No. 162.

METEOROLOGICAL OFFICE, LONDON.

HINTS

TO

METEOROLOGICAL OBSERVERS IN TROPICAL AFRICA,

WITH

NOTES ON METHODS OF RECORDING LAKE LEVELS,

AND

A MEMORANDUM ON THE ORGANISATION OF METEOROLOGICAL OBSERVATIONS.

Published by the Authority of the Meteorological Committee.

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MEMORANDUM OF ADDITIONS AND CORRECTIONS TO M.O. PUBLICATION NO.162.

"Hints to Meteorological Observers in Tropical Africa".

For insertion after paragraph 3, page 8.

Modern barometers are graduated in millibars. A supplementary scale in inches can be engraved on the barometer if desired. Barometers of the Kew pattern are now recommended as being preferable to the Fortin type for use at observing stations.

For insertion after paragraph 2, page 10.

Exposure of Thermometers.

Recent experiments in India have shown that in that hot country thermometers placed in a normally exposed Stevenson screen give a better representation of the temperature of the air than thermometers in a screen under a shelter. The results of this investigation are given in India Meteorological Memoirs, Vol.XXIV, Part III "On Exposure of thermometers in India" by J.H. Field.

If possible, the best site for a thermometer screen is a level piece of ground covered with short grass, in the shape of a rectangle, 30 ft. by 20 ft. The plot should be upon generally level ground. A station on a steep slope, or in a hollow, is subject to exceptional meteorological conditions. The screen should be freely exposed to sun and wind; it should not be shaded by trees or buildings.

The following should be substituted for the forms of clouds given on page 19.

Cirrus (Ci.):- Clouds of delicate and fibrous appearance, without shading, generally white. They appear in very varied forms including tufts and parallel bands.

Cirrocumulus (Cicu.):- Very small white, globular masses without shadows arranged in groups or lines.

Cirrostratus (Cist.):- A thin whitish veil, which does not blur the outlines of the sun or moon. This cloud often gives rise to halos.

Altocumulus (Acu.):- A layer of patches of somewhat flattened globular masses, with or without shadows. In their lightest form they may resemble Cirrocumulus.

Altostratus (Ast.):- A veil, more or less grey or bluish in colour, through which the sun or moon gleams vaguely.

Cumulus (Cu.):- A thick cloud with nearly horizontal base and rounded upper surface exhibiting protuberances.

Stratocumulus (Stcu.):- A layer or patches of fairly large, grey globular masses, with darker parts. They may cover the whole sky and present a wavy appearance.

Stratus (St.):- A uniform layer of cloud resembling fog, but not resting on the ground. When it is broken up into irregular shreds it is designated fractostratus (Frst.).

* Nimbostratus (Nbst.):- A low, amorphous and rainy layer, of a dark grey colour and nearly uniform. This type is of much more frequent occurrence in temperate than in tropical zones.

* Fractonimbus (Frnb.):- Ragged, low clouds of bad weather.

* Cumulonimbus (Cunb.):- Heavy masses of cloud with great vertical development, whose cumuliform summits rise in the form of mountains or towers.

* Note: According to a resolution of the International Meteorological Committee at De Bilt on 7th October, 1933, the term "Nimbus" was excluded from international cloud nomenclature as the name of a specific cloud. It thus appears only in the combinations mentioned above.

ABRIDGED LIST OF PUBLICATIONS ISSUED UNDER THE AUTHORITY OF THE METEOROLOGICAL COUNCIL.

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   Daily Weather Report for the British Isles and Western Europe. Subscription, 5*s.* per quarter.

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   Monthly Meteorological Charts of the North Atlantic and Mediterranean. Price, 6*d.* monthly, 5*s.* per annum (exclusive of postage).

   Monthly Meteorological Charts of the Indian Ocean and Red Sea. Price 6*d.* monthly, 5*s.* per annum (exclusive of postage).

2. Meteorological Information and Statistics for the British Isles:—

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   Diurnal Range of rain at the Observatories. 1900. 2*s.* 6*d.*

   Rainfall Tables of the British Isles, 1866–1880, 7*s.* 6*d.*; 1866–1890, 6*s.*

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   Temperature Tables for the British Isles, 1871–1900. 10*s.* 6*d.*

   — — — Supplement giving tables for computation of mean values for an uniform period. 3*s.*

   Meteorological Atlas of the British Isles. 1883. 5*s.* 6*d.*

3. Statistics for Foreign and Colonial Stations:—

   Meteorological Observations at the Foreign and Colonial Stations of the Royal Engineers, and the Army Medical Department, 1852–1886. 1890. 23*s.*

   Meteorological Observations made at Sanchez, Samaná Bay, St. Domingo, 1886–1888.—By the late W. Reid, M.D. 1890. 8*s.* 6*d.*

   Report on the Meteorology of Kerguelen Island.—By Rev. S. J. Perry, S.J., F.R.S. 1879. 3*s.*

   Climatological Observations at Colonial and Foreign Stations. Tropical Africa, 1900–1902, with Summaries and Maps.—By E. G. Ravenstein, F.R.G.S., 1904. 6*s.*

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PREFACE.

In 1902 the Meteorological Council issued as an official publication a revised edition of the "Hints to Meteorological Observers in Tropical Africa" which were prepared originally in 1892 by a Committee of the British Association for the Advancement of Science, 1891, consisting of E. G. Ravenstein, F.R.G.S. (Chairman); Baldwin Latham, C.E., F.G.S.; G. J. Symons, F.R.S.; and H. R. Mill, D.Sc., Secretary.

The Committee made its final report to the meeting of the British Association at Glasgow in 1901, and the Meteorological Office took up the issue of the "Hints to Observers" in order to meet applications from Colonial Governments and private observers for information respecting the selection and exposure of instruments. Notes on methods of recording lake levels were contributed by the Hydrographic Department of the Admiralty.

The relations between the Office and the Colonial Governments have been still further developed by an understanding arrived at in 1904 between the Council and the Crown Agents for the Colonies under which the Office undertakes the supervision of the supply of meteorological instruments for use in the Colonies upon the requisition of the Crown Agents.

In order further to promote community of usage in the methods of making meteorological observations and publishing the results a memorandum was drawn up at the request of the Secretary of State for the Colonies setting out the method of organisation of meteorological observations as developed in the course of the past thirty-five years by international discussion and agreement.

The present issue is a reprint of the 1902 edition of "Hints to Meteorological Observers in Tropical Africa" with such alterations as have become necessary, and it includes, in addition,

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the memorandum upon the organisation of meteorological observations with some specimen forms for publication of results. It is hoped thereby to increase the facilities for collating the results from various parts of the world. Such an object must be regarded as of primary importance, for it is only by the comparison with corresponding records for other localities or at other times that the meteorologist or the inquirer into the economical conditions of a country can utilise the information that is supplied.

W. N. SHAW.

May, 1907.

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HINTS TO METEOROLOGICAL OBSERVERS

IN

TROPICAL AFRICA.

OBSERVATIONS.

The object aimed at by meteorological observations is a regular record of the readings of trustworthy instruments and of associated phenomena. The observations, whether made several times a day, once a day, or even once a week, should always be made at the same hours. At normal stations observations are made three times a day—at 7 a.m., 2 p.m., and 9 p.m. *Local* mean time should be adopted for the observations and noted as being so adopted in the register. Where normal observations cannot be provided for, observations may be made once daily, preferably at 9 a.m.

Regular daily observations of maximum and minimum temperature and of rainfall at auxiliary stations, or of rainfall alone, are valuable. Irregular observations are of little practical value; observations with untrustworthy instruments are of no value whatever.

EQUIPMENT.

A normal outfit of meteorological instruments and accessories is as follows:—

1. A mercury barometer with vernier reading to ·002 inch.
2. A dry-bulb thermometer.
3. A wet-bulb thermometer with muslin, wick, and a vessel to hold water for moistening the wick.
4. A maximum thermometer.
5. A minimum thermometer.
6. A cage of galvanised iron, with padlock, to contain the thermometers.
7. A rain gauge and measuring glass.
8. A book of detailed instructions in the use of instruments, with a cloud-atlas, and tables for the reduction of barometer readings and dry-and-wet-bulb readings, suitable for tropical countries.
9. A pocket note book ruled for the observations.
10. Register sheets for a fair copy of the observations.

To these may be added, if desired, a grass minimum thermometer for recording the effect of terrestrial radiation, a black bulb thermometer *in vacuo*, and a similar instrument with bright bulb, for recording the maximum effect of solar radiation, a barograph, a thermograph, an anemometer, earth thermometers at depths of 1 ft. and 4 ft.—for recording the temperature underground, and a percolation gauge. With some exceptions, a sunshine recorder is desirable.

Observations of the direction of wind require a properly-mounted wind vane or some other means of identifying the direction. Observations of wind force, amount and kind of cloud, and other items for normal observations can be made without instruments.

The Meteorological Office, London, will select and supply suitable instruments, at its contract prices with an addition not exceeding 5 per cent. for departmental expenses, to those observers who undertake to send a copy of their observations to the Office either directly or through the Foreign or Colonial Office. They will also supply suitable note books and forms of register.

SELECTION OF INSTRUMENTS.

Barometer.[*]—In tropical countries the variations of the barometric pressure from day to day are as a rule very small. The diurnal variation, with two maxima in the day, is the most conspicuous feature of a tropical record, whereas in temperate latitudes there are large fluctuations which do not occur in the tropics except in storms. Special care and accuracy, as well as punctuality in observing, are necessary on that account. The barometer must be so graduated that the reading may be estimated to ·001 inch. For this purpose the Fortin barometer or the Kew pattern barometer may be employed. For skilled observers the Fortin barometer is to be preferred. It requires two settings—one for the cistern, the other for the vernier. An observer who is not well practised in the use of delicate instruments may easily introduce errors by faulty setting, and from that point of view the Kew pattern barometer, which only requires one setting for an observation, is to be preferred.

Thermometers of ordinary pattern may be employed, care being taken that the range of temperature on the scale is sufficient. The maximum and minimum thermometers in the Meteorological Office equipment are of the "Negretti and Zambra" pattern and the "Rutherford" pattern respectively.

Alcohol thermometers are liable to get out of order by the alcohol distilling and condensing in the upper part of the tube. If it does so, the detached alcohol can generally be shaken back by holding the thermometer in the hand, bulb downwards, and jarring the hand.

Both barometer and thermometers should be specified to have "Kew certificates."

Rain Gauge.—The rain gauge may be either five inches or eight inches in diameter, but care must be taken that the measuring glass corresponds with the gauge.

MOUNTING AND EXPOSURE OF THE INSTRUMENTS.

The Barometer should not be exposed to the weather. It may be kept indoors and should be suspended in a vertical

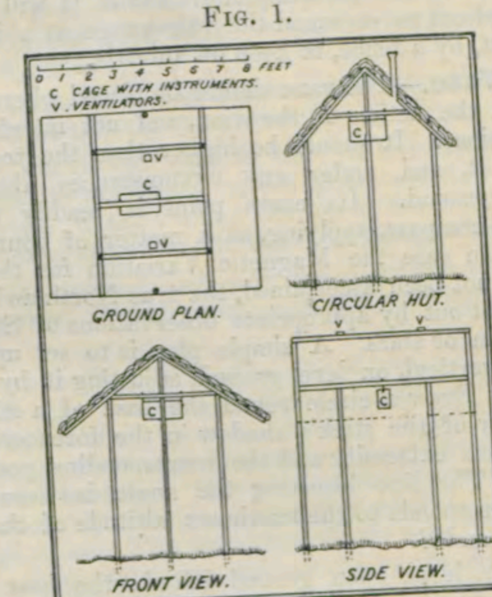
[*] In ordering a barometer the approximate height of the station above sea-level should be stated so that the range of graduation may be adjusted.

position in a good light, not exposed to the sun. The room should not be subject to sudden changes of temperature. The instrument should be fixed at such a height that the observer can read the vernier comfortably when standing upright. The height of the cistern above sea level should be accurately noted in the register.

Barometers should be *carefully* handled. Before moving a Fortin barometer to a new position 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. A Kew pattern barometer may be gradually inclined until the mercury fills the tube. It also must be transported cistern-end upwards.

Thermometers.—The thermometers require a perfectly free exposure to the moving air but protection from the sun and rain. They 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,

FIG. 1.



made of materials available on the spot, would answer this purpose. The accompanying drawings (Fig. 1) give some particulars of suitable huts. 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 thermometers may not be disturbed by vibration.

The solar radiation thermometers should be supported horizontally on a stand at 4 feet from the ground with the bulbs exposed to the full sun. The grass minimum should also be placed horizontally, with a free exposure to the sky, and should be supported with the bulb free from the ground but as near to it as is consistent with free exposure.

Rain Gauge.—The rain gauge must be fully exposed in an open space. 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. It will probably be found expedient to surround the rain-gauge, at a distance of at least 10 feet, by a fence, to keep off animals.

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. In case the Magnetic Variation for the particular locality has not been ascertained, the true North and South line should be set out by appropriate observations of Sun shadows, or of the sun or stars. A simple plan is to set up a straight stick in the vertical, on level ground, adjusting it by means of a plumb line. Draw a circle round the base of a stick through the extremity of the stick's shadow in the forenoon; mark the position of this extremity and the corresponding position at the afternoon. The line bisecting the angle between these two positions corresponds to the maximum altitude of the sun and is therefore N. and S.

Moderately level open ground affords the best site for a meteorological station. A station on a steep hill slope gives records which are not comparable with those of a station on level ground.

INSTRUCTIONS FOR TAKING THE OBSERVATIONS.

Registers.—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 a about them afterwards. The entries in the book should *under no circumstances* be altered or erased, errors should be noted in the margin.

In entering the observations in the permanent register it is absolutely essential that they be correctly copied from the original note book, and carefully checked. Particulars of the position of the station, its height above sea level should be entered on each sheet of the register.

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.

Barometer:—

1. Note (to nearest degree) the reading of the attached thermometer.

2. If the instrument is a Fortin barometer, bring the surface of mercury in the cistern into contact with the ivory point which forms the extremity or zero 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 cone.

If the instrument is a Kew pattern barometer this adjustment is not required, nor is that numbered 5.

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 correcting it to freezing-point or reducing it to the sea-level.

Note on the method of reading the Barometer.—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 position of 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, 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 Fig. (2), the lower edge of the vernier, D, is supposed to be in exact coincidence with scale line 29·5; the barometer therefore reads 29·500 inches. Studying 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 29·5(·)2. 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 Fig. (3), the scale line next below D is 29·650. Looking carefully up the vernier, if the third line above the figure 3 had coincided with a line on the scale, the reading would have been estimated as follows:—The number 3 indicates ·030, and the third subdivision ·006; thus we should get—

Reading on scale	29·650
Reading on vernier ...	{ ·030 ·006
Actual reading	29·686 inches.

In Fig. 3, however, two pairs of lines appear to be almost coincident, and in this case the intermediate thousandth of an inch should be set down as the reading. Thus the reading appears to be 29·684 or 29·686, and the mean 29·685 should be adopted.

Fig. 2.

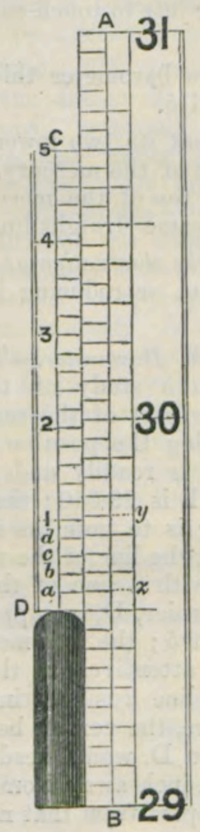
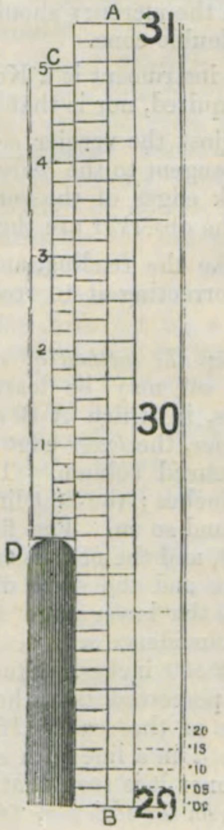


Fig. 3.



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.

The corrections for index error and temperature should be applied to barometer readings before they are published. Tables showing the amounts of these corrections should be entered in the observer's note book.

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 thin muslin. Four 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 fresh water. Hard water should not be used.

The muslin and the conducting threads must be quite free from grease. To remove grease they should be washed in boiling water, prior to use. They should be 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 is intended to ensure the bulb being covered with a thin coating of ice during the observation.

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

For the reduction of readings of dry and wet bulb thermometers, the hygrometric tables issued by the Meteorological Department of the Government of India should be used.

Maximum Thermometer (Negretti & Zambra's):—

1. See that the thread of mercury does not run away from the bulb through vibration or otherwise. If it does, the thermometer should be tilted *very* slightly, but care must be taken that the mercury does not recede from the position of maximum when the temperature falls.

2. Read and set at 7 a.m. or 9 a.m. by noting the point at which the end of the column of mercury is lying, and *enter to previous*

day; unless regular observations are made in the evening as well as morning in which case the maximum thermometer should be read and set at the *evening hour* and *entered to the same day.*

3. Set, by holding the Thermometer bulb downwards and swinging it until the mercurial column becomes continuous throughout.* The end of the mercury should then indicate the same temperature as the Dry-Bulb Thermometer. If there is any difference, note it.

Minimum Thermometer (Rutherford's) :—

1. Read and set at the evening hour, if regular observations are made in the evening ; if not, read and set 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 it is read.*

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

The Solar radiation and grass minimum thermometers must be set each day.

Spirit (minimum) thermometers should be regularly examined for the presence of bubbles in the stem or bulb, or of drops of liquid in the upper part of the stem. When present, they may be removed in the manner described on p. 8.

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 a.m. or 9 a.m. should be entered as having *fallen* on 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 in. 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. If necessary 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.

* If the Maximum thermometer be of the Phillips pattern the column should not become continuous, a portion remains detached by the air speck.

Wind.—*Direction of the wind* should be recorded from the True North. Note the *direction from* which the wind blows from the indications of a freely moving Vane, or by observing the drift of smoke, applying the correction for variation if a magnetic compass is used. Take care that no doubt attaches to the records on account of confusion between Magnetic North and True North.

Whatever mode of observation is used, errors due to perspective are liable to be made unless the observer stands vertically below the indicator.

The force of the wind is estimated on the numerical scale ranging from 0, calm, to 12, a hurricane, first adopted by Admiral Beaufort, in 1805.

The table on pp. 16, 17 is reprinted from a recently published Report* upon an Inquiry into the Relation between estimates of Wind Force, according to Admiral Beaufort's scale and the velocities recorded by anemometers, which has been recently issued by the Office. It gives descriptions of the various wind forces to guide the judgment of observers.

* Official No. 180, 1906.

SPECIFICATION OF THE BEAUFORT SCALE WITH PROBABLE EQUIVALENTS OF THE NUMBERS OF THE SCALE.

Beaufort Number.	Description of Wind.	Mode of Estimating aboard Sailing Vessels.	Specification of Beaufort Scale: For Coast Use, based on Observations made at Scilly, Yarmouth, and Holyhead.	Specification of Beaufort Scale: For Use on land, based on Observations made at Land Stations.	Mean wind force in lbs. per square ft. at standard density. ($P = \cdot 0105B^3$.)	Equivalent hourly velocity for expressing estimates in miles per hour, and *vice versâ* ($V = 1{\cdot}87\sqrt{B^3}$).
0	—	—	Calm	Calm; smoke rises vertically.	0	0
1	Light breeze	Sufficient wind for working ship.	Fishing smacks just have steerage way.	Direction of wind shown by smoke drift, but not by wind vanes.	·01	2
2			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
3			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.	Forces most advantageous for sailing with leading wind and all sail drawing.	Good working breeze; smacks carry all canvas, with good list.	Raises dust and loose paper; small branches are moved.	·67	15
5			Smacks shorten sail ...	Small trees in leaf begin to sway; wavelets form on inland waters.	1·31	21
6	Strong wind...	Reduction of sail necessary with leading wind.	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			Smacks remain in harbour, and those at sea lie to.	Whole trees in motion; inconvenience felt when walking against wind.	3·6	35
8	Gale forces ...	Considerable reduction of sail necessary even with wind quartering.	All smacks make for harbour, if near.	Breaks twigs off trees; generally impedes progress.	5·4	42
9			—	Slight structural damage occurs (chimney pots and slates removed).	7·7	50
10	Storm forces	Close reefed sail running, or hove to under storm sail.	—	Seldom experienced inland; trees uprooted; considerable structural damage occurs.	10·5	59
11			—	Very rarely experienced; accompanied by widespread damage.	14·0	68
12	Hurricane ...	No sail can stand even when running.	—	—	Above 17·0	Above 75

It will be noticed that the criteria referred to depend in many cases rather on the effects which the observer perceives on objects round about him than on his own physical sensations. By adopting this method an estimate of wind force may be obtained which is to some extent independent of the observer's actual position. The latter may be comparatively sheltered, but it should be such as to command a good view of a number of objects, by the behaviour of which wind force can be estimated.

Difficulties of exposure frequently render a good estimate of wind force preferable to a measurement with an anemometer. The latter can only record the speed of that portion of the air which passes it, and unless its exposure is entirely satisfactory this may differ greatly from the general speed of the air passing over the surrounding country.

The question of the velocity equivalents of the Beaufort numbers is one which has claimed much attention. From the nature of the case the estimates of different observers and even the estimates of one and the same observer under different circumstances must vary considerably.

A careful comparison of the Beaufort estimates with the wind velocities recorded simultaneously by anemometers belonging to the Office made in the course of the inquiry referred to above showed that the most probable equivalent hourly velocity for expressing individual estimates in miles per hour or *vice versa* agree very closely with the results calculated by the formula

$$V = 1{\cdot}87\sqrt{B^3}$$

where V is the wind velocity expressed in miles per hour and B the Beaufort number.

The relation between the wind pressure and the Beaufort numbers is given by the corresponding formula

$$P = {\cdot}0105\ B^3$$

where P is the pressure in lbs. per square foot.

The velocity and pressure equivalents calculated from these two formulæ have been included in the table on pp. 16, 17.

To put forward a detailed scale of equivalents as an official statement applicable to present practice would give an appearance of accuracy which is not warranted in existing circumstances and therefore for official use a less detailed statement of the relation between the Beaufort numbers and the corresponding hourly velocity of the wind is given in the following table :—

Beaufort Scale Number.	Corresponding Wind.	Limits of Hourly velocity in miles per hour.
0	Calm	Under 2.
1–3	Light breeze	2–12.
4–5	Moderate wind	13–23.
6–7	Strong wind	24–37.
8–9	Gale	38–55.
10–11	Storm	56–75.
12	Hurricane	Above 75.

Clouds.—The *proportion* of the sky covered with cloud is to e 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 indicated as follows :—

Cirrus (Ci.) :—"Mare's tails." Clouds showing parallel, wavy, or diverging fibres.

Cirro-cumulus (Ci.-Cu.) :—Fleecy cloudlets arranged in groups or lines. "Mackerel" sky without shadows.

Cirro-stratus (Ci.-S.) :—A thin veil of feathery or streaky cloud. This cloud often produces halos.

Alto-cumulus (A.-Cu.) :—"Mackerel" sky including largish globular masses showing some shadow.

Alto-stratus (A.-S.) :—A thick sheet of grey or bluish colour, showing a brilliant patch in the neighbourhood of the sun or moon.

Cumulus (Cu.) :—"Cauliflower" or Woolpack cloud. A cloud of globular well-rounded upper surface with horizontal base.

Strato-cumulus * (S.-Cu.) :—An aggregation of dark globular clouds sometimes covering the whole sky and presenting a wavy appearance.

Stratus (S.) :—Clouds in continuous horizontal sheets.

Nimbus or rain cloud (N.).

Cumulo-nimbus (Cu.-N.). The Thunder cloud, or Shower 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 1st, 11th, and 21st of each month hourly or two-hourly observations may, if possible, be taken, those of the 21st being the most important. This applies more especially to the barometer and its attached thermometer, the dry and wet bulb thermometers, and the direction and force of the wind.

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

* The term Cumulo-stratus (Cu.-S.), used to indicate a combination of cumulus with a form of cirro-stratus, is not included in the international classification.

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. Special instructions contributed by the Hydrographic Office for recording lake levels are appended.

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, *i.e.*, notes of the times of return of the seasons, *e.g.*, the flowering of plants, ripening of crops, migration of birds, and so forth, may be entered in the "Remarks" column of the meteorological register.

NOTES ON METHODS OF RECORDING LAKE LEVELS, WITH SPECIAL REFERENCE TO VICTORIA NYANZA.

Contributed by the Hydrographic Office.

The only accurate method of keeping a complete record of the changes of lake levels, is by means of a self-registering gauge.

One of these instruments would furnish a more accurate record than several water gauges established at different places, and read once a day or even oftener.

If the extreme range of level is known, an instrument can be constructed to suit it, and on a scale of 2 inches to the foot would be of moderate dimensions, and would cost from £40 to £50.

If a long series of records is desired this will probably be the best course.

Automatic gauge.

The instrument would be worked by a float, and would record on a revolving drum.

The only drawback to such an instrument in Uganda would be the provision for necessary repairs to the clock.

A water-gauge clock is necessarily exposed to damp, is very liable to eccentricities in working, and requires periodical cleaning at no long intervals.

The instrument could either be erected on a pier as exists at Port Florence, or a well can be dug at some little distance back from the edge of the lake, with its bottom at a sufficient depth to allow for extreme low level of the lake, and connexion made by a large horizontal pipe also at a sufficient depth to allow for extreme fluctuations.

The latter is best for the clock, and a tray of chloride of calcium in the hut in which the gauge would be placed over the well, would go far to absorb damp, and help to keep the clock in order.

Eye observations.

If it is preferred to continue eye observations on tide gauges, the three stations already established should give a very close approximation of levels.

It would be necessary to construct gauges that will give results free from wave action. This is easily done by making wooden tubes, of square section, for a float to work in, and admitting the water by one or two small holes near the bottom.

The float can either carry a light rod (cane or bamboo), the level of the top of which can be read by a scale, on a flat wooden batten projecting above the tube (Diagram I.), or a fine copper wire can be led from the float, over a sheave or pulley at the top of the tube, to any inconsiderable horizontal distance required, over another sheave, and to a light bob weight, the level of which can be read in a similar manner on a scale. (Diagram II.)

Such gauges could probably be easily constructed on the spot, but the float should not be of wood which is liable to become waterlogged, and sink deeper as time goes on, but of copper, hollow. Even then, care must be taken that there is no leak, or the same thing will happen.

In the diagrams the float is shown square in section, as being easier to make, but its diagonal dimension must be a couple of inches less than that of the side of the square tube, to prevent its jamming in the tube.

A circular section is much to be preferred.

Datum mark.

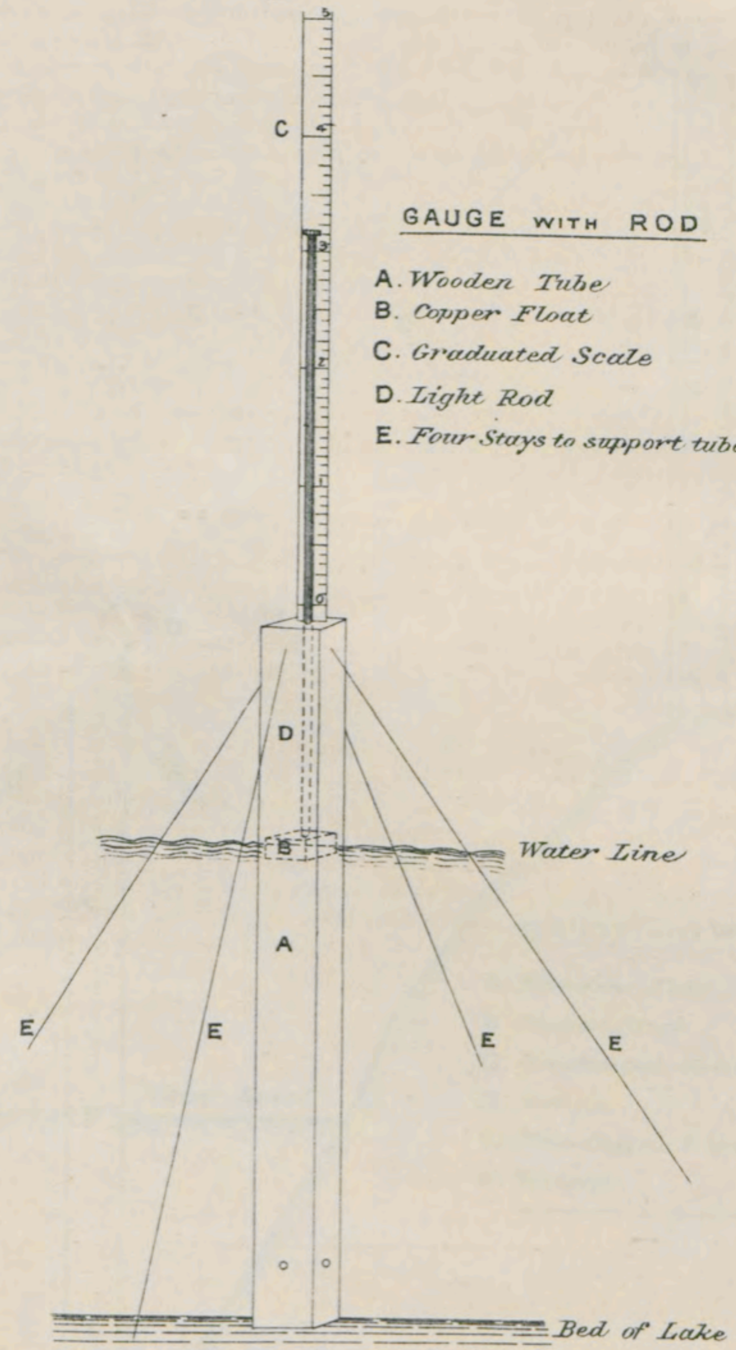
An important point in any case is to have the levels referred to some permanent mark on the land, by which the observations can be renewed in case of accidents to the gauge. This can only be done by levelling, and the difference of level between the fixed mark and some division of the water scale should be recorded.

Wind will, of course, cause considerable variations in level of the lake, and these will be different at different places on the shores, but for the purpose of recording the effective level of the outflow of the Nile, which it is presumed is the principal object, a gauge near the outlet should afford all the information required. If it is desired to ascertain the effect of wind as regards the level of the whole lake, or whether seiches occur, gauges on the German shore should also be established.

W. J. L. WHARTON.

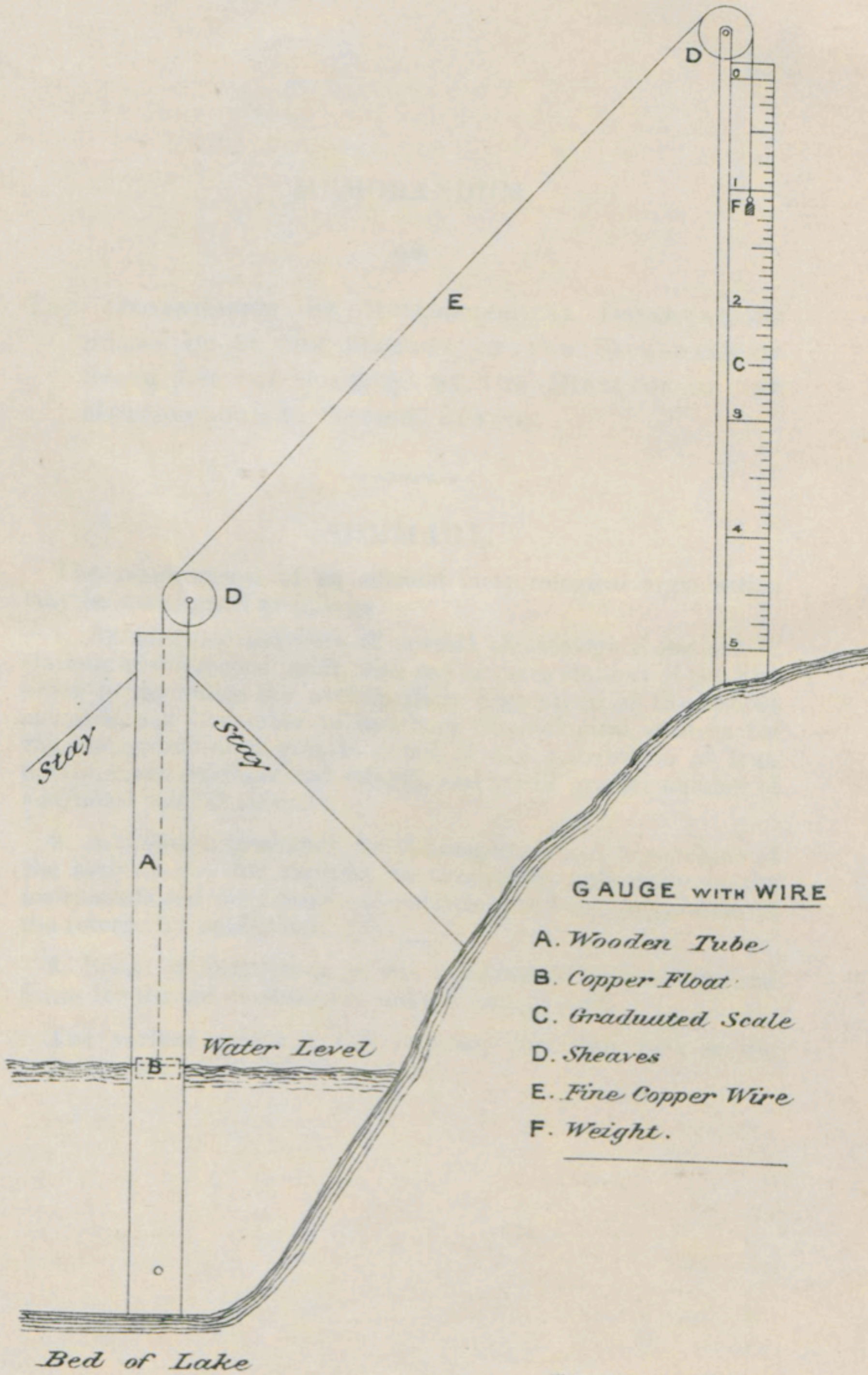
October 29th, 1902.

DIAGRAM I.



1173. 6. 07. Wt 4941. 625.
Weller & Graham. Ltd Litho. London

DIAGRAM. II.



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MEMORANDUM

ON

THE ORGANISATION OF METEOROLOGICAL OBSERVATIONS DRAWN UP AT THE REQUEST OF THE SECRETARY OF STATE FOR THE COLONIES BY THE DIRECTOR OF THE METEOROLOGICAL OFFICE, LONDON.

SUMMARY.

The requirements of an efficient meteorological organisation may be summarised as follows :—

1. An adequate net-work of normal climatological stations or stations of the second order, with one or more stations of the first order to determine the average daily fluctuations of the various elements, and a number of auxiliary climatological stations for the determination in greater detail of the distribution of temperature, and sunshine and rainfall, and a still greater number of additional rainfall stations.

2. A proper central staff for the inspection and supervision of the stations and for securing the necessary uniformity in the instruments and the methods of reduction, and the preparation of the returns for publication.

3. Books of instructions in the handling of instruments, and forms for the use of observers and the central staff.

The various points of this summary are dealt with in the memorandum which follows.

MEMORANDUM

ON THE

Organisation of Meteorological Observations.

The utility of meteorological records depends very largely upon the facility and accuracy with which they can be compared with previous records for the same locality or corresponding records for other localities.

The methods of dealing with meteorological information are of two kinds, the Geographical and the Chronological. By the first method the particulars for a selected period are compared with corresponding particulars at other stations in the neighbourhood or in other countries, and, by the second method, the results for the same locality for a succession of periods,—years, months, or days—are compared with one another. The first method requires uniformity of practice over the area under comparison, and the second continuity of practice. The combination of both methods, which is necessary for the solution of many questions, requires both uniformity and continuity.

Thus for the determination of the question whether a crop which has been successfully cultivated in one country can be expected to yield profitable results in another, we must be able to compare the general sequence of weather changes in the two countries, and in order to determine whether the success is likely to be persistent or fluctuating, we must be able to decide whether the sequence of weather changes is stable or subject to serious modification. It must be understood that the comparison is in no case easy. It is of the nature of a survey but it cannot be improvised for an emergency, it must be organised for years in advance. The details upon which the comparison depends are too numerous for it to be carried out at sight by an inspection of the crude observations at a number of stations, and the comparison of averages arrived at by different methods is hopeless. Consequently some organisation of statistics is necessary and any convention whereby the comparison is reduced to the juxtaposition of statistical results, arrived at by a common system, is of real practical importance.

For observations at sea uniformity of practice dates back to an international congress held at Brussels in 1853, but common action as regards land stations is more difficult.

On the Continent of Europe the questions which have arisen in connexion with the adoption of a uniform system have been

discussed at a series of international congresses, commencing with that in Vienna in 1873. An international committee, consisting of the representatives of the chief government meteorological organisations, has been in existence for many years, and to this committee executive details are referred, while a general conference of the directors of observatories and official institutes meets occasionally for the discussion of matters of common interest.

At these conferences, chiefly on account of distance and consequent expense, very few of the meteorological organisations of the British Empire are represented, but the climatological conditions of the different parts of the Empire are so varied, and the situations of many of the British possessions are so important from the meteorological point of view, that community of action between the meteorological authorities of the different parts of the Empire is of great importance, and therefore it may be useful to give a brief indication of the system that has been evolved from the international discussions.

A complete meteorological organisation for any geographical district consists of an appropriate number of :—

1. Stations of the first order, at which accurate autographic records or hourly observations of the meteorological elements are obtained.

2. Stations of the second order at which regular personal observations of the elements are made at fixed hours, twice or three times a day, with observations of rainfall, maximum and minimum temperature for the 24 hours.

3. Auxiliary stations of the third order, which include (*a*) stations which have a scheme of operations similar to that of stations of the second order but do not comply with all the requirements of such stations; (*b*) stations at which observations of maximum and minimum temperature and rainfall are taken daily, and (*c*) rainfall stations for daily observations of rainfall only.

The functions of these different orders of stations in determining the factors of climate of a district will be understood if I specify the recognised climatic factors according to the international system. They are as follows :—

1. The average barometric pressure for each month, its average daily range and its extreme range.
2. The average temperature for each month and the extremes.
3. The average daily maximum temperature.
4. The average daily minimum temperature.
5. The average dew point, or pressure of water vapour, and relative humidity.
6. The average decimal fraction of the sky covered by clouds.
7. The number of observations of winds from each of the eight points of the compass and the number of calms.
8. The amount of rainfall and the greatest amount in a day.
9. The number of days of rain, snow, hail, thunderstorms, clear sky, overcast sky, (fog), (gale and strong wind 4–7).

The number of hours of bright sunshine is often given though it has not yet come into the international system and no international agreement has yet been arrived at with regard to the method of dealing with black bulb thermometers, grass thermometers, wind force, or earth temperatures, though information on these points is often of importance. They require some conventions as to scales and standards which had not been arrived at in 1873 but which can now be placed upon a satisfactory footing.

First Order Stations.

The function of first order stations as regards climate is mainly concerned with the compilation of proper averages of pressure, temperature, moisture and cloud. To be scientifically correct, and therefore strictly comparable, these averages ought to take account of all the variations throughout the month at whatever hour they may occur, but at the normal climatological stations (the stations of the second order) observations are made only twice or at most three times a day, and the question arises whether the true average values for the twenty-four hours can be computed with sufficient accuracy from the means at the fixed hours. A first order station gives us the opportunity of determining how the means at fixed hours can be treated to give the true means for twenty-four hours at the station, and on the assumption that factors for computation determined in this way are generally applicable for a wider region. The first order station tells us what are the best hours of observation to select for the second order stations, and what are the factors necessary to convert the means for those hours to the true, or scientifically correct average for the day. By an extension of this argument it is clear that the means for the twenty-four hours may be inferred from different combinations of hours and thus the first order stations give us the means of comparing the results of stations with different hours of observation which could not otherwise be comparable.

Again, to take another example, at some third order stations the maximum and minimum temperatures are observed daily, and we wish to know whether the true average temperature for the day can be computed from the means of the maxima and minima. The answer to this question also can be derived from the observations of a first order station.

Self-recording Instruments.

For a regular station of the first order self-recording instruments are required which give correct readings throughout the day and night. Such instruments are elaborate and costly, and the supplementary observations necessary to maintain and check the accuracy of the records are troublesome. Where an institution of the first order cannot be maintained, cheaper forms of recording instruments can be used, such as the aneroidograph, and the alcohol or bi-metallic thermograph, *if proper care is exercised in their use.* It should, however, be remembered that in

order to obtained accurate results with less elaborate instruments, greater scientific skill and judgment are required. In the hands of uninstructed persons the cheaper and simpler form of instrument often gives results which afford no useful information to a central office, and the directions for the use and testing of these instruments should be careful and precise, otherwise they may prove useless when their records come to be discussed.

Second Order Stations.

The full cost of a specially maintained station of the first order in the British Isles is about £500 a year, exclusive of initial expenses, so that the number to be maintained in any meteorological organisation must be necessarily very limited. The selection of their positions and the application of the constants obtained from them requires judgment and experience. Without the data which a first order station affords, it is difficult to form a really satisfactory judgment about the best hours to select for the observations at second order stations, which are the normal stations for climatological purposes. In Europe, the selection of hours has been made chiefly on the basis of the information afforded by the first order stations of the Continent, and they may not be appropriate for the climates of the Colonies, which differ widely in some cases from the European climates. A special examination of the questions mentioned is desirable.* The hours adopted in the several countries are given below. They refer, strictly speaking, to local mean time.

Hours of Observation at Second Order Stations.

Great Britain	9 a.m.	9 p.m.	
France	9 a.m.	12 noon	6 p.m.
	7 a.m.	2 p.m.	6 p.m.
	6 a.m.	12 noon	9 p.m.
Prussia	7 a.m.	2 p.m.	9 p.m.
Rest of Germany ...	8 a.m.	2 p.m.	8 p.m.
Austria	7 a.m.	2 p.m.	9 p.m.
Italy	9 a.m.	3 p.m.	9 p.m.
	(generally only gives extremes).		
Russia	7 a.m.	1 p.m.	9 p.m.
Egypt	8 a.m.	2 p.m.	8 p.m.
U.S.A.	8 a.m.	8 p.m.	
Canada	9 a.m.	2 p.m.	7 p.m.
	7 a.m.	2 p.m.	7 p.m.
	6 a.m.	1 p.m.	6 p.m.
	5 a.m.	12 noon	5 p.m.
	8 a.m.	3 p.m.	8 p.m.
	5 a.m.	?	5 p.m.
	6 a.m.	2 p.m.	10 p.m.
	9 a.m.	4 p.m.	9 p.m.

* In the absence of first order stations, information which can be used in such a discussion can be derived from the special observations taken on "Term-days" described on p. 19.

Argentine	7 a.m.	2 p.m.	9 p.m.
Japan	2 a.m. 2 p.m.	6 a.m. 6 p.m.	10 a.m. 10 p.m.
India	8 a.m. at 220 stations. 10 a.m. and 4 p.m. at 65 stations.		
Hungary...	7 a.m.	2 p.m.	9 p.m.
Switzerland	7 a.m.	1 p.m.	9 p.m
Adelaide...	Every 3 hours.		
Perth	9 a.m.	3 p.m.	
Sydney	?	?	
Melbourne	Time of observations not stated.		

There is thus great diversity of practice, but the various combinations can be used to give comparable averages by the aid of information derived from the first order stations of the several organisations. In the absence of any specific reason based upon meteorological grounds for the selection of other hours, one or other of the selected combination hours should be chosen and the same combination should be used for all the stations in any geographical region.

The hours recommended for Tropical Africa by a committee of the British Association and included on that account in the "Hints to Observers in Tropical Africa," issued by the Meteorological Office, are as follows :—

"At normal stations . . . 7 a.m., 2 p.m. and 9 p.m. Where normal observations cannot be provided for, observations may be made once daily, preferably at 9 a.m."

In some climates observations at certain times are prohibited by medical authorities, and in such cases the assistance of a first order station or some substitute for it is specially necessary in order to bring the climatic factors into properly comparable form.

Third Order Stations.

Auxiliary Climatological Stations. In order to obtain local knowledge of climatic conditions without the elaboration of second order stations, observations of maximum and minimum temperature, and of rainfall which only require attendance once daily are very useful. In order effectively to incorporate the results with those of the more elaborate stations the observations require discussion by a trained meteorologist who can utilize the information from a first order station if there is one sufficiently near, and that from the second order stations of the region. It is an advantage to get the necessary discussion accomplished as soon as possible, because its results may be utilised to render the observations comparable and to obviate the unnecessary multiplication of stations.

Rainfall Stations. The requisite number of rainfall stations for dealing with questions of water supply for economic and agricultural purposes, is many times the number of climatological stations, because rainfall is subject to local variation in a very marked manner. The aspect of a station, the height above ground and generally

the physical features of the neighbourhood all produce their effect upon rainfall and a very detailed system of observations is of great practical utility. A rain gauge is usually visited every day, and it is best that it should be so, but rain gauges suitable for holding a week's fall or even a month's fall can be obtained for positions where more frequent observation is impracticable.

Instruments.

The first essential for comparable results is the use of comparable instruments. The National Physical Laboratory (Kew Observatory Department) affords the means of comparison with the standards of the Kew Observatory for such instruments as require comparison. Barometers and thermometers which have not been tested at Kew should not be employed.

The authorities of the National Physical Laboratory require certain conditions to be complied with before they will issue certificates. For example, thermometers must carry the graduation on the glass stem and errors must not exceed certain limits. These conditions being complied with, it is desirable to use instruments, as far as possible, of uniform type; the small modifications which distinguish the instruments of different makers are generally of little practical importance, and to some extent the interests of the makers and consumers are not identical. For example, the maker of a barograph may modify the dimensions of the apparatus so that a specially ruled form is required, which can only be obtained from the one maker. It is much more convenient for the instruments to conform to standard specifications and use standard forms.

The Meteorological Office has arranged to superintend the supply of meteorological instruments for the Colonies upon the requisition of the Crown Agents.

Reduction of Observations.

The guiding principle with reference to the method of dealing with observations is to give results that will not need subsequent revision and correction, and for that reason all reductions about which any doubt may be entertained should be avoided. The corrections which rest solely with those responsible for the observations are the correction of instrumental readings for index error, the correction of the barometer for temperature, the correction of observations of wind direction for compass error if that is necessary.

The pressure values should be given for the level of the barometer cistern (station level), the reduction to mean sea level if given at all should be quoted separately. It depends upon the determination of level which in some cases may require revision and upon a formula of reduction which is still a subject of discussion. The height of the cistern above mean sea level should always be given as well as the latitude of the station.

The International Committee have prepared a volume of meteorological tables for the reduction of observations, which is published by Gautiers Villars of Paris, and it is desirable that they or tables based upon them should be used for any reductions to which they apply.*

Inspections.

Meteorological stations should be inspected periodically and the state of the instruments and their exposure, as well as the competence of the observers regularly tested. Otherwise systematic errors of various unsuspected kinds are liable to be introduced into the records. Such errors if undetected may vitiate whole series of observations, and render a great amount of labour useless for practical purposes. In this connexion it must be remembered that the immediate and local application of the observations only represents part of their utility. A meteorological survey is not complete until a sufficient body of observations has been collected for changes of climate, whether periodic or otherwise, to be indicated. The result of changes of practice with regard to instruments and methods of observing may be easily confused with real changes of climatic conditions.

Forms for Publication.

The selection of a form for the publication of the results of meteorological observations should be guided by the fact that the results are required almost entirely for the purpose of comparison. Consequently the forms should be similar to, not different from, the forms used elsewhere. Ingenuity in devising novel forms for publication is as misplaced as originality in the units of coinage and weights and measures. A conversion or translation has to be made before the reader can arrive at the sense to be conveyed. The forms in general use are arranged upon the principle that *figures to be compared* should be arranged in *vertical* columns. Thus the headings of the columns are the various meteorological elements and the values of the *same* element for the *same* hour for consecutive days, months, or years come in vertical lines.

Reference may be made to the following books of instructions:—

1. The Observers' Hand-book, published by H.M. Stationery Office, prepared for use in the British Isles.
2. Instructions to Observers of the Indian Meteorological Department.

The Director of the Meteorological Office will be glad to supply further information about methods of working, observers' note-books, forms of return, and Office working forms if it should be required.

Among the forms used in the Meteorological Office are the following:—

* The International Tables do not contain hygrometric tables and for the reduction of the readings of dry and wet bulb thermometers, the Tables issued by the Meteorological Department of the Government of India should be used in Tropical Africa.

1. International Form A, for the publication of Daily Values.

NAME OF STATION. MONTH. 19 .

Height above Mean Sea Level feet. Heights above the Ground:—Bar. feet. Therms. feet. Rain-gauge feet.

LONG ° ' LAT ° ' Gravity correction in.

DAY.	Barometer at 32° F. and Station Level. 7	2	9	Air Temperature. 7	2	9	Max.	Min.	Humidity: Dep. of Wet. 7	2	9	Vapour Pressure. 7	2	9	Percentage. 7	2	9	Wind Direction and Force. 7	2	9	Amount of Cloud. 7	2	9	Rainfall.	Sunshine.	Remarks.	DAY.
1																											1
2																											2
3																											3
4																											4
5																											5
6																											6
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26																											26
27																											27
28																											28
29																											29
30																											30
31																											31
Mean...																											Mean.
Average																											Average.

Forms similar to the above for use either for fair copies of the entries in the rough notebook or as printer's forms when publishing the results, can be obtained through the Meteorological Office, London.

2. Extended International Form B, for the publication of Monthly Summaries.

NAME OF STATION.

LONG. ° ′ LAT. ° ′ Height above mean Sea Level feet.

Gravity Correction in.

Heights above Ground:—Barometer feet. Thermometers feet. Raingauge feet.

MONTH. 19 .	BAROMETER.		AIR TEMPERATURE.												
	Mean at 32° F. and Station Level.	Diff. from Average.	7	2	9	Mean.	Diff. from Av.	MEAN OF		A+B / 2	Diff. from Av.	ABSOLUTE MIN. AND MAX.			
								Min. A.	Max. B.			Min.	Date.	Max.	Date.
	Ins.	Ins.	°	°	°	°	°	°	°	°	°	°		°	
JANUARY ..															
FEBRUARY ..															
MARCH ..															
APRIL															
MAY															
JUNE															
JULY															
AUGUST ..															
SEPTEMBER ..															
OCTOBER ..															
NOVEMBER ..															
DECEMBER ..															
YEAR															

HUMIDITY.												BRIGHT SUNSHINE.				MONTH. 19 .
DEPRESSION OF WET.				VAPOUR PRESSURE.				PERCENTAGES.				Total in Hours.	Diff. from Average.	Per cent. of Possible.	Diff. from Average.	
7	2	9	Mean.	7	2	9	Mean.	7	2	9	Mean.					
°	°	°	°	Ins.	Ins.	Ins.	Ins.									
																JANUARY.
																FEBRUARY.
																MARCH.
																APRIL.
																MAY.
																JUNE.
																JULY.
																AUGUST.
																SEPTEMBER.
																OCTOBER.
																NOVEMBER.
																DECEMBER
																YEAR.

(FORM *continued.*)

MONTH. 19 .	AMOUNT OF CLOUD.				RAINFALL AND OTHER FORMS OF PRECIPITATION.				EARTH TEMPERATURE AT		RADIATION TEMPERATURE.				
											GRASS MIN.			SOLAR MAX.	
	7	2	9	Mean.	Total.	Diff. from Average.	Max.	Date.		4 ft.	No. of Obs. below.*	Absolute Min.	Date.	Mean.	Abs. Max.
					Ins.	Ins.	Ins.		°	°		°		°	°
JANUARY ..															
FEBRUARY ..															
MARCH ..															
APRIL															
MAY															
JUNE															
JULY															
AUGUST ..															
SEPTEMBER ..															
OCTOBER ..															
NOVEMBER ..															
DECEMBER ..															
YEAR															

WEATHER, NO. OF DAYS OF								WIND, NO. OF OBSERVATIONS OF										MONTH. 19 .
Rain.	Snow.	Hail.	Thunder Storms.	Clear sky.	Overcast.	Fog.	Gale.	Forces 4-7.	Calm.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	
																		JANUARY.
																		FEBRUARY.
																		MARCH.
																		APRIL.
																		MAY.
																		JUNE.
																		JULY.
																		AUGUST.
																		SEPTEMBER.
																		OCTOBER.
																		NOVEMBER.
																		DECEMBER.
																		YEAR.

* For this limit 30° is adopted at the Meteorological Office for the stations in the United Kingdom, but for agricultural and other purposes some other limit might be adopted in tropical climates.

This form has been extended to include information as to the duration of bright sunshine, earth temperature and radiation temperature, for which provision is not made in the international form. Space has also been provided for giving differences from the average when available. A similar form can be used for the monthly publication of summaries from a number of stations. The names should then be given in the columns containing the names of the months in the above specimen. If the size of the publication be foolscap, the table may be printed lengthwise across the page.

3. Form for fair copy of observations at auxiliary Climatological Station at which observations of maximum and minimum Temperature, Rainfall, and Sunshine are taken once a day.

CLIMATOLOGICAL REPORT, from ____________________.

Observations made at ________ *.m. each day by* ____________________

during ____________________ 19 .

Date.	TEMPERATURE.		RAINFALL.		SUNSHINE.	Other observations if any.			REMARKS.
	Max.	Min.	Amount.	Estimated Duration.	Total Duration for the day shown by Scorched Card.				As to prevalence of Thunderstorms, Lightning, Hail, unusually heavy Rainfall, Hoar-frost, Snow, &c.
	°	°	Ins.	Ins.	Hours and tenths.				

4. Form adopted by the Meteorological Office for the publication of abridged Monthly Summaries from Auxiliary Climatological Stations.

Station ____________________ Height above sea level. feet.

LONG. ° ′ LAT. ° ′ Height above ground :—Thermometers feet, Rim of rain gauge feet.

MONTH. 19 .	AIR TEMPERATURE.								RAIN AND OTHER FORMS OF PRECIPITATION.					BRIGHT SUNSHINE.			
	Mean of		Mean of A and B.	Diff. of Mean from Av.	Absolute Minimum and Maximum.				Number of Days.	Total Fall.	Diff. from Av.	Most in a Day.		Total in Hours.	Diff. from Av.	Per cent.	Diff. from Av.
	A Min.	B Max.			Min.	Day.	Max.	Day.				Amt.	Day.				
January ..	°	°	°	°	°		°			ins.	ins.	ins.					
February ..																	
March																	
April																	
May																	
June																	
July																	
August																	
September ..																	
October																	
November ..																	
December ..																	
YEAR ..																	

A similar form can be used for the monthly publication of summaries for a number of stations. The name of the stations and their heights above sea level should then be given in the column containing the names of the months in the specimen form.

5. Lustrum Average Form for the computation and publication of results for a series of years.

Station ________________ *Element* ________________

YEARS.	JAN.	FEB.	MAR.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUALS.
Average for years ..													
Highest													
Lowest													
TOTALS													
1901 1902 1903 1904 1905													
TOTAL													
MEAN (5 years)													
MEAN years ( )													
1906 1907 1908 1909 1910													
TOTAL													
MEAN (5 years)													
MEAN years ( )													

The form should be continued in a similar manner for periods of five years. In the forms in use at the Meteorological Office, which measure 19 × 13 ins., provision is made for including observations up to the end of the year 1930. A similar form has been used for the period 1866 to 1900. The form is used for the computation of the monthly averages of mean maximum temperature, mean minimum temperature, mean temperature, amount of rainfall, number of rain days, duration of bright sunshine, percentage of possible bright sunshine, &c.