

CHAPTER 1

OBSERVATIONAL ROUTINE

1.1. PROCEDURE AT A FULL SYNOPTIC STATION

1.1.1. Observations at each scheduled hour are usually made in the following order:

- Temperature, dry-bulb
- Temperature, wet-bulb (used in conjunction with the dry-bulb reading to derive the vapour pressure, relative humidity and dew-point)
- Amount of precipitation (selected stations only)
- Amount of cloud
- Types of cloud
- Height of cloud base
- Present weather
- Visibility
- Wind direction and speed
- Pressure tendency and characteristic
- Atmospheric pressure
- Past weather and any special phenomena occurring either at the time of observation or since the last observation are also recorded.

The main synoptic hours of observation are 0000, 0600, 1200 and 1800 GMT. Intermediate synoptic hours are 0300, 0900, 1500 and 2100 GMT.

1.1.2. Additional routine observations made in the United Kingdom at certain specified hours. These include:

- Extreme screen temperatures (maximum and minimum): read and reset at each of the hours 0600, 0900, 1800 and 2100 GMT
- Grass minimum temperature: at 0900 GMT (also at 0600 GMT without resetting)
- Soil temperatures: at 0900 GMT at selected stations
- Concrete-slab minimum temperature: at 0900 GMT
- State of concrete slab: at 0900 GMT
- State of ground: 3-hourly at 0000, 0300, 0600, . . . 2100 GMT
- Amount of precipitation: a distinction is made here between rainfall measurements made for climatological purposes and those made for synoptic purposes. Climatological measurements are made at 0900 and 2100 GMT (or 0900 only). Synoptic stations will, in addition, measure rainfall at the main synoptic hours, reporting at 0600 and 1800 GMT the previous 12-hour total rainfall, and at 0000 and 1200 GMT the previous 6-hour total rainfall. Selected stations also report the hourly rainfall. Measurements of rainfall for synoptic purposes will be made using another, quite separate, gauge for the purpose. A separate gauge is used to preserve the integrity of the measurements made for climatological purposes.

Snow depth: the depth of accumulated undrifted snow is reported (see the *Handbook of weather messages*, Parts II and III) by synoptic stations at 0600 GMT. All stations making synoptic observations will also report the snow depth at 0600, 0900, 1800 and 2100 GMT whenever snow is lying to an undrifted depth of 0.5 cm or more and additionally, as specified in 9.7 on page 152, at any other main or intermediate synoptic hour.

Note that these measurements are separate from the measurement of the water equivalent which is reported under rainfall; the water equivalent is dealt with in 9.4 on page 142.

Duration of bright sunshine: at stations equipped with sunshine recorders the card is changed daily as soon as possible after sunset. Exceptionally, the cards may be dealt with in accordance with 10.3 and 10.5, pages 154 and 158 respectively.

1.1.3. Selected stations include the following supplementary data in a separate message at 0900 GMT and 2100 GMT.

At 0900 GMT:

Maximum temperature	}	for the period 2100 GMT (previous day) to 0900 GMT, or 0900 GMT (previous day) to 0900 GMT if the station does not report at 2100 GMT
Minimum temperature		
Amount of precipitation		

Grass minimum temperature	}	read at 0900 GMT
Soil temperature at 30 cm and 100 cm		
Concrete-slab minimum temperature		

State of concrete slab at 0900 GMT

Depth of snow at 0900 GMT

Depth of fresh snow at 0900 GMT

Total hours of bright sunshine for previous day

Occurrence of hail, thunder, gale, snow or sleet on previous day

Existence of fog at 0900 GMT on previous day

States of ground three-hourly from 1200 GMT (previous day) to 0900 GMT.

At 2100 GMT:

Maximum temperature	}	for the period 0900 GMT to 2100 GMT.
Minimum temperature		
Amount of precipitation		

1.1.4. Autographic instruments. The charts on most autographic instruments are changed either daily or weekly. Some, for example the electrical anemograph, record on roll charts lasting for one month. The charts on instruments with daily clocks are changed at the time of the 0900 GMT observation, those with weekly clocks are changed about 0900 GMT on Mondays; monthly roll charts are normally changed at 0000 GMT on the first day of the month. If this day falls on a Saturday or Sunday at stations which are not manned at the weekend, the change is made on the first Monday of the month.

Before a chart is changed, the name and details of the station, dates and serial number of the chart are entered in ink on the new chart. A time mark is

made one or two hours after a chart has been changed, and on weekly and monthly charts thereafter at about 1200 GMT daily (or 1800 GMT if more convenient). On daily charts it is useful to have a second time mark 8–12 hours after the first. All time marks are recorded to the nearest minute; an appropriate note is entered in the Register and details of date and time are transferred to the chart after removal. For anemograms it is preferable to annotate the chart at the time the mark is made.

The appropriate measured value and the time are noted in pencil on each chart at the beginning and end of each trace. After each chart has been taken off the instrument, these and all other details required on the chart are completed neatly in ink. On daily thermograms and hygrograms, values of dry-bulb temperature (screen) and relative humidity (measured by psychrometer) are noted on the respective charts at the time of observation at the main synoptic hours, 0000, 0600, 1200 and 1800 GMT, whenever possible. On weekly barograms the mean-sea-level (MSL) pressure, measured by precision aneroid barometer or mercury barometer, is noted against the daily time marks.

The serial number for each chart is obtained by reference to Met. O. Leaflet No. 11, The Meteorological Office Calendar, published annually.

Where autographic instruments are maintained in a screen (thermograph and hygrograph) or in the open (recording rain-gauge), charts may be exposed to precipitation during changing. It is advisable to provide them with some form of protection both before and after exchanging charts; a waterproof folder or a suitable container can help to avoid unnecessary spotting of traces and excessive dampness of the chart. It is unavoidable at times and, if it occurs, charts must be dried before attempting to enter the chart details in ink.

All autographic instruments must be inspected from time to time during the day to make sure they are working correctly. Care must be taken that the observer's daily familiarity with the instruments does not lead him to overlook the deterioration that takes place in instrument performance over a period of time. Gradually accumulating deposits on nibs, clock timing incorrect, and a slow shift in instrument calibration are examples of deteriorations to which an observer can grow accustomed but which can be corrected. See also 1.10 and 1.11, pages 14–17.

1.1.5. Pilot-balloon observations are made at Meteorological Office stations as necessary to meet special requirements. Instructions are given in *Measurement of upper winds by means of pilot balloons*.

1.1.6. Recording observations. Observations (other than pilot-balloon observations) are recorded in the Daily Register (Metform 2050). Detailed instructions for making the entries are given in the *Handbook of weather messages*, Part III. A pocket-size pad of observation slips (Metform 2051) is provided for use when the observations are being made, and the recorded observations are copied from the slip into the Daily Register. Care must be taken at this stage to ensure that the transcription of the entries from the observation slip to the Register is correct.

1.2. PROCEDURE AT STATIONS MAKING ABBREVIATED REPORTS

Many auxiliary reporting stations make abbreviated reports in a code, the details of which are given in the *Handbook of weather messages*, Part III, and also in the publication *Abbreviated weather reports*. The latter also contains details for the entry of all such observations in Metform 2611 (Register of observations). The hours for observations are not the same for all stations but are arranged individually to suit local requirements or to suit the times when the observer is available. The following observations are required at each hour of observation:

Temperature, screen dry-bulb	} if required by Meteorological Office Headquarters
Dew-point	
Amount of cloud	
Types of cloud	
Heights of cloud	
Present weather	
Visibility	
Wind direction and speed	
Past weather	

Some stations report supplementary data at 0900 and 2100 GMT (or at 0900 GMT only). They report these data in the form in the *Handbook of weather messages*, Part III, and in *Abbreviated weather reports*.

1.3. PROCEDURE AT STATIONS MAKING SPECIAL REPORTS FOR AVIATION

1.3.1. Special reports. To meet the needs of aviation, meteorological offices situated on aerodromes are required to make additional reports. The times, frequency and format of these additional reports are the subject of special instructions to the stations concerned. The two most common forms of report are outlined below.

1.3.1.1. *Reports of sudden changes.* These reports are identified by the preliminary letters MMMMM, indicating a deterioration, or BBBBB, indicating an improvement, in certain elements either below or above certain defined limits; (see the *Handbook of weather messages*, Part III, for the conditions governing the making of these reports). The weather is to be kept constantly under observation to ensure that occasions when changes in weather conditions demanding these reports are not missed.

1.3.1.2. *Aviation routine weather reports.* An abbreviated report (METAR) in a form specifically for use for aviation purposes is given in the *Handbook of weather messages*, Parts II and III. The content of this report, which can also contain plain-language elements, includes:

- Wind direction and speed
- Visibility
- Runway visual range (if required)
- Present weather

Amount and types of cloud
Height of cloud base
Screen dry-bulb temperature } (if required)
Dew-point }
Pressure: QNH value (see 7.6, page 106).

1.4. PROCEDURE AT STATIONS MAKING PLAIN-LANGUAGE WEATHER REPORTS

Simplified weather reports, in plain language, are made at a number of Automobile Association and Royal Automobile Club town offices and Motorway Maintenance Depots. These reports, which are entered on Metform 5967B or D (Plain-language weather observations), indicate the state of sky, the weather, the visibility and state of roads. Some stations also report dry-bulb and minimum temperatures. The schedule for these reports varies; usually only two or three reports a day are made from any one site, but in winter, when motorway maintenance compounds are manned continually, 3-hourly reports throughout the 24 hours are made at many of these sites.

Reports are telephoned to a collecting centre and are used for forecasting in the public service sector.

1.5. PROCEDURE AT CLIMATOLOGICAL STATIONS

1.5.1. Climatological stations, manned by voluntary co-operating observers, normally make the following instrumental and visual observations once a day at 0900 GMT:

Temperature, dry-bulb, in the screen
Temperature, wet-bulb, in the screen
Temperature extremes, maximum and minimum, in the screen (both thermometers are then reset)
Amount of precipitation 0900–0900 GMT (rain in the measuring glass is then poured away)
State of ground (see Chapter 6)
Snow depth (see 9.7, page 152)
Amount of cloud
Present weather
Visibility
Past weather: a brief account for the previous day, midnight to midnight GMT, is kept and entered on the monthly return.

The above observations are the basic requirements from a climatological station but those who wish to do so, providing the site is satisfactory, may add instruments to indicate or record the following:

Sunshine duration (see 10.4, page 156)
Temperature, grass minimum (thermometer then reset)
Temperature, bare-soil minimum (thermometer then reset)
Temperature, concrete-slab minimum (thermometer then reset)
Temperature, soil (as may be arranged for individual stations)
Wind: direction in tens of degrees from true north, and speed in knots

Atmospheric pressure (readings from a precision aneroid or mercury barometer).

At all climatological stations the observations are recorded in Metform 3100 (Pocket Register) and then transcribed on to a monthly return. Instructions for completing this return are given in Metform 3100A which is supplied to observers voluntarily co-operating with the Meteorological Office.

1.5.2. Stations at Health Resorts. A number of coastal and inland resorts participate in the Meteorological Office Health Resort Scheme. In addition to carrying out the 0900 GMT climatological observations listed in 1.5.1, Health Resort stations make an observation at 6 p.m. daily. These reports are entered in Metform 3100 and are encoded for telephoning to a collecting centre. Details of the collecting centres used by individual stations and the form of the coded message are notified to each station.

The report made at 6 p.m. is intended for release to the Press and includes two groups of Beaufort letters (see 4.5.1, page 73), each not exceeding five in number, which describe the past weather from 8 a.m. to noon, and noon to 6 p.m. respectively. Alternatively, if a single word can be used to describe the weather throughout either of those periods, this word can be substituted for the group of Beaufort letters. In addition, the following observations are made and reported at 6 p.m. clock time:

Temperature, dry-bulb, in the screen

Temperature, maximum, in the screen (the thermometer is not reset)

Temperature, minimum, in the screen, as read at 0900 GMT on the day of the report

Amount of precipitation. (The two totals reported are for the periods 6 p.m. on the previous day to 0900 GMT, and 0900 GMT to 6 p.m. on the day of the report. The rain in the measuring glass is poured back into the rain-gauge after the 6 p.m. measurement.)

Sunshine duration. (The two totals reported are for the periods 6 p.m. to sunset on the previous day, and from sunrise to 6 p.m. on the day of the report.)

At Health Resort stations the sunshine cards may be changed at 6 p.m. or between sunset and sunrise as the observer prefers. Whichever practice is adopted, it must be maintained regularly. The special procedure for changing the cards is explained in 10.3, page 154.

1.5.3. Agricultural meteorological stations. These are climatological stations maintained by those with a direct interest in the effects of weather on agriculture. These stations carry out the routine in 1.5.1 above and, in addition, record at 0900 GMT the soil temperatures at one or more depths, bare-soil minimum temperature, and usually the run of wind at a height of 2 metres. Some stations also record solar radiation.

1.6. GENERAL REMARKS ON OBSERVING

The preceding paragraphs merely list the items to be observed. Details of the items to be observed in each case are set down in the chapters which follow.

Sufficient information is given here for observers at climatological stations to complete the 0900 GMT daily observations without reference to other publications, but Metform 3100A is required for instructions for completing the monthly returns. Observers at other types of station must refer to publications indicated in the preceding paragraphs and which are repeated below for convenience.

- (a) At stations which make abbreviated synoptic reports, observers refer to *Abbreviated weather reports*.
- (b) At full synoptic stations, observers refer to the *Handbook of weather messages*, Parts II and III.
- (c) At aerodromes where special reports are made for aviation by meteorological staff, observers refer to the *Handbook of weather messages*, Parts II and III. Where reports are made by Air Traffic Control staff, reference is more conveniently made to a wall-card—*Codes for observations in METAR form*.

There is no essential difference between the observation of items at a climatological station and at a synoptic station. At a synoptic station where the schedule of observations is hourly throughout the 24 hours, or covers at least several hours each day, it is essential that the watch on the weather is as close and continuous as possible. At a climatological station where normally only one observation a day is recorded (at 0900 GMT) and where, for example, the observer may be an employee of a local authority, or someone with other duties, or a private person making observations as a matter of interest, the maintenance of a record of the weather occurring between the hours of observation is very much more difficult, but no less important. The observer has to try to make his record as complete and as reliable as is practicable and, if possible, state clearly the period of the day covered by the weather diary. It will provide not only the basis for the preparation of climatological statistics, which are used for a wide variety of scientific and industrial purposes, but it may also have to be produced in a Court of Law.

1.7. TIME STANDARDS AND PUNCTUALITY

In the United Kingdom the standard of time for all meteorological observations is Greenwich Mean Time (GMT). When time by public clocks is one hour ahead of GMT an observation for 0900 GMT, for example, is made at 10 a.m. clock time.

At overseas stations manned by Meteorological Office staff, the standard of time for all synoptic purposes is also GMT, but for climatological purposes the local zone time (LZT) is used (see 1.7.7). This LZT is that appropriate to the meridian of a station, though a variation of up to one hour is permissible where such variation would bring the station's practice into accord with local time standards. The standard of time used at an overseas station should be plainly stated in the Daily Register, on monthly returns, and on all records and tabulations.

1.7.1. Standard hours of observations for synoptic purposes. As decided by the World Meteorological Organization, GMT is standard throughout the

world for synoptic purposes. The main standard times for surface synoptic observations are 0000, 0600, 1200 and 1800 GMT; the intermediate standard times are 0300, 0900, 1500 and 2100 GMT. Standard times for surface observations at other than main and intermediate hours are 0100, 0200, 0400, 0500 GMT, etc. The evaluation of elements composing a surface synoptic observation should be made in as short a time as possible, just prior to the official time of observation. About 10 minutes should normally suffice to complete the observation.

1.7.2. Hours of climatological observations at stations in the United Kingdom. At climatological stations, and at stations which measure rainfall only, the standard hour of observation is 0900 GMT. Health Resort stations are a special case, and for these stations a special evening observation is made at 6 p.m. clock time throughout the year in addition to the climatological observation at 0900 GMT. The reason for this exceptional use of clock time is that special reports have to be sent to newspapers at times related to that of going to press. Synoptic stations may be required to compile climatological returns for a variety of hours as determined by other instructions.

1.7.3. Hours of climatological observations at stations outside the United Kingdom. At overseas synoptic stations manned by Meteorological Office staff, monthly returns are required for the eight synoptic hours (0000, 0300, . . . 2100 GMT) at which the observations are made. The climatological terminal hours for the measurement of amounts of precipitation and extreme temperatures are 0900 and 2100 local zone time (LZT), or the hours of synoptic observation nearest to 0900 and 2100 LZT.

1.7.4. Hours of observing amount of precipitation and extreme temperature at synoptic stations: European (Region VI) practice. Rainfall amounts are included by full synoptic stations at 0000, 0600, 1200 and 1800 GMT in their weather reports. The amounts reported are for the previous six hours at 0000 and 1200 GMT, and the totals of the previous twelve hours at 0600 and 1800 GMT. Extremes of temperature (maximum and minimum) are observed at 0600, 0900, 1800 and 2100 GMT. The method of obtaining the values to be included in synoptic reports is explained in the Daily Register.

Additionally in the United Kingdom, as noted in 1.1.2, measurements of rainfall are made at 0900 and 2100 GMT (or at 0900 only) for climatological purposes; at certain stations hourly rainfall reports are made.

1.7.5. Punctuality is essential in all meteorological observing. The observations of the elements composing a weather report cannot all be made at once, but the World Meteorological Organization has recommended that the pressure observations should be made at the exact hour, that visibility should normally be the last of the outdoor observations to be made, and that the other elements should be observed in the 10 minutes immediately preceding the hour. However, at synoptic stations, timing schedules for onward transmission of the reports to the collecting centre may necessitate the completion of the observation before the exact hour: this may vary from 5 to 10 minutes. When any element changes significantly during the 10-minute period of observation, and the observer is able to assess this change, the new assessment of the changing element may be the last thing to be observed.

Definitions of 'times' of observations are given below in 1.7.5.1 to 1.7.5.3.

The order of the observations advised in 1.1.1, 1.2 and 1.5.1 is usually the most convenient at stations where the layout follows the plan suggested in Appendix I (page 179) and where instruments record or indicate surface wind speed and direction remotely; where there are no such instruments, surface wind speed and direction should be observed before the visibility. The order of precedence has to be varied in special circumstances, but should ensure that all the scheduled elements are observed within the 10 minutes before the official time of observation.

If a balloon observation is made to determine the height of the cloud base, sufficient time must be allowed to ensure that the normal observation of all other elements is completed by the required time.

1.7.5.1. *Actual time of observation* of an element means the time at which the observation of that particular element is completed. For any element which is changing during the period when an observer is making his observation, the actual time of observation of that element should approximate as closely to the 'official time of observation' as will permit the observer to assess the change.

1.7.5.2. *Official time of observation* is the time of observing the last element necessary to complete a surface synoptic observation. This will normally be the reading of the barometer, but when any element changes and the observer is able adequately to assess the change, the new assessment of this element may be the last to be observed. This official time of observation is entered in the Daily Register (and, where applicable, on Metform 2309). This time should be as near as possible to the standard time of observation.

1.7.5.3. *Standard time of observation* means the internationally agreed time as contained in World Meteorological Organization resolutions (see 1.7.1).

1.7.6 Numbering of hours. When recording the time of occurrence of phenomena etc. the four-figure system is always used. The first two figures give the hour from 00 to 23 and the last two figures give the minutes. For example, 25 minutes past midnight is recorded as 0025, and 25 minutes before midnight as 2335. The day is regarded as beginning at 0000 GMT, and this is logged as the standard time of the first observation of the day, not as the last of the preceding day.

1.7.7. Specification of zone time. Although GMT is universally adopted as standard for the making of synoptic reports in all parts of the world, it is sometimes necessary to specify time in terms of zone time. In this system the local time varies according to the longitude in steps of an hour per unit of 15 degrees of longitude, and a letter is appended to the four-figure time group to indicate the zone, according to the following scale:

Z = GMT

A, B, C, . . . L, M (omitting the letter J) are zone times appropriate to areas centred on longitudes 15°E, 30°E, 45°E, . . . 165°E, 180°(E).

N, O, P, . . . X, Y are zone times appropriate to areas centred on longitudes 15°W, 30°W, 45°W, . . . 165°W, 180°(W). The complete scheme is given in the table on page 12.

ZONES FOR LONGITUDE EAST OF GREENWICH, GMT BEING BEHIND ZONE TIME

Index letter of time standard.....	Z	A	B	C	D	E	F	G	H	I	K	L	M
Correction to obtain GMT from zone time (hour).....	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12
Standard longitude of corresponding zone	0°	15°E	30°E	45°E	60°E	75°E	90°E	105°E	120°E	135°E	150°E	165°E	180°(E)

ZONES FOR LONGITUDE WEST OF GREENWICH, GMT BEING AHEAD OF ZONE TIME

Index letter of time standard.....	Z	N	O	P	Q	R	S	T	U	V	W	X	Y
Correction to obtain GMT from zone time (hour).....	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	+11	+12
Standard longitude of corresponding zone	0°	15°W	30°W	45°W	60°W	75°W	90°W	105°W	120°W	135°W	150°W	165°W	180°(W)

Examples:

1300D = 0900Z 1300M = 0100Z 1300R = 1800Z

The zones for which the time standards have index letters M and Y are separated by the international date-line. Thus 0600M is the same as 0600Y but the latter is dated one day earlier than the date of the former. The following times are identical:

$\left. \begin{array}{l} 1400M \\ 0800F \\ 0200Z \end{array} \right\}$ with a given date, d $\left. \begin{array}{l} 2000S \\ 1400Y \end{array} \right\}$ with the preceding date, $d - 1$

1.7.8. Sunrise and sunset. The World Meteorological Organization (WMO) recommended in 1957 that, in accordance with current astronomical practice, the definitions of sunrise and sunset should refer to the times when the sun's upper limb contacts the apparent horizon. From July 1964, the Meteorological Office adopted the WMO recommendations: sunrise and sunset are now defined as the instant at which the upper limb of the sun appears in contact with the horizon, it being assumed that both observer and horizon are at sea level. The 'duration of daylight' or 'length of day' are terms used for the interval between sunrise and the following sunset. This quantity may be obtained from the *Nautical almanac* or, more simply, from Table 171 of the *Smithsonian meteorological tables*, pages 506–512 (Sixth revised edition).

The times of sunrise and sunset vary with latitude and with the declination of the sun. Diagrams illustrating the variations are given in Figure 23 on pages 191–194. If these times are required with any accuracy for a station, reference will have to be made to the current edition of the *Nautical almanac* (published annually).

Copies of both the *Nautical almanac* and the *Smithsonian tables* are available for reference in the National Meteorological Library at Bracknell and in most Public Libraries.

1.8. AVOIDANCE OF ERRORS

By approaching his task systematically an experienced observer should be able to complete a set of observations in 10 minutes without sacrificing accuracy to speed. The program must be carried out briskly but not hastily. In the chapters which follow, attention is drawn to the sources of error likely to arise in various types of observation, but it is important to note the need for checking entries immediately after they are made in the Register. This does not mean that all the readings should be repeated. The checking ensures that nothing has been omitted and that no gross error has been made by sheer inadvertence. One of the commonest of such errors is the misreading of a thermometer by 5 or 10 whole degrees; when any instrument is read it is advisable to take a second glance to avoid elementary mistakes of this kind.

Another object in checking the entries is to ensure that they are mutually consistent. If some rain is measured there must be an entry of precipitation somewhere in the 'past weather' column. Fresh snow lying must similarly be accounted for. There should be no inconsistency between entries of visibility and present weather or past weather. Such examples might be multiplied almost indefinitely and the point need not be laboured. At synoptic stations, where observations are initially written on the observations slip (Metform 2051) and then copied into the Daily Register, great care should be taken to avoid errors in copying.

The Register is the official record of all surface observations made. It is therefore the basic document to which reference has to be made when answering enquiries which involve the observations. Corrections must never be made by erasure of the original entry, but are to be made by following the procedures given in section 7.4 of the *Handbook of weather messages*, Part III and in *Abbreviated weather reports*.

1.9. OBSERVING AT NIGHT

Outdoor instrumental observations at night, requiring the use of a light, must be completed at least two minutes before non-instrumental observations to give the observer's eyes time to adapt to the dark (but see the special instructions given in 3.4.1, page 48, concerning the use of the Meteorological Office visibility meter).

1.9.1. Cloud form and amount. When cloud observations are made at night the principle of continuity is to be borne in mind. The observer should watch the sky towards dusk and so obtain some guidance as to the clouds which are likely to be present after the daylight has gone. If, during the hours of darkness, there is an onset of precipitation and the observer is in doubt as to the form of clouds present, the table on page 29 will assist him in identifying the form of clouds by the character of the precipitation.

If the air is clear, the estimation of total amount of cloud should not usually be difficult because stars will be visible in the areas of the sky free from cloud, but the brightest stars and planets are visible through thin veils of cirrocumulus, cirrus or cirrostratus. The intensity of the darkness is of some assistance in deciding whether the sky is wholly covered or not with dense low cloud; if there is any light at all, variation of contrast or luminance may indicate patches of low cloud with medium or high cloud above.

On occasions of fog which is so thick as to make it impossible to tell whether or not there is cloud above, the amount is recorded as 9 but taken as 8 for statistical purposes, and cloud types are shown as '/'. If cloud can be seen through the fog, the amount of cloud is to be estimated as well as circumstances permit. If the moon or stars can be seen through the fog and there is no evidence of cloud, the cloud amount is to be recorded as 0 (see 2.4.1, page 30).

1.9.2. Cloud height. The cloud height at night is to be determined whenever possible with the assistance of a cloud-base recorder, cloud searchlight, or by balloon and lantern. Where no instruments are available but there is sufficient light for the type of cloud to be distinguished, the height is to be estimated in the same way as in daylight to the best of the observer's ability (see 2.5.3, page 32).

1.9.3. Visibility. Instructions relating to determining visibility at night are given in 3.4 (page 47).

1.9.4 Weather. In observing weather at night the observer must be on his guard against mistaking the flashes created by electric trains for distant lightning.

1.10. CARE OF INSTRUMENTS AND EQUIPMENT

It is essential that the meteorological instruments and equipment on a station be kept clean and, by simple routine maintenance, kept in good working order; this will promote their good performance and lengthen their useful life.

Details of the routine maintenance that must be carried out on a specific instrument will be found in the appropriate chapter of this handbook. A notebook should be maintained in which each instrument is allotted several pages so that a chronological record of routine maintenance, checks and adjustments can be logged. The pages allotted to each instrument can be vertically ruled for appropriate headings; for example, under the section allocated to the thermograph:

Date	Instrument number	Job	Remarks	Initials
5.3.82	345/71	Monthly service	Instrument cleaned, bearings lubricated, temperature setting adjusted	ABC

In addition, a brief note of the action taken and the time it was done should be entered in the remarks column of the observation Register.

1.10.1. General principles. Some general principles to be followed in handling the mechanical parts of recording instruments are given below.

- (a) Consult the Installation/Operator's Instructions issued by the Operational Instrumentation Branch of the Meteorological Office.
- (b) Do not use unsuitable cleaning materials (e.g. of a corrosive or clogging nature).
- (c) Use the correct lubricant, usually good quality clock oil. Apply it sparingly and only to bearings where it is needed, and remove any surplus.
- (d) Do not defer cleaning or the routine maintenance until the instrument has reached a condition of neglect which prevents it from working properly. Cleaning should be done regularly, and all instruments should be maintained in good working order.
- (e) If a tool needs to be used on an instrument, perhaps for the purposes of adjustment, then use the correct tool of the correct size as this will avoid damage. Never use a knife blade as a substitute for a screwdriver.
- (f) Replace any instrument as soon as possible if it appears to be unserviceable. Spares are normally held of those items particularly liable to damage or breakage, e.g. thermometers.

Store all equipment, and spares in particular, so that they are safe from loss or damage but are readily available for use. Ensure that replacements are speedily arranged for unserviceable instruments and for spares which have been used.

1.10.2. Methods of cleaning. General advice and methods of cleaning the different materials most often used in instruments are listed below.

- (a) *Plain brass or copper parts.* These may be kept bright with an oily rag or with metal polish applied sparingly. The inside of a rain-gauge funnel, however, should only be rubbed with a dry cloth.
- (b) *Lacquered brass or copper parts.* Clean with a soft lint-free cloth. Where there is exposure to damp, a little petroleum jelly may be applied.
- (c) *Polished woodwork* (cases of barographs etc.). Clean with a soft lint-free cloth. A little linseed oil may be rubbed in with a soft cloth if necessary.

- (d) *Glass and porcelain* (thermometer stems, windows of recording instruments). Clean off dirt with a moist rag or lint-free cloth.
- (e) *Plain bearings, pinions and hinges of instrument cases*. Lubricate sparingly with a touch of good quality clock oil (but see 1.10.1(a) above).
- (f) *Steel parts*. Clean with an oily rag. A trace of petroleum jelly will protect the steel from rust.
- (g) *Painted woodwork* (thermometer screens etc.). Woodwork should be brushed clean whenever necessary, and at stations affected by soot or smoke a thorough cleaning with soap and water should be carried out once a month. Detergent and water may also be used.
- (h) *Painted surfaces liable to inking*. The ink should be removed while wet with a damp cloth. Older stains can be removed by the application of a small quantity of whiting applied with a damp cloth. Methylated spirit may be used with the whiting if there is no risk of this getting on to lacquered brass or polished woodwork. Inhibisol or similar product may also be used.
- (i) *Chromium-plated parts*. Use a soft dry cloth. Do not apply metal polish.

1.10.3. Housing of loose meteorological instruments and equipment. Stations making a full set of observations may have the following additional items which are not permanently installed but must be readily available for use in the enclosure:

- (a) rain measure,
- (b) grass minimum thermometer,
- (c) bare-soil minimum thermometer,
- (d) concrete-slab minimum thermometer, and
- (e) extra rain-gauge bottles.

If the enclosure is considered safe from petty theft or interference, the rain measure and the three minimum thermometers may be left out of doors. Otherwise loose equipment must be brought back into the office after use.

If left out of doors, the rain measure must be inverted over a short wooden post or dowel which should be driven into the ground conveniently close to the rain-gauge. The diameter of the post or dowel should be only very slightly less than the diameter of the rain measure. If kept within the office, the rain measure should be retained inverted on a suitable holder.

Two of the additional minimum thermometers may be stored in the screen after reading. If the grass minimum thermometer has been exposed on attached rubber supports, the thermometer (with the supports attached) can simply be placed in the front well of the floor of the screen. The bare-soil minimum or concrete minimum thermometer may then be stored by resting it in the U-shaped slots of those rubber supports; this will ensure that both thermometers are stored at the required angle of 2° to the horizontal, with the bulb end lower than the stem. Where the special rubber supports are not used, the thermometers can be stored in the screen in a near-vertical or sloping position, with the bulb end in the well provided. If, for any reason,

the thermometers cannot be stored in the screen, they should be brought indoors and stored in their appropriate containers in a near-vertical position, bulb end down.

With the exception of the minimum thermometers, as detailed above, the thermometer screen must not be used for the stowage of any extraneous equipment.

1.11. TABULATION AND CUSTODY OF AUTOGRAPHIC RECORDS

Considerable official use is made of the tabulations from autographic records in answering enquiries and for investigations. Moreover, the original anemograms, barograms, thermograms, hygrograms or record of rainfall charts are often required for special study, either in the Meteorological Office or by individuals in other organizations, or for reproduction and publication. It is of the utmost importance that every care should be taken to ensure that the instruments are working properly and that the records are satisfactory. Charts should be kept clean, with distinct unbroken traces and accurate time marks so that reliable tabulations may be prepared (see also 1.1.4). Each meteorological office in the United Kingdom equipped with the necessary instruments makes tabulations, on the appropriate forms, of anemograms, record of rainfall charts and sunshine records obtained at the station.

Photocopies of tabulations are often supplied in answer to enquiries. It is therefore essential that tabulations should be completed in black or blue-black permanent ink and the use of blue or other light shades of ink should be avoided. Inks which fade with time must not be used.

Serious faults on the more complicated autographic instruments (e.g. anemographs) which cannot be dealt with locally should be referred by Meteorological Office stations to their Area or Regional Maintenance Centre for advice, and by other stations to their parent station or administering authority as appropriate.