

HINTS
TO
METEOROLOGICAL OBSERVERS
IN
TROPICAL AFRICA,
WITH
INSTRUCTIONS FOR TAKING OBSERVATIONS.

Prepared by a

COMMITTEE OF THE BRITISH ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE, 1891.

E. G. RAVENSTEIN, F.R.G.S., *Chairman.*

BALDWIN LATHAM, C.E., F.G.S.

G. J. SYMONS, F.R.S., *Secretary*, 62, Camden Square, London, N.W.

LONDON, 1892.

LONDON:

KENNY & Co., PRINTERS, 25, CAMDEN ROAD, N.W.

HINTS TO METEOROLOGICAL OBSERVERS

IN

TROPICAL AFRICA.*

Prepared by a Committee of the British Association.

The Committee appointed by the British Association are prepared to supply a few competent and approved observers in Tropical Africa with the following instruments:—

1. A Fortin's Barometer.
2. A Dry Bulb Thermometer.
3. A Wet Bulb " "
4. A Maximum " "
5. A Minimum " "
6. A Rain Gauge.

The Thermometers are placed within a cage of galvanized iron, ready for suspension under shelter.

The corrections to be applied to the readings of the instruments furnished by the Committee have been ascertained, and will be forwarded to each observer. Observations, however, should be entered in the Register as actually recorded by the instrument, and without applying any of these corrections.

Observers making use of instruments not supplied by the Committee, are earnestly requested to furnish a description of them (maker's name and number), with such notes on their errors as may be in their possession.

Every opportunity for comparing the instruments at a station with other instruments in the possession of travellers and others should be availed of.

The Committee will be happy to make careful abstracts of any Meteorological Journals from Africa which may be intrusted to them.

They will also forward (gratis) copies of these "Hints," and of their "Register," to any observer who may apply for them.

Descriptions of certain instruments, not as a rule supplied by the Committee, will be found in "Hints to Meteorological Observers," prepared under the direction of the Council of Royal Meteorological Society by W. Marriott, London (Stanford), 1892. Price 1s. These instruments are the Kew Barometer, Philips's Maximum Thermometer, Black and Bright Bulb Thermometers *in vacuo*, Grass Minimum Thermometer, Symons's Earth Thermometer, Percolation Gauge, Robinson's Anemometer, and the Sunshine Recorder.

NOTES ON MOUNTING THE INSTRUMENTS.

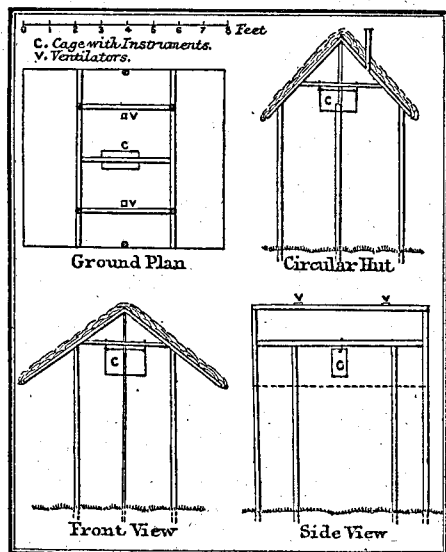
Fortin's Barometer should be mounted in a room not subject to sudden or great changes of temperature. Care should be taken to suspend the instrument vertically, to place it in a good light and not near a fire-place, or where it is exposed to the sun.

* In preparing these "Hints for African Observers" the "Hints" prepared by Mr. W. Marriott, under the direction of the Council of the Meteorological Society, have been largely drawn upon.

It is to be fixed at such a height that the observer can read the vernier comfortably when standing upright. The height of the cistern above the ground should be noted in the Register.

Barometers should be *carefully* handled. Before moving one first turn the screw below the cistern until the mercury fills the tube, then turn the barometer carefully over, and carry it with the cistern end upwards.

Thermometers.—The Thermometers are placed within an iron cage, which should at all times be kept locked, so as to prevent interference with the instruments. This cage is suspended under a thatched shelter, which should be situated in an open spot at some distance from buildings, must be well ventilated, and guard the instruments from being exposed to sunshine or rain, or to radiation



from the ground. A simple hut, made of materials available on the spot, would answer this purpose. Such a hut is shown in the accompanying drawing. A gabled roof with broad eaves, the ridge of which runs from north to south, is fixed upon four posts, standing four feet apart. Two additional posts may be introduced to support the ends of the ridge beam. The roof, at each end, projects about 18 inches. In it are two ventilating holes. The tops of the posts are connected by bars or rails, and on a cross-bar is suspended the cage with the instruments. These will then be at a height of six feet above the ground. The gable ends may be permanently covered in with mats or louvre work, not interfering with the free circulation of the air, or the hut may be circular.

The roof may be covered with palm-fronds, grass, or any other material locally used by the natives as building material. The floor should not be bare, but covered with grass or low shrubs.

Care should be taken to fix the cage firmly, so that the maximum and minimum Thermometer may not be disturbed by vibration.

Rain Gauge.—It should be firmly fixed in the ground with the top of the rim one foot, or if on bare soil one foot three inches, above it, and perfectly horizontal.

Wind Vane.—The Vane should be placed where it is freely exposed to the action of the wind, and not interfered with by local conditions. It should be higher than the trees or buildings near it, and under any circumstances about 25 feet above the ground. Its north point is readily obtained by means of a compass, applying, as a matter of course, the local variation.

INSTRUCTIONS FOR TAKING THE OBSERVATIONS.

Hours of Observation.—At Stations of the Second Order the instruments are to be read at 7 a.m., 2 p.m., and 9 p.m., with the exception of the maximum and minimum thermometers and the rain gauge, which are only read at 7 a.m.

At Climatological Stations the observations are made only once daily, viz., at 9 a.m.

Register.—All the original observations should be written down at the time in a properly ruled note book, which should be preserved for reference in case any question should arise about them afterwards.

In entering the observations in the register supplied by the Committee it is absolutely essential that they be correctly copied from the original note book, and carefully checked.

The first Monthly Register should be accompanied by a description of the station and of its environs, as also an account of the situation, &c., of the instruments. Any subsequent changes in the latter should be duly noted.

Fortin's Barometer.

1. Note to nearest degree the reading of attached thermometer.
2. Bring surface of mercury in the cistern into contact with the ivory point which forms the extremity of the scale by turning the screw at the bottom of the cistern. The ivory point and its reflected image in the mercury should appear just to touch each other and form a double core.
3. Adjust the vernier scale so that its two lower edges shall form a tangent to the *convex* surface of the mercury. The front and back edges of the vernier, the top of the mercury, and the eye of the observer are then in the same straight line.
4. Take the reading, and *enter the observation as read* without either reducing it to freezing-point or reducing it to the sea-level.

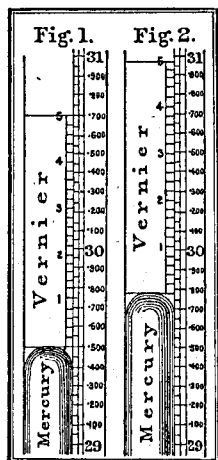
The scale fixed to the barometer is divided into inches, tenths, and half-tenths, so that each division on this scale is equal to 0.050 in.

The small movable scale or vernier attached to the instrument enables the observer to take more accurate readings; it is moved by a rack and pinion.

Twenty-four spaces on the fixed scale correspond to twenty-five spaces on the vernier; hence each space on the fixed scale is larger than a space on the vernier by the twenty-fifth part of 0.050 in., which is 0.002. Every long line on the vernier (marked 1, 2, 3, 4, and 5) thus corresponds to 0.010 inches.

If the lower edge of the vernier coincides with a line on the fixed scale, and the upper edge with the twenty-fourth division of the latter higher up, the reading is at once supplied by the fixed scale as in Fig. 1, where it is 29.500 inches.

If this coincidence does not take place, then read off the division on the fixed scale, above which the lower edge of the vernier stands. In Fig. 2 this is 29.750 inches. Next look along the vernier until one of its lines is found to coincide with a line on the fixed scale. In Fig. 2 this will be found to be the case with the second line above the figure "2." The reading of the barometer is therefore:



On fixed scale	29.750
On vernier ($12 \times .002$)024
Correct reading	29.774

Should two lines on the vernier be in equally near agreement with two on the fixed scale, then the intermediate value should be adopted.

5. Lower the mercury in the cistern by turning the screw at the bottom until the surface is well below the ivory point; this is done to prevent the collection of impurities.

Dry Bulb and Wet Bulb Thermometers.—Readings should be

entered without applying any corrections for the errors of the instruments. They should be stated in degrees and tenths of degrees.

Five, or preferably ten, minutes before reading the Dry Bulb Thermometer in damp weather it is to be wiped dry.

The Wet Bulb Thermometer requires special attention: The bulb should be covered with a piece of the thinnest muslin. Eight threads of darning cotton, in the form of a noose, should be *loosely* tied round the neck of the bulb, and led through a small hole in the cover of the water receptacle or cup. Take care to have this cup at all times filled with clean rain or filtered water.

The muslin and the conducting threads should be washed in boiling water, prior to use, and changed at least once a month, or whenever there is any appearance of dirt upon them.

When the temperature sinks below freezing point, wet the bulb with a camel hair brush about an hour before use, this will produce a thin coating of ice.

After a frost the water in the receptacle should be thawed, and the muslin and conductor washed, to restore proper action.

Maximum Thermometer (Negretti & Zambra's):

1. See that the end of the column nearest the bulb has not run away from it through vibration or otherwise. If it has the Thermometer should be tilted *very* gently until the detached column comes in contact with the contraction in the tube.

2. Read at 7 a.m. or 9 a.m. by noting the point at which the end of the column of mercury is lying. *Enter to previous day.*

3. Set, by holding the Thermometer Bulb downwards and shaking it until the mercurial column becomes continuous throughout. The end of the mercury should then indicate the same temperature as the Dry Bulb Thermometer.

Minimum Thermometer (Rutherford's):

1. Read at 7 a.m. or 9 a.m. by noting position of the end of the index *furthest* from the bulb. *Enter to the day on which read.*

2. Set, by raising the bulb and allowing the index to slide to the end of the column of spirit. When set, the index furthest from the bulb should indicate nearly the same temperature as the dry bulb.

Rain Gauge.—The Gauge should be examined daily at 7 a.m. or at 9 a.m. During exceptionally heavy rains it may be necessary to measure the contents of the Gauge at more frequent intervals, but the total results should in all cases be inserted in the Register under the hours named.

The rain measured at 7. or 9 a.m., should be entered as having fallen the previous day.

The measurement is effected by pouring the contents of the gauge (bottle or can) into a glass measure, each division of which represents 0.01 inch. The Reading to be taken midway between the two apparent surfaces of the water.

If hail or snow should be collected in the funnel, it is to be melted and measured as rain. This is done by adding to the hail or snow a measured quantity of hot water, and by afterwards deducting the quantity so added from the total measurement.

Wind.—Note the *direction* from which the wind blows from the indications of a freely moving Vane, or by observing the drift of smoke by means of a magnetic compass, applying the correction for variation.

The *Force of the Wind* is to be noted according to Beaufort's Scale, as follows:—

	Corresponding Velocity in Miles per hour.
0. Calm	0—5
1. Light Air	6—10
2. Light Breeze	11—15
3. Gentle	16—20
4. Moderate.....	21—25
5. Fresh	26—30
6. Strong.....	31—36
7. Moderate Gale	37—44
8. Fresh	45—52
9. Strong.....	53—60
10. Whole	61—69
11. Storm	70—80
12. Hurricane	81 and upwards.

Clouds.—The *proportion* of the sky covered with cloud is to be estimated, the scale adopted being 0—10, 0 representing a perfectly cloudless sky, and 10 showing that the *whole* sky is clouded.

The *forms* of clouds should be described as defined by Howard, as follows:—

Cirrus:—Parallel, wavy, or diverging fibres.

Cirro-cumulus:—A fleecy cloud.

Cirro-stratus:—A thin veil of feathery or streaky cloud.

Cumulus:—A cloud of a convex or well-rounded shape.

Cirro-Stratus:—A blending of Cirro-Stratus with Cumulus.

Stratus:—Clouds in continuous horizontal sheets.

Nimbus or rain cloud.

Under *motion* enter the direction whence the cloud is moving.

Weather.—Note any phenomena which may have occurred since the last observation.

Term-Days.—On the 21st of each month hourly or two-hourly observations should, if possible, be taken. This applies more especially to the barometer and its attached thermometer, and to the dry and wet bulb thermometers.

Additional Observations.—If the station is favourably situated for measuring the height of a lake-level or ascertaining the flooding of a river, this should be done. These observations should be made regularly daily, but if this is impracticable, once a week is much better than none. The water-gauge should be divided into inches and tenths. The manner of fixing it must depend entirely upon local circumstances: its zero should coincide with the lowest level of the water, but in practice it will generally be necessary to accept an arbitrary zero, and to indicate all readings below it by a minus sign. It is desirable that the zero of the gauge should be referred to a bench mark cut in the face of a rock, or failing that, in the trunk of a tree.

Well-measurements may prove of interest. Measure the distance from the mouth of the well to the surface of the water in it, and *not* the depth of the well. At stations on the sea-shore, on lakes or rivers, the temperature of the water may likewise be recorded.

Phenological notes may be entered in the "Remarks" column.