Chapter 13 Weather

The Difference Between Weather and Climate

The term weather should not be confused with climate, though they are very closely related to each other in the study of meteorology and climatology. We don't hear people saying that the climate of the day is warm or cold, but we do talk of warm weather, a cold morning, a sunny afternoon, a rainy day or a chilly night. Any casual remarks about the atmospheric conditions of a certain place at a certain time are about weather. It is never static, and thus cannot be generalized. In the same country, even over a small area, the weather can vary tremendously. It may be sunny in one part of the district, but raining heavily a few miles away. Strong gales may be experienced along the coasts while the interior may be relatively calm. It is important to realise that any place can be subjected to haphazard changes in weather at any time.

When we speak of climate we mean the average atmospheric conditions of an area over a considerable time. For climatic averages, a minimum period of 35 years is desirable. This involves the systematic observation, recording and processing of the various elements of climate such as rainfall, temperature, humidity, air pressure, winds, clouds and sunshine before any standardization of the climatic means or averages can be arrived at. The climate of Malaysia is described as *hot, wet, equatorial climate* which is a summing up of the average everyday climate of the country throughout the year.

The degree of variability in the climate or weather of a country also differs. Generally speaking, the climate of temperate latitudes is far more variable than that of the tropics. The climate of the British Isles is so changeable that many people have commented that 'Britain has no climate, only weather'. Conversely, the climate of Egypt is so static that it makes a good deal of sense when people say that 'Egypt has no weather, only climate'.

The Importance of Climate and Weather

The profound influence of climate and weather over man's activities can be seen from his everyday life. Forces of nature have regulated to a very great extent the sort of food we eat, what we wear, how we live and work. Our mental alertness, our physical characteristics and even our racial differences when closely examined have at least some relationship with climate. The direction of winds once controlled the pattern of trading routes. The safety of modern air communications is closely tied to accurate meteorological reports from the ground stations. Despite the advances made in science and technology, farmers and their crops are still at the mercy of the climate and the weather. Conditions of temperature, precipitation and humidity may promote or discourage the growth of fungus and diseases which may be injurious to both men and crops. Death rates are normally high in tropical countries and low in deserts, because germs are not transmitted readily in regions of high temperature and low humidity. Cool, fresh mountain air is always good for health.

Weather Bureaux or Meteorological Stations are scattered all over the globe, including the oceans, using some of the most up-to-date weather instruments to gather a wide range of data as raw materials for the construction of weather maps or synoptic charts. Though men are still unable to tame the forces of nature such as floods, droughts, typhoons or hurricanes, a sound knowledge of the trends or the weather systems can often help to avoid or reduce the seriousness of the calamities. Professional meteorologists are able to forecast the weather fairly accurately from local observations. A fall in the barometer, a change of cloud types, a bright sunset or even a whisper of the wind can be very useful tips to a weather forecaster in detecting what is going to happen next. A casual glance at the sky will be sufficient for a weather expert to sum up the conditions of the atmosphere.

To-day farmers are becoming more and more dependant upon *meteorological services.* A knowledge of the likely weather of a place will be useful for a farmer to plan his work for the season or the year. Frequent *agricultural bulletins* issued by the Meteorogical Office will assist farmers to take due precautions against frosts, hail, heavy snowfall or a period of possible drought. Sailors at sea are warned promptly of any on-coming gale or typhoon. Modern air transport, military operations, geographical expeditions, even important games and outings, often take due consideration of meteorological reports. A fair knowledge of the weather is not only useful but often essential.

The Elements of Weather and Climate

To collect various climatic data and to prepare maps and charts of them, the following elements of climate are normally observed and measured by weather instruments.

1. Rainfall. Rainfall including other forms of precipitation (snow, sleet and hail) is always measured by a metal instrument called a rain gauge (Fig 96). It consists of a copper cylinder with a metal funnel either 5 inches or 8 inches in diameter, which leads into a smaller copper container or a glass bottle. The hole in the funnel that leads down to the container is very small so that evaporation of the collected rain is minimised. The gauge should be at least one foot

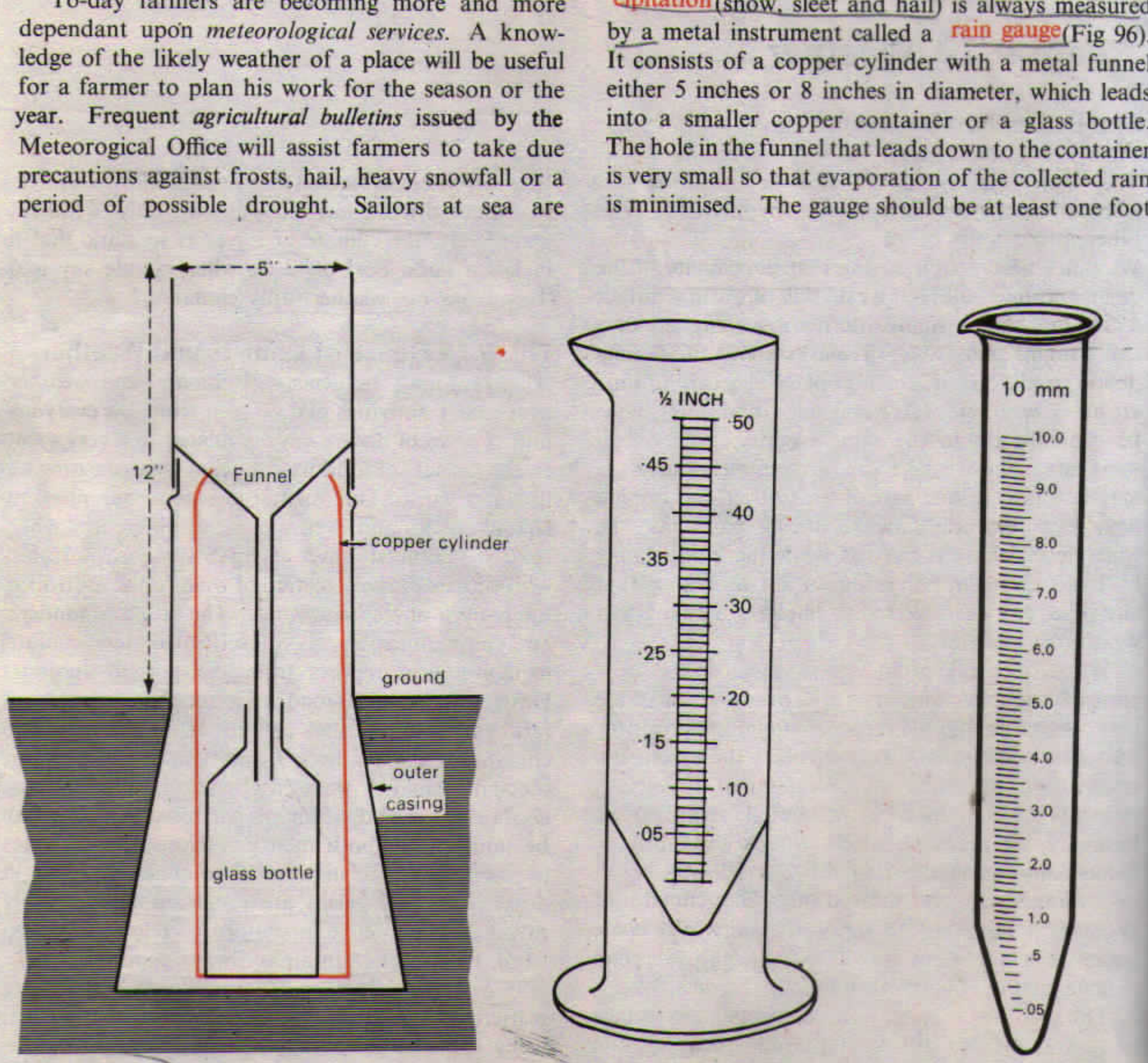
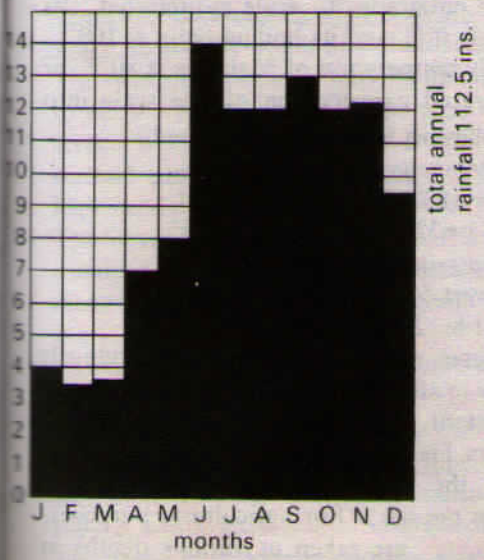


Fig 96 (a) A rain gauge (b) Ordinary measuring cylinder (c) A calibrated taper measure ove the ground and firmly fastened, to avoid splashing. The instrument should be sited well away from tall buildings, high trees and other objects which would shelter it.

The *measurement* of the rainfall is done by removing the funnel, emptying the rain in the container into a graduated cylinder with a 1½ inch diameter. The reading should be done at eye-level and to an accuracy of 0·01 inch. For greater accuracy, a special kind of taper measure as shown in Fig. 96 (b) which tapers at the bottom may be used. It gives an accuracy up to 0·005 inch. An inch of rainfall means the amount of water that would cover the ground to a depth of 1 inch, provided none evaporated, drained off or percolated away. For meteorological recordings, a *rain-day* is reckoned as a period of 24 hours with at least 0·01 inch or more rain being recorded. If the amount exceeds 0·04 inch, it is considered a wet day. For general reckoning, the average rainfall for Malaysia is less than 0·3 inch a day. Only a torrential downpour can account for more than an inch of rainfall in a day. The rain gauge must be examined every day. In temperate regions, snowfall is carefully melted by warming the funnel and then measured. For all practical purposes 10 to 12 inches of snow may be considered as equivalent to 1 inch of rain.

The daily records of rainfall will be added at the end of the month to find the total rainfall for that month. The total for each month is again added at the end of the year to find the *annual rainfall*. The **mean annual rainfall** is obtained from the averages of annual rainfall taken over a long period of say 35 years. For plotting in rainfall maps, places having the same mean annual rainfall are joined by a line called an isohyet, as shown in many atlases. Rainfall can also be graphically depicted as shaded rainfall columns, one for each month of the year as in Fig. 97 or in dispersal diagrams, one dot for each year for as many years as possible as in Fig. 98. The former illustrates the monthly rainfall regime over a year and the latter shows at a glance the range of dry and wet years for 35 years.

2. Pressure. Air is made up of a number of mixed gases and has *weight*. It therefore exerts a pressure on the earth's surface which varies from place to place and from time to time. This force that presses on the surface of any object can be fairly accurately measured. The instrument for measuring pressure is a barometer, as shown in Fig. 99, invented by the scientist Galileo and his assistant Torricelli in 1643. The ordinary mercury barometer consists of a long glass tube, sealed at the upper and open at the lower end. The lower end is inverted in a bowl of mercury, whose surface is exposed to the air. Variations in the atmospheric pressure on the mercury surface are balanced by the column of mercury in the glass tube. This gives the pressure of the air and can



97 A rainfall histogram showing the monthly rainfall of Kota Kinabalu, E. Malaysia

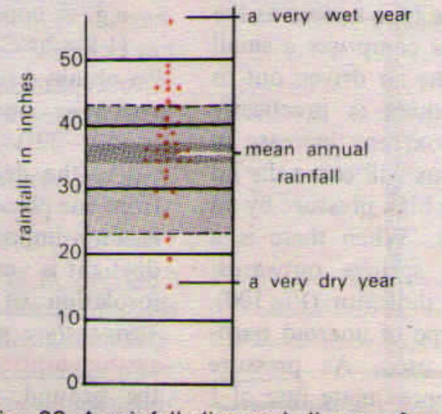


Fig 98 A rainfall dispersal diagram for Gibraltar for 35 years

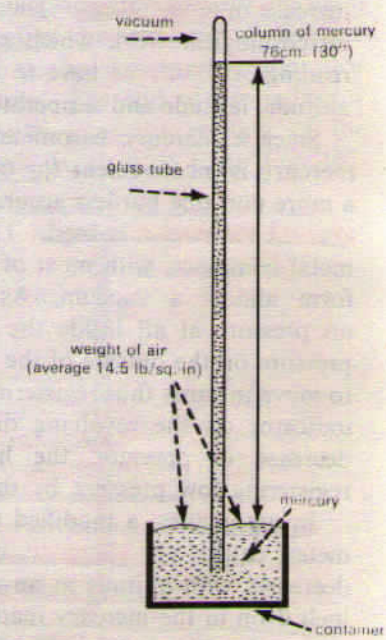


Fig 99 A mercury barometer

be read off quickly from the scale on the glass tube. Any liquid could be used for this purpose, but mercury has been chosen because it is the heaviest liquid known. If ordinary water were used, the corresponding column for normal atmospheric pressure would be 34 feet! At sea level, the mercury column is 29.9 inches, or 760mm. If the pressure increases, the air pressing on the surface will force up the mercury column to about 31 inches (high pressure). When the pressure decreases, as less air presses on the surface, the mercury column will drop about 28 inches (low pressure). As pressure is a force, it is more appropriate to measure it in terms of a unit of force. A new unit known as the millibar (mb) was adopted by meteorological stations in 1914. A normal atmospheric pressure equivalent to 14·7 lb. per square inch in weight or a reading of 29·9 inches of mercury in the column is 1013 millibars. On maps places of equal pressure are joined by lines called isobars. In temperate latitudes, pressure changes are very rapid in the formation of cyclones and anticyclones. In normal circumstances, they vary from 960 mb. to 1,040 mb.

Pressure readings vary with a number of factors. A *sea-level* reading of 30 inches will be halved on *mountainous* regions of 3·5 miles above sea level. This is because as one ascends there is less air above and so the weight, or pressure is less. The barometer is also sensitive to gravitational forces at different latitudes. The mercury itself also expands with an increase in temperature. Therefore for professional meteorological work which requires very accurate readings, corrections have to be made in respect of altitude, latitude and temperature.

Since a mercury barometer that dips in liquid mercury is inconvenient for outdoor measurement, a more portable but less accurate type known as the aneroid barometer is used. This comprises a small metal container, with most of the air driven out to form almost a vacuum. As there is practically no pressure at all inside the box, any increase in pressure on the outside of the box will cause the lid to move inwards thus registering high pressure by an indicator on the revolving dial. When there is a decrease in pressure, the lid springs outwards, registering low pressure by the indicator (Fig.100).

In aeroplanes, a modified type of aneroid barometer called an altimeter is used. As pressure decreases with altitude at an approximate rate of 1 inch drop in the mercury reading for every 900 feet ascent, the altimeter gives the reading in feet for height attained instead of millibars or inches. With this,

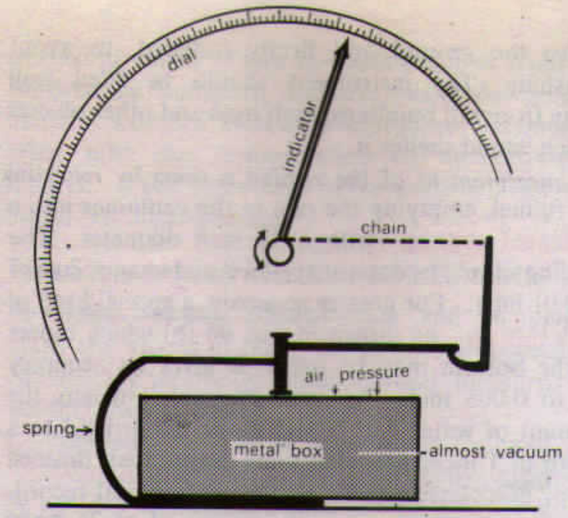


Fig 100 An aneroid barometer

the pilot will be able to tell the altitude of the plane above sea level. For a continous record of pressure changes, as is sometimes required, the self-recording barogram is used.

3. Temperature. Temperature is a very important element of climate and weather. The instrument for measuring temperature is the thermometer which is a narrow glass tube filled with mercury or alcohol. It works on the principle that mercury *expands* when heated and *contracts* when cooled. On thermometers, temperatures are marked in one of two ways. In °F. (Fahrenheit) the freezing-point is 32°F. and the boiling-point is 212°F. For most scientific purposes the Centigrade °C. scale is preferred. Its freezing-point is 0°C. and its boiling-point is 100°C. The mean daily temperature of Malaysia is 80°F. or 26.7°C. For rapid conversation of one scale into another, the following formulae may be used.

To obtain *Fahrenheit* = (1·8 × °C.) + 32°F.

e.g. to convert 20°C. into Fahrenheit:

(1·8 × 20°C.) + 32°F. = 36° + 32° = 68°F.

To obtain *Centigrade* = (°F. − 32) ÷ 1·8

e.g. to convert 59°F. into Centigrade:

(59° − 32°) ÷ 1·8 = 27 ÷ 1·8 = 15°C.

As the degree of 'hotness' varies tremendously from one place to another, the siting of the instrument is very important. A temperature taken in open daylight is very high, because it measures the direct insolation of the sun. It is better described as *'temperature in the sun'*. For agricultural purposes, earth temperatures are taken at various depths in the ground. The thermometer is enclosed in a special glass tube and the bulb is embedded in paraffin wax, so that they are less sensitive to abrupt temperature changes. To assess the possible damages

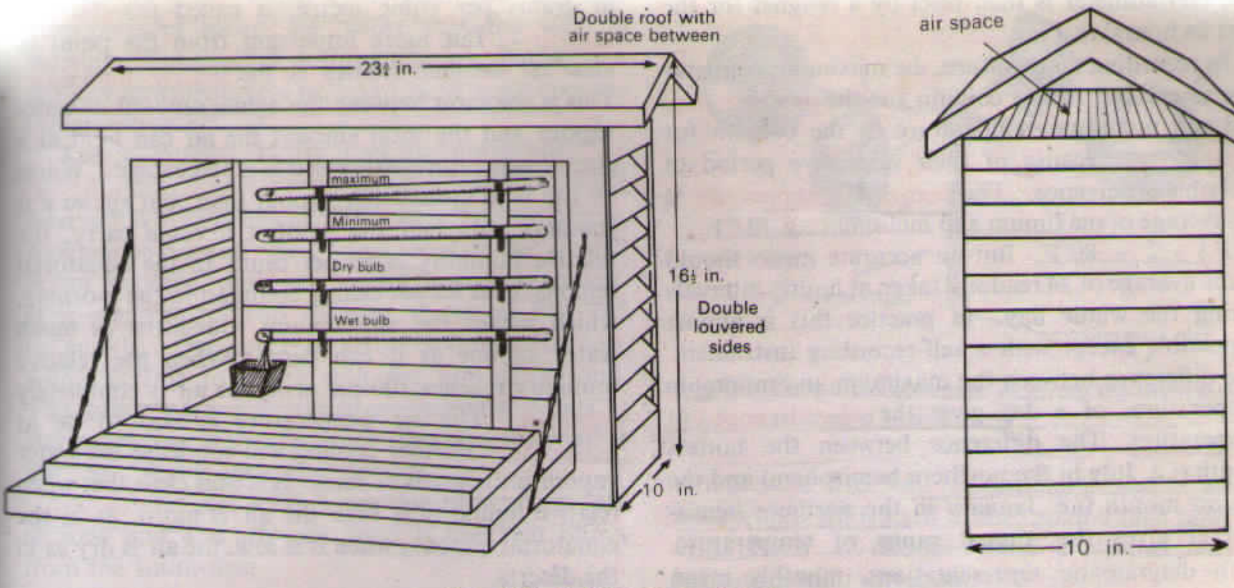


Fig 101 A Stevenson Screen

done by ground frosts to crops in temperate latitudes, grass temperatures are also taken.

But the temperatures that we are so accustomed to in climatic graphs are shade temperatures, that is the temperatures of the air. Precautions therefore must be taken to exclude the intensity of the sun's radiant heat. This is done by placing the thermometers in a standard meteorological shelter known as the Stevenson Screen (Fig. 101). It consists of a white wooden box raised 4 feet above the ground on stilts. The roof is double-layered with an intervening air space to exclude much of the direct rays of the sun. The sides of the box are louvred like 'venetian blinds' to allow free circulation of the air. One side of the screen is hinged to serve as a door which can be opened and closed to give access to the instruments kept inside. The floor of the screen is also louvred. The Stevenson Screen normally carries maximum and minimum thermometers, dry and wet bulb thermometers. Larger ones may also contain a self-recording thermogram and hygrogram.

Maximum and minimum temperatures are measured by the maximum and minimum thermometers. They are either in the form of separate thermometers or joined in a U-shaped glass tube as in the *Six's thermometer*. The maximum thermometer records the highest temperature reached during the day. The mercury in the closed glass tube expands when the temperature rises. It pushes a metal indicator up the tube and this stays at the maximum level when the temperature drops. The end of the indicator nearest the mercury, as indicated in Fig. 102, gives the reading of the maximum temperature, which is 87°F. in this case. To reset the mercury for the next day's reading, swing it hard or draw the indicator back by a magnet.

The minimum thermometer records the lowest temperature reached during the day; it probably occurs in the middle of the night or early in the morning. The glass tube is filled with alcohol which allows the indicator to slide freely along the tube. When the temperature drops, the alcohol contracts and drags the indicator towards the bulb by the surface tension of the indicator. When the temperature rises, the alcohol flows past the indicator leaving it where it was. The end of the indicator farthest from the bulb gives the reading of the minimum temperature, which is 73°F. in Fig. 102.

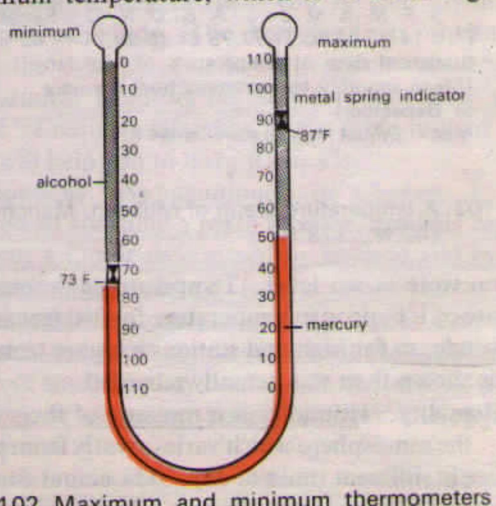
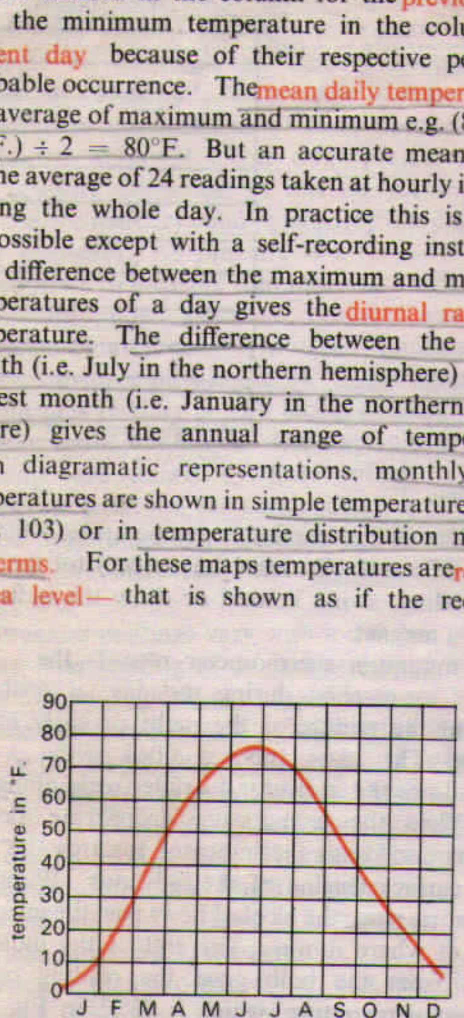


Fig 102 Maximum and minimum thermometers

The thermometer is then reset by a magnet for the next 24 hours' reading.

In recording temperature, the maximum temperature is entered in the column for the previous day and the minimum temperature in the column for current day because of their respective period of probable occurrence. The mean daily temperature is the average of maximum and minimum e.g. (87°F. + 73°F.) ÷ 2 = 80°F. But an accurate mean should be the average of 24 readings taken at hourly intervals during the whole day. In practice this is almost impossible except with a self-recording instrument. The difference between the maximum and minimum temperatures of a day gives the diurnal range of temperature. The difference between the hottest month (i.e. July in the northern hemisphere) and the coldest month (i.e. January in the northern hemisphere) gives the annual range of temperature.

In diagramatic representations, monthly mean temperatures are shown in simple temperature graphs (Fig. 103) or in temperature distribution maps as isotherms. For these maps temperatures are reduced to sea level— that is shown as if the recording



	J	F	M	A	M	J	J	A	S	O	N	D	Range
F°.	8	14	30	47	60	71	77	75	61	48	29	14	69°

Statistical data of temperature of Mukden (Mean monthly temperatures from January to December)
Mean annual temperature is 44°F.

Fig 103 A temperature graph of Mukden, Manchuria (42°N., 123°E.)

station were at sea level. Temperatures decrease at the rate of 1°F. drop in temperature for 300 feet ascent in altitude, so for highland stations a higher temperature is shown than was actually recorded.

4. Humidity. Humidity is a measure of the dampness of the atmosphere which varies greatly from place to place at different times of day. The actual amount of water vapour present in the air, which is expressed in grams per cubic metre, is called the absolute humidity. But more important from the point of view of weather studies is the relative humidity. This is the ratio between the actual amount of water vapour and the total amount the air can hold at a given temperature, expressed as a percentage. Warm air can hold more water vapour than cold air, so if it contains only half the amount it *could* carry, the relative humidity is 50 per cent. In the equatorial regions, over 80 per cent is common in the morning, which means the air contains four-fifths as much water vapour as it can carry. When the relative humidity reaches 100 per cent, the air is completely saturated. The air temperature is said to be at dew-point. Further cooling will condense the water vapour into clouds or rain. It is thus clear that when relative humidity is high the air is moist, as in the equatorial regions; when it is low, the air is dry as in the deserts.

The instrument for measuring relative humidity is the hygrometer, which comprises wet-and dry-bulb thermometers placed side by side in the Stevenson Screen (Fig. 104). The dry-bulb is, in fact, the ordinary thermometer that measures the shade temperature mentioned earlier. The wet-bulb is kept wet by a wick that dips into a reservoir of distilled water. When the air is not saturated evaporation, which produces a cooling effect, takes place from the moist wick. The wet bulb therefore always shows a lower reading than the dry bulb. With reference to prepared tables for calculating relative humidity, under the difference column of the dry and wet bulb reading, the relative humidity can be obtained as a percentage. Normally a large difference indicates a low R.H. and a small difference a high R.H. If both have the same reading, R.H. is 100 per cent; the air is saturated.

5. Winds. Wind is air in motion and has both direction and speed. Unlike other elements in climate such as rain, snow or sleet, winds are made up of a series of gusts and eddies that can only be

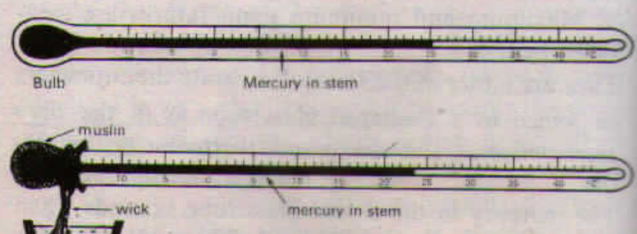


Fig 104 The hygrometer consisting of wet and dry bulb thermometers

felt but not seen. When leaves fall, trees sway and dust particles move, we realise that the wind is blowing. But there is nothing tangible that we can show or measure unless we make use of some conventional instruments.

The instrument widely used for measuring wind direction is a wind vane or weather cock. As wind direction is always blocked by trees and tall buildings, weather cocks and wind vanes need to be erected in an exposed position, to get a true direction. It is made up of two parts as shown in Fig. 105 (a) and (b). One part is an arrow or vane on the top, which is free to move with the prevailing wind. The other part with the four compass points is stationary and shows in which direction the wind is moving. Winds are always named from the direction they blow; an east wind is one that blows from east to west and a south-west wind is one that blows from the south-west.

Most of the weather cocks that we see on church spires and country buildings seldom give a correct indication of wind directions. They are either too low or are blocked by taller structures nearby. The direction of smoke-drift or flag movements in fairly open spaces provides the most reliable indication of wind direction. Sometimes a piece of *woven-cloth* with a tail is fixed to the top of a high pole and drifts freely in mid-air. This is another way of indicating wind direction.

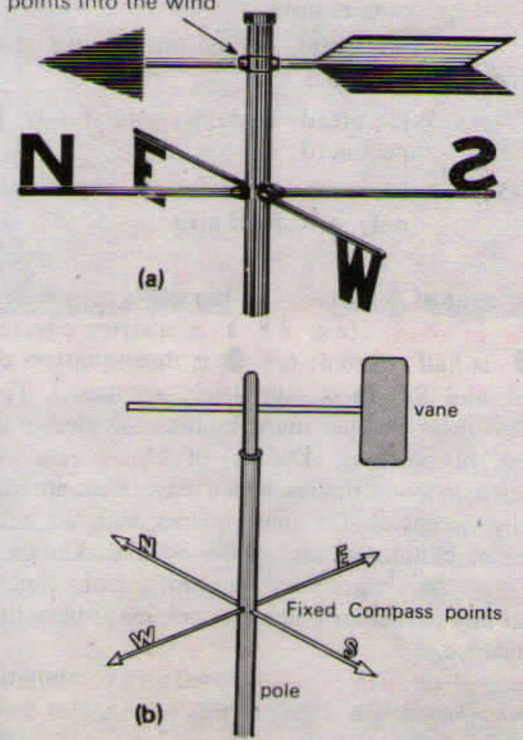


Fig 105 Wind Vanes

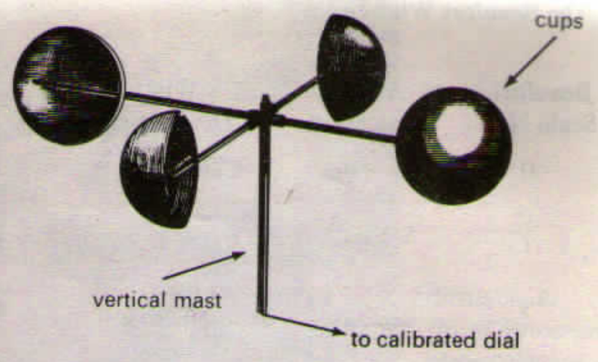


Fig 106 Simplified sketch to illustrate the main features of a wind anemometer

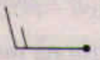
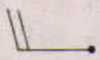
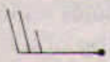
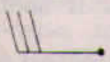
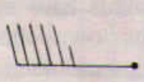
The speed of wind is usually measured by an anemometer (Fig. 106). It consists of three or four semi-circular cups attached to the ends of horizontal spokes mounted on a high vertical spindle. As the concave sides of the cups offer greater resistance to the winds, the horizontal spokes will rotate, moving a central rod which transmits the velocity (speed) of the wind in miles per hour to an electrically operated dial. **But the speed recorded is not absolutely accurate because after the winds have abated, the** rotation continues due to its own momentum. With some modifications, the anemometer can also record wind directions.

Since an anemometer is not easily available, a little practice of local wind observations will help us to assess the speed of winds. By seeing the way some objects move, a great deal can be said about the strength of winds. The best guide is obtainable from the Beaufort Wind Scale which was devised by Admiral Beaufort in 1805 for estimating wind speed. Frequent reference to the table in your free time will help you to learn it quickly.

6. Sunshine. As mentioned in Chapter 1, the amount of sunshine a place receives, depends on the seasons, a factor determined by latitude and by the position of the earth in its revolution around the sun. Tourist resorts, particularly in the higher temperate latitudes, are most concerned about the numbers of hours of sunshine they receive. In the tropics, where sunshine is abundant people are less interested in the amount.

In the meteorological station, sunshine duration is recorded by a sun-dial, 4 inches in diameter,

The Beaufort Wind Scale

Beaufort Scale No.	Arrow Indication	Wind Description	Speed (m.p.h.)	Effects (a guide to observation)
0		Calm	Less than 1	Smoke rises vertically
1		Light air	1–3	Wind direction shown by smoke-drift but not by wind-vanes
2		Slight Breeze	4–7	Wind felt on face; leaves rustle; vanes moved by wind
3		Gentle Breeze	8–12	Leaves and twigs in constant motion; winds extend light flags
4		Moderate Breeze	13–18	Raises dust and loose paper; small branches moved
5		Fresh Breeze	19–24	Small trees in leaf begin to sway; crested wavelets form on inland water
6		Strong Breeze	25–31	Large branches in motion; whistling heard in telegraph wires .
7		Moderate Gale	32–38	Whole tree in motion; walking inconvenienced
8		Fresh Gale	39–46	Twigs broken off trees; progress generally impeded
9		Strong Gale	47–54	Slight structural damage occurs, chimney pots removed
10		Whole Gale	55–63	Considerable structural damage, trees uprooted
11		Storm	64–75	Widespread damage, very rarely experienced
12		Hurricane	More than 75	Widespread devastation, experienced only in tropical areas

through which the sun's rays are focussed upon a sensitized card, graduated in hours. A line is made on the card when it is sufficiently heated, but not when the rays are faint. On maps places with equal sunshine duration are joined by isohels.

7. Clouds. When air rises, it is cooled by expansion. After dew-point has been reached cooling leads to condensation of water vapour in the atmosphere. Tiny droplets of water vapour which are too small to fall as rain or snow (less than 0·001 cm., approximately 0·0005 inches in radius) will be suspended in the air and float as clouds. Their ***form, shape, height and movements*** tell us a great deal about the sky conditions and the weather we are likely to experience. It is fascinating and very rewarding to know something about the clouds which we see everyday. For meteorological purposes, the amount of cloud-cover in the sky is expressed in eighths or oktas (e.g. 2/8 ◗ is quarter covered; 4/8 ◑ is half covered; 6/8 ◕ is three-quarters obscured and 8/8 ● is completely overcast.) They are shown on weather maps by discs, shaded in the correct proportions. Details of cloud type are indicated in code figures which have been internationally accepted. On maps places with an equal degree of cloudiness are joined by lines known as isonephs. As clouds vary so quickly from time to time at any particular place, isoneph maps have little significance.

The classification of clouds is based on a combination of *form, height and appearance*. Four major cloud types and their variations can be recognised.

(a) High Clouds: mainly cirrus (Ci) of feathery form at 20—40,000 feet above ground.

Cirrus cloud
Royal Netherlands Meteorological Institute

Cirrocumulus cloud
Meteorologie National Paris

Cirrostratus with scattered cumulus
Meteorologie National Paris

i. **Cirrus (Ci)** This looks fibrous and appears like wisps in the blue sky; it is often called 'mares' tails'. It indicates fair weather, and often gives a brilliant sunset.

ii. **Cirrocumulus (Cc)** This appears as white globular masses, forming ripples in a 'mackerel sky'.

iii. **Cirrostratus (Cs)** This resembles a thin white sheet or veil; the sky looks milky and the sun or moon shines through it with a characteristic 'halo'

(b) Medium Clouds: mainly alto (Alt) or middle-height clouds at 7—20,000 feet.

iv. **Altocumulus (Alt-Cu)** These are woolly, bumpy clouds arranged in layers and appearing like waves in the blue sky. They normally indicate fine weather.

v. **Altostratus (Alt-St)** These are denser, greyish clouds with a 'watery' look. They have a fibrous or striated structure through which the sun's rays shine faintly.

(c) Low Clouds mainly stratus or sheet clouds below 7,000 feet.

vi. **Stratocumulus (St-Cu)** This is a rough, bumpy cloud with the waves more pronounced than in altocumulus. There is great contrast between the bright and shaded parts.

vii. **Stratus (St)** This is a very low cloud, uniformly grey and thick, which appears like a low ceiling or highland fog. It brings dull weather with light drizzle. It reduces the visibility of aircraft and is thus a danger.

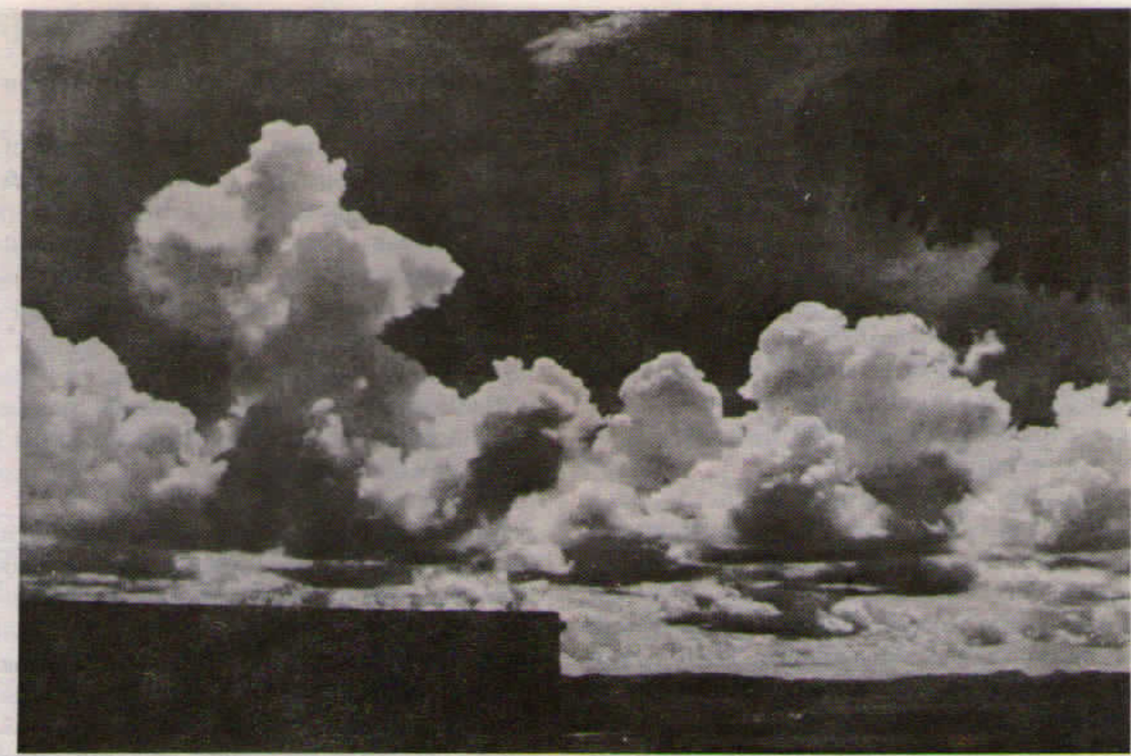
viii. **Nimbostratus (Ni-St)** This is a dark, dull cloud, clearly layered, and is also known as a *'rain cloud'*. It brings continuous rain, snow or sleet.

(d) Clouds with great vertical extent: mainly cumulus or heap clouds with no definite height (2-30,000 feet).

ix. **Cumulus (Cu)** This is a vertical cloud with a rounded top and horizontal base, typical of humid tropical regions, associated with up-rising convectional currents. Its great white globular masses may look grey against the sun but it is a 'fair weather cloud'.

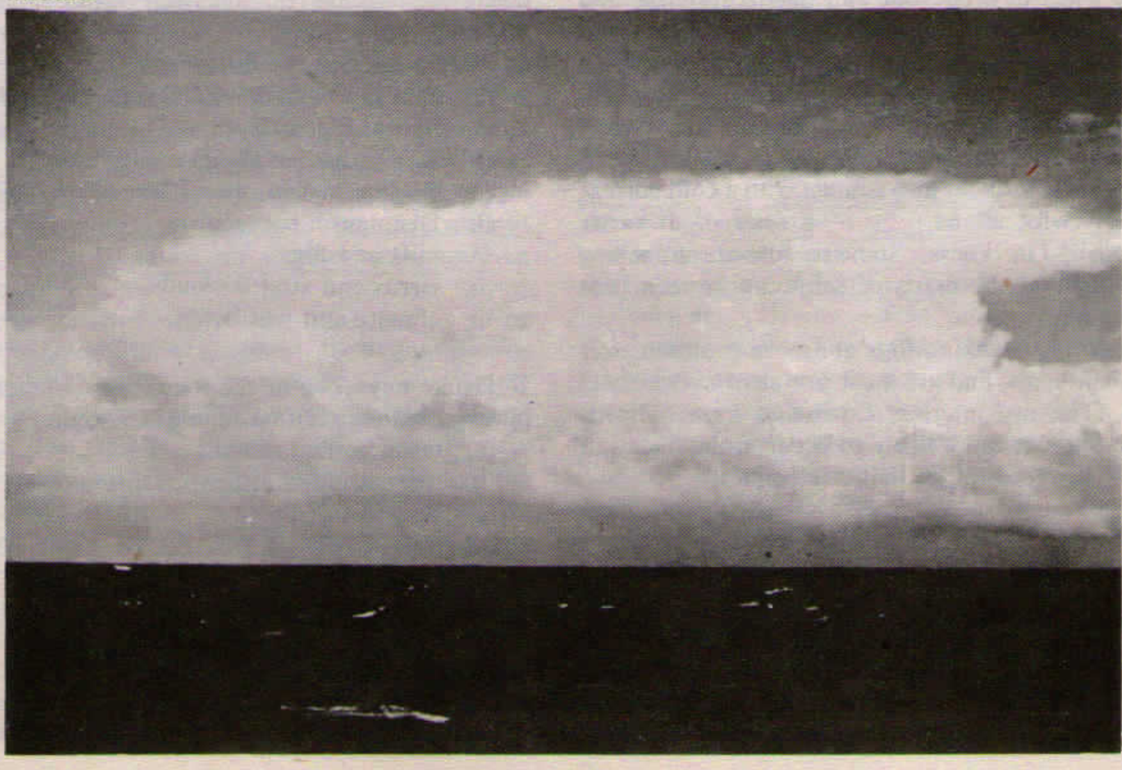
x. **Cumulonimbus (Cu-Ni)** This is, in fact, an overgrown cumulus cloud, extending for a tremendous vertical height from a base of 2,000 feet to over 30,000 feet. Its black and white globular masses take a fantastic range of shapes. Its cauliflower top often spreads out like *an anvil*. This is frequently seen in tropical afternoons. It is also referred to as a *'thunder-cloud'* and brings convectional rain, accompanied by lightning and thunder

Altocumulus cloud *Royal Netherlands Meteorological Institute*



Cumulus cloud *J. Mondaine*

Cumulonimbus cloud *Royal Netherlands Meteorological Institute*



8. Other Elements pertaining to visibility. Other elements affecting visibility include haze, mist and fog.

(a) Haze This is caused by smoke and dust particles in industrial areas or may be due to unequal refraction of light in air of different densities in the lower atmosphere. The term is usually used in connection with the reduction of visibility in regions of low humidity, less than 75 per cent. When visibility is less than $1\frac{1}{4}$ miles, haze is present.

(b) Mist The condensation of water vapour in the air causes small droplets of water to float about forming clouds at ground level called mist. It reduces visibility to about 1,000 metres or 1,100 yards. Unlike haze, mist occurs in wet air, when the relative humidity is over 75 per cent.

(c) Fog Ordinary fog is due to water condensing on dust and other particles like smoke from houses and factories. It only occurs in the lower strata of the atmosphere as a sort of dense '*ground cloud*'. The visibility in fog is even less than 1,000 metres. In industrial areas, like those of the Black Country and northern England, very thick smoky fog is formed, called smog. The visibility may be reduced to 220 yards or even less.

Fogs that occur on hills are called hill fogs. They are most common in the morning, even in the tropics, and disperse when the sun rises. In temperate lands, when days are hot and nights are clear and still, fogs may also result from cooling of the land surface by radiation. The lower layers of the air are chilled and water vapour in the atmosphere condenses to form radiation fog or land fog. When the cooling surface is over the sea or when a damp air stream is brought into contact with a cold current as off Newfoundland, sea fog is formed. It varies in depth and thickness. Some sea fogs are so shallow and light that the masts of ships can be seen protruding above them.

Generally speaking fogs are more common over seas than lands, and are most prevalent over coastal areas. The dry interiors experience haze or mist. Dense fogs are more likely to occur in the high and middle latitudes rather than the tropics.

QUESTIONS AND EXERCISES

1. (a) What instruments are normally kept in the school weather station?
   (b) Why is it important that the times of observation and the method of recording should be uniform?
   (c) Explain what precautions you would take to ensure that your observations and records from the various instruments are accurate.

2. Name the instruments you would use to measure the following elements of climate.
   (a) relative humidity
   (b) atmospheric pressure
   (c) wind velocity

   For any *two* of the above, and with annotated diagrams, explain how the instruments work.

3. What weather elements are measured by the following apparatus?
   (a) a rain gauge
   (b) the Six's maximum and minimum thermometers
   (c) a wind vane

   Describe how the above apparatus function and state what special precautions must be taken when taking readings from them.

4. *Either:* Explain the following
   (a) Wind speed at 2,500 feet is greater than that at the surface.
   (b) Britain has no climate, only weather
   (c) Fog is, in fact, cloud at ground level

   Or: Distinguish between
   i. mist and fog
   ii. cirrus and stratus clouds
   iii. climate and weather

5. Define any *three* of the following terms or phrases, in their relation to weather studies.
   (a) mean annual rainfall
   (b) diurnal range of temperature
   (c) Beaufort Scale
   (d) synoptic charts
   (e) lapse rate