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AIR MINISTRY

METEOROLOGICAL OFFICE

THE OBSERVER'S PRIMER

BEING
SHORT INSTRUCTIONS
IN THE
METHOD OF TAKING AND REPORTING
READINGS
OF
TEMPERATURE AND RAINFALL

SPECIALLY PREPARED FOR METEOROLOGICAL OBSERVERS IN BRITISH
CROWN COLONIES.

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PREFACE

The following instructions for taking observations of temperature and rainfall have been drawn up (at the instance of the Secretary of State for the Colonies) to meet the needs of meteorological observers in those British Crown Colonies and Protectorates in which the stations are so inaccessible that only the simplest observations can be made.

It is assumed throughout that the observer is in communication with some administrative officer or department such as the Department of Agriculture to whom reports are sent, and by whom forms and new instruments are supplied. In those cases where there is no such local authority, all returns and communications should be addressed to the Director, Meteorological Office, Air Ministry, Kingsway, London, W.C.2.

TABLE OF USEFUL MAXIMS

(From the *Handbook of Instructions for Meteorological Observers in Egypt, the Sudan and Palestine*, issued by the Physical Department, Ministry of Public Works, Egypt.)

Be **regular** and **punctual**.

Keep the instruments **clean**.

Carefully **file** all letters and circulars after reading them.

Check each observation after booking it.

Train your substitute. If he is not efficient the chances are that his mistakes will be attributed to you.

See that the wet bulb is well **moistened**.

After setting the maximum and minimum thermometers **compare** them with the dry bulb every morning.

Examine the thermometers for **breaks** in the columns.

Do not forget to **date** all records.

Everyone is interested in the weather. Do not let any **unusual** weather pass without recording it.

Take a pride in your meteorological station.

THE OBSERVER'S PRIMER

HOW TO TAKE READINGS OF TEMPERATURE AND RAINFALL.

1. GENERAL INSTRUCTIONS.

- (i) **Four rules.**—Observations of the weather should be made
Regularly every day.
Punctually, at the same time or times each day.
Carefully, without mistakes.
On instruments which are well kept and accurate.

All these rules are very important and failure to keep any of them spoils the record.

(ii) **Deputy observer.**—Besides the regular observer there should be someone else (the "deputy observer") at the station who knows how to take the observations and how to set the thermometers. He should go with the regular observer sometimes to take the observations. Then if the regular observer falls sick or has to be away from the station the observations can be carried on by the deputy observer.

(iii) **Time of observation.**—The observations must be made each day at exactly the same time. The time must be taken from a good watch or clock which is kept correct. If the observer cannot take the observations at the exact time he should come as near to that time as he can and write in his note-book the time at which he reads the instruments. For instance, if the regular hour of observation is 9h., but on one day the observer cannot observe until twenty minutes past nine, he must write in his book: "Observations at 9.20." The standard of time used should be stated in the note-book.

(iv) **Missed observations.**—If on any particular day the observations cannot be taken at all the space must be left blank. **Do not guess at them.** But **for rainfall** in such a case leave the water in the rain-gauge until the next day and then measure the total amount of rain which has fallen in the two days. Enter this amount in the note-book with a remark that it is the amount of rain which has fallen during two days (or as many days as have been omitted).

(v) **Checking the readings.**—Always look twice at the instruments in order to be sure that the readings are correct. Read an instrument, enter the reading in the note-book, and then read the instrument again before passing on to the next.

The instruments must be kept clean and easy to read, but as they break easily they must be handled carefully. The "maximum" and "minimum" thermometers may sometimes

become inaccurate and indicate wrong temperatures. This must be watched for; a wrong temperature is worse than no observation at all. More is said about this in section 3.

2. EXPOSING THE INSTRUMENTS.

(i) **The site.**—The meteorological observations require a piece of open ground, rather flat. There should be no houses or other buildings very near and no trees sheltering it. It should not be very near to land which is irrigated or frequently watered.

The set of instruments usually found at a small meteorological station includes four thermometers and a rain gauge (with a rain measure).

(ii) **The thermometers and the screen.**—The thermometers are as follows:—

“Dry-bulb” thermometer.

“Wet-bulb” thermometer (with muslin, wick and water-bottle).

“Maximum” thermometer.

“Minimum” thermometer.

These four thermometers should be exposed in a wooden “screen” which is a box on legs with ventilation openings at the sides, bottom and top to let the air move freely through it. The best type of screen is the Stevenson, illustrated in Figure 1. The screen will generally be sent with the instruments. If it is to be made at the station the officer with whom you are corresponding should be asked for full instructions how to do it.

It was formerly supposed that the best method of exposing thermometers in hot countries was in a thatched shelter with open sides, but it is now known that even in hot countries the Stevenson screen provides a better exposure than does a thatched shelter. The Stevenson screen is also cheaper to make.

The screen should be painted white and repainted at intervals whenever necessary.

(iii) **The position of the screen.**—The screen should be set up near the middle of the open space. It should be at least twice as far from any building or tree as the building or tree is high. It should be set up so that the door opens towards the north in the Northern Hemisphere and towards the south in the Southern Hemisphere. The four legs of the screen must be fixed firmly in the ground to prevent shaking by strong winds. If ants or rot are feared, the legs, unless they are of metal, should be protected.

(iv) **The arrangement of the thermometers in the screen.**—The thermometers must be placed in the screen so that each one can be read without moving any of them. A good arrangement is illustrated in Figure 1. The dry-bulb and wet-bulb thermometers should hang upright near the back of the screen; their

bulbs should be well above the floor. If, as is usual, the dry-bulb thermometer is on the left and the wet-bulb thermometer on the right hand, then the bottle containing the water for the wet-bulb thermometer should stand still further to the right.

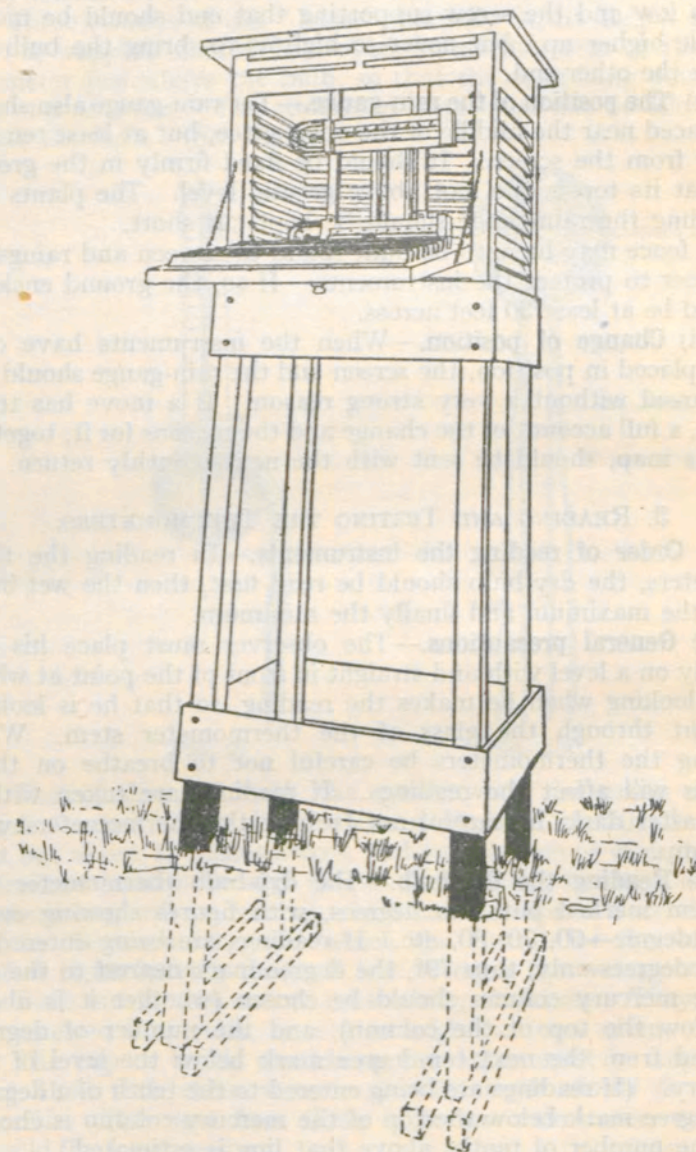


FIG. 1.

The maximum and minimum thermometers should be hung crossways, sloping a little (so that the bulb ends are a little lower than the other ends). They should be in front of the dry and wet-bulb thermometers, near the top and bottom of the screen, hung by means of four screws placed in the wooden up-rights. The maximum thermometer is generally placed above the minimum. To determine the appropriate slope of the maximum

thermometer place it in a trial position; warm it (by closing the hand round the bulb), let it cool (by taking the hand away) and the column of mercury in the tube should retain its position. If it slips back into the bulb, the bulb end of the thermometer is too low and the screw supporting that end should be moved a little higher up, but never so high as to bring the bulb end above the other end.

(v) **The position of the rain-gauge.**—The rain-gauge also should be placed near the middle of the open space, but at least ten feet away from the screen. It should be fixed firmly in the ground so that its top is one foot above ground level. The plants surrounding the rain-gauge should be kept cut short.

A fence may have to be built round the screen and rain-gauge in order to protect the instruments. If so, the ground enclosed should be at least 30 feet across.

(vi) **Change of position.**—When the instruments have once been placed in position, the screen and the rain-gauge should not be moved without a very strong reason. If a move has to be made, a full account of the change and the reasons for it, together with a map, should be sent with the next monthly return.

3. READING AND TESTING THE THERMOMETERS.

(i) **Order of reading the instruments.**—In reading the thermometers, the dry bulb should be read first, then the wet bulb, next the maximum and finally the minimum.

(ii) **General precautions.**—The observer must place his eye exactly on a level with and straight in front of the point at which he is looking when he makes the reading, so that he is looking straight through the glass of the thermometer stem. While reading the thermometers be careful not to breathe on them as this will affect the readings. If readings are taken with a lamp after dark, be careful not to heat the thermometers with the lamp.

(iii) **Reading the dry bulb.**—The dry-bulb thermometer has its stem marked out into degrees, with figures showing every tenth degree—60, 70, 80, etc. If readings are being entered to whole degrees only, thus 79°, the degree mark **nearest** to the top of the mercury column should be chosen (whether it is above or below the top of the column), and the number of degrees counted from the next ten-degree mark below the level of the mercury. (If readings are being entered to the tenth of a degree, the degree mark below the top of the mercury column is chosen and the number of tenths above that line is estimated.)

(iv) **Reading the wet bulb.**—The wet-bulb thermometer is next read. Before reading take care to see that the bulb is properly wet. This is most important. If the muslin is even slightly dry, the reading will be too high. In this case the bulb must be wetted, and, after waiting ten minutes, read again. With due attention to the water bottle, wick and muslin, however, the bulb should always be properly wet.

The bulb should be covered by one thickness only of muslin. The muslin should be stretched smoothly on the bulb and tied on with a cotton thread. After fixing, it should be carefully trimmed with a pair of scissors.

Three strands of the "wick" (actually Strutt Belper cotton, No. 8) supplied should be looped round the stem of the thermometer just above the bulb, so that the ends hang down into the cup of water. The strands of wick must not be allowed to cover the bulb. (See Figure 2.)

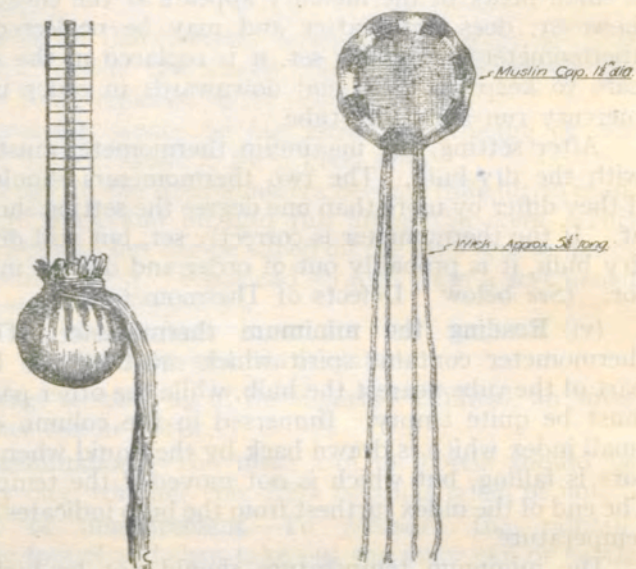


FIG. 2.

FIG. 2(a)

The muslin and wick can conveniently be made up into small "caps." For this purpose a circle of muslin should be cut out about $1\frac{1}{2}$ inches across, and two strands of wick threaded in and out round the edge (Figure 2a). When the wick is pulled a small bag will be formed which can be slipped over the bulb of the thermometer, after which the threads of the wick are pulled tight, leaving the ends free to enter the water container.

Both muslin and cotton must always be clean. They should be renewed frequently, once a fortnight or more often.

The cup or bottle containing the water must be kept clean and filled with clean water. *Distilled water should be used if possible.* The next best thing is to use rain-water, a supply should be kept ready.

(v) **Reading the maximum thermometer.**—The maximum thermometer is read by observing the position at the end of the column of mercury furthest from the bulb. This reading should not be lower than any of the dry-bulb readings during the past twenty-four hours. After entering the reading in the note-book, the observer must make the comparison with the dry-bulb reading before setting the thermometer.

The maximum thermometer is then set in the following way. The instrument is taken out of the screen and held upright in the hand with the bulb end lowest and the lower end of the wooden frame is tapped gently on the palm of the other hand until the column of mercury becomes continuous from the bulb upwards. If the mercury will not easily run down, swing the thermometer downwards clear of any objects with a rapid sweep of the outstretched arm, the thermometer being grasped at the upper end so that the bulb is outward. Sometimes after setting a small break in the mercury appears at the constriction; this, however, does not matter and may be neglected. When the thermometer is properly set, it is replaced in the screen, taking care to keep the bulb end downwards in order not to let the mercury run along the tube.

After setting, the maximum thermometer must be compared with the dry bulb. The two thermometers should read alike; if they differ by more than one degree the setting should be looked at. If the thermometer is correctly set, but still differs from the dry bulb, it is probably out of order and defects must be looked for. (See below "Defects of Thermometers.")

(vi) **Reading the minimum thermometer.**—The minimum thermometer contains spirit which must fill the bulb and the part of the tube nearest the bulb, while the other part of the tube must be quite empty. Immersed in the column of liquid is a small index which is drawn back by the liquid when the temperature is falling, but which is not moved if the temperature rises. The end of the index furthest from the bulb indicates the minimum temperature.

The minimum temperature should not be higher than the dry-bulb reading taken at the same time or at any time during the preceding twenty-four hours. (It may be higher than the wet-bulb reading.) After entering the reading in the note-book and making sure that this is so, take the thermometer out of the screen and incline it with the bulb end upwards until the index has slipped down to the end of the column of spirit. The thermometer is then replaced in the screen, taking care not to let the index slide back again. When it has been replaced in the screen the end of the index furthest from the bulb should show the same temperature as the dry-bulb thermometer: make sure that this is so. If after setting the minimum thermometer shows a different temperature from the dry bulb, and the setting is found to be correct, the thermometer has probably become faulty and must be examined for defects.

(vii) **Defects of thermometers.**—The dry-bulb or wet-bulb thermometer is out of order—

if the mercury column is broken anywhere, or if a thread of mercury is detached from the column and is sticking in the tube.

The maximum thermometer after setting is out of order—
if the mercury column shows any break except a slight one where the tube is narrowed.

This defect is put right by holding the frame of the thermometer at the end remote from the bulb, then making a few rapid downward swinging motions with the arm stretched out to its full extent. The force of the swing will then drive the sticking mercury down towards the bulb.

The minimum thermometer is out of order—

if the column of spirit is broken up, or if part of the spirit has collected at the upper end of the tube.

This can generally be put right by swinging the thermometer as described above.

After a minimum thermometer has been put right, it must be stood upright inside the screen, bulb end downwards, for an hour before being replaced in its proper position.

If a thermometer cannot be put right by swinging do not go on using it, but exchange it for a good one.

If the markings on the thermometers become difficult to read, mix some lamp black and oil and rub along the stem. This catches in the divisions but can be wiped off the intervening spaces with the finger or a cloth. Blacklead scraped from a soft pencil can be used instead of lamp black.

4. READING THE RAIN-GAUGE.

The rain-gauge is made up of three parts—a funnel, an outer can and an inner can or bottle.

(i) **Daily examination.**—The inner can or bottle should be examined every day, whether you think rain has fallen or not.

(ii) **Method of measurement.**—To measure the rainfall, first lift out the funnel and then take out the inner can or bottle in which the rain-water is collected. Pour this water into the measuring glass. Then hold the glass exactly upright or stand it on something level, and look at it with the eye on a level with the lowest part of the water surface and note what marking of the scale is nearest to it. The markings on the rain-gauge glasses are not all of the same kind. Some glasses are marked in inches, some in millimetres (mm.).

(iii) **Trace.**—If there is some water in the gauge, but less than .005 inch or .05 mm, that is, not enough to reach half-way up to the first division on the glass,* write the word "Trace" in the note-book.

(iv) **Large amounts.**—If there is so much water that the measuring glass will not hold it all, nearly fill the glass, read the amount and write it down, then pour the water into a jug. Then pour more of the rain-water from the gauge into the measuring glass and measure again going on until the rain-gauge is empty. Then add up these amounts, like this:

0.47 inch
0.46 inch
0.27 inch
1.20 inch

* In the new measuring glasses the .005 in. and .05 mm. graduations are themselves marked on the glass.

The total amount, 1.20 inch is to be entered in the note-book. The measurement should be made again from the water in the jug to prevent mistakes.

If so much rain has fallen that the water has filled the inner can or bottle and there is some in the outer can, the gauge must be taken out of the ground and **all** the water measured. This must be done with great care because heavy falls of rain like this are important.

(v) **Method of entry.—Clearness essential.**—In writing down the amount, always be careful to put in the dot showing the decimal point. If the measuring glass is marked in inches, there must always be two figures after the decimal point, the first showing tenths of an inch and the second hundredths of an inch. One or both of these figures may be an 0, but it should never be left out. The figure 4.07 means 4 inches and 7 hundredths. The figure 4.70 means 4 inches and 7 tenths. If only the figures 4.7 are written, another person will not know if you mean 4.07 or 4.70 inches. If the rain measure is marked in millimetres (mm.) there should always be one figure after the decimal point.

(vi) **Broken measure.**—If the measuring glass gets broken always report it **at once** and ask for a new one. If you have no spare measuring glass, do not try to measure the rain in any other way, but keep the water in a **closed** bottle carefully labelled. Write down in the note-book the date on which the glass was broken. If the end of the month comes before you get the new glass, use another bottle for the next month's rainfall. When the new glass comes, measure the water in each bottle separately, and enter the amounts in the note-book, taking care to note that the amount includes all the rain that has fallen during several days.

For instance :

July 20th Measuring glass broken.
 July 31st Rainfall July 20th to July 31st, 3.71 inches.
 August 8th New measuring glass No. 8331 received.
 Rainfall August 1st to August 7th, 1.07 inches.

5. THE NOTE BOOK AND MONTHLY RETURN.

(i) **Printed note-book.**—To keep the observations, a properly ruled note-book is needed. Suitable note-books have been printed and should always be used.*

* If, in an emergency you cannot get any of these, an ordinary lined note-book should be ruled up. If the station possesses four thermometers (dry-bulb, wet-bulb, maximum and minimum) and a rain-gauge, the columns needed will be like this :

Date		Day of week	Hour	Dry	Wet	Max.	Min.	Rain	Remarks
Month	Day								

A separate line in the **note-book** should be used for all the observations made at one time, and plenty of space should be allowed. The column for rainfall will be headed "inches" or "mm." according to the units on the measuring glass. The column headed "Remarks" should be used for the time at which rain fell, time of thunderstorms and any other details about the weather of the day which strike the observer. For instance :

" Rain 10 a.m. to 6 p.m. ; thunderstorm 2 p.m. to 4 p.m."

Always be very careful to make it clear whether you mean morning or afternoon, either by putting in the letters a.m. or p.m. (morning or afternoon) or by using the twenty-four hour way of reckoning time. In the twenty-four hour way of reckoning the morning hours are counted from 1 to 12 as usual but leaving out the letters a.m. and the afternoon hours are counted as 13 to 24 instead of 1 to 12 p.m. 9 a.m. is 9h. on the twenty-four hour day, while 9 p.m. is 21h.

If the column of "Remarks" is carefully filled up, it will be very helpful to anyone making use of the record.

(ii) **The monthly register.**—From the note-book the observations must be copied on to the monthly form supplied by the office or department to which reports are to be sent. This form should always be filled up in ink. Before writing in the actual observations always fill in the name of the station, the month and year in which the observations were taken, the hour or hours of observation and all the other information for which space is provided on the form.

(iii) **Temperature in the register.**—The readings of the dry and wet-bulb thermometers and of the minimum thermometer must always be entered to the day on which they were taken. If as is usual the maximum thermometer is read in the morning it must be entered to the day before that on which it is read. This is because the highest temperature of the day usually occurs in the early hours of the afternoon, and if the thermometer is read in the morning, it is the highest temperature of the preceding afternoon which is recorded. If the maximum thermometer is read in the evening, the figure should be entered to the day on which it is read.

(iv) **Rainfall in the register.**—The rainfall is usually measured in the morning, and in this case the amount is always entered to the preceding day. This should be done even when the rain actually fell in the early morning of the day of observation. The rainfall is only entered to the day of reading if it is measured in the evening. Always write down on your return whether your measurements are in inches or millimetres (mm.).

(v) **Example of entry.**—Thus, if the hour of observation is 9h., the observations taken on the 2nd of the month will be entered as follows :

Observations at Busoga during January, 1923

Hour of observation 9h.

Date	Dry Bulb	Wet Bulb	Maximum	Minimum	Rain-fall	Remarks
1			78		In.	
2	70·3	68·2		68	2·08	Heavy rain 14-20h.

The observations of maximum temperature and rainfall taken on the morning of the first day of the month are to be entered to the last day of the preceding month.

(vi) **Completing the register.**—Always copy in your remarks from the note-book in full, entering them to the date to which they refer.

After the observation on the first day of the following month, the maximum temperature and rainfall for the last day of the month can be entered on the return. The various columns should then be added up and the totals in the columns for temperature divided by the number of days in the month. The total of the rainfall column is not divided, but the days on which a measurable amount of rain fell (at least 0·01 inch or 0·1 mm.) are counted up and the number entered in the space provided.

(vii) **Despatching the register.**—The return is now complete. Look over it and make sure that you have not forgotten anything. If any of the temperatures appear to be unusually high or low, verify them. Then sign the return and send it off as early as possible.

(viii) **Preservation of note-books.**—When your note-book is full and all the observations have been copied on to the monthly forms do not destroy the note-book. Label it outside with the period to which it refers and keep it. You may want to refer to it again.

SUMMARY OF THE DAILY ROUTINE

(To be cut out, pasted on a card and hung in the thermometer screen.)

AT THE THERMOMETER SCREEN.

1. Enter the date and time in the note-book.
2. Read the dry-bulb thermometer and book the reading.
3. Read the wet-bulb thermometer and book the reading.
4. See that the muslin on the bulb is damp and that there is plenty of water in the bottle.
5. See that the reading is **not higher** than the dry-bulb reading.
6. Check these readings.
7. Read the maximum thermometer and book the reading.
8. See that the reading is **not lower** than the **highest** dry-bulb reading during the preceding 24 hours (or since the last setting).
9. Check the reading of the maximum thermometer.
10. Set the maximum thermometer (*see* p. 8).
11. Compare the maximum thermometer after setting with the dry-bulb thermometer.
12. Read the minimum thermometer and book the reading.
13. See that the reading is **not higher** than the **lowest** dry bulb reading during the preceding 24 hours (or since the last setting).
14. Check the reading of the minimum thermometer.
15. Set the minimum thermometer (*see* p. 8).
16. Compare the minimum thermometer after setting with the dry-bulb thermometer.

AT THE RAIN-GAUGE.

1. Lift out the funnel and take out the inner can or bottle.
2. If this inner can or bottle is dry write the word "Nil" in the column of the note-book headed "Amount of rain."
3. If there is some water in the inner can or bottle, pour it into the measuring glass and hold the measuring glass quite level.
4. If there is some water but not enough to reach half-way up to the first division on the glass,* write the word "trace" in the note-book.
5. If all the water will go into the measuring glass, read the amount and book it, and then check the reading.
6. If there is too much water to go into the measuring glass at once, nearly fill the glass, read the amount, write it down and pour the water into a jug. Then pour more water from the gauge into the glass, read the amount and write it down, going on until the gauge is empty. Add up the amounts you have written down and write the total in the note-book. Check the amount by measuring the water you have poured into the jug in the same way. (*See* p. 9.)
7. Look at the bottom of the gauge to see that the inner bottle or can has not overflowed. If it has, take the rain-gauge out of the ground and measure **all** the water.

* See note p. 9.

