observation (Scale G.). |

Full explanation :—At 2 p.m. True cirrus covering about a quarter of the sky, moving with moderate velocity from N.W. The cloud radiating from W.N.W., and lying in a thin bank whose centre bears W.S.W. (true) from station. Wind at surface S.W. strong, weather hazy.

EXAMPLE 2.

Noon 29241 99992 18033

Full explanation :—Noon. Sheet cirrus, amount doubtful, movement very slight from West. R.-Point doubtful. Bearing of centre of bank doubtful, but portion visible, rather dense. Wind at time of observation S.S.W., gentle breeze; sky three fourths covered with lower forms of cloud.

EXAMPLE 3.

Noon 30000 06000 04010

Full explanation :—Very small quantity of high cirro-cumulus, motionless, radiating from E.N.E. no bank. Wind at surface N.E., light airs, no lower cloud.

APPENDIX B.

Instructions as to the Use of the Self-Registering
Aneroid Barometer.

SOME stations are supplied with self-registering aneroid barometers, and to the observers at such stations the following rules apply:—

1. The main object for which this instrument is supplied is to enable the observer to furnish information as to the character of the changes in barometric pressure which take place between the fixed hours of observation. The information should be communicated in as few words or figures as possible, and these should follow the ordinary groups of figures in the telegraphic reports.

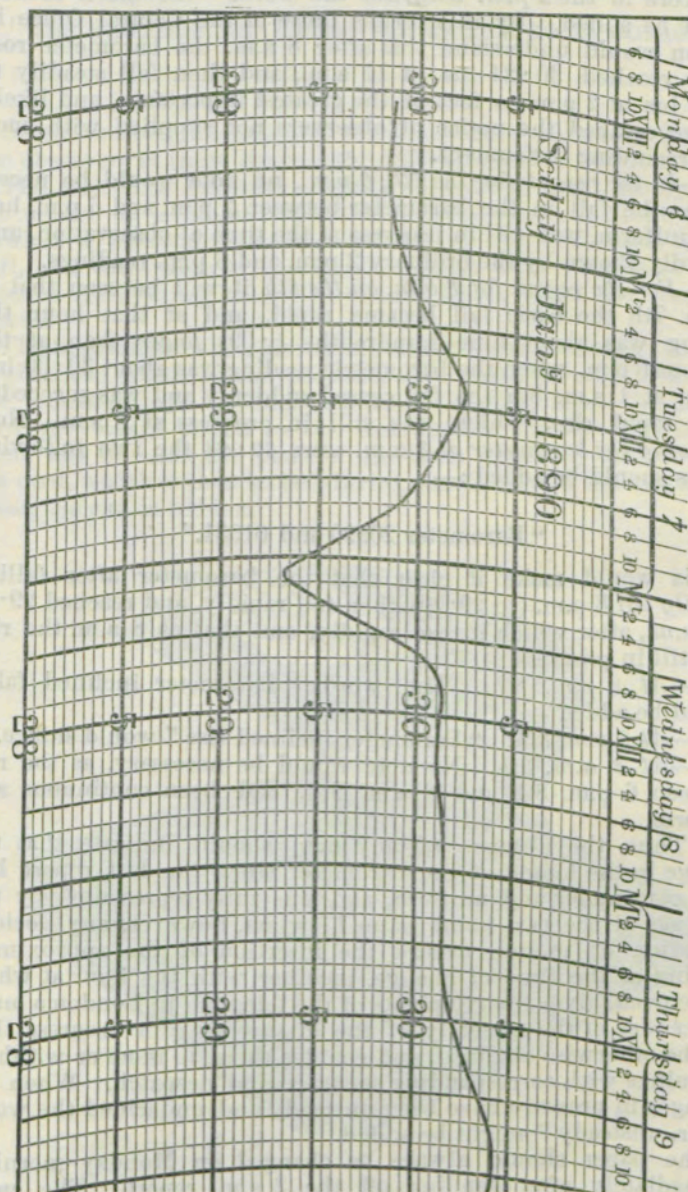
2. For stations which send reports three times daily, the words sent in the 8 a.m. reports should refer to the changes which have occurred since 6 p.m. on the previous day.

Those sent at 2 p.m. should refer to the changes noted since 8 a.m.

Those sent at 6 p.m. should refer to the changes noted since 2 p.m.

When any "Special" telegram is sent (see p. 9), any important change that has occurred since the previous telegram should be similarly noted.

3. In order that the required information may be accurately transmitted the principles indicated in the following rules must be observed:—



Note A.—Referring to the accompanying curve, it will be seen that soon after 11 a.m. on January 7 the barometer, which had been rising, ceased to do so, and began to fall briskly. It will also be seen that between that hour and 2 p.m. the barometer fell about

nine hundredths of an inch. Now, *supposing the 2 p.m. reading of the mercurial barometer, corrected and reduced, to be 30·15, the corresponding reading at 11 a.m. would have been 30·24. Therefore to the 2 p.m. telegram the words "Barometer 11024"* should be added. By this means those at the Central Office in London would understand that after 8 a.m. the barometer rose till it reached 30·24 ins. at 11 a.m., and then fell steadily to 30·15 ins. at 2 p.m., a fact of the greatest importance, and likely to have escaped the notice of observers not supplied with such a self-recording instrument.

B.—*In the report for the 7th, 6 p.m.*, no note would be necessary, as the fall in the barometer between 2 p.m. and 6 p.m. had been uniform, was still in progress at the time of observation, and was fully shown by the ordinary 2 p.m. and 6 p.m. readings.

C.—*For the report for 8 a.m. on the 8th* it will be seen that at 8 p.m. 7th the baric fall became rapid, and at that hour the reading was about nine hundredths ($\cdot 09$) lower than at the previous 6 p.m., when the barometric reading was about 30·00 ins. Again, at 1 a.m. 8th the fall ceased suddenly and was succeeded by a rapid rise, which was still in progress at 8 a.m. Now *supposing the barometer at 8 a.m. were 30·04* the two following groups should be added :—

"Barometer 20990 and 01931."

This would make it clear that the barometer after falling steadily till 8 p.m. (to 29·90) then fell rapidly, and reached 29·31 at 2 a.m., after which it rose rapidly, and that at 8 a.m. the rise was still in progress.

D.—*At 2 p.m. 8th.* The words "Barometer inclined fall" should be added.

E.—*At 6 p.m. 8th.* "Barometer inclined rise" would suffice.

F.—*At 8 a.m. 9th.* No note would be necessary, as the rise between 6 p.m. 8th and 8 a.m. 9th, had been continuous and uniform.

4. Thus, the absence of any note should indicate that the change in the height of the barometer since the last report had been continuous and uniform, and was fully represented by the readings at the two hours named; when, however, any decided alteration of motion occurs, the insertion of the approximate reading at the time of change, together with the hour at which it occurred, gives the recipients of the telegram in London a much better idea of the intensity of the disturbances in progress than can be otherwise obtained, and enables them to issue or withhold Warnings with corresponding accuracy and despatch. When the changes in pressure have been unsteady and undecided the words "Bar. unsteady" might be added.

The paper should always be changed on Monday morning, immediately after sending off the 8 a.m. report. The curve should be carefully dated as shown in the diagram on p. 35, and be sent to the Meteorological Office by the *first available post*.

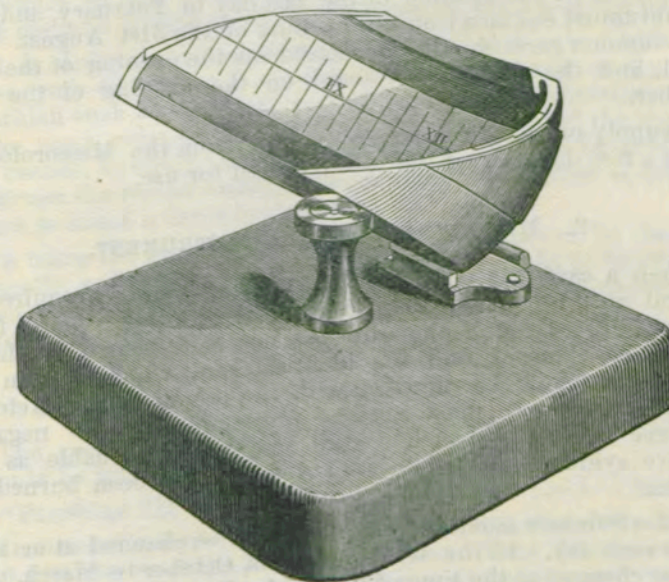
APPENDIX C.

Instructions for Using the Sunshine Recorder.

SOME stations are supplied with sunshine recorders, and for the observers at these stations the following notes are prepared.

The Sunshine Recorder consists of a metal bowl, firmly fixed by means of a brass bracket to a slate base; in front of the bowl is a pedestal, upon the curved top of which rests a glass ball, and the inside of the bowl is fitted with a series of three grooves for holding the strips of card upon which the record is scored.

The instrument when placed in position faces true south; the lens (a glass ball) rests on the pedestal, and, when the sun is shining the focussed rays produce a burn, or scorch, upon the slip of card previously placed in the instrument. As the sun travels from east to west, the place of the burn gradually moves along the card, which is thus scored during sunshine, and left untouched when the sun is hidden.



The instrument, after being adjusted and fixed in position, (an operation usually performed by one of the Inspectors of the Meteorological Office) should not be interfered with in any way. If, from any cause the slate base becomes loose and is thus liable to be shifted out of position the fact should be immediately reported to the Office.

1. CHOICE AND INSERTION OF THE CARDS.

Cards are provided of three patterns, straight for the equinoxes, and curved for summer and winter. The summer and winter cards are alike except as to length (the summer cards being the longer), and as to the position of the figures with respect to the curvature of the cards. Those on the summer cards are erect when the *convex* edge of the card is held uppermost, and those on the winter cards when the *concave* edge is uppermost.

The Equinoctial cards must be inserted in the centre groove of the bowl, the summer cards in the lower groove, and the winter cards in the upper groove.

The EQUINOCTIAL (straight) cards are to be used from the 1st of March to the 12th of April inclusive, and again from the 1st of September to the 12th October inclusive. The SUMMER (long, curved) cards are to be used from the 13th of April to the 31st of August inclusive, and the WINTER (short, curved) cards from the 13th of October to the last day of February inclusive.

The changes in the use of the various kinds of cards should, of course, be made after sunset on the dates prior to those just mentioned. The first equinoctial card should be inserted in the instrument on the evening of the last day in February, and (for the autumnal equinox) on the evening of the 31st August. The first summer card should be inserted on the evening of the 12th April, and the first winter card on the evening of the 12th October.

A supply of each form of card is sent from the Meteorological Office a few days before they are required for use.

2. MANAGEMENT OF THE INSTRUMENT.

When a card has been inserted, nothing more is required in general until next day, when the card is withdrawn and a fresh one put in. Even if the card has not been scored it should always be changed, and the identical card which was in the instrument should be returned with the others to the Meteorological Office; it must not be forgotten that the negative evidence afforded by such a card may be as valuable as the positive evidence yielded by a card which has been burned by the sun.

In the Summer months the cards should be changed at or after sunset each day. In the Winter months, October to March, they may be changed at the time of taking the 6 p.m. observations.

3. DATING AND MARKING THE CARDS.

Every card should have clearly written upon it the name of the place, the date, and the time of insertion and withdrawal; this should be done as soon as possible after the card has been removed from the instrument.

Should the instrument have been moved, or should anything have occurred to interfere with the accuracy of the score in any way, an explanatory note should always be written on the back of the card.

4. TABULATION OF THE CARDS.

The points on which observers have generally asked for information have been two :—

- (1.) How to deal with cases in which the scorch is *faint*, such as is usually the case near sunrise and sunset, or when the sun is shining through a slight haze.
- (2.) How much of the trace to measure when the sun has been shining *brightly* but *intermittently*, or when a strong burn has been abruptly stopped.

In the first of these cases it is recommended that the whole of the trace, *as far as it can FAIRLY be seen*, should be measured, the measurement being carried right to its extreme ends.

In the second case it must be remembered that when the sun is shining with moderate power there is always a slight lateral extension of the trace, due to the smouldering of the card, and in consequence the trace will probably be as long for one minute of sunshine as for two or three. For this smouldering a slight allowance should be made, and the measurement should not in such cases be carried to the extreme limits of each of the burns.

It is difficult to lay down a hard-and-fast rule which shall meet every case, because special circumstances may easily occur in which such a rule ought to be modified, and therefore something must necessarily be left to the judgment of the observer. He cannot, however, go far wrong if he will always be careful not to *strain* the record unduly, remembering that what is required is not so much a *large* total as a *correct* one.

In using the glass scale the parts of hours should be measured to *tenths*, and not to minutes; and the scale ought to be so placed upon the card that one of its curved lines may correspond to the outer edge of the card.

5. REPORTING THE HOURS OF SUNSHINE BY WIRE.

The amount of sunshine recorded during the preceding day should be transmitted in the 8 a.m. telegram thus :—

“Sunshine 119” (= 11.9 hours) or “015” (= 1.5 hours).

In time of snow, the snow should be removed from the ball and from between the ball and the card. Hoar frost should also be removed from the ball as soon as possible, and in towns, especially those where there is generally much smoke, the ball should be wiped daily to remove any soot and dirt which may have become deposited upon it. Care should also be taken to keep clean the grooves in which the cards slide; if the cards fit tightly their edges may be burnished, and if owing to rain they cannot be withdrawn without tearing, they should be carefully cut out with a sharp knife.

6. RETURN OF CARDS TO THE METEOROLOGICAL OFFICE.

As soon as possible after the close of each month the cards should be posted, addressed to—

The Director,
Meteorological Office,
63, Victoria Street,
London, S.W.,

and their receipt will be at once acknowledged by printed post card. It is particularly requested that each month's cards shall be returned to the Office before the 7th of the following month; and also that in packing them for transmission through the post they shall always be kept flat, and not be folded.

APPENDIX D.

Special Telegraphic Codes for use by Observers at Auxiliary Stations only.

CODE No. 1.

FOR TELEGRAPHING EVENING (6 P.M.) OBSERVATIONS TO THE METEOROLOGICAL OFFICE.

The message should consist of 4 groups of 5 figures each—counting as 4 words. Whenever it is impossible to supply any portion of the information the vacant space should be filled in with ciphers, so as to keep the group intact.

COMPOSITION OF GROUPS.

First Group.—*Barometer reading* at 6 p.m. (three figures); and *Direction of Wind*, as per accompanying scale (two figures) —

Scale for Wind Direction.

| | | | |
|--------|------|--------|------|
| N. | = 32 | S.S.W. | = 18 |
| N.N.E. | = 02 | S.W. | = 20 |
| N.E. | = 04 | W.S.W. | = 22 |
| E.N.E. | = 06 | W. | = 24 |
| E. | = 08 | W.N.W. | = 26 |
| E.S.E. | = 10 | N.W. | = 28 |
| S.E. | = 12 | N.N.W. | = 30 |
| S.S.E. | = 14 | N. | = 32 |
| S. | = 16 | Calm | = 00 |

Specimens of group:—

- (a) 99604 = *Barometer reading* 29.96 inches (the first figure always omitted); *Wind Direction* N.E.
(b) 00122 = *Barometer reading* 30.01 inches; *Wind Direction* W.S.W.

Second Group.—*Force of Wind*, by Beaufort Scale (two figures); *Weather* at 6 p.m., also by Beaufort Scale (one figure); *Dry Bulb temperature* at 6 p.m. (two figures).

Beaufort Scale for Wind Force.

| | | | |
|-----------------|------|-------------|------|
| Calm | = 00 | High wind | = 07 |
| Light air | = 01 | Fresh gale | = 08 |
| Light breeze | = 02 | Strong gale | = 09 |
| Gentle breeze | = 03 | Whole gale | = 10 |
| Moderate breeze | = 04 | Storm | = 11 |
| Fresh breeze | = 05 | Hurricane | = 12 |
| Strong breeze | = 06 | | |

Scale for Weather.

- | | |
|---------------------------------|--------------------|
| 0 = Sky quite clear. | 5 = Rain falling. |
| 1 = Sky a quarter clouded. | 6 = Snow falling. |
| 2 = Sky half clouded. | 7 = Mist or haze. |
| 3 = Sky three quarters clouded. | 8 = Fog. |
| 4 = Sky entirely overcast. | 9 = Thunder storm. |

Specimens of group:—

(a) 02360 = *Force of Wind* 2 (a light breeze); *Weather*, Sky three quarters clouded; *Dry Bulb temperature* 60°.

(b) 10549 = *Force of Wind* 10 (a whole gale); *Weather*, Rain falling; *Dry Bulb temperature* 49°.

Third Group.—*Maximum temperature for day* (two figures); and *Amount of Bright Sunshine for day, up to 6 p.m.*, in hours and tenths of hours (three figures) —

Specimens of group:—

(a) 48032 = *Maximum temperature* 48°; *Amount of Bright Sunshine* 3·2 hours.

(b) 69118 = *Maximum temperature* 69°; *Amount of Bright Sunshine* 11·8 hours.

(c) 40000 = *Maximum temperature* 40°; *Amount of Bright Sunshine* Nil.

Fourth Group.—*Minimum temperature for 24 hours ending with 6 p.m.* (two figures), and *Amount of Rainfall* for same period (three figures) —

Specimens of group:—

(a) 38024 = *Minimum temperature* 38°; *Rainfall* 0·24 inch.

(b) 42102 = *Minimum temperature* 42°; *Rainfall* 1·02 inch.

(c) 35005 = *Minimum temperature* 35°; *Rainfall* 0·05 inch.

At stations possessing only one rain gauge some care will be required to keep the morning and evening measurements quite distinct. The water measured at 6 p.m. should be replaced in the gauge, and only the water measured at 9 a.m., which will be the total for the 24 hours, should be thrown away. The evening measurement will be the amount collected between 9 a.m. and 6 p.m. *plus* the amount collected in the previous 15 hours—that is, between 6 p.m. of the previous day and 9 a.m. of the day itself.

Any exceptional phenomenon noticed during the day, such as a thunderstorm, unusually heavy rain, &c., should be reported, very briefly, in words after the groups of figures, with the time of its occurrence.

CODE No. 2.

FOR TELEGRAPHING WEATHER INFORMATION ORDINARILY
SENT BY POST CARD.

The message to consist of three groups of five figures each, counting as three words. Whenever it is impossible to supply any portion of the information the space to be filled in with ciphers, so as to keep the groups intact.

COMPOSITION OF GROUPS.

First Group.—*Maximum and Minimum temperatures*, to whole degrees (two figures each); *Weather at time of observation* (one figure), sent by following Scale.

Scale for Weather.

- | | |
|---------------------------------|--------------------|
| 0 = Sky quite clear. | 5 = Rain falling. |
| 1 = Sky a quarter clouded. | 6 = Snow falling. |
| 2 = Sky half clouded. | 7 = Mist or haze. |
| 3 = Sky three quarters clouded. | 8 = Fog. |
| 4 = Entirely overcast. | 9 = Thunder storm. |

Specimens of group:—

(a) 56495 = *Maximum temperature* 56°; *Minimum temperature* 49°. *Weather*, Rainy.

(b) 40310 = *Maximum temperature* 40°; *Minimum temperature* 31°. *Weather*, Sky quite clear.

Second Group.—*Amount of Bright Sunshine* (three figures) *Weather in past 24 hours* (two figures) sent by above scale, and placed in the order in which it occurred.

Specimens of group:—

(a) 05542 = *Sunshine* 5·5 hours; *Weather in past 24 hours* 4 = overcast, followed by 2 = sky half clouded.

(b) 10249 = *Sunshine* 10·2 hours; *Weather in past 24 hours* 4 = overcast, followed by 9 = thunder storm.

(c) 00036 = *Sunshine* nil; *Weather in past 24 hours* 3 = sky three quarters clouded, followed by 6 = snow.

Third Group.—*Amount of Rainfall* (three figures), followed by two ciphers, to make the group complete.

Specimens of group:—

- | | | |
|-----------|---|---------------------|
| (a) 00000 | = | Rainfall nil. |
| (b) 00500 | = | Rainfall 0·05 inch. |
| (c) 06100 | = | Rainfall 0·61 inch. |
| (d) 12600 | = | Rainfall 1·26 inch. |

Any exceptional phenomena should be reported briefly in words at the end of the message, with the time of its occurrence.

CODE No. 3.

FOR TELEGRAPHING SUNSHINE INFORMATION ONLY.

The amount should be given as a group of three figures, pre-
faced by the words "Bright Sunshine." The duration must be
reported in hours and tenths of hours.

Specimens of group :—

| | | |
|---------|---|----------------------|
| (a) 000 | = | No Sunshine. |
| (b) 008 | = | Duration 0·8 hour. |
| (c) 054 | = | Duration 5·4 hours. |
| (d) 112 | = | Duration 11·2 hours. |

CODE No. 3.

THE THREE DARTING REGISTER INFORMATION SHEET

The amount should be given as a group of three figures, preceded by the word, "Bright Sunshine." The direction must be reported in hours and tens of hours.

Direction of group:—

| | | |
|---------|---|--------------------|
| (a) 000 | = | No Sunshine |
| (b) 001 | = | Direction 00 hours |
| (c) 002 | = | Direction 01 hours |
| (d) 003 | = | Direction 02 hours |

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