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INDIA METEOROLOGICAL DEPARTMENT

INSTRUCTIONS TO OBSERVERS

AT THE

SECOND AND THIRD CLASS OBSERVATORIES

1934



DELHI : MANAGER OF PUBLICATIONS
1934

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FOREWORD.

This departmental hand-book, prepared by Dr. S. C. Roy, is intended for use by the Observers at second and third class observatories in India. The first four chapters should be very carefully read by each Observer and the instructions contained therein should be followed strictly in the daily observational work. The Meteorological Department will be glad to explain to the Observer any instructions that are not clear to him. He should also take every opportunity to discuss all doubtful points in the book with an Inspector when one visits his station.

This hand-book and the departmental cloud atlas together replace the old "Instructions to Observers", which is now out of print.

Poona,
May, 1930.

C. W. B. NORMAND,
Director General of Observatories.

FOREWORD TO THE SECOND EDITION.

A new edition of this hand-book is needed to meet demands from outside the department and the opportunity has been taken departmentally to revise several portions of the text and to bring the Instructions generally up to date.

Poona,
December, 1933.

C. W. B. NORMAND,
Director General of Observatories.

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CHAPTER I.

INTRODUCTORY REMARKS.

1. CLASSIFICATION OF OBSERVATORIES.—The Observatories of the India Meteorological Department are of 4 classes :—

- (a) **First Class** observatories are provided with eye-reading and self-recording instruments.
- (b) **Second Class** observatories are furnished only with eye-reading instruments. Regular observations are taken twice daily and telegraphed to the different forecasting centres.
- (c) **Third Class** observatories have the same instrumental equipment as the second class ones, but observations are taken only once a day and telegraphed to the different forecasting centres.
- (d) **Other** observatories are either less equipped or are not required to telegraph the observations.

The majority of the Indian observatories belong to the second or the third class and it is chiefly for these observatories that this handbook is intended.

2. INSTRUMENTAL EQUIPMENT.—The basic instrumental equipment of a second or third class station is :—

- (i) Mercury barometer.
- (ii) Four thermometers—Dry bulb, Wet bulb, Maximum and Minimum fixed inside the Stevenson screen.
- (iii) Raingauge and Measure Glass.
- (iv) Wind Instruments—Windvane and Anemometer.
- (v) Observatory Watch.

3. METEOROLOGICAL ELEMENTS.—The meteorological elements which are to be observed at a second or third class station are stated below :—

- (i) **Barometric pressure**, that is, the pressure of the air observed with the barometer.
- (ii) **Dry bulb temperature**, that is, the temperature of the air inside the Stevenson screen at the time of observation.

- (iii) **Wet bulb temperature**, which gives, in conjunction with the dry bulb temperature, the humidity of the air.
- (iv) **Maximum temperature**, that is, the highest temperature reached by the air inside the screen since the last setting of the maximum thermometer.
- (v) **Minimum temperature**, that is, the lowest temperature reached by the air inside the screen since the last setting of the minimum thermometer.
- (vi) Amount of **rain** fallen between successive observations.
- (vii) Direction and force of **wind** given by the Windvane and the Anemometer readings respectively.
- (viii) **Visibility** obtained by the observation of the 'visibility land marks'.
- (ix) Amounts and forms of **cloud** and their directions of movement.
- (x) Character of the **weather** since last observation and at the time of observation.
- (xi) State of **sea and swell** (coast stations) or of **ground** (inland stations).

4. HOURS OF OBSERVATIONS.—

- (i) **Regular hours** of observations at the **second class** stations are 8 hrs. local time and 17 hrs. Indian Standard Time (I.S.T.). At **third class** stations regular observations are taken only at 8 hrs. local time.
- (ii) **Extra Observations** may be requisitioned at any hour by the various forecasting centres. The standard of time adopted for the special observations is always Indian or Burma Standard Time.

NOTE.—'Indian Standard Time' is exactly $5\frac{1}{2}$ hours ahead of Greenwich Mean Time and is the time corresponding to long. $82\frac{1}{2}^{\circ}$. It is distributed daily by telegraph line from the Alipore Observatory and is kept at all Railways, and Post and Telegraph Offices. 'Burma Standard Time' is $6\frac{1}{2}$ hours ahead of Greenwich Mean Time or one hour ahead of 'Indian Standard Time'. The clock or the watch that regulates the observations must be compared every day with the clocks of the Post and Telegraph Office.

5. ORDER OF OBSERVATIONS.—The barometer should be set and read *exactly* at the stated hours of observations, correct to a minute. The thermometers should be read next, in the order, dry

bulb, wet bulb, maximum and minimum. Observations of the other elements should then follow the order, rainfall, wind, visibility, cloud, weather and state of sea or ground.

6. OBSERVER'S DUTIES.—The routine duties of an Observer are :—

- (i) To make *regular* and *careful* observations *punctually* at the prescribed hours of observations.
- (ii) To note the general character of the *weather* not only at the fixed hours of observations, but throughout the day, and to record any unusual or remarkable weather phenomenon with the time of its occurrence.
- (iii) To compare *each morning* the readings of the maximum and minimum thermometers with that of the dry bulb thermometer after setting them.
- (iv) To prepare and despatch the *weather telegram*, marked 'XW', to the different forecasting centres, *immediately* after the observations are taken.
- (v) To send out, promptly, **heavy rainfall telegrams** to the various officers on the warning list.
- (vi) To take **extra observations** whenever requisitioned by any forecasting centre, and telegraph these observations 'XW' or 'XXW', as asked for.
- (vii) To copy *in ink*, each day's observations into the *Monthly Meteorological Register* the *next day* and to maintain the *Weather Diary* regularly.
- (viii) To post the *Monthly Meteorological Register* and *Weather Diary*, together with the carbon copies of weather telegrams of each month, to the controlling Meteorological Office **before the 4th of the succeeding month**.
- (ix) To post to the controlling Meteorological Office the **Pocket Register**, in a *separate cover*, within a day or two of the despatch of the corresponding Monthly Meteorological Register and Weather Diary.
- (x) To prepare *yearly returns* of the stock of instruments and forward them to the Meteorological Head Quarters, Poona, as soon after the 1st April as possible.
- (xi) To keep the instruments *clean* and *free from dust*.
- (xii) To provide a competent **Deputy Observer** to take observations in his absence.

- (xiii) To notify to the controlling Meteorological Office *permanent changes of observerships* together with the 'charge list' of instruments, etc., on prescribed forms.

NOTE.—*The regular observer should train the deputy observer thoroughly. If the deputy observer is inefficient, the chances are that his mistakes will be counted against the regular observer.*

7. GENERAL INSTRUCTIONS REGARDING OBSERVATIONS—

- (i) **Punctuality :** Punctuality is a matter of great importance in making meteorological observations. The Observer should take great care to ensure that the clock or the watch by which he is guided, keeps correct *Indian or Burma Standard Time or Greenwich Mean Time* as the case may be.

To avoid delay and irregularity he should make it his business to be ready near the barometer a few minutes before the prescribed time of observations. The Observer should record in the *Pocket Register* the *exact* hours and minutes at which the barometer is read. He should understand that it is a detectable deception to put on permanent record the reading of a barometer at, say, 8 h. 15 m. as the reading at 8 h.

- (ii) **Honesty :** Every observation should be recorded *honestly* as read. In cases of doubt the observations should be repeated twice or thrice, until the observer is satisfied. If any observations are not taken, the spaces in the *Pocket Register* allotted for them should be left blank. The reason for the omission of readings must, however, be clearly stated. In no case, should concocted figures be inserted subsequently.

- (iii) **Immediate Entry of Observations :** Each observation must be written down in the *Pocket Register* *immediately after it is taken*. The readings should *never* be jotted down on scraps of paper with the intention of copying them later on.

- (iv) **Check on Entry :** *Check* each observation after noting it down in the *Pocket Register* to make sure that no mistake has been made.

8. GENERAL INSTRUCTIONS FOR THE CARE OF INSTRUMENTS—

- (i) The positions of the instruments must never be changed, except under orders from the Meteorological Department.
- (ii) When an instrument is out of order and the Observer is unable to remedy its defect, the Meteorological Head Quarters, Poona, should be ~~in~~formed immediately.

- (iii) Unserviceable instruments should in no case be thrown away by the Observer without the *previous approval* of the controlling Meteorological Office.
- (iv) The barometer is a very delicate instrument and must be handled with great care. The Observer should *in no circumstances* try to remedy any defect found in a barometer without previous instructions from the controlling Meteorological Office.
- (v) The bottle attached to the wet bulb thermometer must always be filled with rain or distilled water. The muslin and thread should be renewed *once a fortnight in fine weather, once a week in dusty weather, and immediately after a duststorm.*
- (vi) Wind instruments should be cleaned and oiled *at least once a fortnight in dusty weather and once a month in the rainy season.*
- (vii) Tall grass or shrubs should not be allowed to grow round the Raingauge as these would vitiate its exposure.

CHAPTER II.

INSTRUMENTAL OBSERVATIONS AND THE CARE OF INSTRUMENTS.

9. INSTRUCTIONS FOR SETTING AND READING THE BAROMETER.—There are two types of barometers in use known as the **Fortin** barometer and the **Kew pattern** barometer. These are described in Section 34.

The mode of setting and reading a **Fortin** barometer is as follows :—

- (i) **Attached Thermometer :** Read the thermometer attached to the barometer to the nearest degree, a minute or so before the time specified for the barometer observation, and enter the reading in column 3 of the *Pocket Register*. This should be done first because the Observer's presence near the instrument is likely to heat the attached thermometer more quickly than the mercury in the barometer tube.
- (ii) **Gently tap** the cistern and the tube of the instrument two or three times with the *pads* of the fingers to prevent the mercury from adhering to the glass.

- (iii) **Setting of the mercury surface in the cistern:** Raise the surface of the mercury in the cistern by screwing up the plunger at the base until the top of the *ivory point just touches its image in the clean mercury surface*. If the ivory point appears to press down upon the mercury surface and to form a little cup-like hollow, lower the mercury surface by unscrewing the plunger and then re-adjust the mercury level by screwing up the plunger *very slowly* until the tip of the ivory point and its image just meet.
- (iv) **Setting of the Vernier:** Adjust the vernier by means of the milled-head screw on the right hand side till its lower edge is a tangent to the *convex* top of the mercury column, *i.e.*, the front and back edges of the vernier and the top of the mercury column must all lie in the same straight line. This can only be ascertained if the *eye of the Observer is at the same level as the topmost point of the mercury column*. Thus when the vernier is correctly set the appearance of the top of the mercury and the vernier will be as in Fig. 1. If the vernier appears to cut off part of the mercury as in Fig. 2, then it has been set too low, and if the appearance is as in Fig. 3, then the vernier has been set too high.

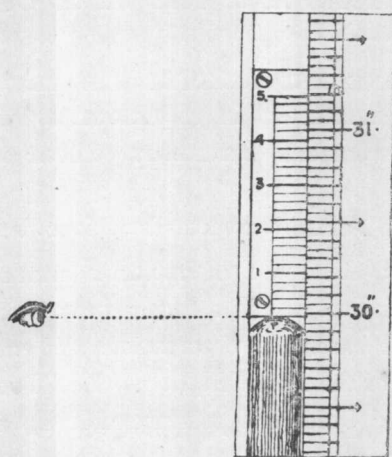


FIG. 1.

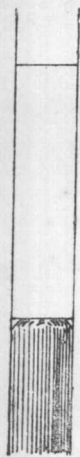


FIG. 2.

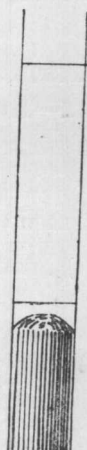


FIG. 3.

VERNIER SET CORRECTLY

TOO LOW.

TOO HIGH.

A good plan for setting the vernier is as follows:—First place the vernier intentionally too high, so that a light space can be seen between

the vernier and the top of the mercury column. Then lower the vernier very gradually so that this light space becomes less and less, and eventually the *lower edge of the vernier just touches the highest point of the mercury column*. No light space must be visible from any position of the eye between the edge of the vernier and the highest point of the curved mercury surface, but with the eye at the correct level (*see Fig. 1*) the *bright triangles on each side should appear as large as possible*.

- (v) **Reading the Scale and the Vernier :** The fixed scale on the right of the vernier is graduated to 0.050 of an inch. First note between which two graduations the top of the mercury column stands and record the lower one. Thus in Fig. 1 the mercury top lies between 29.950" and 30.000" and hence the reading on the fixed scale should be taken as 29.950". Then look along the vernier and see which of its lines most nearly coincides with a line on the fixed scale. Each division marked by figures 1, 2, 3, etc., on the vernier is equal to .010" and each sub-division between the figures is equal to .002". In Fig. 1 the third line above 3 of the vernier is continuous with a line on the fixed scale. The number 3 corresponds to .030" and the third sub-division corresponds to $(3 \times 0.002") = .006"$. Thus in the foregoing example (*see Fig. 1*),

Reading on scale	29.950"
Reading on Vernier	{ .030"
	{ .006"
Actual reading	<hr/> 29.986" <hr/>

- (vi) Enter in column 4 of the *Pocket Register* the actual reading of the barometer thus obtained.
- (vii) Check the reading after entering it in the *Pocket Register* by making a fresh setting. Be very careful to avoid errors of .05", i.e., error in counting the number of divisions on the fixed scale. If the vernier has a small bit projecting at the corner of its lower edge, care should be taken to read the fixed scale where the zero line (and *not* the projecting end) of the vernier meets the scale; otherwise errors of the order of .05" may be committed.

- (viii) After each observation unscrew the plunger in the cistern so as to leave the mercury surface well below the ivory point. If this is not done the mercury and the ivory point will become dirty by prolonged contact with each other.

If the barometer is of the **Kew pattern**, no adjustment of the cistern has to be made, otherwise the instrument is set and read exactly as the **Fortin**.

10. BAROMETRIC CORRECTION AND REDUCTION.—The barometer reading has to be (a) corrected for index error (*i.e.*, an error inherent in the instrument) and temperature, and (b) reduced to standard gravity at latitude 45° and mean sea level. A **Barometer Correction Card** is supplied to each station to enable its Observer to apply corrections (a) and reduction (b). A specimen card of this type is reproduced on the next page.

The correction is to be added or subtracted according as the sign at the head of table is + or —. The temperature of the Attached Thermometer must be used always in Table A and Dry Bulb temperature in Table B. The following example will serve to illustrate the use of the card :—

Station X Y Z Bar No. 953.

Attached thermometer	62°
Dry bulb thermometer (Index correction applied)	65°
Barometer as read (column 4 of the pocket register)	29.936
Index error (as given on the top of the card)	+018
The temperature correction corresponding to attached thermometer 62° and barometer reading 30.0 (from Table A)	—091
∴ barometer corrected for index error and temperature	29.863
Enter therefore 29.863 in column 5 of the pocket register.	
Reduction to latitude 45° and mean sea level corresponding to dry bulb temperature 65° and corrected barometer 29.9 (Table B)	+409
∴ barometer corrected for index error and temperature and reduced to latitude 45° and sea level	30.272
Enter 30.272 in column 6 of the pocket register.	

Specimen Barometer Correction Card.

Station X Y Z Lat. 30° 12' Long. 71° 31'.

Height above M. S. L. 420 feet.

Bar. No. Casella Fortin 953. Index error +.018.

TABLE A.

Correction for temperature.

Attached thermo- meter.	Barometer Reading.		
	29.0"	29.5"	30.0"
	Correction to be applied.		
	<i>Subtract.</i>		
52°	-.061	-.062	-.064
54	-.067	-.068	-.069
56	-.072	-.073	-.074
58	-.077	-.078	-.080
60	-.082	-.084	-.085
62	-.088	-.089	-.091
64	-.093	-.095	-.096
66	-.098	-.100	-.101
68	-.103	-.105	-.107
70	-.109	-.110	-.112
72	-.114	-.116	-.118
74	-.119	-.121	-.123
76	-.124	-.126	-.128
78	-.129	-.132	-.134
80	-.135	-.137	-.139

TABLE B.

Reduction to latitude 45° and mean sea level.

Dry bulb thermo- meter.	Barometer corrected for Temperature.					
	29.0"	29.2"	29.4"	29.6"	29.8"	30.0"
	Correction to be applied.					
	<i>Add.</i>					
52°	+.404	+.407	+.410	+.412	+.415	+.418
54	+.403	+.406	+.409	+.411	+.414	+.417
56	+.401	+.404	+.407	+.409	+.412	+.415
58	+.400	+.403	+.406	+.408	+.411	+.414
60	+.399	+.402	+.405	+.407	+.410	+.413
62	+.398	+.401	+.404	+.406	+.409	+.412
64	+.397	+.400	+.403	+.405	+.408	+.411
66	+.395	+.398	+.401	+.403	+.406	+.409
68	+.394	+.397	+.400	+.402	+.405	+.408
70	+.393	+.396	+.399	+.401	+.404	+.407
72	+.391	+.394	+.397	+.399	+.402	+.405
74	+.390	+.393	+.395	+.398	+.400	+.403
76	+.388	+.391	+.394	+.396	+.399	+.402
78	+.387	+.390	+.392	+.395	+.397	+.400
80	+.385	+.388	+.390	+.393	+.395	+.398

11. CARE OF THE BAROMETER—

- (i) Great care must be exercised in handling the barometer. When touching the instrument care should be taken *not to displace it from the vertical.*
- (ii) The instrument should be lightly dusted every day with a small soft brush. It should never be rubbed with cloth.
- (iii) The chief defects to which mercury barometers are subject are (1) the entry of air into the space above the mercury and (2) some mechanical defect of the vernier-head or plunger screw. If the barometer is found in any way defective, the matter should be immediately reported to the controlling Meteorological Office by telegram. *The Observer should in no case try to remedy the defect himself unless specially instructed to do so.*
- (iv) A barometer is so placed that there is always good light for setting and reading the instrument but the sun should not shine on it directly. If the instrument is found to be exposed to the direct rays of the sun at any hour of the day, this fact should be intimated to the controlling Meteorological Office.
- (v) When taking special observations in the night, or if the natural illumination is insufficient to set the barometer during the day-time, illuminate the instrument with the lamp supplied to you. Do not place a lighted match or other naked light behind the instrument, as this frequently leads to very inaccurate setting.

12. INSTRUCTIONS FOR READING THERMOMETERS.—The four thermometers, dry bulb, wet bulb, maximum and minimum, are exposed in a shelter of approved pattern called the Stevenson screen (see Section 35, page 60).

Hours of Reading and Setting.—The dry and the wet bulb thermometers are to be read at *each* observation immediately after taking the barometer reading, but the maximum and minimum thermometers are to be read and set only *once* in 24 hours at the time of the *morning observation* (8 A.M. local time).

The following instructions should be followed carefully in taking thermometer readings :—

- (i) **Order of Reading.**—Having let down the door of the Stevenson screen *first* read the dry bulb and the wet bulb thermometers as *quickly* as is consistent with accuracy, so that they may not be heated by the presence of your body or by your breathing directly on the bulbs. Then read the maximum and the minimum thermometers.
- (ii) **What to observe.**—In the case of the dry bulb, the wet bulb and the maximum thermometers observe the position of the end of the mercury column (*see* Fig. 4) ; but in the case of the minimum thermometer note the position of the end of the dumb-bell-shaped index *furthest from the bulb* (*see* Fig. 5).

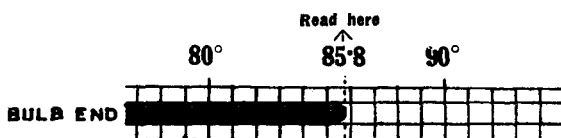


FIG. 4 MERCURY THERMOMETER.

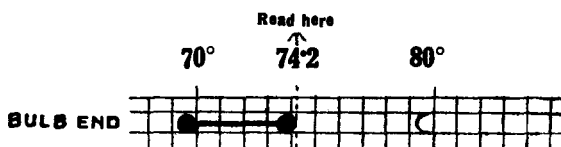


FIG. 5 MINIMUM THERMOMETER

- (iii) **Degree of accuracy.**—Read all the thermometers to the nearest *tenth* of a degree. This can be done by dividing mentally one degree into ten equal parts. *Always use the graduations etched on the glass stem of the thermometers and not the bold graduations on the porcelain or metal plate on which the thermometer is mounted.*
- (iv) **Sighting Error.**—While taking a reading make sure that the straight line joining your eye to the end of the mercury column (or index in the case of minimum) is at right angles to the length of the column. Errors due to wrong sighting

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