CHAPTER 14 Atmospheric Pressure and Winds

Syllabus

Atmospheric Pressure and Winds

Meaning and factors that affect atmospheric pressure.

Major pressure belts of the world.

Factors affecting direction and velocity of wind — pressure gradient, Coriolis Effect.

Permanent winds — Trades, Westerlies and Polar Easterlies.

Periodic winds — Land and Sea breezes, Monsoons,

Local winds — Loo, Chinook, Foehn and Mistral

Variable winds — Cyclones and Anticyclones

Jet Streams — Meaning and importance

Air is a physical substance. It is a mixture of several gases present in the atmosphere and it has its own weight. Air exerts pressure on the earth's surface. *The weight of air on a unit area of the earth is called* ***Air Pressure.***

Atmospheric Pressure refers to the force per unit area exerted against a surface by the weight of the air above that surface. Pressure is expressed in millibars (mb) and measured with a mercury barometer. The average atmospheric pressure at sea level is 1013.25 mb. or 760 mm (the height of the column of mercury in a barometer at sea level). Atmospheric Pressure decreases with height.

Atmospheric pressure is an important factor in producing changes in weather. Contrasts in temperature cause changes in air density which are responsible for variations in pressure. These variations cause horizontal movement of air called *winds*. Winds transport heat and moisture from one region to another and thus help in the occurrence of precipitation and affect both temperature and humidity.

MEASUREMENT OF PRESSURE

Pressure is normally measured in millibars. The variations in pressure are shown on maps by means of *Isobars*. These are lines joining the places having the same barometric pressure. The barometer consists of a long narrow tube filled with mercury. There are two types of barometers —*Fortin's Barometer* and *Aneroid Barometer.*

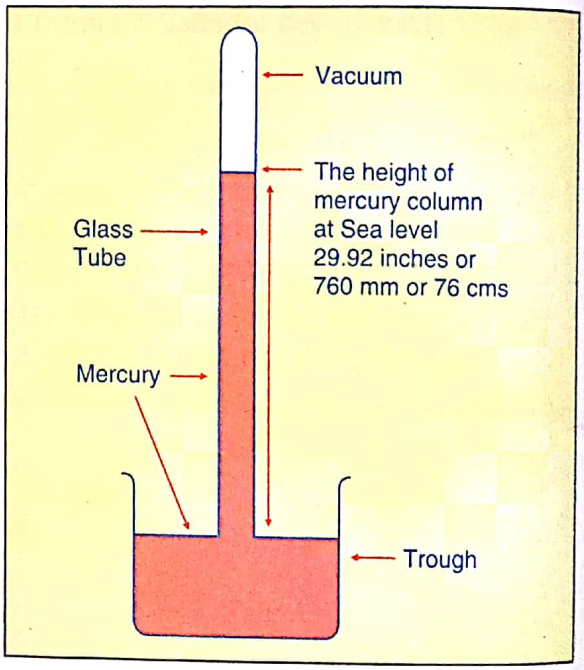

Fig. 14.1. A Simple Barometer

ressure Gradient

ressure gradient is defined as the decrease in ressure per unit distance in the direction in which he pressure decreases most rapidly. In other ords, the rate of change of atmospheric pressure etween two points on the earth's surface is called *ressure gradient.* On the weather chart this is ndicated by the spacing of isobars. The gradient s steep if they are close together and gentle if they are far apart. Close spacing of isobars indicates a strong pressure gradient, while wide spacing suggests a weak gradient.

FACTORS AFFECTING ATMOSPHERIC PRESSURE

1. Altitude

The atmospheric pressure decreases with height or altitude. The atmospheric pressure is highest at sea level. This is because at higher altitudes the air is thinner or less dense than the air at the sea level.

The maximum air density is at the earth's surface; air density decreases with height (because the pull of the earth's gravity is less). The fewer number of gas molecules at higher altitudes means fewer molecular collisions and a decrease in air pressure. Since the atmosphere is highly compressible, the overlying layers exert pressure on low lying layers.

As the pressure decreases, the amount of oxygen available to breathe also decreases. At high altitudes, atmospheric pressure and available oxygen get so low that people feel breathless. Mountain climbers use bottled oxygen when they ascend very high peaks. They also take time to get used to the altitude because quickly moving from higher pressure to lower pressure can cause decompression sickness. Decompression sickness, also called "the bends", is also a problem for scuba divers who come to the surface too quickly.

Aircraft create artificial pressure in the cabin so passengers remain comfortable while flying.

2. Temperature

Atmospheric pressure decreases with increase in temperature. This is because when the temperature rises, air expands. The molecules of air move far apart (become less dense) and hence exert less pressure. On the contrary, with decrease in temperature the air gets compressed and the space between molecules decreases (becomes more dense) and exerts more pressure on the region. That is why the Equatorial region has a low pressure belt, whereas the Polar regions have high pressure belts.

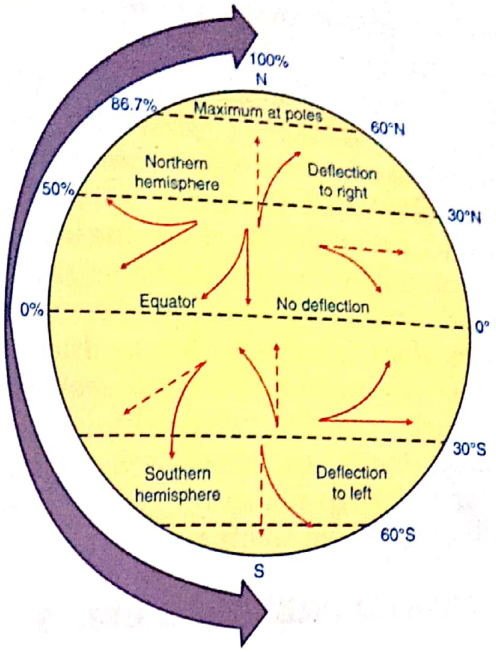

Fig. 14.2. Rotation affects pressure

3. Water Vapour

Water vapour concentration affects atmospheric pressure because the molecular weight of water (18 g/mol) is less than the average molecular weight of air (about 29 g/mol). When water evaporates and enters the atmosphere as a gas, the water vapour molecules take the place of other gas molecules in the air. So, a volume of wet (or humid) air weighs less than an equal volume of dry air. Therefore, humid air is less dense and exerts less pressure than dry air.

4. Rotation of the Earth

Due to the rotation of the earth, bulk of the air at the Poles is thrown away towards the Equator. Since the Equatorial region receives great amount of heat throughout the year, the air becomes warm and light and therefore, it rises and creates low pressure. At the Poles, the cold heavy air sinks down and creates high pressure. In fact, temperature and rotation of

the earth together contribute to the formation of world pressure belts.

These factors make air pressure an important parameter in predicting weather. In general weather becomes stormy when air pressure falls (generally due to warmer, humid air and/or convergence of air masses at the surface of the earth which cause convection and rising air) and becomes fair when air pressures rises (generally due to drier, colder air and/or divergence of air masses). When a low-pressure system moves into an area, it usually leads to cloudiness, wind and precipitation. High-pressure systems usually lead to fair and calm weather.

WORLD PRESSURE BELTS

The distribution of atmospheric pressure across the latitudes is termed ***global horizontal distribution of pressure.*** Its main feature is its zonal character known as *pressure belts*. On the earth's surface, there are in all seven pressure belts. They are the *Equatorial Low, the two Sub-tropical Highs, the two Sub-polar Lows,* and the *two Polar Highs*. Except the Equatorial low, the others form matching pairs in the Northern and Southern Hemispheres.

There is a pattern of alternate high and low pressure belts over the earth. This is due to the spherical shape of the earth—different parts of the earth are heated unequally. The Equatorial region receives great amount of heat throughout the year. Warm air being light, the air at the Equator rises, creating a low pressure.

At the poles the cold heavy air causes high pressure to be formed. It is also due to the rotation of the earth. In the Sub-polar region around latitudes 60° to 65° North and South of the Equator, the rotation of the earth pushes up the bulk of the air towards the Equator, creating a low pressure belt in this region.

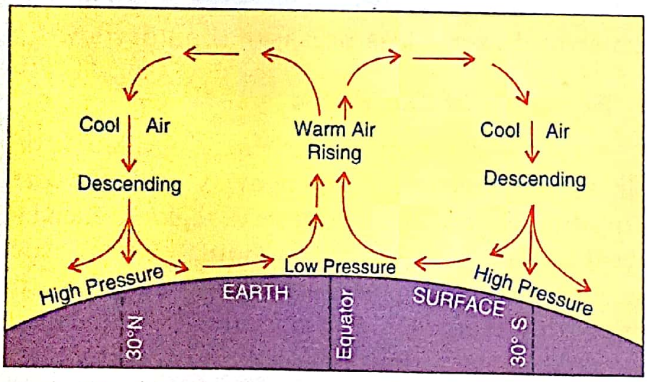

Fig. 14.3. The formation of pressure belts

(i) *Equatorial Low Pressure Belts*

This low pressure belt extends from 0 to 5° North and South of Equator. Due to the vertical rays of the sun here, there is intense heating. The air therefore, expands and rises as convection current causing a low pressure to develop here. This low pressure belt is also called as *doldrums*, because it is a zone of total calm, i.e., without any breeze.

(ii) *Sub-tropical High Pressure Belts*

At about 30°North and South of Equator lies the area where the ascending Equatorial air currents descend. This area is thus an area of high pressure. It is also called the *Horse latitude*.

Winds always blow from high pressure to low pressure. So the winds from sub-tropical region blow towards Equator as *Trade winds* and towards Sub-Polar Low-Pressure as *Westerlies*.

(iii) *Circum-polar Low Pressure Belts*

These belts located between 60° and 70° in each hemisphere are known as Circum-polar Low Pressure Belts. In the Sub-tropical region the descending air gets divided into two parts. One part blows towards the Equatorial Low Pressure Belt. The other part blows towards the Circum-polar Low Pressure Belt. This zone is marked by ascent of warm Sub-tropical air over cold polar air blowing from poles. Due to earth's rotation, the winds surrounding the Polar region blow towards the Equator. Centrifugal forces operating in this region create the low pressure belt appropriately called *Circum-polar Low Pressure* Belt. This region is marked by violent storms in winter.

(iv) *Polar High Pressure Areas*

At the North and South Poles, between 70° to 90° North and South, the temperatures are always extremely low. The cold descending air gives rise to high pressures over the Poles. These areas of Polar high pressure are known as the *Polar Highs*. These regions are characterised by permanent Ice Caps.

SHIFTING OF PRESSURE BELTS

If the earth had not been inclined towards the sun, the pressure belts, as described above, would have been as they are. But it is not so, because the earth is inclined 23½° towards the sun. On account of this inclination, differences in heating of the continents, oceans and pressure conditions in January and July vary greatly. January represents winter season and July, summer season in the Northern Hemisphere. Opposite conditions prevail in the Southern Hemisphere.

When the sun is overhead on the Tropic of Cancer (21 June) the pressure belts shift 5° northward and when it shines vertically overhead on Tropic of Capricorn (22 December), they shift 5° southward from their original position. The shifting of the pressure belts causes seasonal changes in the climate, especially between latitudes 30° and 40° in both hemispheres. In this region the Mediterranean type of climate is experienced because of shifting of permanent belts southwards and northwards with the overhead position of the sun. During winters Westerlies prevail and cause rain. During summers dry Trade Winds blow offshore and are unable to give rainfall in these regions.

When the sun shines vertically over the Equator on 21st March and 23rd September (the Equinoxes), the pressure belts remain balanced in both the hemispheres.

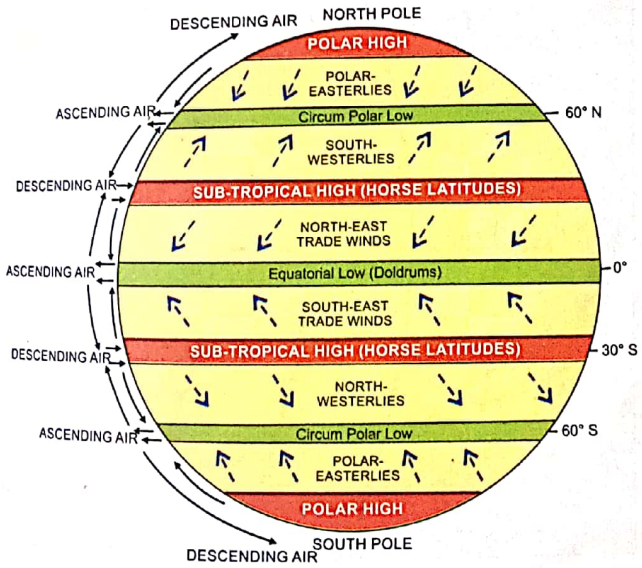

Fig. 14.4. Pressure Belts

WINDS

Air flows from areas of high pressure to areas of low pressure. *Horizontal movement of the air is called* ***wind.*** It is nature's attempt to balance inequalities in air pressure. *The vertical or nearly vertical movement of air is referred to as* ***air current.*** Winds and air currents manage a system of circulation in the atmosphere.

Factors Affecting Direction and Velocity of wind

Direction and speed of wind are controlled by a combination of factors. These are the pressure gradient, the Coriolis force, altitude, latitude, rotation of earth, the centripetal acceleration and friction.

1. Pressure Gradient

We have already studied about the pressure gradient. The greater the difference in pressure between two points, the steeper is the pressure gradient and higher is the wind speed. Since winds blow from higher to lower pressure area and perpendicular to the isobars, these wind blows are parallel to the gradient and at right angles to the isobars.

2. Coriolis Effect

The earth rotates on its inclined axis. If it did not, winds would follow the direction of the pressure gradient. But the rotation produces

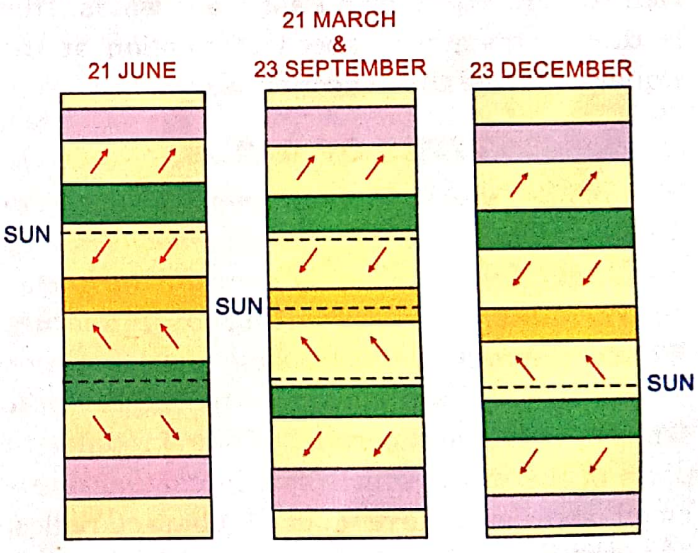

Fig. 14.5. Shifting of the Pressure Belts

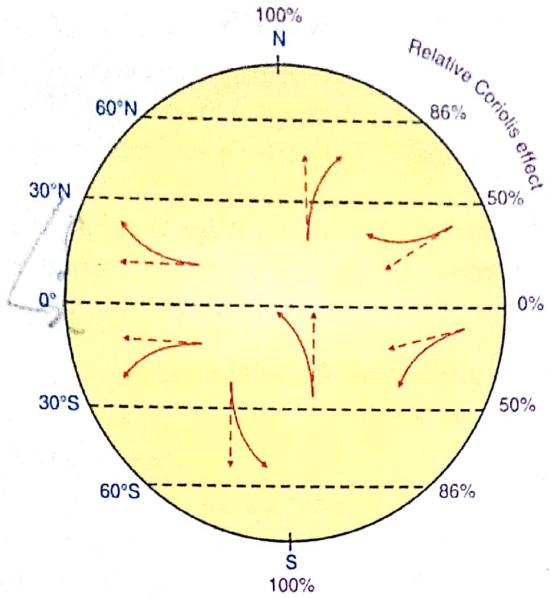

Fig. 14.6. Coriolis Force. The dotted arrows show the actual direction of winds, the arrows show the deflected winds.

another force other than the pressure force. It is called the '*Coriolis Effect or 'Coriolis Force*', which deflects the air.

The deflection is the least at the Equator and greatest at the Poles. This tends to turn the flow of air by changing its direction from its original straight path. The wind starts deflecting to its right in the Northern Hemisphere. In the Southern Hemisphere it starts deflecting to its left from its original path. Thus a wind blowing from north becomes north-easterly in the Northern Hemisphere. A wind blowing from south becomes south-easterly in the Southern Hemisphere, e.g., North East Trade winds. This is due to maximum speed of rotation at the Equator, hence the deflection is less.

TYPES OF WINDS

The winds which blow throughout the year from one latitude to the other in response to the latitudinal differences in air pressure are known as ***Permanent*** *or* ***Prevailing*** *or* ***Planetary Winds.*** *Certain winds reverse their direction periodically with season and are called* ***Periodic Winds.*** There are certain winds in different parts of the world which flow in comparatively small area and have special characteristics. These are called *Local Winds.*

PERMANENT WINDS

The Trade Winds

The winds blowing from the Sub-Tropical High Pressure area (30°N and S) towards the Equatorial Low Pressure belt are the extremely steady winds known as the *trade winds.*

The name trade comes from the German word *trade* meaning 'track'. 'To blow trade' means 'to blow steadily in the same direction and in a constant course.'

North and South of the Equatorial Belt are the Trade Winds in the zone lying between 5° and 30° North and South. In other words, they cover almost the entire area between 30°N and 30°S latitudes on both sides of the Equator. The Trade Winds are a result of a pressure gradient from the Sub-Tropical Belt of High Pressure to the Equatorial Belt of Low Pressure.

In the Northern Hemisphere, the wind moving towards the Equator, is deflected by the earth's rotation to flow south-westward. Thus, the prevailing wind there is from the North-East, and it has been named as the '*North-East Trade*'. In the Southern Hemisphere, deflection of the wind is towards the left, this causes the '*South-East Trades.*'

Trade winds bring heavy rainfall to the eastern coasts of continents lying within the Tropics. On the western coasts of continents, these winds do not bring any rainfall. It is

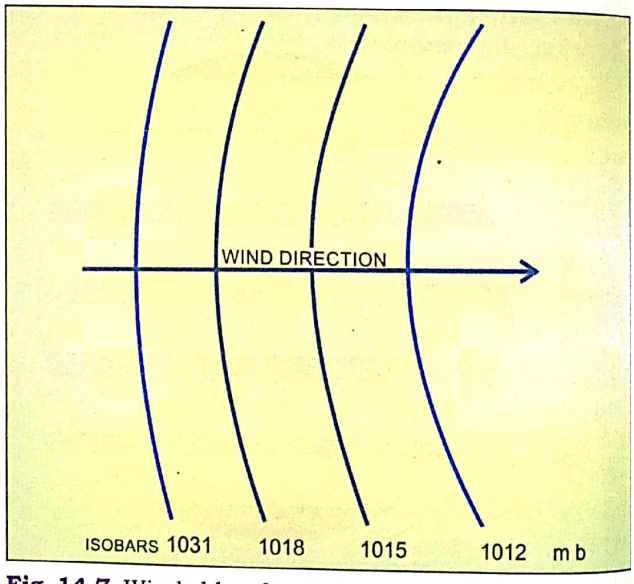

Fig. 14.7. Winds blow from high pressure to low pressure

because here they are 'off-shore' winds or winds blowing just parallel to the shores. Therefore, the western areas within the tropics suffer from aridity. The great deserts of the Sahara, Kalahari, Atacama and the Great Australian Deserts all lie on the western margins of the continents, within the tropical latitudes.

Characteristics of Trade Winds: They blow from Sub-tropical High Pressure to Equatorial Low Pressure.

(i) Since they are warm winds, they pick up moisture and are responsible for heavy rainfall on eastern sides of tropical lands.

(ii) They are called North-East Trades in Northern Hemisphere and South East Trades in Southern Hemisphere. The winds and pressure belts move a few degrees north and south along with the movement of the overhead sun.

(iii) They have fixed velocity and are regular.

(iv) They are permanent or prevailing winds.

The Westerlies

The Westerlies or the Prevailing Westerly Winds blow between 35° and 60° North and South latitudes from the Sub-Tropical High Pressure Belts towards the Sub-Polar Low-Pressure Belts.

In the Northern Hemisphere, the Westerlies generally blow from the south-west to the north-east, and in the Southern Hemisphere from the north-west to the south-east. These are on shore winds on the west coasts and off-shore winds on their east coasts. The on-shore winds bring rainfall while the off-shore winds do not bring rainfall.

Characteristics of Westerlies

(i) They blow from Sub-tropical High Pressure to Sub-polar low.

(ii) They are very strong winds, and often blow from the western side of landmass.

(iii) They are interspersed by cyclones and cause light drizzle.

(iv) They are stronger in the southern hemisphere as there is absence of landmass.

The Polar Easterlies

The winds that originate in the North and South Polar regions and blow towards Circum-polar Low Pressure Zone are known as *Polar Winds*. They start from Polar High Pressure Zone, and originate from ice-capped landmass in Arctic and Antarctic latitudes. In the Northern Hemisphere, they blow from the north-east, and are called the *North-East Polar Winds*; and in the Southern Hemisphere, they blow from the south-east and are called the *South-East Polar Winds*.

They are also deflected to the west in both hemispheres and hence are known as *Polar Easterlies*.

Characteristics of Polar Winds

(i) They are very cold winds.

(ii) They are also referred to as Polar Easterlies from the direction in which they blow.

(iii) When they blow over oceans they become warm.

PERIODIC WINDS

Periodic winds blow at regular intervals or in regular cycles. They are winds that result from localised differences in pressure and temperature. For example, land and sea breezes and the seasonal winds.

Land and Sea Breezes

They are caused by differential rate of heating of the land and the sea.

During the day land gets heated faster than the adjoining sea. This creates a low pressure zone on the land and high pressure zone over the sea. Thus the winds blow from sea to land and are called *Sea Breezes*. At night reverse of this happens and winds blow from land to sea and are called *Land Breezes*.

Monsoons are periodic seasonal winds blowing in the regions of South East Asia and Northern Australia. The word 'monsoon' is derived from the Arabic word *Mausim* meaning 'season'. They develop because of differences in heating conditions of the continent and

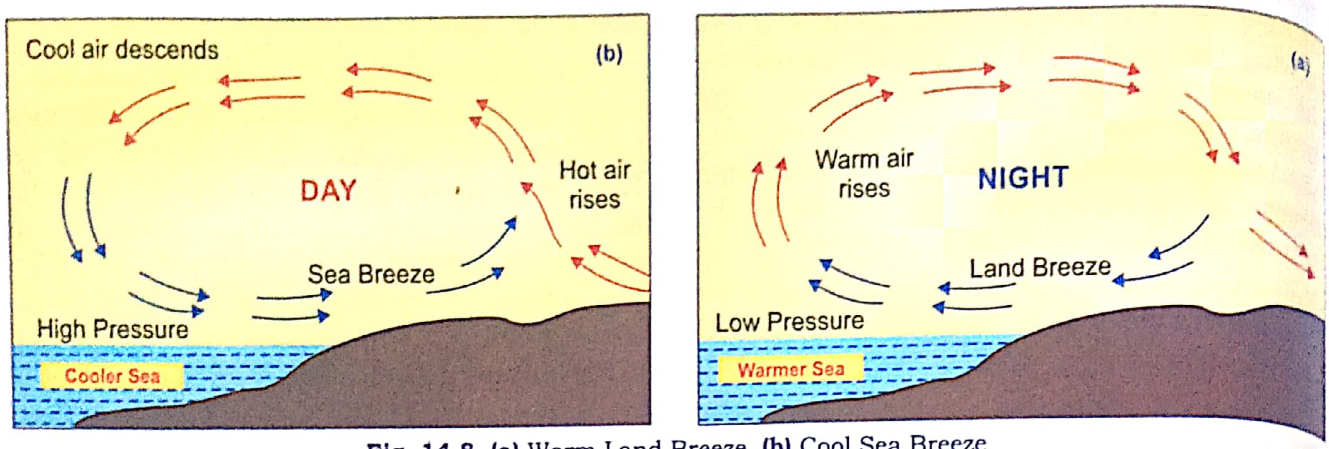

Fig. 14.8. (a) Warm Land Breeze, **(b)** Cool Sea Breeze

the oceans. They are divided into two wind systems—the Summer Monsoon and the Winter Monsoon.

Summer Monsoons

In summer the land gets more heated than the sea. Hence there develops a centre of low pressure on the land. Over the adjoining sea, the air is comparatively cool, and a high pressure develops there. This causes the winds to blow from the sea to the land. It is the *'Summer Monsoon.'*

In May, June and July, the plains of India and China are heated by the vertical rays of the sun. The intense heat develops a continental low pressure. During these months, over the Indian Ocean, a high pressure area develops. So, the winds blow from the Indian Ocean northward and north-westward into Asia [Fig 14.9 (a)]. As they blow from the sea to the land, they bring heavy rainfall to South-East Asia. The summer monsoon winds blow south-west; so they are known as the *'South-West Summer Monsoon.'*

Winter Monsoons

During winter season, the conditions are just reverse of those of summers. A high pressure develops over a big landmass stretching from Central Asia up to north-west Indian plain. At the same time a low pressure zone develops in the Indian Ocean. As the winds blow from the land to the sea, they bring cold dry weather. They are incapable of producing rain.

When these winds blow over seas and pass over the adjoining land, they bring some rainfall.

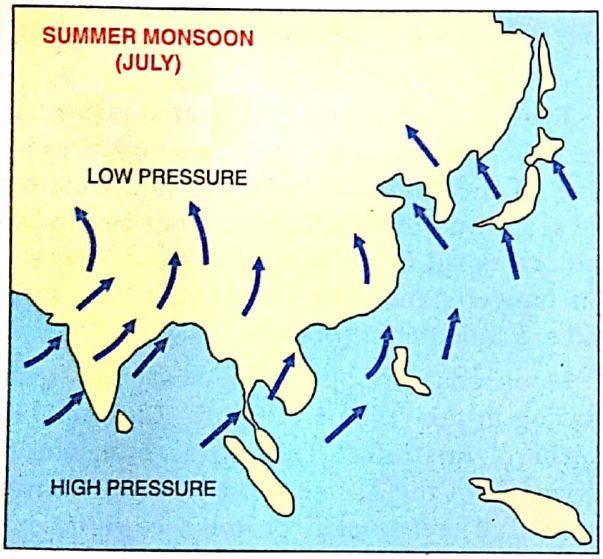

Fig. 14.9 (a) Summer Monsoon Winds

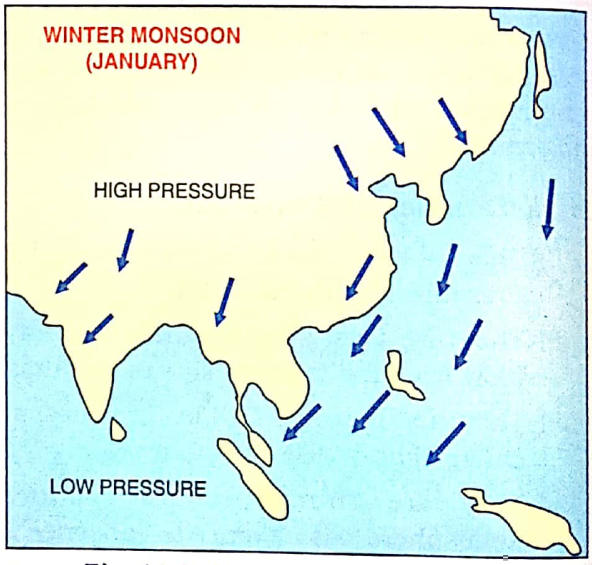

Fig. 14.9 (b). Winter Monsoon Winds

The Southern Coromandel Coast (Tamil Nadu) in India and the Vietnamese Coast and the west coast of Japan get rain from winter monsoons. The winter monsoon winds blow north-east; so the monsoon is known as the *'North-East Winter Monsoons.'*

LOCAL WINDS

Local winds are restricted to a certain place only. They may be warm or cold depending upon the area from which they blow. For example, Harmattan is a hot local wind of Sahara desert.

Loo: In the plains of northern India and Pakistan, sometimes a very hot and dry wind blows from the west in summer in the afternoons. It is known as *loo*. Its temperature invariably ranges between 45°C and 50°C. It may cause sunstroke to people.

Foehn and Chinook: A strong warm wind develops on the leeward side of the Alps. Due to regional pressure gradient, air is forced to cross the barrier. As the air ascends the southern slopes of the Alps, it expands and cools. Condensation takes place when the air is saturated, causing rain and snowfall on the higher slopes. However, on descending the northern slopes, the wind experiences an increase in pressure and temperature. Due to this air is compressed and warmed. Most of its moisture is lost and it reaches the valley bottom as a dry, hot wind, called the *Foehn*. The temperature of the wind is from 15°C to 20°C. The wind is of use for melting snow and it hastens the ripening of grapes. Similar kind of wind in the USA and Canada move down the west slopes of the Rockies and are known as *chinooks*. The word *chinook* literally means 'snow eater'. It is beneficial to ranches east of the Rockies as it keeps the grasslands clear from snow.

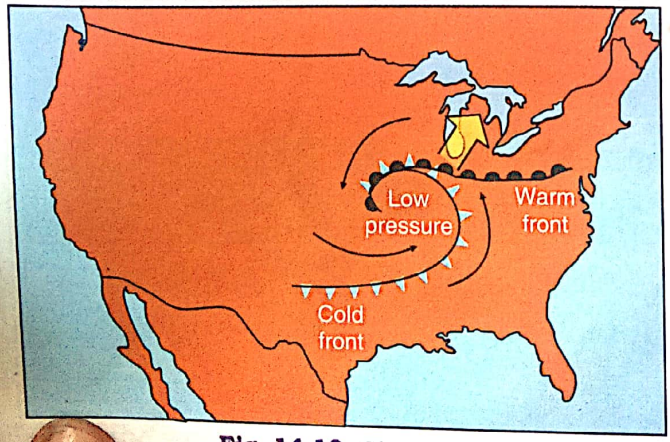

Fig. 14.10. Chinooks

Mistral: During winter, areas adjacent to highlands may experience a local cold wind which originates over the snowcapped mountains or highlands and blows down the valley. These winds have been given local names. The most famous is the *mistral* that blows from the Alps over France towards the Mediterranean Sea. Even though the skies are clear, the mistral brings down the temperature below freezing point.

These local winds often have a considerable effect on climatic conditions, notably on the temperature of a place.

VARIABLE WINDS

These winds are related to pressure systems and blow in small areas. They are called variable because they do not blow in any definite direction and their direction varies with the movement of the pressure system. Their speed also depends on the intensity of the depression. They last only for a few days. Two chief types of variable winds are—*Cyclones* and *Anticyclones*.

Cyclones

In low latitudes, an intense depression with a low pressure centre is known as a Tropical *cyclone* in the Indian Ocean area, as *hurricanes* in the Caribbean, *typhoons* in China and *willy-willies* in Australia.

A Cyclone is a portion of the atmosphere in which the pressure is lowest in the centre. The winds blow inward in the opposite direction, i.e., from the south or south-west in the front of the cyclone and from the north-or north-west in its rear. When a cyclone approaches, the reading on a barometer falls because of low pressure, but the thermometer rises due to the warm south or south-west winds. The rising moisture-laden air of such a cyclone results in heavy rain in the centre of the depression. Cyclones on account of the Coriolis Force blow in an anti-clockwise direction in the Northern Hemisphere and clockwise in the Southern Hemisphere.

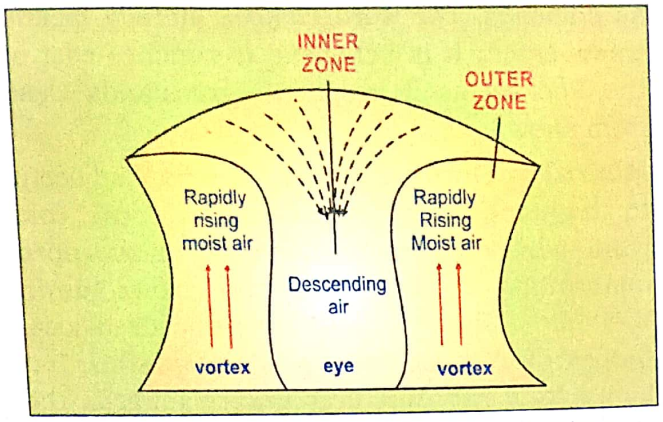

Fig. 14.11. A cross section of a tropical cyclone

Tropical Cyclones: Cyclones are associated with turbulent weather conditions, thick cloud cover, strong winds and rainfall. Tropical cyclones, thus, cause heavy damage to property and loss of human lives. The cyclones generally originate in the tropical region between 8° and 20° N and S. They are more frequent in summer because of the movement of the Doldrum belt away from the Equator. Most often they originate in the South China Sea and cause a lot of damage to life and property in the countries bordering that region. In the Bay of Bengal and the Arabian Sea, they cause great damage as they are strong winds even though their range is small.

The central part of a cyclone is a calm region and is known as the eye of the cyclone surrounded by a turbulent vortex (Fig 14.11). The force of the winds depends on the intensity of the low pressure centre and the surrounding high pressure. The greater the difference, the stronger is the wind.

The weather conditions associated with a tropical cyclone are:

1. When there is a tropical cyclone the air is still, but the temperature and the humidity are high. There is sudden drop in air pressure.
2. When the front of the vortex arrives, there are strong winds and thick clouds, then the winds become violent with great speed. Dense clouds and heavy rain reduce visibility.
3. The eye of the cyclone heralds a calm condition.
4. When the rear of the vortex arrives, there are violent winds, thick clouds and heavy rain. The wind blows in the opposite direction.

A Tornado: A tornado is a tropical cyclone, which occurs over land. Its diameter is hardly 300 or 400 metres. It looks like a dark, funnel-shaped cloud extending downward from the base of the thunderstorm. It has low pressure in the centre, with very strong winds blowing inwards. The speed of the winds may be as high as 500 to 800 km per hour. Tornadoes are generally experienced over tropical waters in North America.

Other forms of Tropical cyclones are *hurricanes* in south-east Caribbean region; *typhoons* in eastern China, Japan and Philippines islands and *cyclones* in the Bay of Bengal and Arabian sea.

Temperate Cyclones: Temperate cyclones are active over mid-latitudinal region between 35° latitude and 65° latitude in both hemispheres. They are also known as extra-tropical or wave cyclones. Unlike tropical cyclones which are produced and developed mainly over the sea, temperate cyclones are produced both on land and on sea. Whereas the tropical cyclones are limited to a small area and usually travel from east to west, the temperate cyclones occupy areas measuring a couple of thousands of kilometres and move from west to east. In a temperate cyclone, wind speed is low and all the sectors of the cyclone have different temperatures. The rainfall is light and continues for many days.

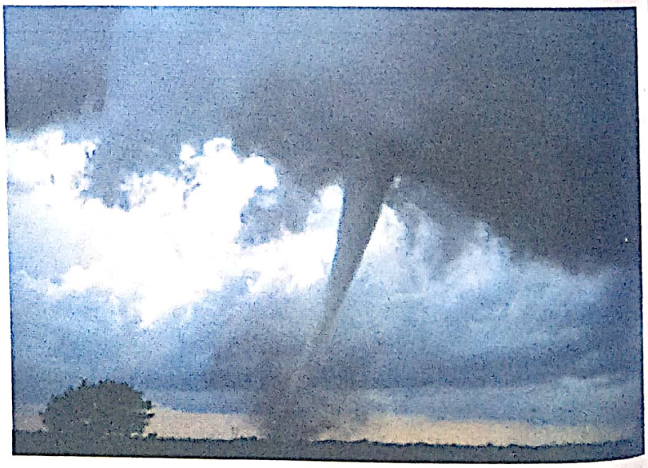

Fig. 14.12. Tornado

Difference between Tropical Cyclones and Temperate Cyclones

Tropical Cyclones	Temperate Cyclones
1. Tropical cyclones are produced mainly over the sea.	1. Temperate cyclones are produced both on land and on sea.
2. They generally originate in the tropical region between 8° and 20°N and S.	2. They originate in the mid-latitudinal region between 35° latitude and 65° latitude.
3. They are limited to a small area.	3. They occupy areas measuring thousands of kilometres.
4. They travel from east to west.	4. They travel from west to east.
5. They are forecasted by high temperature and humidity but still air.	5. They are forecasted by fall in temperature and pressure, wind shifts and a halo around the sun and the moon.
6. They are associated with violent winds with great speed, dense clouds and heavy rains.	6. The wind speed is low and the rainfall is light, which continues for many days.
7. They are largely a summer phenomena.	7. They are most intense in winter.

The centre of a tropical cyclone is known as the *eye* and the wind is calm at the centre with no rainfall. In a temperate cyclone, there is not a single place where winds and rains are inactive. Direction of winds rapidly change at the front. The temperate cyclones are associated with anticyclones which precede and succeed a cyclone. The approach of a temperate cyclone is marked by fall in temperature, fall in the mercury level, wind shifts and a halo around the sun and the moon. A light drizzle follows which turns into a heavy downpour.

Anticyclones

An anticyclone is a fine atmospheric condition. There is High Pressure in the core or centre and Low Pressure around it. Winds blow gently outwards. These winds are clockwise in Northern Hemisphere and anticlockwise in the Southern Hemisphere. Since they are centres of high pressure they are found in region of descending air currents. Fig. 14.13 shows the wind circulation in an anticyclone.

JET STREAMS

Jet streams refer to the concentrated bands of rapid air movement found at the tropopause and the stratosphere, located at 10-15 kilometres above the surface of the Earth. They are formed near boundaries of adjacent air masses with significant differences in temperature, such as the Polar region and the warmer air to the south. They are associated with latitudes where the poleward temperature gradient is particularly strong. Two such zones occur in each hemisphere. The sub-tropical jet stream occurs at about 30° latitude and the other, the polar front jet stream is associated with the polar front zone in each hemisphere. The major jet streams are westerly winds (flowing west to east) in the Northern Hemisphere.

During the summer, easterly jets are formed in tropical regions, typically in a region where dry

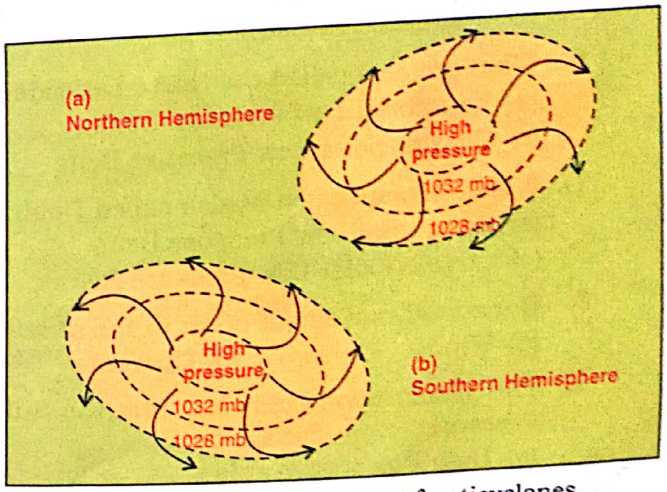

Fig. 14.13. The direction of anticyclones

air encounters more humid air at high altitudes. Low level jets can form wherever low level winds are squeezed together, typically between an oncoming front and a high pressure cell.

Importance of Jet Streams

1. Most weather systems do not just sit over an area, they are instead moved forward with the jet stream. The position and strength of the jet stream then helps meteorologists forecast future weather events.
2. The airline industry consistently uses the jet stream for its flights. By flying commercial aircraft within the jet stream the flight time gets reduced. The reduced flight time and aid of the strong winds lead to reduction in fuel consumption.
3. Precipitation usually increases in California because the polar jet stream moves farther south and brings more storms with it. In addition, precipitation often increases in Europe because the jet stream is stronger in the Northern Atlantic.

Whatever the position of the jet stream, it has a significant impact on the world's weather patterns and severe weather events like floods and droughts. It is, therefore, essential that meteorologists understand as much as possible about the jet streams and continue to track its movement, to monitor weather conditions around the world.

EXERCISES

I. Choose the correct option:

1. The weight of air on a unit area of the earth:
   (a) weight pressure (b) air pressure
   (c) unit pressure (d) area pressure
2. Horizontal movement : _____ :: Vertical movement : air current
   (a) conduction (b) convection (c) winds (d) coriolis
3. The force per unit area exerted against a surface by the weight of the air above that surface:
   (a) Force Pressure (b) Area Pressure
   (c) Air Pressure (d) Atmospheric Pressure
4. The average atmospheric pressure at sea level:
   (a) 1014.5 mb (b) 1015.2 mb (c) 1013.25 mb (d) 1017.75 mb
5. The decrease in the pressure per unit distance in the direction in which the pressure decreases most rapidly is called
   (a) Pressure Gradient (b) Distance Pressure
   (c) Decreased Pressure (d) Unit/Distance Gradient
6. What are also called the Horse Latitude?
   (a) Equatorial Low Pressure Belts (b) Sub-Tropical High Pressure Belts
   (c) Circum-polar Low Pressure Belts (d) Polar High Pressure Areas
7. Which pressure belt is also called Doldrums?
   (a) Equatorial Low Pressure Belts (b) Sub-Tropical High Pressure Belts
   (c) Circum-polar Low Pressure Belts (d) Polar High Pressure Areas
8. Horizontal movement of air in the atmosphere:
   (a) Winds (b) Currents (c) Pressure (d) None of the above.
9. The steady winds blowing from the Sub-Tropical High Pressure towards the Equatorial Low Pressure:
   (a) High Pressure Winds (b) Low Pressure Winds
   (c) Trade Winds (d) Steady Winds

10. Which amongst the following is NOT a characteristic of Trade Winds?
(a) They have varying velocity and are irregular
(b) They are permanent or prevailing winds
(c) They are called North-East Trades in Northern Hemisphere
(d) They have fixed velocity and are regular

11. Alps : _____ :: Rockies : _____
(a) Chinook, Mistral (b) Polar Easterlies, Foehn
(c) Foehn, Mistral (d) Foehn, Chinook

12. What is the tropical cyclone over land called?
(a) Tropical Cyclone (b) Temperate Cyclone
(c) Tornado (d) Mistral

13. The concentrated bands of rapid air movement at the tropopause:
(a) Jet Streams (b) Tornado (c) Mistral (d) Wave Cyclones

14. Which of the following is true about Jet streams?
(a) Forecast weather (b) Reduce flight time
(c) Increase precipitation (d) All of the above.

15. Calm region in the centre of the cyclone:
(a) focus (b) eye (c) core (d) All of the above.

16. Which of the following is NOT a tropical cyclone?
(a) hurricane (b) typhoons (c) mistral (d) willy-willies

17. Your uncle was puzzled because his flight from Delhi to London was more than 9½ hours long but his return from London was about 8½ hours. As a student of geography how would you explain this to him.
(a) The pressure gradient supported the return flight.
(b) Flying along a jet stream reduces flight time.
(c) The Coriolis Force deflects air reducing flight time.
(d) None of the above.

II. Short Answer Questions

1. Name the four main pressure belts of the earth.
2. What is the Circum-polar Low Pressure Belt?
3. How does the Coriolis Force vary latitudinally?
4. Name the three chief types of wind.
5. What are periodic winds?
6. What are local winds? Name any two local winds.
7. Name two types of variable winds. Why are they so called?
8. Why are cyclones frequent in summer in the tropical region?
9. Mention any two differences between Tropical Cyclones and Temperate Cyclones.
10. How are cyclones named differently in different parts of the world?
11. What are two chief characteristics of anticyclones?

III. Define the following terms:

(a) Pressure Gradient. (b) Winds. (c) Coriolis force.
(d) Altitude. (e) Monsoons.

IV. Distinguish between the following:

1. Cyclones and Anticyclones.
2. Permanent and Periodic Winds.
3. Summer and Winter Monsoons.

V. Structured Questions

1. (a) What is meant by the term 'Atmospheric Pressure'?
   (b) Explain briefly the factors that affect Atmospheric Pressure.
   (c) Give a geographical reason for each of the following:
      (i) The Westerlies in the Southern Hemisphere blow with greater force than those in the Northern Hemisphere.
      (ii) There is a seasonal shifting in pressure belts.
      (iii) As we go higher, the atmospheric pressure decreases.
   (d) Draw a well labelled diagram showing the pressure and wind belts of the earth.
2. (a) Briefly explain the three chief types of winds.
   (b) Describe some of the important types of local winds.
   (c) Give a geographical reason for each of the following:
      (i) The winds are directed to the right of their flow in the Northern Hemisphere.
      (ii) Temperature and pressure are inversely related to one another.
      (iii) Humid air is lighter than dry air.
   (d) What is Coriolis Effect? How does it affect the planetary winds?
3. (a) Explain the weather conditions associated with tropical and temperate cyclones.
   (b) What are the Jet Streams? What is the significance of the Jet Streams?
   (c) Give a geographical reason for each of the following:
      (i) Doldrums is a low pressure belt.
      (ii) Equatorial regions have low atmospheric pressure throughout the year.
      (iii) Low atmospheric pressure prevails over the Circum-polar region.
   (d) Draw a well labelled diagram showing a cyclone in the Northern Hemisphere.

VI. Thinking Skills

1. State two situations when you physically felt the effect of the atmospheric pressure. Give reasons to support your answer.
2. You must have read in newspapers or seen on TV channels, the news of cyclonic storms like Amphan, Nisarga, Fani, Yaas, Tauktae, Gulab, etc. affecting different parts of the country. Find out the origin and effects of atleast three of these cyclonic storms.

VII. Project Work

In 2019, the Arabian Sea recorded the formation of four cyclones, Vayu, Hikka, Kyarr and Maha – a phenomenon after more than a century. Formation of cyclonic storms is normal in the Arabian Sea but rare if it develops in October-November. Usually the Bay of Bengal sees cyclones during this period. Prepare a project report tracing cyclonic storms that occurred along the eastern coast as well as the western coast of India over last ten years.

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