



## **INSOLATION AND TEMPERATURE**

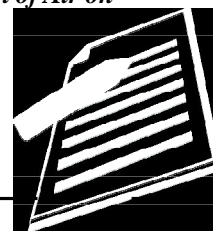
In the previous lesson we have studied that the air surrounding the earth is called the atmosphere. The atmosphere is made up of different types of gasses, water vapour and dust particles. Atmosphere is essential for survival of plant and animal life. They also require optimum temperature to keep themselves warm and grow. Have you ever thought what is the source of heat and energy received on the surface of the earth? Why does earth's surface get warm during the day and cool down during the night? Let us find answer to all these and other related questions in this lesson.



### **OBJECTIVES**

After studying this lesson, you will be able to :

- explain the importance of insolation and establish relationship between angle of incidence of sun's rays and the intensity of heat received from them at a place;
- explain the different processes involved in heating and cooling of the atmosphere (conduction, convection, radiation and advection);
- explain the heat budget with the help of a diagram;
- differentiate between solar radiation and terrestrial radiation;
- explain the causes of global warming and its effects ;
- explain the various factors affecting the horizontal distribution of temperature;
- explain with the help of map, the main characteristics of temperature distribution in the world in the month of January and July;
- explain the conditions in which inversion of temperature occurs.



### 10.1 INSOLATION (Solar Radiation)

The sun is the primary source of energy on the earth. This energy is radiated in all directions into space through short waves. This is known as solar radiation.

Only two billionths or (two units of energy out of 1,00,00,00,000 units of energy radiated by the sun) of the total solar radiation reaches the earth's surface. This small proportion of solar radiation is of great importance, as it is the only major source of energy on the earth for most of the physical and biological phenomena.

Incoming solar radiation through short waves is termed as insolation. The amount of insolation received on the earth's surface is far less than that is radiated from the sun because of the small size of the earth and its distance from the sun. Moreover water vapour, dust particles, ozone and other gases present in the atmosphere absorb a small amount of insolation.

- Sun is the primary source of energy on earth.
- Insolation is the incoming solar radiation.

#### (a) Factors influencing Insolation

The amount of insolation received on the earth's surface is not uniform everywhere. It varies from place to place and from time to time. The tropical zone receive the maximum annual insolation. It gradually decreases towards the poles. Insolation is more in summers and less in winters.

The following factors influence the amount of insolation received.

- (i) The angle of incidence.
  - (ii) Duration of the day. (daily sunlight period)
  - (iii) Transparency of the atmosphere.
- (i) **The Angle of Incidence :** Since the earth is round, the sun's rays strike the surface at different angles at different places. The angle formed by the sun's ray with the tangent of the earth's circle at a point is called angle of incidence. It influences the insolation in two ways. First, when the sun is almost overhead, the rays of the sun are vertical. The angle of incidence is large hence, they are concentrated in a smaller area, giving more amount of insolation at that place. If the sun's rays are oblique, angle of incidence is small and sun's rays have to heat up a greater area, resulting in less amount of insolation received there. Secondly, the sun's rays with small angle, traverse more of the atmosphere, than rays striking at a large angle. Longer the path of sun's rays, greater is the amount of reflection and absorption of heat by atmosphere. As a result the intensity of insolation at a place is less. (see fig. 10.1)

The domain of Air on the Earth

Notes

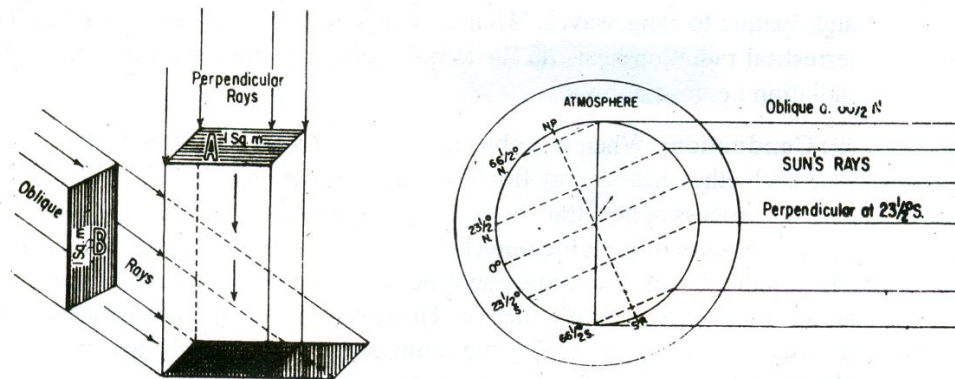


Fig. 10.1 : Effect of Angle of Incidence on Insolation

- (ii) **Duration of the day :** Duration of the day varies from place to place and season to season. It decides the amount of insolation received on earth's surface. The longer the duration of the day, the greater is the amount of insolation received. Conversely shorter the duration of the day leads to receipt of less insolation.
- (iii) **Transparency of the atmosphere:** Transparency of the atmosphere also determines the amount of insolation reaching the earth's surface. The transparency depends upon cloud cover, its thickness, dust particles and water vapour, as they reflect, absorb or transmit insolation. Thick clouds hinder the insolation to reach the earth while clear sky helps it to reach the surface. Water vapour absorb insolation, resulting in less amount of insolation reaching the surface.

- Amount of insolation at a place depends upon angle of incidence, duration of the day and transparency of the atmosphere.

## (b) Heating and cooling of the Atmosphere

Sun is the ultimate source of atmospheric heat and energy, but its effect is not direct. For example, as we climb a mountain or ascend in the atmosphere, temperature become steadily lower, rather than higher, as we might expect. This is because the mechanism of heating the atmosphere is not simple. There are four heating processes directly responsible for heating the atmosphere. They are : (i) Radiation (ii) Conduction (iii) Convection and (iv) Advection.

- (i) **Radiation :** Radiation is the process by which solar energy reaches the earth and the earth loses energy to outer space. When the source of heat transmits heat directly to an object through heat waves, it is known as radiation process. In this process, heat travels through the empty space. The vast amount of heat energy coming to and leaving the earth is in the form of radiation. The following facts about radiation are worth noting.

- (i) All objects whether hot or cold emit radiant energy continuously.
- (ii) Hotter objects radiate more energy per unit area than colder objects.
- (iii) Temperature of an object determines the waves length of radiation. Temperature and wave length are inversely related. Hotter the object shorter is the length of the wave.
- (iv) Insolation reaches the earth's surface in short waves and heat is radiated from the earth in long waves.

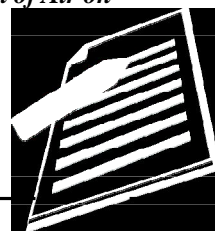
You will be amused to know that atmosphere is transparent to short waves and opaque to long waves. Hence energy leaving the earth's surface i.e. terrestrial radiation heats up the atmosphere more than the incoming solar radiation i.e. insolation.

- (ii) **Conduction:** When two objects of unequal temperature come in contact with each other, heat energy flow from the warmer object to the cooler object and this process of heat transfer is known as conduction. The flow continues till temperature of both the objects becomes equal or the contact is broken. The conduction in the atmosphere occurs at zone of contact between the atmosphere and the earth's surface. However, this is a minor method of heat transfer in terms of warming the atmosphere since it only affects the air close to the earth's surface.
- (iii) **Convection:** Transfer of heat by movement of a mass or substance from one place to another, generally vertical, is called convection. The air of the lower layers of the atmosphere get heated either by the earth's radiation or by conduction. The heating of the air leads to its expansion. Its density decreases and it moves upwards. Continuous ascent of heated air creates vacuum in the lower layers of the atmosphere. As a consequence, cooler air comes down to fill the vacuum, leading to convection. The cyclic movement associated with the convectonal process in the atmosphere transfer heat from the lower layer to the upper layer and heats up the atmosphere.
- (iv) **Advection:** Winds carry the temperature of one place to another. The temperature of a place will rise if it lies on the path of winds coming from warmer regions. The temperature will fall if the place lies on the path of the winds blowing from cold regions. This process of horizontal transport of heat by winds is known as advection.



### INTEXT QUESTION 10.1

1. Answer the following questions in one or two words:
  - (a) By which process heat energy travels from the sun to the earth?





- (b) What part of solar radiation is received by the earth's surface?
- (c) Name the process in which heat is transferred by winds.
- (d) Name the three factors influencing the amount of insolation received at a place.
- (i)\_\_\_\_\_ (ii)\_\_\_\_\_ (iii)\_\_\_\_\_
2. Select correct alternative for each of the following and mark (✓) on it.
- (a) Insolation comes to the earth's surface in  
(i) short waves, (ii) long waves, (iii) both of them, (iv) none of them
- (b) Atmosphere is heated by  
(i) insolation, (ii) heat radiation from the earth, (iii) both of them, (iv) none of them.
- (c) Even after the sunset the air near the earth's surface continues to receive heat by-  
(i) insolation, (ii) terrestrial radiation, (iii) conduction, (iv) convection

### 10.2 HEAT BUDGET

The insolation is made up of energy transmitted directly through the atmosphere and scattered energy. Insolation is the amount of solar radiation that reaches the earth's surface through shortwaves. The earth also radiates heat energy like all other hot object. This is known as terrestrial radiation. The annual mean temperature on the surface of the earth is always constant. It has been possible because of the balance between insolation and terrestrial radiation. This balance is termed as a heat budget of the earth.

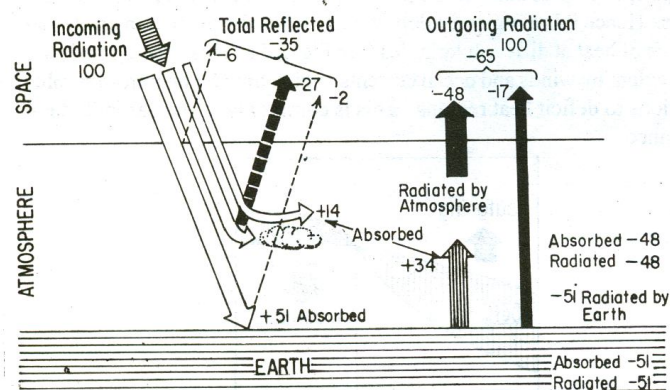
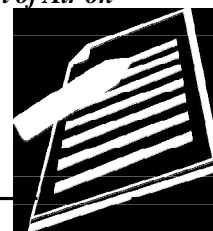


Fig. 10.2 : Heat Budget (balance between insolation and terrestrial radiation)



Let us suppose that the total heat (incoming solar radiation) received at the top of the atmosphere is 100 units (see fig. 10.2) Roughly 35 units of it are reflected back into space even before reaching the surface of the earth. Out of these 35 units, 6 units are reflected back to space from the top of the atmosphere, 27 units reflected by clouds and 2 units from the snow and ice covered surfaces.

Out of the remaining 65 units (100-35), only 51 units reach the earth's surface and 14 units are absorbed by the various gases, dust particles and water vapour of the atmosphere.

The earth in turn radiates back 51 units in the form of terrestrial radiation. Out of these 51 units of terrestrial radiation, 34 units are absorbed by the atmosphere and the remaining 17 units directly go to space. The atmosphere also radiates 48 units (14 units of incoming radiation and 34 units of outgoing radiation absorbed by it) back to space. Thus 65 units of solar radiation entering the atmosphere are reflected back into the space. This account of incoming and outgoing radiation always maintains the balance of heat on the surface of the earth.

- Heat budget is the balance between insolation (incoming solar radiation) and terrestrial radiation.

Although the earth as a whole, maintains balance between incoming solar radiation and outgoing terrestrial radiation. But this is not true what we observe at different latitudes. As previously discussed, the amount of insolation received is directly related to latitudes. In the tropical region the amount of insolation is higher than the amount of terrestrial radiation. Hence it is a region of surplus heat. In the polar regions the heat gain is less than the heat loss. Hence it is a region of deficit heat. Thus the insolation creates an imbalance of heat at different latitudes (see Fig. 10.3 This is being nullified to some extent by winds and ocean currents, which transfer heat from surplus heat regions to deficit heat regions. This is commonly known as latitudinal heat balance.

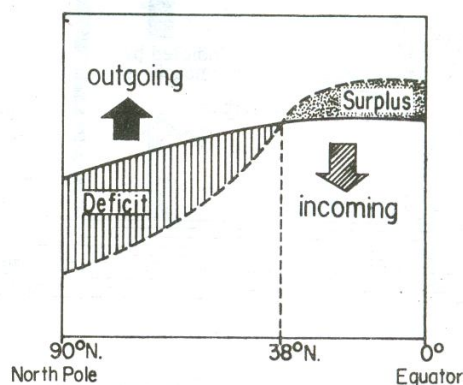


Fig. 10.3 Latitudinal Heat Balance




**Notes**

### 10.3 GLOBAL WARMING

Global warming is one of the major environmental problem our earth is facing. Scientist see its close association with depletion of Stratospheric ozone layer and increase in atmospheric carbon dioxide.

As you know that the upper portion of the stratosphere contains a layer of ozone gas. Ozone is capable of absorbing a large amount of sun's ultraviolet radiation thus preventing it from reaching the earth's surface. Scientist have realised that the thickness of the ozone layer is reducing. This is disturbing the balance of gases in the atmosphere and increasing the amount of ultraviolet radiation reaching the earth. Ultraviolet radiation is responsible for increasing the global temperature of the earth's surface besides it can severely burn human being's skin, increase the incidence of skin cancer, destroy certain microscopic forms of life and damage plants. There is a gradual increase in the carbon dioxide content of the atmosphere. It is estimated that the carbon dioxide content of the atmosphere has increased 25 per cent in the last hundred years. Carbon dioxide allows insolation to pass through but absorbs terrestrial radiation. Increase of carbon dioxide in the atmosphere has the effect of raising the atmospheric temperature. It is estimated that the temperature of atmosphere has increased by about  $0.5^{\circ}\text{C}$  in the last 1000 years. Large scale deforestation, fossil fuel burning, burning of garbages, combustion processes in factories and volcanic eruptions are some of the factors responsible for the increase of carbon dioxide in the atmosphere.

If the depletion of ozone layer and the increase in the carbon dioxide content continue, the time would come when the temperature of the atmosphere will rise to the extent that it would melt polar ice caps, increasing the sea level and causing submergence of coastal regions and islands. The phenomenon of world wide increase of atmospheric temperature due to depletion of ozone layer and the increase of carbon dioxide content is known as global warming.

- Latitudinal heat balance is the transfer of heat from lower to higher latitudes by winds and ocean currents to counter the imbalance created by insolation at different latitudes.
- Global warming is the world - wide increase of atmospheric temperature due to depletion of ozone layer and in the increase of carbon dioxide content.



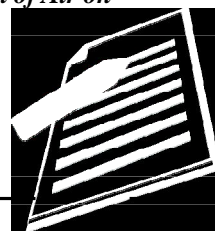
#### **INTEXT QUESTIONS 10.2**

1. Define the following terms:

(a) Heat Budget:

---

(b) Latitudinal Heat Balance:



(c) Global Warming

2. Answer the following questions very briefly:

(a) What percentage of insolation is received by the earth?

(b) What part of the incoming solar radiation is reflected back to space from the top of the atmosphere?

(c) Name the regions of surplus heat

(d) Which is the region of deficit heat?

## 10.4 TEMPERATURE AND ITS DISTRIBUTION

Temperature indicates the relative degree of heat of a substance. Heat is the energy which make things or objects hot, while temperature measures the intensity of heat. Although quite distinct from each other, yet heat and temperature are closely related because gain or loss of heat is necessary to raise or lower the temperature. The celsius scale, named after the swedish astronomer. Anders Celsius, is accepted internationally by Scientists for reporting air temperature. The historical temperature records of several English-speaking countries include values on the Fahrenheit scale, Fahrenheit temperatures may be converted to their celsius equivalents by the formula

$C = \frac{5}{9}(F - 32)$ . Moreover, difference in temperature determines the direction of flow of heat. This we can understand by studying temperature distribution.

Distribution of temperature varies both horizontally and vertically. Let us study it under:

(a) The horizontal distribution of temperature

(b) The vertical distribution of temperature

**(a) Horizontal Distribution of Temperature**

Distribution of temperature across the latitudes over the surface of the earth is called its horizontal distribution. On maps, the horizontal distribution of





temperature is commonly shown by “Isotherms”, lines connecting points that have equal temperatures. An isotherm is made of two words ‘iso’ and ‘therm’, ‘Iso’ means equal and ‘therm’ means “temperature. If you study an isotherm map you will find that the distribution of temperature is uneven.

The factors responsible for the uneven distribution of temperature are as follows:

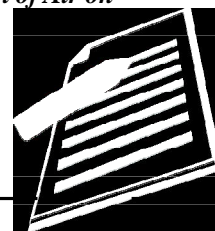
- (i) Latitude
- (ii) Land and Sea Contrast
- (iii) Relief and Altitude
- (iv) Ocean Currents
- (v) Winds
- (vi) Vegetation Cover
- (vii) Nature of the soil
- (viii) Slope and Aspect

(i) **Latitude :** You have already studied under ‘insolation’ that the angle of incidence goes on decreasing from equator towards poles (fig. 10.1). Higher the angle of incidence, higher is the temperature. Lower angle of incidence leads to the lowering of temperature. It is because of this that higher temperatures are found in tropical regions and they generally decrease at a considerable rate towards the poles. Temperature is below freezing point near the poles almost throughout the year.

(ii) **Land and Sea Contrast:** Land and sea contrast affects temperature to a great extent. Land gets heated more rapidly and to a greater degree than water during sunshine. It also cools down more rapidly than water during night. Hence, temperature is relatively higher on land during day time and it is higher in water during night. In the same way there are seasonal contrasts in temperature. During summer the air above land has higher temperature than the oceans. But the air above oceans gets higher temperature than landmasses in winter.

Notwithstanding the great contrast between land and water surfaces, there are differences in the rate of heating of different land surfaces. A snow covered land as in polar areas warms very slowly because of the large amount of reflection of solar energy. A vegetation covered land does not get excessively heated because a great amount of insolation is used in evaporating water from the plants.

(iii) **Relief and Altitude:** Relief features such as mountains, plateaus and plains control the temperature by way of modifying its distribution.



Mountains act as barriers against the movement of winds. The Himalayan ranges prevent cold winds of Central Asia from entering India, during winter. Because of this Kolkata is not as cold as Guangzhou (Canton) in winter though both are situated almost on the same latitude. (fig. 10.4).

As we move upwards from sea level, we experience gradual decrease in temperature. Temperature decreases at an average rate of  $6^{\circ}\text{C}$  per 1000 m. altitude. It is known as normal lapse rate. The air at lower elevations is warmer than that of higher elevations because it is closest to the heated surface of the earth. As a result mountains are cooler than the plains even during summers (see fig.10.4). It is worth remembering that the rate of decrease of temperature with altitude varies with time of day, season and location.

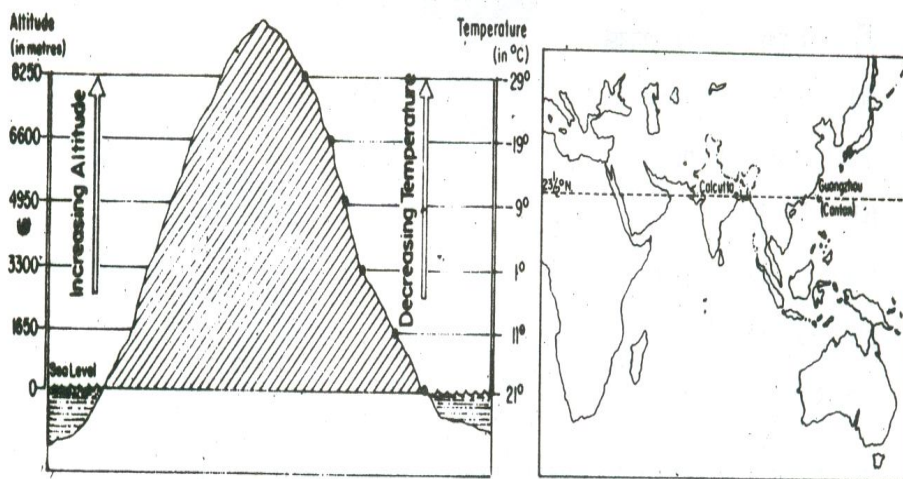


Fig. 10.4 Effect of Altitude on Temperature

Quito and Guayaquil are two cities of Ecuador (South America) situated near the equator and relatively close to each other. Quito is at 2800 metres. high from mean sea level while Guayaquil is just at 12 metres altitude. However because of difference in altitude. Quito experiences annual mean temperature of  $13.3^{\circ}\text{C}$  while in Guayaquil it is  $25.5^{\circ}\text{C}$ .

- (iv) **Ocean Currents:** Ocean currents are of two types - warm and cold. Warm currents make the coasts along which they flow warmer, while cold currents reduce the temperature of the coasts along which they flow. The North-Western European Coasts do not freeze in winter due to the effect of North Atlantic Drift (a warm current), while the Quebec on the coast of Canada is frozen due to the Cold Labrador Current flowing along it, though the Quebec is situated in lower latitudes than the North-West European Coast (see fig.10.5).

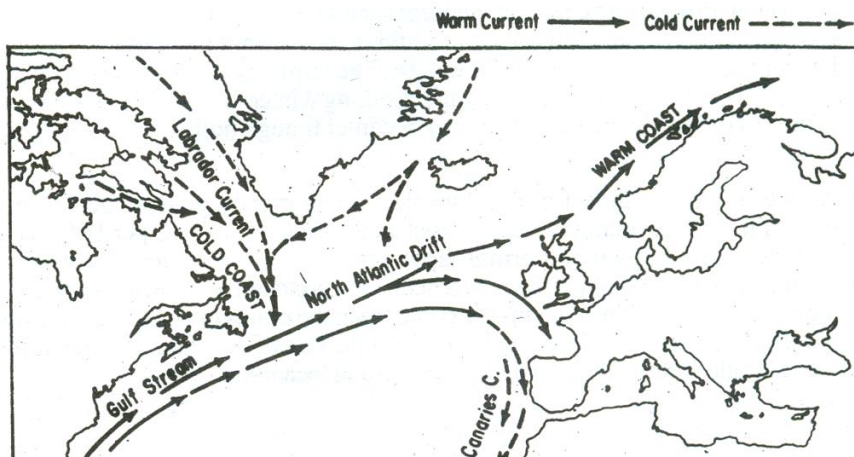


Fig. 10.5 Effect of Warm and Cold Ocean Current

- (iii) **Winds :** Winds also affect temperature because they transport heat from one region to the other, about which you have already studied under advection.
- (vi) **Vegetation Cover:** Soil devoid of vegetation cover receives heat more rapidly than the soil under vegetation cover. Because vegetation cover absorbs much of sun's heat and then prevents quick radiation from the earth whereas the former radiates it more rapidly. Hence the temperature variations in dense forested areas are lower than those in desert areas. For example annual range of temperature in equatorial regions is about  $5^{\circ}\text{C}$  while in hot deserts, it is as high as  $38^{\circ}\text{C}$ .
- (vii) **Nature of the Soil:** Colour, texture and structure of soils modify temperature to a great degree. Black, yellow and clayey soils absorb more heat than sandy soils. Likewise heat radiates more rapidly from sandy soils than from black, yellow and clayey soils. Hence temperature contrasts are relatively less in black soil areas than those of sandy soils.
- (viii) **Slope and Aspect :** Angle of the slope and its direction control the receipt of insolation. The angle of incidence of sun's rays is greater along a gentler slope and smaller along a steeper slope. The ray in both the cases carry an equal amount of solar energy. Greater concentration of solar energy per unit area along gentler slope raises the temperature while its lesser concentration along steeper slopes lowers the temperature. For such reasons, the southern slopes of the Himalaya are warmer than the northern ones. At the same time the slopes, in terms of aspect, exposed to the sun receive more insolation and are warmer than those which are away from the direct rays of the sun. The northern slopes of the Himalaya for example, not facing the sun are exposed to cold northerly winds are obviously colder. On the other hand the southern slopes of the Himalaya are sun-facing and are also shelter from the northerly cold winds are warmer. Hence we observe

settlements and cultivation largely on the southern slopes of the Himalaya while the northern slopes are more under forest area.

- Latitude, land and sea contrast, relief and altitude, oceans currents, winds, vegetation cover, nature of soil, slope and aspect control the distribution of temperature in the world.

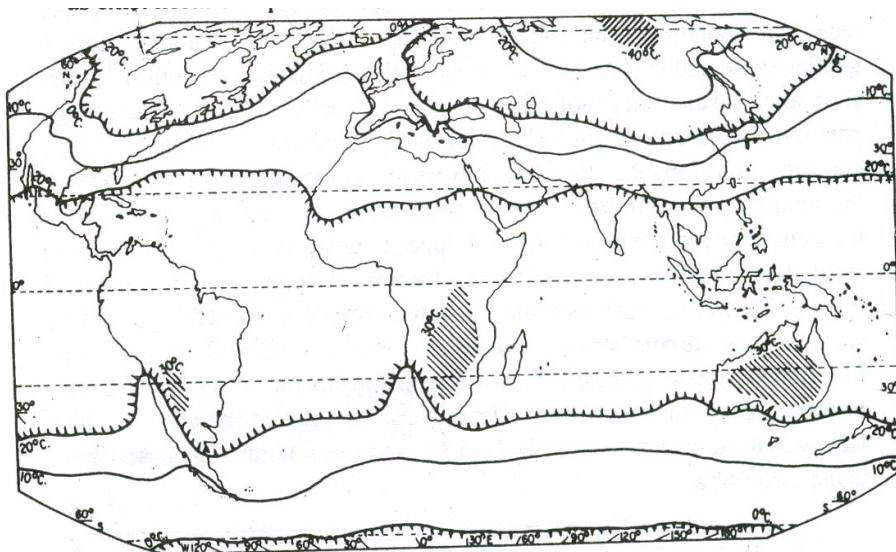
The horizontal distribution of temperature over the globe can be studied easily from the maps of January and July months, since the seasonal extremes of high and low temperature are most obvious in both northern and southern hemispheres during these months.

### (I) Horizontal Distribution of Temperature in January

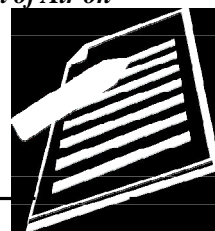
In January, the sun shines vertically overhead near the Tropic of Capricorn. Hence it is summer in southern hemisphere and winter in northern hemisphere. High temperature is found over the landmasses mainly in three regions of the southern hemisphere. These regions are North-west Argentina, East, Central Africa, and, Central Australia. Isotherm of 30°C closes them. In northern hemisphere landmass are cooler than oceans. During this time North-east Asia experiences lowest temperatures. (see fig. 10.6)

As the air is warmer over oceans than over landmasses in the northern hemisphere, the Isotherms bend towards poles when they cross the oceans. In southern hemisphere, the position of the isotherms is just reverse. They bend towards poles when they cross the landmasses and towards equator when they cross oceans.

Large expanse of water exists in southern hemisphere. Hence, isotherms are regular and widely spaced in the southern hemisphere. While they are irregular and closely spaced in northern hemisphere due to large expanse of landmasses. For these reasons no extreme seasonal contrasts between land and water are found in middle and higher latitudes in the southern hemisphere as they exist north of equator.



**GEOGRAPHY** Fig. 10.6 Horizontal Distribution of Temperature (January)





The domain of Air on the Earth



Notes

## (II) Horizontal Distribution of Temperature in July

During this period the sun shines vertically overhead near the Tropic of Cancer. Hence, high temperatures are found in the entire northern hemisphere. Isotherm of 30°C passes between 10° N and 40° N latitudes. The regions having this temperature include South Western USA, the Sahara, the Arabia, Iraq, Iran, Afghanistan, desert region of India and China. However, lowest temperature of 0°C is also noticed in the Northern Hemisphere during summer in the central part of Greenland (see fig. 10.7)

During summer in the northern hemisphere, isotherms bend equatorward while crossing oceans and polewards while crossing landmasses. In southern Hemisphere the position of isotherms is just opposite.

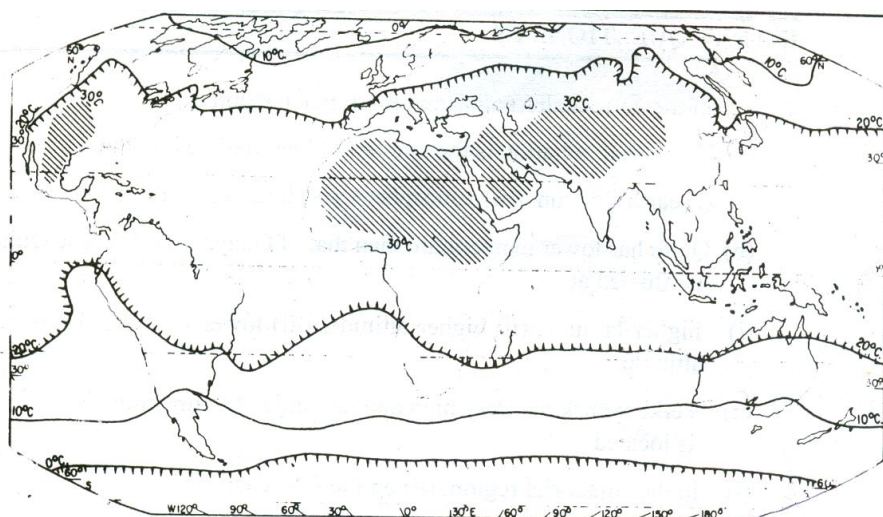


Fig. 10.7 Horizontal Distribution of Temperature (July)

Isotherms are wide spaced over oceans while they are closely spaced over landmasses.

A comparison between the January and July isotherm maps reveals the following important characteristics.

The latitudinal shifting of highest temperature as a result of migration of the vertical rays of the sun.

The occurrence of highest values in the low latitudes and the lowest value in the high latitudes is due to the decreasing insolation from equator to the poles.

In northern hemisphere the isotherms on leaving the land usually bend rather sharply towards poles in winter and towards the equator in the summer. This behaviour of the isotherms is due to the differential heating and cooling of landmasses. The continents are hotter in the summer and colder in the winter than the oceans.

Difference between the average temperatures of warmest and the coldest months is known as annual range of temperature. Annual range of temperature is larger in the interior parts of the continents in middle and high latitudes of the northern hemisphere. Verkhoyansk in Siberia records  $66^{\circ}\text{C}$  the highest annual range of temperature in the world. Its lowest average winter temperature is  $-50^{\circ}\text{C}$ . Hence it is aptly called 'cold pole' of the earth.

- The difference between average temperature of the warmest and the coolest months is known as annual range of temperature.



### INTEXT QUESTIONS 10.3

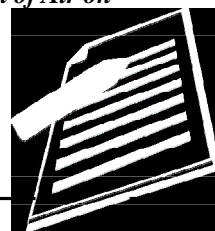
1. Select the correct alternative and mark tick ( $\checkmark$ ) on it:
  - (a) Terrestrial radiation is the amount of heat radiated by the  
(i) earth, (ii) sun, (iii) atmosphere, (iv) hydrosphere
  - (b) Quito has lower temperature than that of Guayanquil because Quito is situated at  
(i) higher latitude, (ii) higher altitude, (iii) lower latitude, (iv) lower altitude.
  - (c) Verkhoyansk has very high annual range of temperature because it is located  
(i) in the equatorial region, (ii) on the sea coast, (iii) in the interior parts of Asia (iv) on mountain
2. Give a geographical term for each of the following statements:
  - (a) The process of horizontal transport of heat by winds.  
\_\_\_\_\_
  - (b) Imaginary lines on a map joining the places of equal temperature, reduced to sea level.  
\_\_\_\_\_
  - (c) Difference between the mean temperatures of the hottest and that of the coldest month.  
\_\_\_\_\_

### (b) Vertical Distribution of Temperature

The permanent snow on high mountains, even in the tropics, indicate the decrease of temperature with altitude. Observations reveals that there is a fairly regular decrease in temperature with an increase in altitude. The average

## MODULE - 4

*The domain of Air on the Earth*



Notes



rate of temperature decrease upward in the troposphere is about  $6^{\circ}\text{C}$  per km, extending to the tropopause. This vertical gradient of temperature is commonly referred to as the standard atmosphere or normal lapse rate, but it varies with height, season, latitude and other factors. Indeed the actual lapse rate of temperature does not always show a decrease with altitude.

### (c) Inversion of Temperature

Long winter night, clear sky, dry air and absence of winds leads to quick radiation of heat from the earth's surface, as well as from the lower layers of the atmosphere. This results in the cooling of the air near the earth's surface. The upper layers which lose their heat not so quickly are comparatively warm. Hence the normal condition in which temperature decreases with increasing height, is reversed. The cooler air is nearer the earth and the warmer air is aloft. In other words, temperature increases with increasing height temporarily or locally. This phenomenon is termed as inversion of temperature. Sometimes the cold and dense air remains near the surface for number of days. So the phenomenon of inversion of temperature is also seen for days together.

The phenomenon of inversion of temperature is especially observed in intermontane valleys. During winters the mountain slopes cool very rapidly due to the quick radiation of heat. The air resting above them also becomes cold and its density increases. Hence, it moves down the slopes and settles down in the valleys. This air pushes the comparatively warmer air of valleys upwards and leads to the phenomenon of inversion of temperature. Sometimes the temperature falls below freezing point in the valleys leading even to the occurrence of frost. In contrast, the higher slopes remain comparatively warmer. That is why mulberry planters of the Suwa Basin of Japan and the apple growers of Himachal Pradesh avoid the lower slopes of the mountains to escape winters frost. If you have been to any hill station you would have seen that most of the holiday resorts and the houses of affluent persons are built on the upper slopes.

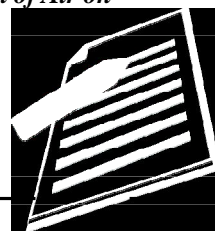
- Temperature usually decreases with increasing altitude.
- The normal lapse rate is  $6^{\circ}\text{C}$  per 1000m metres ascend.
- The phenomenon in which temperature increases with increasing altitude temporarily and locally under certain conditions is known as inversion of temperature.



### INTEXT QUESTIONS 10.4

1. Select the correct alternative for each of the following and mark tick ( ) on it:





- (a) Temperatures decrease with increase in -
    - (i) altitude, (ii) depth, (iii) pressure, (iv) both altitude and depth
  - (b) The normal lapse rate is 6°C per
    - (i) 561 metres, (ii) 1000 m, (iii) 651 metres (iv) 156 metres
  - (c) The phenomenon in which temperature increases with increasing altitude is known as
    - (i) temperature anomaly, (ii) inversion of temperature, (iii) lapse rate, (iv) insolation
2. Tick (✓) the true statements and cross (x) on the false ones
- (a) Cold air is light.
  - (b) Cold air is dense.
  - (c) Clear sky dry air and absence of winds causes rapid radiation leading to the phenomenon of inversion of temperature.
  - (d) Inversion of temperature occurs very frequently in plain
  - (e) Apple growers of the Himachal Pradesh avoid lower slopes
  - (f) The cool and dense air sliding down the mountain slopes pushes the comparatively warm and light air of valleys of words.
  - (g) Inversion of temperature occurs locally and temporarily.

**WHAT YOU HAVE LEARNT**

Sun is the primary source of energy on earth. Sun's energy reaching the earth in short waves is called insolation. The amount of insolation depends upon angle of incidence, duration of the day and transparency of the atmosphere. The processes involved in the heating and cooling of the atmosphere are radiation, conduction, convection and advection. Radiation predominates other three processes. Terrestrial radiation is the amount of heat radiated back from the earth. There is a balance between the receipt of insolation and the terrestrial radiation on earth's surface. It is known as heat budget. Global warming is the world wide increase of atmospheric temperature due to depletion of ozone layer and increase in carbon dioxide

Temperature measures the intensity of heat. Distribution of temperature varies both horizontally and vertically. Certain factors control its distribution. They are latitude, land and water contrast, winds, ocean currents, altitude and aspect of slope. Horizontal distribution of temperature is shown on a map with the help of isotherms, the imaginary lines joining places of equal temperature.

*The domain of Air on  
the Earth*



Notes

Temperature also decreases with increasing altitude. The rate at which it decreases in normal conditions is known as normal lapse of temperature. It is  $6^{\circ}\text{C}$  per 1000m of height. The phenomenon of inversion of temperature occurs when temperature increases with increase in height: It is generally local and temporary in character.



## TERMINAL QUESTIONS

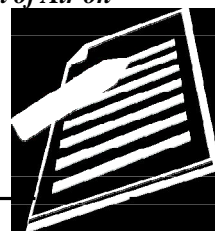
1. Answer the following questions at the most in one sentence:
  - (a) What is meant by normal lapse rate?
  - (b) What is insolation?
  - (c) Define terrestrial radiation.
  - (d) At which rate does temperature decrease with increase in altitude?
2. Write in about 50 words on each of the following
  - (a) Distribution of temperature in the world in January
  - (b) Heat Budget
  - (c) Comparison between. January & July isotherms.
  - (d) Latitudinal heat balance.
3. Describe the factors that influence the horizontal distribution of temperature.
4. Mark and label the following on an outline map of world.
  - (a)  $30^{\circ}\text{C}$  isotherm in July
  - (b) Verkhoyansk
  - (c) The Sahara
  - (d) Borneo island
5. Why do different parallel of latitude receive different amount of insolation?
6. Draw a diagram to explain the heat budget of the earth.



## ANSWER TO INTEXT QUESTIONS

### 10.1

1. (a) Radiation (b) Two billionths part (c) Advection (d) (i) Angle of incidence, (ii) Duration of the day and (iii) Transparency of the atmosphere



2. (a) short waves (b) heat radiation from the earth (c) terrestrial radiation

**10.2**

1. (a) see 10.2 (b) see 10.2 (c) see 10.3  
2. (a) 51% (b) 6% (c) Tropical Region (d) Polar region

**10.3**

1. (a) earth (b) higher altitude (c) in the interior parts of Asia  
3. (a) Advection (b) Isotherms (c) Annual range of temperature

**10.4**

1. (a) altitude (b) 1000 metres (c) inversion of temperature  
2. (a) False, (b) True, (c) True, (d) False', (e) True, (f) True, (g) True

**HINTS TO TERMINAL QUESTIONS**

1. (a) The normal rate at which temperature decreases with increase in altitude.  
(b) The portion of solar radiation that reaches the surface of the earth.  
(c) Heat radiated from the earth's surface.  
(d) 6°C at every 1000 metres altitude.
2. (a) Please refer to para to 10.4 (a) (I)  
(b) Please refer to para 10.2  
(c) Please refer to para 10.4 (a) (II)  
(d) Please refer to para 10.2 (a)
3. Please refer to para 10.4 (a)
4. Please see maps of this lesson
5. Please see para 10.1 (i)
6. Please see Fig. 10.2