4

STUDY OF WEATHER MAPS

You know that the word "weather" refers to the atmospheric conditions of a place at a given time. These atmospheric conditions are very important for us. We are interested to know about them in advance as these affect our day to day activities. That is why, weather forecast is an important news item, in most of the radio and television news bulletins and daily newspapers. Some leading news papers publish weather maps also. In this lesson, we will study the importance of weather forecast, various instruments used for measuring weather elements and then learn how to interpret weather maps.

OBJECTIVES

After studying this lesson, you will be able to:

- explain recording and uses of data collected from weather instruments;
- recognise various signs and symbols used in the weather maps;
- identify areas of high and low pressure in a weather map;
- recognise the steep and gentle pressure gradients in a weather map;
- establish relationship on a weather map between (a) temperature and pressure; (b) pressure and the direction of winds and (e) pressure gradient and velocity of wind;
- state the distribution of precipitation on a weather map;
- predict the possibility of precipitation/rainfall on the basis of cloud cover given on a weather map;
- interpret a weather map.

4.1 WHAT IS A WEATHER MAP?

A weather map is a symbolic representation of weather conditions of an area at a

Notes

given time. So in a weather map you will find various symbols related to temperature, pressure, direction and velocity of winds, clouds, amount of precipitation and other weather phenomena. All these weather phenomena are calculated numerically and different symbols have been provided for each weather element.

4.2 IMPORTANCE AND USES OF WEATHER MAPS

We all know that weather affects the condition and way of life of people everywhere. Hence, to know about it in advance is of universal importance. Due to the developments in the field of meteorology, the science of weather, we are in a better position to forecast weather conditions. Meteorological departments spread all over the world keep recording and exchanging with one another the data relating to weather through telecommunication networks. Artificial satellites orbiting our earth are also being used to measure and interpret weather phenomena. India is using its own satellite-INSAT-2D for this purpose.

Following are the uses of weather maps

(i) Weather maps are used in predicting weather conditions for a day, a week or a month in advance. These predictions help us to take safety measures.

(ii) Weather forecasts are also very useful to farmers, fishermen, and crew of ships.

(iii) Prediction of atmospheric conditions a few hours ahead may facilitate air flights

4.3 WEATHER INSTRUMENTS

The study of climate and weather conditions is an important aspect to the student of geography. A number of instruments are used to measure the weather elements such as temperature, humidity, pressure, wind and rainfall. Therefore, there is a need to study these instruments to understand their functions, applications and uses. A brief account of some of these instruments is given below:

(a) Thermometer

Thermometer is used to measure the temperature. It is made of a glass tube having a narrow and uniform bore. It is sealed at one end and another is fitted with a bulb. The bulb is filled with mercury or alcohol. The air is evacuated from the bore before sealing it.

Thermometer is marked with two fixed points i.e., the lowest which indicates the freezing point of water and the other is the uppermost indicating the temperature of boiling point of water. (see fig. 4.1) The difference between the boiling and freezing points is graduated into equal divisions called degrees. There are two most common types of thermometers i.e., Celcius and Fahrenheit.

Celcius Thermometer was invented by a swedish astronomer, Anders Celsius in 1742. On this thermometer 0^0C is the temperature at which water freezes

and 100^{0}C is that of boiling water. The interval of these two points (freezing and boiling) is graduated into 100 equal divisions.

Fahrenheit Thermometer was invented by a German physicist, Danial Fahrenheit in 1710. On this thermometer 32^{0}F is the freezing point and 212^0 F is the boiling point of water. The interval between them is graduated into 180 equal divisions. Thus, the difference between Celcius thermometer and Fahrenheit thermometer is 1:1.8 (1^{0}C is equal to 1.8^{0}F). The following formula is used for the conversion of Celcius to Fahrenheit and vice-versa.

(i) From Celcius to Fahrenheit (Cx(9/5))+32

(ii) From Fahrenheit to Centrigrade (5/9) (F-32)

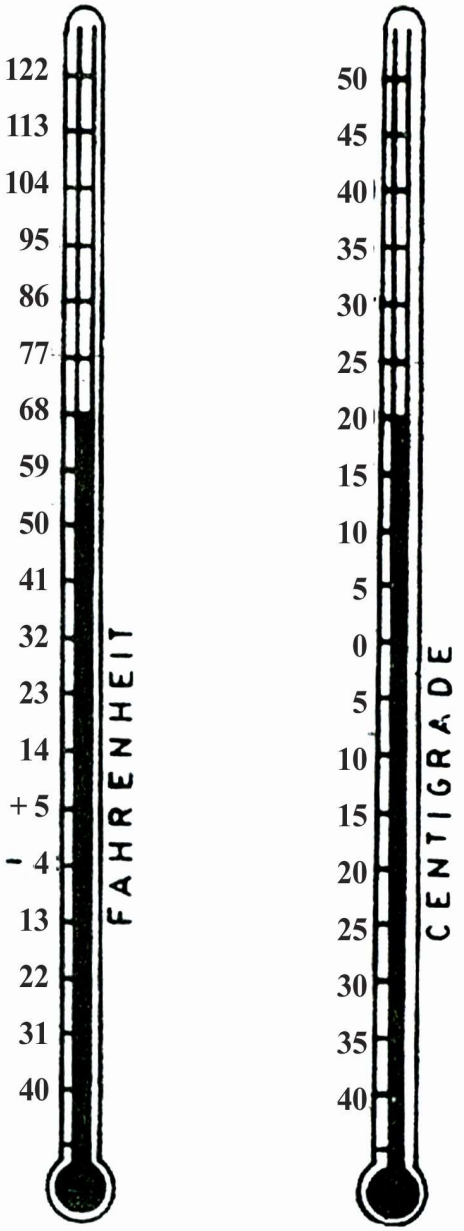
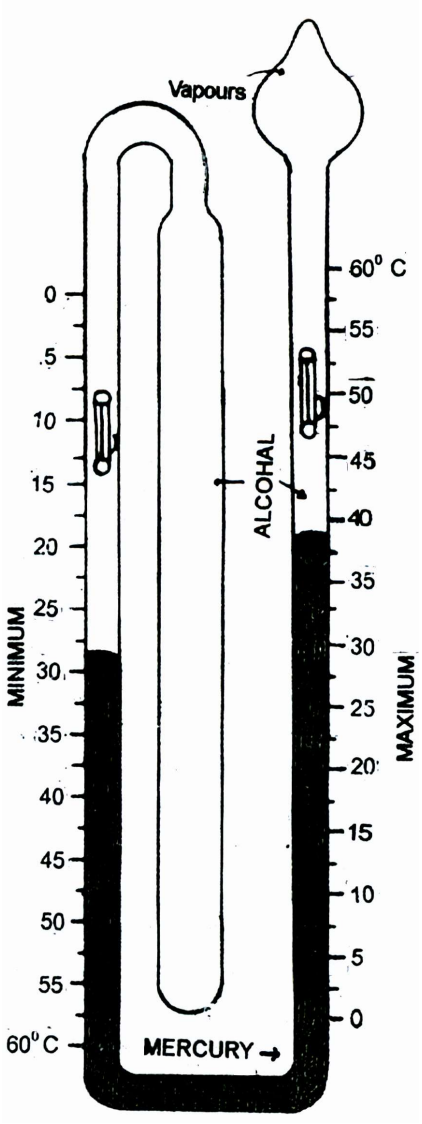


Fig. 4.1 Thermometers

(i) Maximum and Minimum Thermometer (Six's Thermometer)

It is a special type of thermometer used for measuring the maximum and minimum temperature for a given point of time. It is made of a U-shaped glass tube consisting of two bulbs on the top of both limbs. The lower part of the tube is filled with mercury and the bulbs contain alcohol and its vapour. In each limb there is a steel index on the mercury surface. Both limbs are graduated according to scale. The scale reads opposite along either limbs. Usually, the right limb reads maximum temperature on the other hand, the left limb is used to measure the minimum temperature in which reading goes on decreasing from the bottom. (see fig. 4.2). The thermometer is set by bringing the indices on the mercury surface with the help of a small horse shoe shaped magnet. As the temperature increases, the alcohol of the bulb starts expanding and pushing the mercury

in the right limb and the index is pushed upward. On the other hand, the alcohol starts contracting with a low temperature resulting in rise of mercury in the left limb. The indices of both the limbs are pushed upward in the case of increase or decrease of temperature. The lower end of each index gives correct reading of maximum and minimum temperature. The thermometer is again set for measuring the temperature for the next day by bringing down the indices to the mercury level with the help of the magnet.



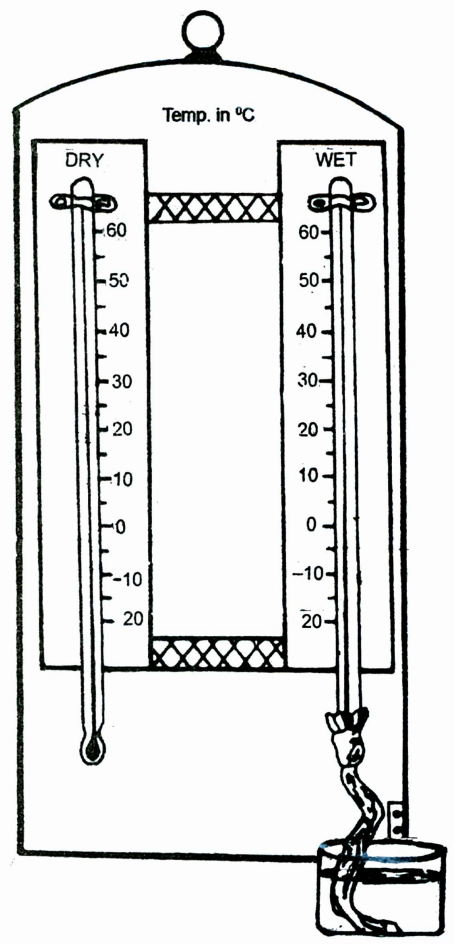


Fig. 4.2 Maximum & Minimum Thermometer *Fig. 4.3 Wet and Dry Bulb Thermometer*

(ii) Wet and Dry-Bulb Thermometer

Wet and dry-bulb thermometer is also known as hygrometer which helps to measure the humidity of the atmosphere. This instrument consists of two identical thermometers fixed to a wooden or a metal frame. The bulb of dry bulb thermometer is uncovered. This is known as dry-bulb thermometer while the bulb of other thermometer is covered with a piece of a muslin cloth. It is known as wet bulb thermometer. The muslin is kept continuously moist by dipping it into a small vessel of water (see fig. 4.3).

The temperature in the dry-bulb thermometer is not affected by the amount of water vapour available in the air and therefore, it records always more temperature than the wet-bulb thermometer. On the other hand, temperature in the wet-bulb thermometer changes according to the amount of water vapour present in the air. The difference between the readings in the wet-bulb is called wet bulb depression. If there is no depression, the air becomes saturated and the relative humidity reaches 100 per cent. The difference between wet and dry-bulb thermometers becomes small when humidity is more in the air but it becomes larger when the air is dry. The temperature of wet and dry bulb thermometers helps to find out the relative humidity with the help of a table.

(b) Barometer

It is used to measure the atmospheric pressure. There are mainly three types of barometers in use.

(i) **Mercurial Barometer** is the most accurate instrument commonly used for the measurement of pressure, and other related atmospheric phenomena. It works on the principles of balancing the column of air against column of mercury in a glass tube. The tube is sealed at one end and is filled with mercury and inverted into a cup which also contains mercury (see fig. 4.4). Under standard conditions the mercury rests at 76 cm. or 29.92 inch high in the tube at the sea level. Fluctuations in pressure will produce differences in the height of the mercury in the tube. It is measured through the scale mounted along the tube. The actual pressure is determined by adjusting the temperature, errors in the instrument and variations of gravitational force with latitude and altitude. The corrected reading is known as station pressure. The station pressure of mountains will be lower than that of valleys. The station pressure is converted to sea-level pressure in order to make a direct comparison of pressure at different altitudes.

Fig. 4.4 Mercurial Barometer

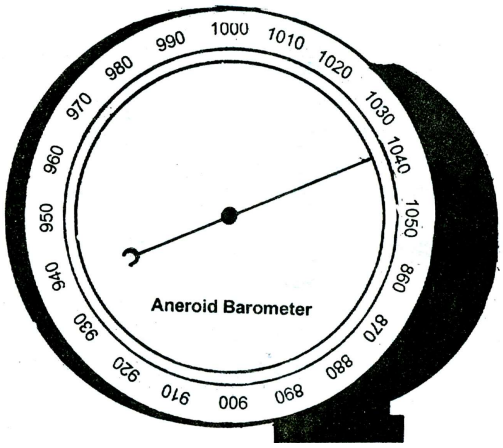


Fig. 4.5 Aneroid Barometer

If measurement is given into inch, it is necessary to convert it into millibar by multiplying it with 33.864 (because one inch of mercury exerts the pressure equal to 33.864 mb.). On an average the atmospheric pressure is about 1013.2 mb. at the mean sea-level.

(ii) Aneroid Barometer is also common in use for measuring the atmospheric pressure. Aneroid is derived from the Greek word aneros which means without liquid. It is a light and portable instrument and, therefore, it suits explorers, mountaineers, travelers, etc.

It consists of a sealed, circular and airtight metalled box. The lid of the instrument is very sensitive fitted with a spring inside the box. (see fig. 4.5). With an Increase or decrease of pressure, the lid helps in the movement of the attached pointers. There is a lever connected to the pointer indicating the readings on the graduated dial. The pointer moves in clockwise direction when the pressure increases, and it moves in the counter-clockwise direction with the decrease of pressure. Unlike mercurial barometer, the reading of aneroid barometer is not corrected for temperature. The pressure of a place

is taken directly with the help of the pointer moving on the dial. This barometer is less accurate than the mercurial barometer.

(iii) Fortin's Barometer, a sophisticated barometer is used for measuring the atmospheric pressure. It consists of a glass tube whose upper end is closed and the bottom is left open. The tube is filled with mercury and inverted into a cistern which also contains mercury. The bottom of the cistern is fitted with an adjusting screw S (see fig. 4.6). Before taking readings, the screw S is used to bring the mercury level in the cistern to a fixed point. With an increase of pressure, the level of mercury rises into the tube and it comes down when the pressure is decreased. An ivory index (I) pointing down vertically, is fixed to the cistern to indicate both the fixed point and zero of the scale together.

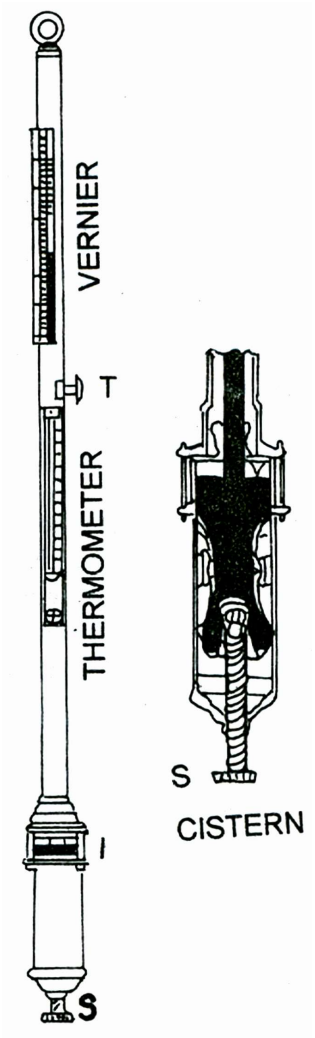


Fig. 4.6 Fortin's Barometer

The barometer is fitted in a brass container on which scale is marked. It has a slit through which mercury level in the tube can be seen clearly. There is a vernier (V) attached to a brass plate. The slit and vernier are adjusted by means of another screw (T). On the barometer, there is a thermometer attached for temperature corrections for every reading of pressure.

Two adjustments are required before setting up the instrument for reading. First, by bringing the mercury level in the cistern to touch the tip of the ivory index (I) through operating screw S and secondly, by bringing the zero of the vernier (V) to coincide with the surface of the mercury in the tube through operating the screw (T).

(c) Rain Gauge

It is an instrument used for measuring the amount of rainfall. It is cylinder-shaped usually made of metal and fitted with a funnel which directs the rain into the receiving bottle (see fig. 4.7). The standard rain gauge has a diameter of 20 cm. (8 inches) with a capacity of 60 centimetres (23 inches) of rainfall. The circumference of the base of the bottle is equal to the circumference of the funnel mouth. The funnel is fitted with 12.5 cm below the mouth

of the cylinder to avoid splashing out the water from the funnel. Thus, all the rain water accumulates into the bottle. The instrument should be placed in an open and leveled area away from trees, buildings, and other high objects to allow free and uninterrupted fall of rain drops into the rain gauge.

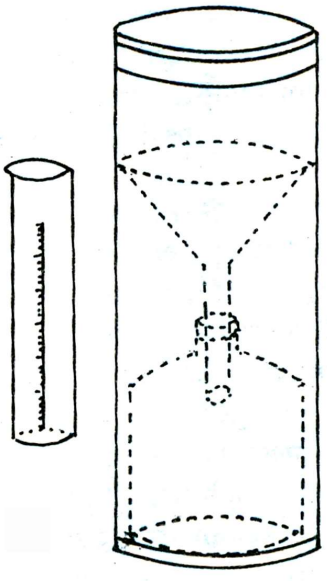


Fig. 4.7 Rain Gauge

The water collected in the bottle is measured in a measuring jar which is graduated either in millimeters or inches. The area of the measuring jar has a definite relationship with the area of the receiving bottle. For example, if the ratio is 10:1, meaning thereby 10 millimeter water in the jar represents 1 centimeter rainfall. The amount of rainfall is also measured through a thin graduated stick by inserting it into the bottle. In India, the reading is taken everyday at 8:00 a.m. which gives the amount of rainfall for the previous 24 hours.

When snowfall, hailstorm or other ice forms are expected, the funnel and receiving bottle are removed from the gauge and only the cylinder is used. A known quantity of warm water is added to the gauge for melting snow and ice. When melting is completed, the water is measured with the help of the measuring jar and the quantity of added warm water is deducted to know the actual amount of precipitation.

(d) Wind Vane

This is an instrument used for determining the wind direction. It consists of a rotating plate or a cock which is balanced on a vertical rod. It moves freely without any friction therefore, it can respond even to slight blow of wind. The plate has a pointed arrow on the one end but the other end is broad and is known as, tail. The arrow always points to the source or direction from where the wind comes and the tail to the direction to which the wind goes. The four directions (north, south, east and west) are shown below the plate to facilitate in determining the actual direction of the wind. (see fig. 4.8).

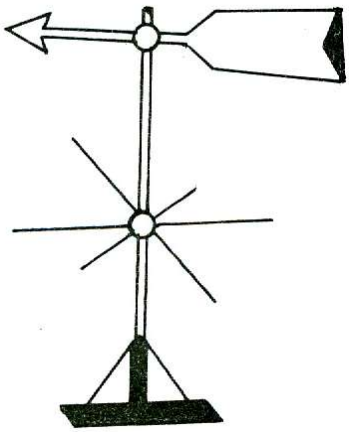


Fig. 4.8 Wind Vane

(e) Anemometer

This is an instrument used to measure the wind velocity. The most common type in use is the Robinson's cup anemometer. The instrument consists of three or four hemispherical metalled cups mounted with arms (see fig. 4.9). These cups rotate freely even with the slight movement of air and help the vertical spindle to rotate. At the bottom of the spindle there is a dial to record the velocity of the wind (kilometers, or miles or knots per hour).

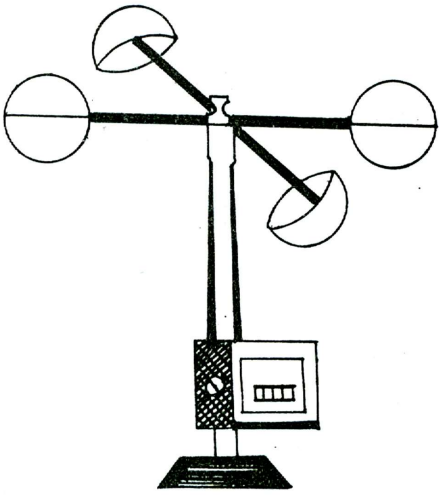


Fig. 4.9 Anemometer

4.4 WEATHER SYMBOLS

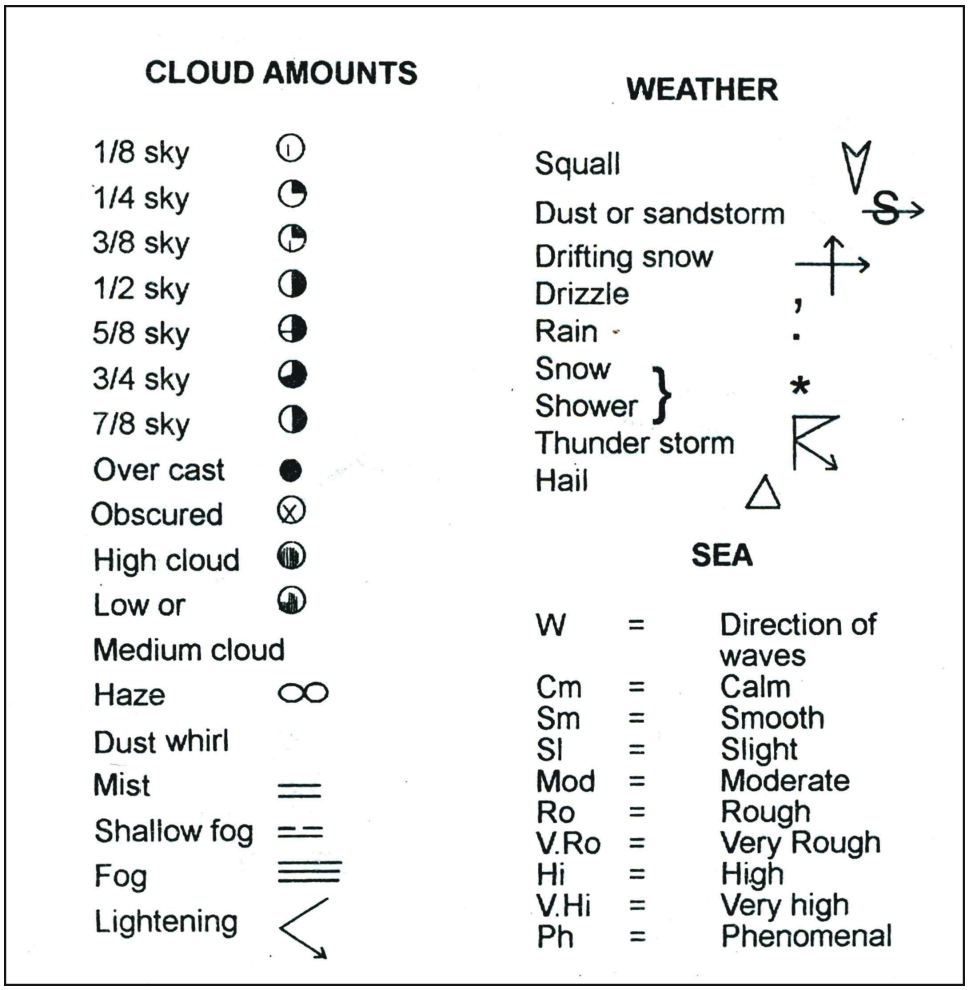


Fig. 4.10 Conventional Signs and Symbols in a weather map

As has been mentioned earlier that without signs and symbols, it would be difficult to derive information from a map. Weather maps cannot be properly understood without weather symbols. A detailed key of these symbols is generally given at the top on the top right side of every weather map. These symbols provide information regarding wind-direction and speed, rainfall, amount of cloud, other forms of precipitation, lighting, storms and sea conditions. In short, weather symbols help us to understand and to interpret weather maps.

The system of weather symbols was first devised by Admiral Beaufort in 1806. He later modified it in 1830. The same system is even now being used with a few modifications. The symbols are given below. (see fig. 4.10).

4.5 STUDY OF ISOBARIC SYSTEMS

We have studied earlier that pressure conditions are shown by isobars on a weather map. Isobars are the lines which join the places of equal atmospheric pressure converted to sea level. Different pressure conditions are depicted by different isobaric patterns on weather maps. Hence it is imperative to understand first these isobaric patterns or systems. It will train your mind to read and interpret weather maps easily and correctly. These isobaric systems are associated with different weather conditions. It is not necessary at all these isobaric systems appear in all the weather maps.

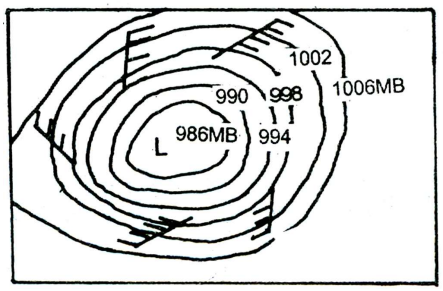


Fig. 4.11 Depression

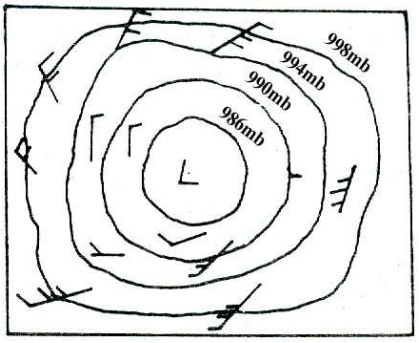


Fig. 4.12 Cyclone

(i) Depression or Cyclones

When the isobars are arranged as concentric circles or ellipses with decreasing pressure towards the centre, the system is called a depression or a cyclone. (see fig. 4.11 and 4.12*)*. The diameter of these depression varies from a few hundred kilometres to a diameter of over two thousand kilometres. The direction of winds in the depression is anti-clock wise in northern hemisphere and clockwise in southern hemisphere. These depressions are of two types shallow and deep depressions. When the

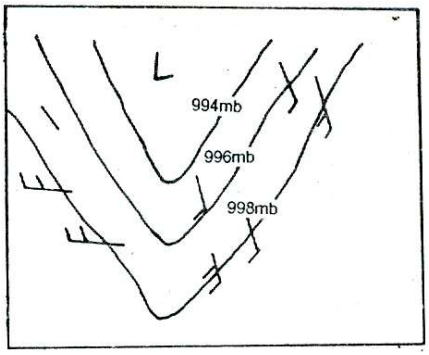


Fig. 4.13 Trough of low pressure

isobars are drawn closer to each other, it is called deep depression in tropical regions. The velocity of winds within such depression is more due to steep pressure gradient. When isobars are drawn at some distance from each other, the system is called a shallow depression or a temperate cyclone. Because of shallow pressure gradient the velocity of winds is comparatively less than in a deep-depression. Tropical cyclones are generally of smaller diameter (900 kms) than temperate cyclones or depressions (1600 to 3000 kms). Due to difference in pressure gradient the tropical cyclones are more intense than the temperate depressions.

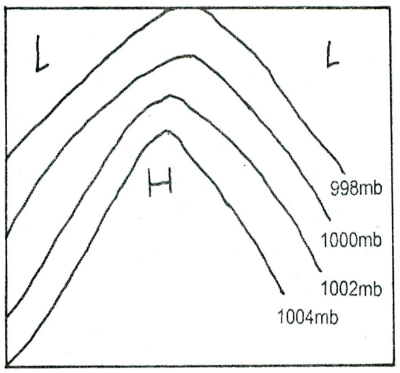


Fig. 4.14 Wedge

(ii) Trough of low pressure

When a low pressure area lies between two high pressure areas, the isobars take the form of letter "V" with low pressure within it, is called a trough of low pressure. (see fig. 4.13).

(iii) Wedge

Sometimes, a high pressure area lies between two depressions. The isobars, in such a situation resemble an inverted "V" with high pressure within it. Such an isobaric system or arrangement of isobars is called a wedge. (see fig. 4.14). The weather conditions in the front part of wedge are fine. The rear part of it is associated with cloudy and muggy weather.

(iv) Anticyclone

As the name suggests, anticyclone is a pressure system just reverse of the cyclone. The isobars are oval or circular in shape with high pressure in the centre. (see fig. 4.15). The winds blow outwardly in a clockwise direction in Northern Hemisphere and anti-clock wise in the Southern Hemisphere. The associated weather conditions with anticyclones include light winds, clear sky and at times, slight drizzle may occur. The diameter of an anticyclone is generally large and its movement is very slow. Its life is longer as compared to cyclone.

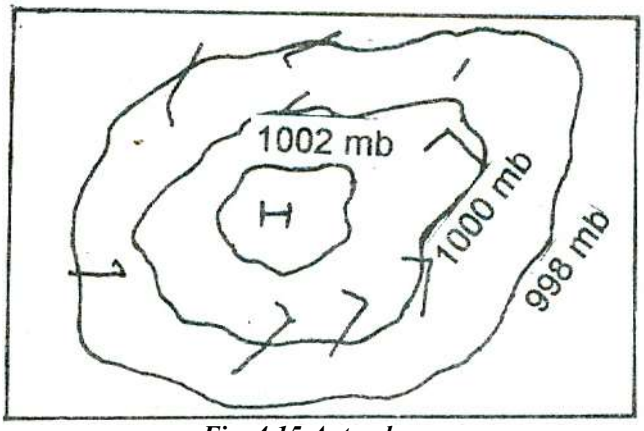


Fig. 4.15 Antycylone

(iv) Col

When the isobaric system representing a region lying between two highs and two lows gives an appearance of saddle back, called a Col. (see fig. 4.16). It is associated with light variable winds. The direction of winds depends on the intensity of the lows and highs.

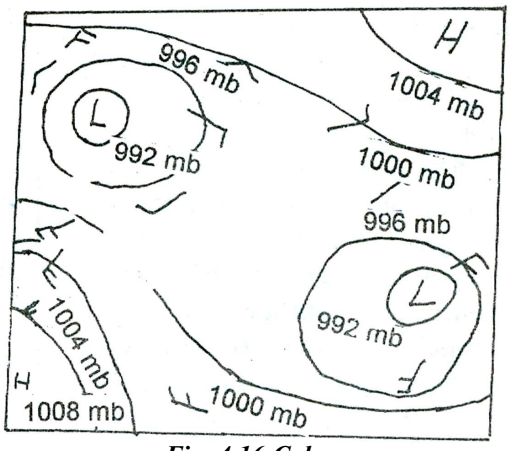


Fig. 4.16 Col

4.6 INTERPRETATION OF A WEATHER MAP

A weather map is generally interpreted under the following headings:

(i) General Information

This includes the day, date and time and the area to which the weather conditions are related. This information is printed on the top of each weather map. It also includes the scale of the map and important symbols used in showing various weather conditions.

(ii) Pressure

Pressure conditions include the interpretation of isobaric systems represented by the isobars. It also includes the studying of pressure gradient.

(iii) Wind

The wind system includes the direction and velocity of winds in relation to the distribution and spacing of isobars.

(iv) Sky Condition

This includes the nature and amount of cloud cover and other atmospheric phenomena such as haze, lightning, mist, fog and dust storms etc.

(v) Precipitation

Under this heading, general distribution of precipitation and special areas of heavy and scanty precipitation are studied.

(vi) Sea Conditions

Conditions of the sea are described as rough, smooth and calm.

Now, we are in a position to study and interpret a weather map.

Example 1

(i) General Information

Look at the weather map given overleaf. The map shows the weather conditions observed on Wednesday, 12 December, 1984 (21, Agrahayana, 1906 Saka) at 08.30 hrs. I.S.T.

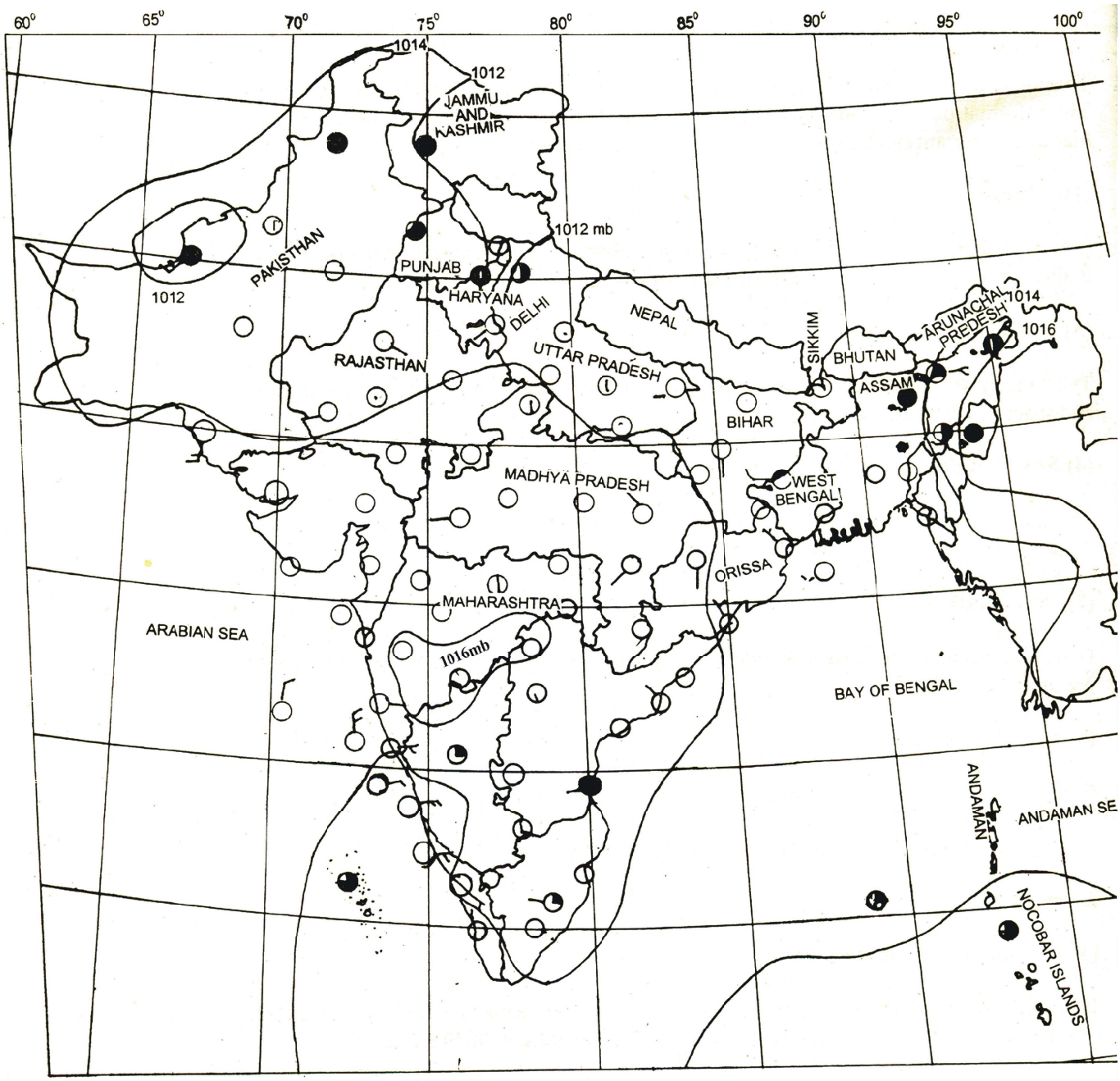


Fig. 4.17 Weather Map of 12th December 1984

(ii) Pressure Conditions

If you look at the isobars, you will see two areas of high pressure and three areas of low pressure prevailing over Indian subcontinent.

(a) Areas of High Pressure

Two areas of high pressure are well marked. One spreads over southern Maharashtra, north western Andhra Pradesh and northern part of Karnataka and it is enclosed by an isobar 1016 mb. The other area of high pressure lies in the north eastern part of the country and occupies greater part of Myanamar (Burma). This area of high pressure is also marked by an isobar of 1016 mb.

(b) Areas of Low Pressure

Three areas of low pressure are existing over the sub-continent. These low pressure areas are marked by isobar of 1012 mb. One of these low pressure occupies areas lie over Jammu and Kashmir and adjoining parts of Himachal Pradesh, Punjab, Haryana and north western Uttar Pradesh. The second low pressure area lies in the western part of Pakistan. The third area lies in the southern parts of the Bay of Bengal. It encloses parts of Nicobar Islands also.

(c) Pressure Gradient

As the isobars are widely spaced throughout the country except in north eastern part, it indicates a gentle pressure gradient in the whole country in general.

(iii) Wind

(a) Wind Direction

The general direction of winds is north east over the sea and south west over the land.

(b) Wind Velocity

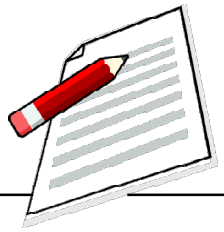
Since the gradient of pressure is gentle over most parts of the sub-continent, the velocity of wind is less than 5 knots (1 knot = 1.852 km) per hour. However, it is above 10 knots along Konkan coast, southeast of Sri Lanka and parts of Baluchistan in Pakistan. Thus, most of the areas in the country experience light breeze.

(iv) Sky Conditions

These refer to cloud cover, nature of clouds and other atmospheric phenomena.

(a) Cloud Cover

The sky is almost clear from clouds in most parts of country except in north western and north eastern states, Gujarat around Surat, Malabar and Coromandal coastal areas, interior Karnataka and Andaman and Nicobar



Islands. In these areas, the cloud cover varies from 1/ 8 to overcast sky.

(b) Other Atmospheric Phenomena

Mist is reported around Imphal and hazy weather conditions prevail in most parts of the country.

(v) Precipitation

Rain has been fairly widespread in Jammu and Kashmir, showers have also been experienced in part of Sub-Himalayan region, West Bengal, Sikkim and Himachal Pradesh. The weather remained mainly dry over the rest of the country.

(vi) Sea Conditions

The sea is normally calm and smooth. However, it is reported to be moderate in the south west of Thiruvananthapuram.

(vii) Weather Forecast

It is expected that rain or snow will be fairly widespread in Himachal Pradesh, Jammu and Kashmir and scattered in hills of Uttarakhand. Rain or thunder showers may also be isolated in Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Meghalaya, Nagaland, Manipur, Mizoram, Tripura. Sub-Himalayan region of West Bengal and Sikkim, Haryana, Punjab, Southern Tamil Nadu and South Kerala. The weather will be mainly dry over rest of India.

Example 2

You have studied weather conditions on a winter day of 1984. Now, let us take another weather map and study weather conditions on a rainy day of the same year.

(i) General Information

Look at the weather map given overleaf. The map shows the weather conditions observed and recorded on Friday, the 6th July 1984 or 15 Asadha 1906 Saka at 08.30 hrs. I.S.T.

(ii) Pressure Conditions

From the weather map it is quite clear that pressure decreases from south to north and towards north west.

(a) Areas of High Pressure

Two areas of high pressure are well marked, one lies in Arabian Sea off the Malabar Coast and the other lies south east of Nicobar Islands. Isobars of 1008 millibar and 1010 millibar mark the boundaries of these high pressure areas respectively. A weak wedge of high pressure has also developed along the western coast.

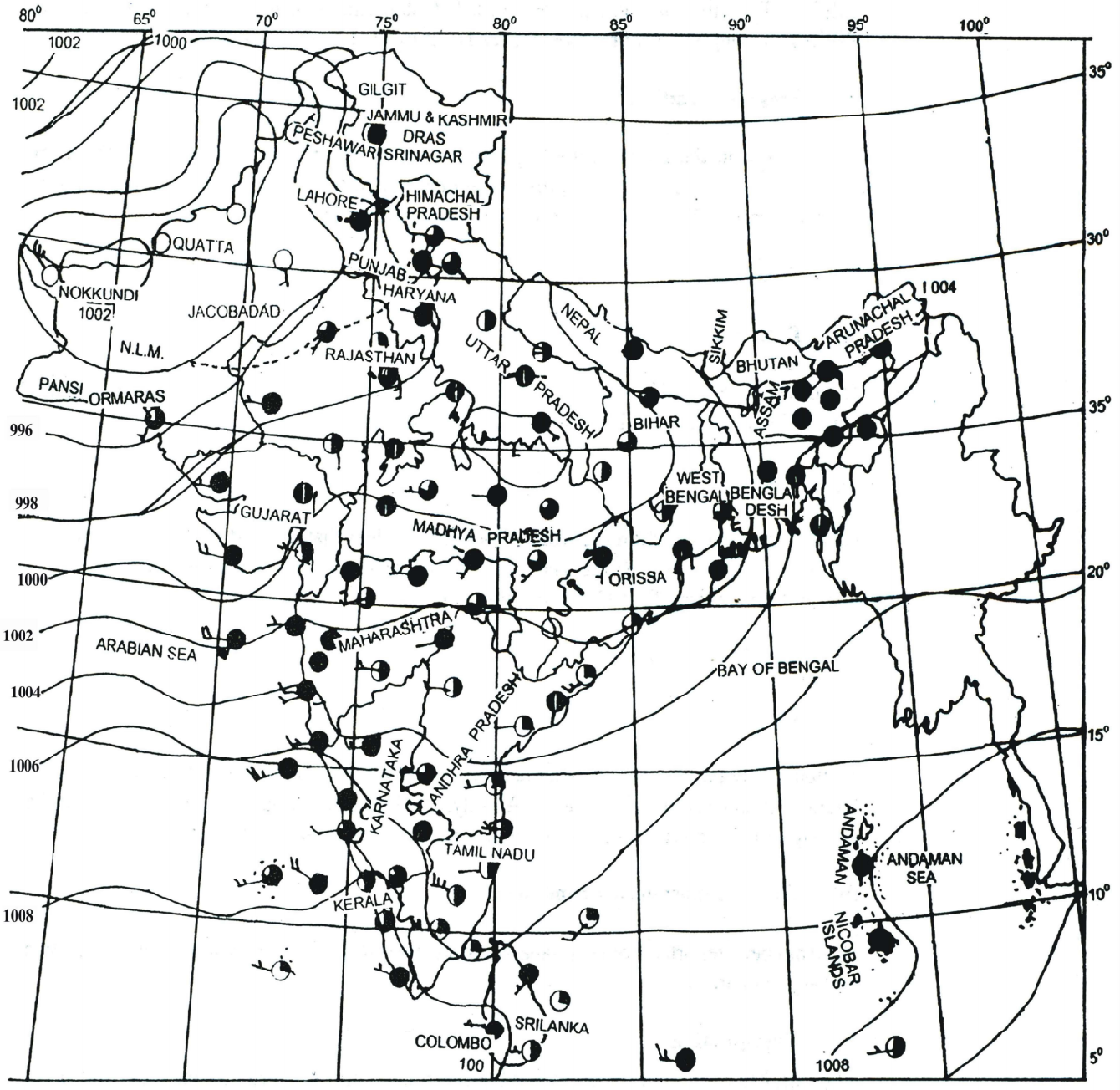
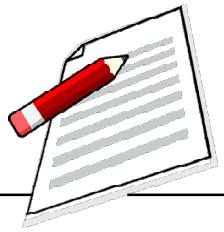


Fig. 4.18 Weather Map of 6th July 1984



(b) Areas of Low Pressure

Two areas of low pressure exist over two different parts of Indian sub-continent, one of these lies over Madhya Pradesh and adjoining Uttar Pradesh and is bounded by the isobar of 998 millibar. The other area exists over Pakistan and is bounded by the isobar of 992 millibar. A trough of low pressure is spread over most of North West India.

(c) Pressure Gradient

The isobars on the map are well spaced except on the western coast where there are comparatively closer. A gentle pressure gradient prevails over most parts of the country, Arabian Sea and West Coastal regions have moderate pressure gradient.

(iii) Wind

(a) Direction

The direction of wind is south west in most parts. However, it is easterly in upper Gangetic plains, Punjab, Himachal Pradesh and Jammu and Kashmir.

(b) Velocity

Look at the symbols showing wind velocity. It is clear that in most of northern parts, the velocity of winds is 5 to 10 knots per hour. It is however above 10 knots along western coast, interior Maharashtra, Tamil Nadu and Baluchistan.

(iv) Sky Conditions

(a) Cloud Cover

Symbols showing cloud cover ranging from 1/4 to overcast sky are distributed throughout the country. It makes quite clear that on 6th July, 1984 monsoon was active in all parts of India and vigorously active in Gujarat, Assam, Andaman Islands and parts of Punjab.

(b) Other Atmospheric Phenomena

Haze has been reported from Haryana, north and west Rajasthan and eastern Madhya Pradesh and adjacent areas.

(v) Precipitation

The rain has been widespread in north eastern parts and western coastal areas and fairly widespread in Uttarakhand, Himachal Pradesh, Madhya Pradesh, central and eastern Maharashtra, and northern Andhra Pradesh. Rain has been scattered in interior parts of central and eastern states and isolated in western, central parts of India. South West Andhra Pradesh, Rajasthan and Lakshadweep experienced dry weather. Amount of rainfall

varied from less than 1 cm to 13.9 cms (Cherrapunji). Note the rainfall of different places.

(vi) Sea Conditions

Since the winds along the eastern coast and Bay of Bengal are gentle, the sea is normally calm and smooth. However, it is moderate along Konkan coast in Arabian Sea.

(vii) Weather Forecast

It is expected that rain or thunder showers will be widespread in greater parts of the subcontinent and fairly wide spread in Andaman and Nicobar Islands, Eastern States, Gangetic Plains, Central States and coastal areas. Rains will be scattered in rest of the country.

EXERCISE FOR PRACTICAL RECORD BOOK

1. Study the given weather map of 12 Dec. 1984 and answer the following questions:

   (i) Name the two areas of high pressure

   _____

   (ii) Name the two areas of low pressure

   _____

   (iii) Which area experienced misty conditions?

   _____

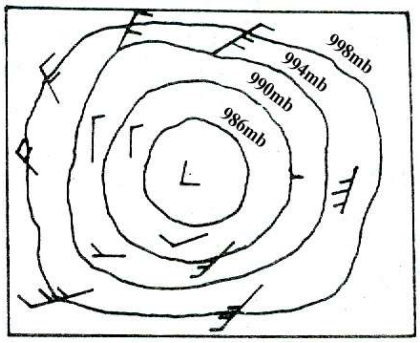
   (iv) Name an area which received rainfall.

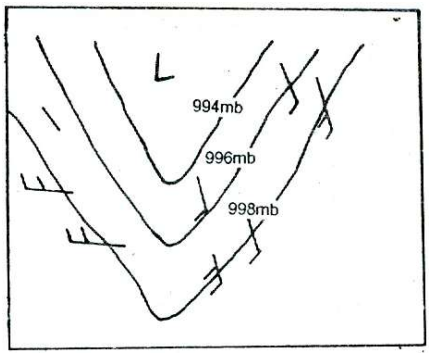
   _____

2. Show the following pressure systems with the help of isobars:

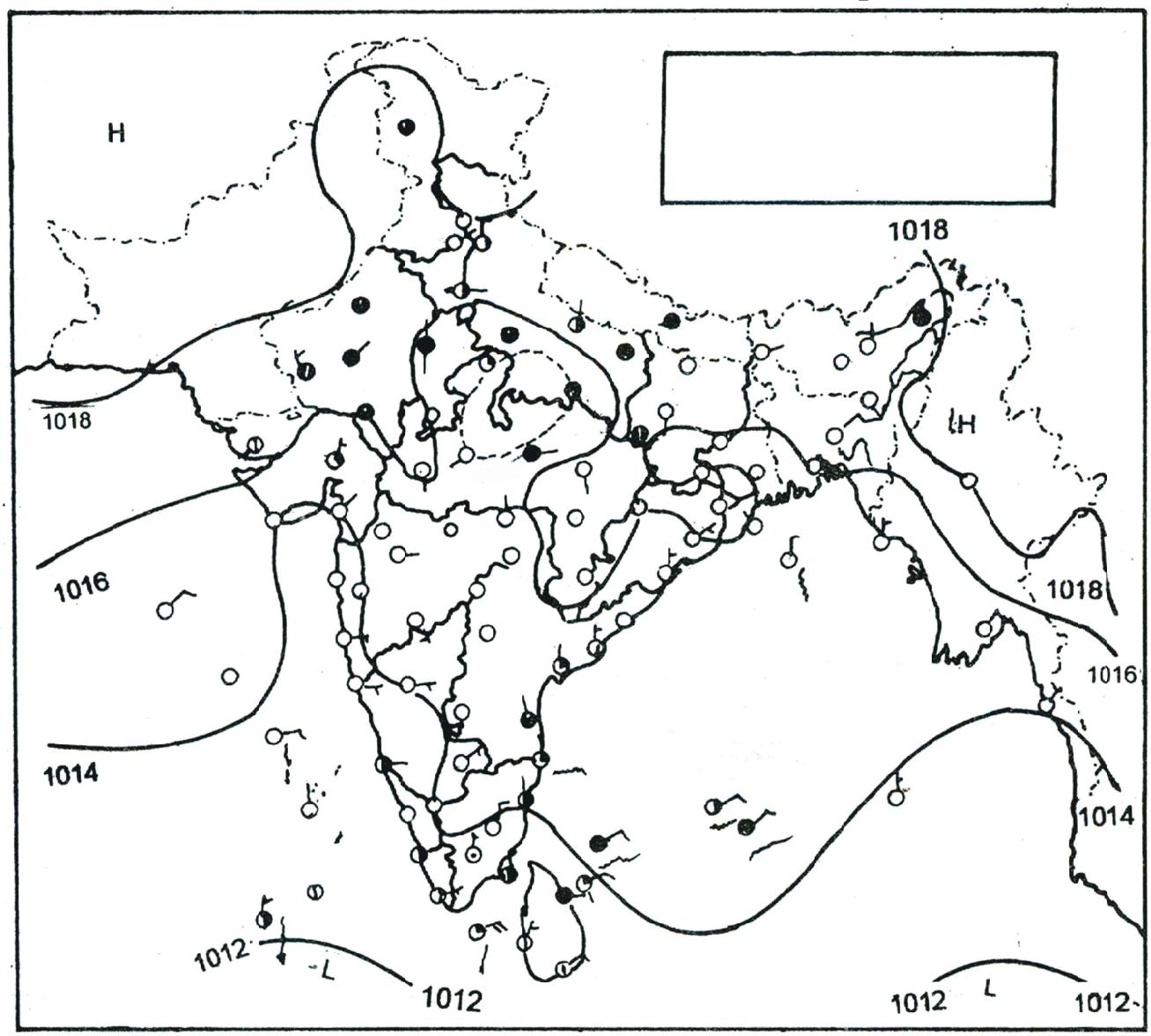
   (a) Tropical Cyclone (b) Temperate Cyclone

3. Recognise and name the following isobaric systems:





4. Study the given weather chart and find the general wind direction, cloud conditions and sea conditions.



5. The map given below shows, different isobaric systems-depression, tropical cyclones, anticyclone, wedge, trough and a col. These are marked by a, b, c, d and e on the map. Recognise these pressure systems and write below-the map their appropriate names.