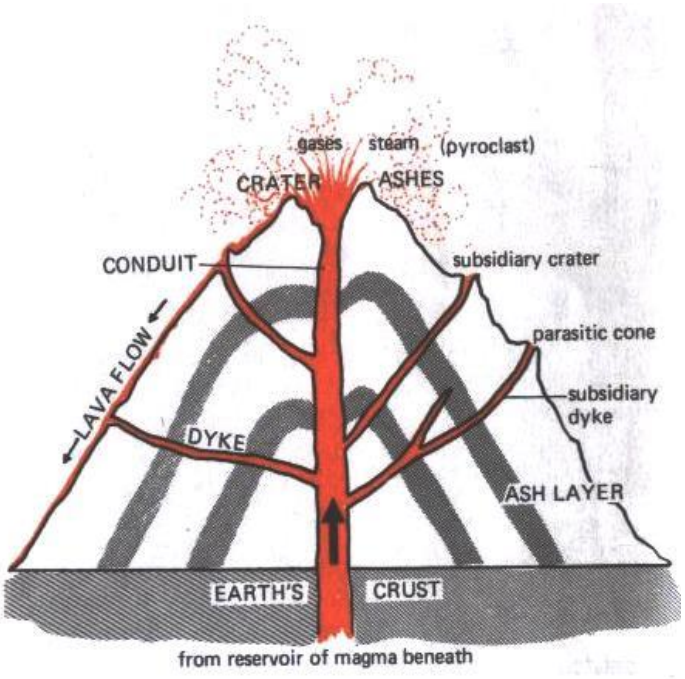
DISTINCTION IN GEOGRAPHY

NOTES FOR SENIOR SECONDARY
(GRADE 10-12)



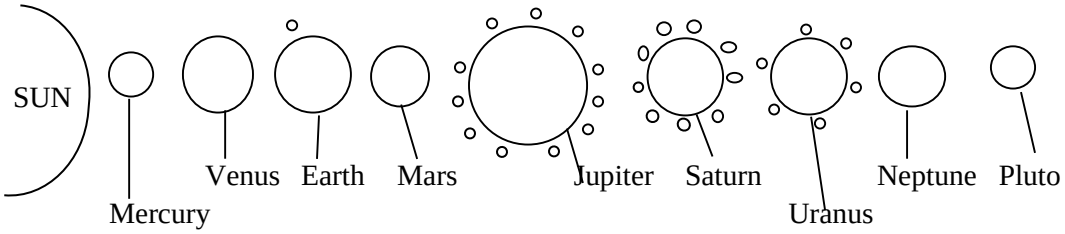
By. S Mulwanda

THE EARTH AND THE UNIVERSE

The universe comprises a lot of bodies; many of them are far much bigger than the Earth. These bodies include the stars. The larger stars have been estimated to be many millions of times the size of the Earth. The stars are not scattered regularly in space; they occur in clusters, better described as galaxies or nebulas. The Earth's own galaxy is called the Milky Way and contains about 100 000 million stars.

The stars appear small because they are very far away. The light from the nearest star travelling at the speed of light (i.e. 299 400 kilometers /186, 000 miles per second) takes something like four years to reach as.

The Solar System



The solar system comprises the sun and its nine planets which are believed to have been developed from the condensation of gases and other lesser bodies. All the planets revolve round the sun in **Elliptical Obits**. Like the Earth, the planets shine by reflection light of the sun.

ORDER OF PLANETS

1. **Mercury** – the smallest and nearest planet to the sun. It is about 579 000 000 km away. Its revolution around the sun is 88 days, which is the length of a year in mercury. The planet has a dense atmosphere of heavy inner gases it has no satellite or moon.
2. **Venus** – it is twice the distance of mercury away from the sun, it is the next closest planet. Venus is often considered as Earth's twine because of their close proximity in size, mass (weight) and density. It is a hot planet and has a dense atmosphere of carbon dioxide.
3. **Earth** – it has an atmosphere consisting of a mixture of gases. Its surface temperature ranges from -50^{o} to $+50^{o}$. Life is possible on this planet. The Earth has 1 natural moon or satellite that revolves eastwards around the Earth once in every 28 days. The Earth takes $365^{1}/_{4}$ days to revolve around the sun. That is the length of the years on Earth.
4. **Mars** – it has a reddish appearance and dark parches on its surface. It is smaller than Earth but it is believed by most professional astronomers to be the next planet after Earth to have the possibility of some plant life. It has 2 moons. Scientific research is carried on so much on this planet.
5. **Jupiter** – it is the largest planet in the solar system. Its surface is made of many gases like hydrogen, helium and methane. It has 12 moons or satellites. It is very cold due to its distance away from the sun.
6. **Saturn** – it is the second largest planet. It has three rings and nine satellites around it. It is so far from the sun that it takes $29^{1}/_{2}$ years to complete its orbit.
7. **Uranus** – it was discovered in late 18^{th} century. It is another giant planet 50 times larger than Earth and 15 times as heavy. It has a greenish- bluish appearance. It is tilted at an angle of 88^{o} hence it rotates in a retrograde or backward manner. Unlike other planets, Uranus orbits around the sun in

a clockwise direction from east to west with five satellites revolving round it. It has a faint equatorial ring discovered in 1979.

8. **Neptune –** one of the newly discovered planets. Very little is known about it. It closely resembles Uranus but has 2 moons and is very cold and it has blue appearance.
9. **Pluto –** newly discovered. It takes 247 years to complete its orbit due to distance from the sun. When it is near the sun (perihelion) and when it is farthest from the sun (aphelion) the distance is 2766 million miles.

THE EARTH MOVEMENT

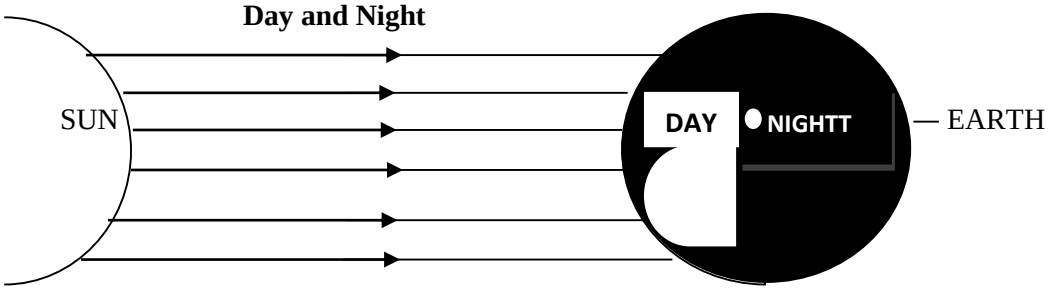
The Earth like all planets has two distinct movements. These are; - **rotation** and **revolution**

1. **ROTATION**

   The earth rotates once i.e. it rotates through 360º, in 24 hours. This means that it rotates through 15º in 1 hour or through 1 degree in 4 minutes. The rotation of the earth results in:

   1. **A difference of 1 hour between two meridians 15º apart.**
   2. **The deflection of winds and ocean currents**
   3. **The daily rising and falling of tides**
   4. **Day and night-** when the earth rotates on its axes only one position of it come into the rays of the sun and experiences daylight. The other position which is always from the sun's rays will be in darkness. As the earth rotates from west to east every part of the earth's surface will be brought under the sun at the same time or other. Apart from the earth surface that emerges from darkness into the sun's rays experience sunrise, later when it is gradually observed from the sun's beams it experiences **sunset**.

      The sun is in fact stationary and it is the earth which rotates. The illusion is exactly the same as when we travel in a fast moving train. The tress and houses around as appear to move and we feel that the train is stationary.



One part of the Earth emerges from darkness into daylight at sunrise when the Earth into the sun's rays.

REVOLUTION

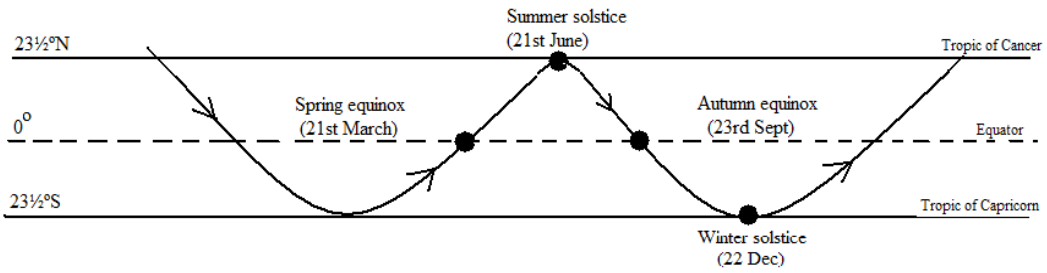
The earth takes 365¼ days to revolve once around the sun. Every fourth is given 366 days and this is called a leap year. All other years have 365 days. The earth's axis always points in the same direction in the sky i.e. toward the pole star. It is permanently tilted at an angle of 66½° to the earth's orbital plane. The revolution of the earth and the inclination of its axis results in:

1. Varying lengths of day and night at different times of the year- The axis of the Earth is inclined to the place of the sun at an angle of $66^1/_2$, giving rise to different seasons and varying lengths of day and night. If the axis were perpendicular to this plane, all parts of the globe would have equal days and nights at all times of the years. But we know this is not so. In the northern hemisphere winter (December) as we go northwards, the hours of darkness steadily increase. At the Arctic Circle ($66^1/_2$°N) the sun never rises and there is darkness for the whole day in mid winter on 22nd December. Beyond the Arctic Circle the number of days with complete darkness increases, until we reach the North Pole (90°N) when half the year will have darkness. At the Article the sun never 'sets' at midsummer (21st June) and there is a complete 24hour period of continuous daylight. In summer the region north of the Arctic Circle is popularly referred to as *land of the midnight sun.*

In the **southern hemisphere**, the same processes take place except that the conditions are reversed. When it is summer in the northern hemisphere, the southern hemisphere will experience winter. Midsummer at the North Pole will be midwinter at the South Pole.

2. The changes in the altitude of the midday sun at different times of the year- In the course of a year the earth's revolution round the sun with its axis inclined at $66^1/_2$ to the plane of the ecliptic changes the apparent altitude of the midday sun.
The sun is **vertically overhead at the equator** on two days each year. These are usually 21st March and 23rd September though the date changes because a year is not exactly 365 days. These two days are termed equinoxes meaning equal nights because on these two days all parts of the world have equal length of days and nights.

- On June 21st the sun is overhead at midday along the Tropic of cancer ($23^1/_2$N). These are called the **summer solstice**.
- On 22nd December the sun is overhead at midday along the tropic of Capricorn ($23^1/_2$S). This is called **winter solstice**.
- The tropics are the mark limits of the overhead sun. Beyond these (thus tropic of cancer and Capricorn) the sun is **never overhead**. Such regions have four distinct seasons like spring, summer, autumn and winter.
- Beyond the Article circle ($66^1/_2$N) and Antarctic Circle ($66^1/_2$S), where darkness lasts for 6 months and daylight is continuous for 6 months and it is always very cold.
- In the tropics days and nights are almost equal throughout the year.



A simplified diagram showing the annual movement of the sun and the causes of the seasons

3. **Seasonal changes and their effects on temperature**-Summer is usually associated with much heat and brightness and winter with cold and darkness. In summer the sun is higher in the sky than in winter. When the sun is over head its rays fall almost vertically on the earth, concentrating its heat on a small area;

temperature therefore rises and summers are always warm. In winter the oblique rays of the sun, come through the atmosphere and have much of their heat absorbed by atmospheric impurities and water vapour. The sun's rays fall faintly and spread over a great area. There is thus little heat and temperatures remain low.

Dawn and Twilight

The brief period between sunrise and full daylight is called **Dawn** and that between sunset and complete darkness is termed **Twilight**. This is caused by the fact that during the periods of dawn and twilight the earth receives **diffused** or **refracted light** from the sun whilst it is still below the horizon. Since the sun rises and sets in a vertical path at the equator the period during which refracted light is received is short. But in temperate latitudes, the sun rises and sets in an oblique path and the period of refracted light is longer. It is much longer still at the poles, so that the winter darkness is really only twilight most of the time.

Location of Places on the Earth

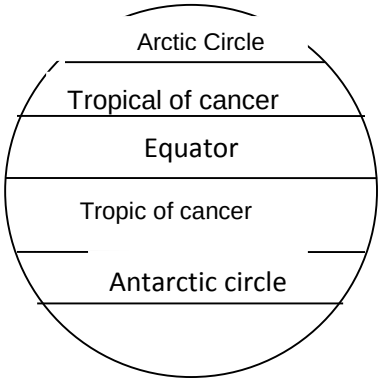
The earth's surface is so vast that unless 1mathematical methods are used, it is impossible to locate any place on it. For this reason imaginary lines have been drawn on the globe. One set of these lines running east to west and parallel to the equator are called **Latitudes**.

The other set runs north to south parallel to the prime meridian (0^o) pass through and meet at the poles called **Longitudes**.

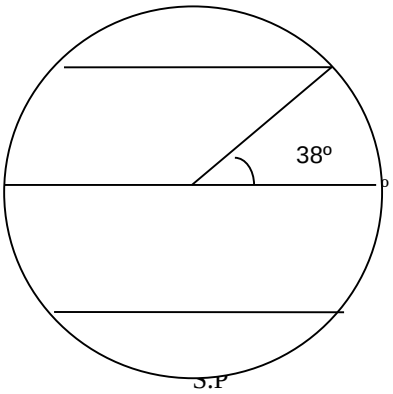
The intercession of longitude and latitude points any place on the earth's surface.

Latitudes

Latitude is the angular distance of a point on the earth's surface measured in degrees from the centre of the earth. It is **parallel** to a line the equator, which lies midway between the poles. These lines are therefore called **parallels of latitude** and on a globe are actually circles, becoming smaller pole wards. The equator represents 0^o and the north and south poles are 90^oN and 90^oS. Between these points lines of latitude are drawn at intervals of 1^o. For precise location on a map, each degree is subdivided into 60minutes and each minute into 60 seconds. The most important lines of latitude are the equator the tropic of cancer ($23^1/_2{}^o$S) the tropic of Capricorn ($23^1/_2{}^o$S), the Arctic Circle ($66^1/_2{}^o$N) and the Antarctic Circle ($66^1/_2{}^o$S). As the earth is slightly flattened at the poles, the line linear distance of a degree of latitude at the pole is a little longer than that at the equator. For example (0^o) it is 110km (68.704 miles) at 45^o it is 111km (69.054 miles) and at the poles it is 111.7 km (69.407 miles). The average is taken as 111km (69 miles). This is a useful figure and can be used for calculating distances to any place e.g. Cairo is 30^oN, it is therefore 30 X 111 or 3330 km from the equator.



Most important lines of latitude



the latitude of 38º N is the angular distance of a Point on the Earth's surface north of the centre of the Earth.

How to Calculate the Angle of elevation of the Midday Sun.

The changing altitude of the midday sun would also be expressed as angle of elevation. Elevation is height at a given datum line changes in the altitude is caused due to the apparent movement of the sun. The apparent movement of the sun is not the true movement of the sun but the earth.

Procedure of calculating the angle of elevation

1. When both the overhead sun and the place are in the same hemisphere, subtract the overhead sun angle from the place and the difference subtracted it from 90^o
   e.g. Milan is 46^oN find the angle of elevation on 21st June $90 – (46\text{-}23^1/_2)$

   $90 – 22^1/_2$

   $\underline{67^1/_2{}^o}$
2. When the one sun is overhead at the equator use the formula 90 – n. where n is the latitude angle of the place. For example what is the angle of elevation in Lusaka 25^o on 21st march? 90-25=65.
3. When the overhead sun and the place are in difference hemispheres add the overhead sun angle and the angle of the place then subtract from 90. Cairo is 30^oN, what is the angle of elevation of the midday sun on 22nd December.

   $30^o + 23^1/_2 = 53^1/_2$

   <e = 90 – Latitude

   $= 90 - 53^1/_2 = \underline{36^1/_2}$

Examples

1. On 22nd December the sun is overhead at the tropic of Capricorn. What will be sun's angle of elevation of 60^oN? <e = (90 – latitude)

   $23^1/_2$

   $\underline{+ 60}$

   $\underline{83^1/_2}$

   $= 90 – 83^1/_2$

   $= \underline{16}/_2$
2. On 21st June, the sun is overhead at the tropic of Cancer. What will be the angle of elevation at 10^oS

   $23^1/_2{}^oN$

   $\underline{-10^oS}$

   $\underline{13^1/_2}$

   <c= (90 - latitude)

   $= 90 – 13^1/_2$

   $= \underline{76^1/_2}$
3. Calculate the angle of elevation for latitude 20^oS when the sun is overhead at the tropic of cancer.

   20^oS

   $\underline{+ 23^1/_2{}^oN}$

   $\underline{43^1/_2}$

   <e = (90 - latitude)

   $= 90 – 43^1/_2$

   $= \underline{46^1/_2}$
4. On 21st September the sun overhead at the equator. What is the angle of elevation at latitude 90^oN?

   90^oN

   $\underline{+ 0}$

   $\underline{90}$

   <e = (90 - latitude)

   $= 90 – 90$

   $= \underline{0^o}$
5. On 21 June the sun is overhead at the tropic of cancer. What is the angle of elevation for latitude 10^oS?

   90

   $23^1/_2N$

   $\underline{+10S}$

   <e = (90 - latitude)

   $= 90 – 33^1/_2$

   $= \underline{56^1/_2}$

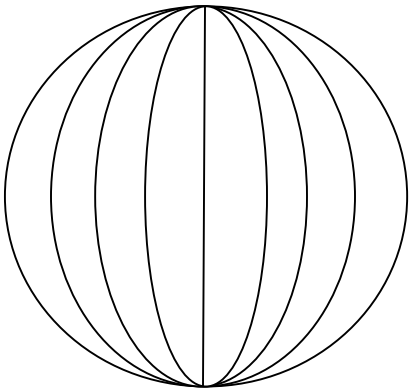
$33^1/_2$

6. What will be the angle of elevation for latitude 20°N when the sun is overhead at latitude 20°N?

20°N	<e = (90 - latitude)
-20°N	= 90 - 0
0	= 90°

Longitude

- **Longitude is an angular distance measured in degrees along the equator east or west of the prime meridian**. On the globe longitude is shown as a series of semicircles that run from the pole passing through the equator. Such lines are also called **Meridians**. Unlike the equator which is centrally placed between the poles, any meridian could have been taken to begin the numbering of longitude. All other meridians radiate eastwards and westwards up to 180°from the **Prime Meridian** (0°). All places except those on meridian 180° will have longitudes so many degrees east and west of Greenwich. Lines of longitudes meet at the poles. All lines of longitude are great circles. The importance of longitude is also on time calculation. The Greenwich Mean Time is the standard time. It is also called world Time.



Meridians or longitudes

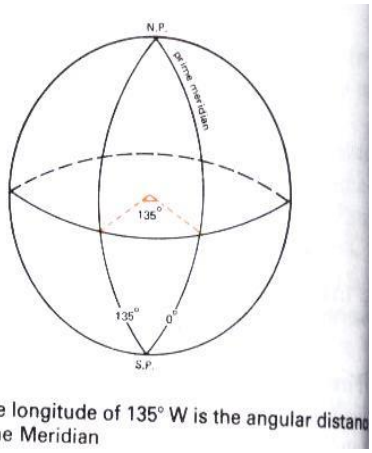


Fig. 1.17(b) The longitude of 135° W is the angular distanc
west of the Prime Meridian

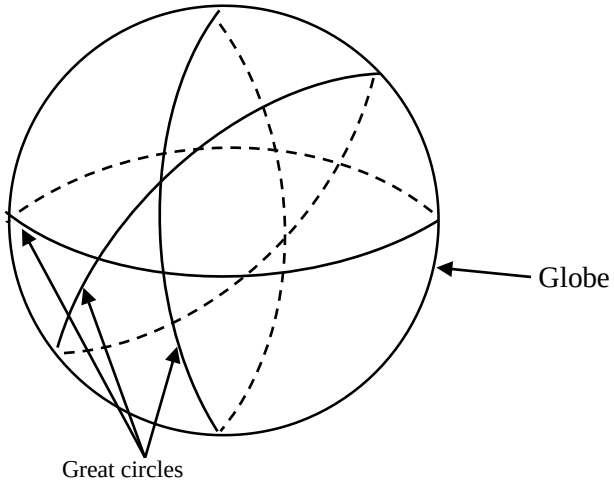
Uses of Longitude

1. To locate and fix places on the maps.
2. To find distance between meridian in km/miles
3. To calculate time east or west of any given meridian.

The Great Circles

Any circle which divides a globe into hemisphere is a great circle. The equator is great circle and Greenwich meridian together with meridian 180°W make another great circle likewise meridian 10°E and 170° W and 20° E and 160°, make two more great circles.

The number of great circles is limitless great circles can extent in any direction east to west north to south, north – east to south – west and so on. Great circles are of equal length.



Longitude and Time

Local time-since the earth makes one complete rotation of 360º in one day or 24 hours, it passes through 15º in one hour or 1º in 4 minutes. The earth rotates from west to east, so every 15º we go eastwards, local time is advanced by 1 hour. Conversely, if we go westwards, local time is retarded by 1 hour. We may thus conclude that places east of Greenwich see the sun earlier and again time, whereas places west of Greenwich see the sun later and lose time.

If we know GMT, to find local time, we merely have to add or subtract the difference in the number of hours from the given longitude. A simple memory aid for this will be **east – gain** or **add** and **west lose or subtract**.

Hence when it is noon in (London 0º 5ºW), the local time for Kuala Lumpur (102ºE) will be mathematically 6 hours 48 minutes ahead of London of 6:48 pm but the local time for New York (74ºW) will be mathematically 4 hours 56 minutes behind London or 7:04 hours we can put it in another way, when Londoners are having lunch, Malaysians will be having breakfast.

The rotation of the earth round the sun means that any point in time different places will experience a different time of day.

Time Calculation

Every point on the earth surface rotates through 360º every 4 hours. This implies that there's a relationship between the angle through which the earth rotate and time taken to rotate through this angle.

$$\frac{\cancel{24}^{1}}{\cancel{24}_{1}} \text{ hours } \frac{\cancel{360}^{\circ 15}}{\cancel{24}_{1}}$$

1 hour 15º

Further we know that 1 hour =60 minutes hence

$$\frac{\cancel{60}^{4}}{\cancel{15}_{1}} \text{ minutes } \frac{\cancel{15}^{\circ 1}}{\cancel{15}_{1}}$$

4 minutes 1º

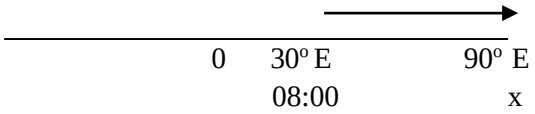
The earth is divided into 25 equal time zones of 15º each

- Longitudes the lines that run east and west of the prime meridian are used to calculate time. The longitudes meet at the line 180º E and W, also known as the international dateline.
- As we move towards the west we lose time.

Examples

1. Time in Zambia 30ºE is 08:00hours. Find the time at point P 90ºE

Solution



Difference in longitude = >90º -30º = 60º

= 1 hour → 15º

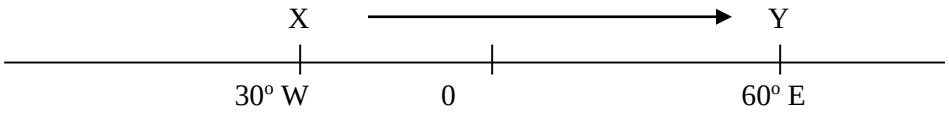
= X → 60º

$\frac{\cancel{15}^{1}}{\cancel{15}_{1}} \times \frac{\cancel{60}^{4}}{\cancel{15}_{1}}$

X = 4

Time at P = 08:00 + 4 hours = <u>12:00 hours</u>

2. Town X is situated at longitude 30º West and Town Y is located on Longitude 60º E. When local time at X is 08: 00 hrs, what is the local time at Y?



08: 00 hrs X

30º + 60º = 90º

1 h = 15º

X 90º

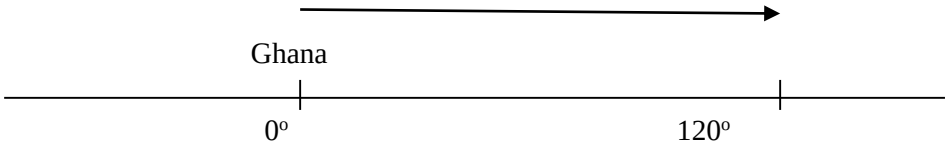
$\frac{\cancel{90}}{\cancel{15}} = \frac{\cancel{15}X}{\cancel{15}}$

X = 6

08: 00
+ 06: 00
14: 00

Therefore, time at Town X is 14: 00 hrs.

3. A jet destined for place X, 120° E, leaves Ghana (0^0) at 14: 00hrs GMT, and takes one hour to fly every 30 degrees. At this speed, what would be the local time at place X when the jet arrives their?



14: 00 hrs X

$0^o + 120^o = 120^o$

1hr = 30°

X 120°

4

$30X/30 = 120/30$

X = 4

14: 00
+ 04: 00
18: 00

Determining the Longitude of a Place

There are many ways of determining the longitude of a place. The simplest way is to compare the local time with GMT (Greenwich Mean Time) by listening to BBC radio e.g. the captain of a ship in the midst of the ocean wants to find out in which longitude this lies. It means that he is 4 ms ahead of Greenwich and must be of Greenwich. His longitude is 4 x 15° or 60°E.

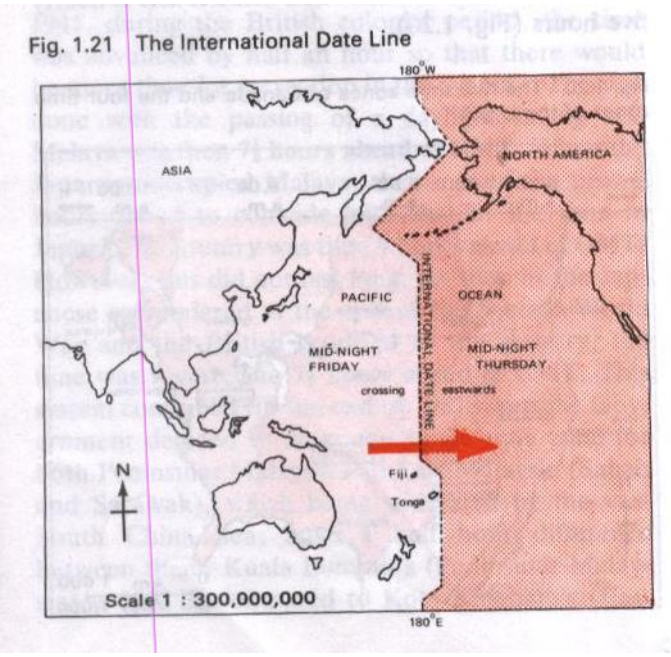
Standard Time & Time Zones

If each town was to keep of it meridian there would be much difference in local time between one time and another. For example, Kano is about 4°45 east of Lagos and if each followed its local time there would be a difference of 19 minutes between the two. People moving travelling from one town to another would have to keep on altering their watches. To avoid difficulties of this nature, the world is divided into 24 belts each 15 of longitude wide and the local time of the central meridian for each belt is applied to that belt, which is called a **time zone**. The local time of the central meridian is called the **standard time.**

A country of great longitudinal width has several time zones e.g. those which have a longitudinal width of 165° are divided into 11 time zones.

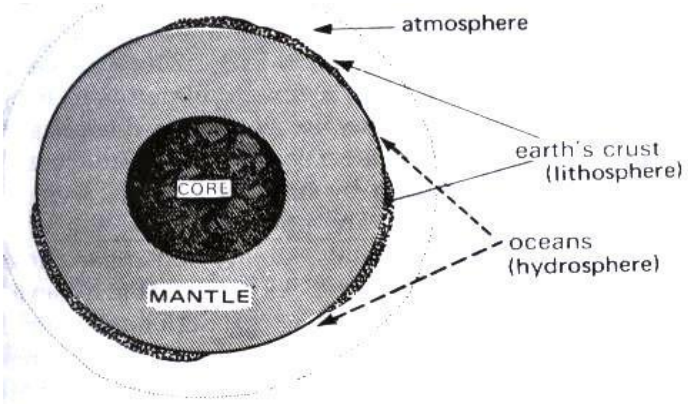
The International Date Line

A traveler going eastward gain time from the GMT until he / she reaches the 180°E meridian when he will be 12 hours ahead the GMT. Similarly when going westwards his losses 12 hours. Thus a total difference of 24 hours or day between the 2 sides of the 180° meridian. This is the International Date Line where the date by exactly one day can be crossed.



THE EARTH'S CRUST

The structure of the Earth



A section showing the structure and composition of the Earth.

The earth is made up of several concentric layers and these are:

1. **The Earth's crust or the Lithosphere**-this is the outer layer which comprises two distinct parts. The upper part consists of granitic rocks and forms the continents. Its main mineral constitutes are **silica** and **alumina.** So it is collectively referred to as the **sail.** It has an average density of 2.7. The lower part is the continuous zone of denser basaltic rocks forming the ocean flow, comprising mainly silica, iron

and magnesium. It is therefore called sima and has an average density of 3.0. The sail and sima together form the earth's crust.

2. **Mesosphere** (Mantle) is immediately beneath the lithosphere or crust. It is composed of a very dense rock rich in **olivine.**
3. **Barysphere (**core) this is the inner layer and is made up mainly of Iron (Fe) with some Nickel and is called **nife**. The temperatures are very high (1927^{o}C) and with extreme pressure.
4. **Hydrosphere** parts of the earth's crust are immersed by oceans and seas.
5. **Atmosphere** comprises of a mixture of gases which form an envelop around the earth.

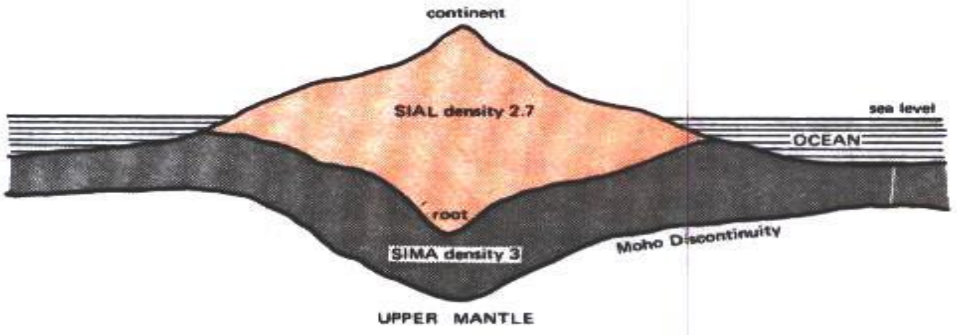


Fig. 2.2 A section showing how the continent (SIAL) floats on the denser SIMA

EARTH MOVEMENT AND THE MAJOR LANDFORM

The face of the earth is constantly being reshaped by the agents of denudation (i.e.) running water, rain, frost, heat, wind, ice glaciers and waves, so that our present **land forms** are very varied and diverse but these factors only modify the pattern of mountains, plateau and plains which have been modeled by movement of the earth's crust.

The Forces Which Produce Physical Features

Internal forces (operate with the earth's crust) under internal forces we have the earth movement (vertical and lateral) volcanic eruptions (external and internal).

External forces (operate on the surface of the earth's crust). Under external forces we have denudation (weathering, erosion and transport and deposition) by water, ice, wind, living organism.

Earth's Movement

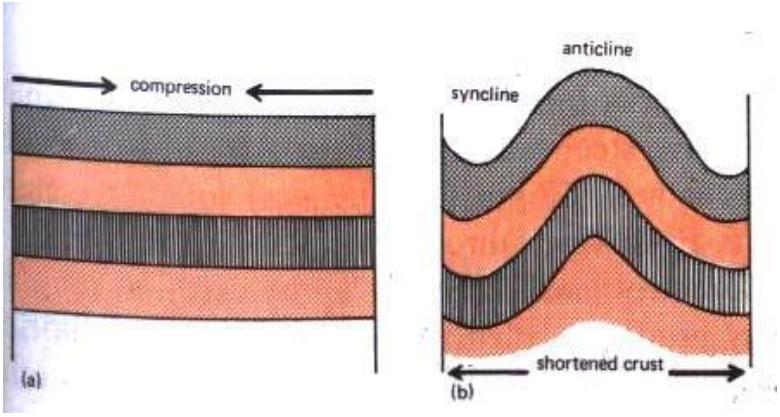
1. **Vertical – (**up and down) movement cause folding of the crustal rocks. Features produced include plateau, Block Mountain (horst), basins sometimes escarpments.

2. **Lateral** – (sideways) movements cause **faulting** of the crustal rocks. Features produced include, **Fold Mts, Rift Valleys** sometimes **Block Mts.**

Types of Mountains

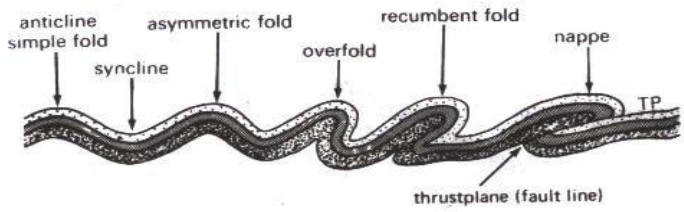
Mountains make up a large proportion of the earth's surface. There **four** main types of Mountains according to their mode of formation.

1. **Fold Mountain** – these mountains are the most important and most wide **spread**. They are caused by the large scale earth movement when **stresses** are set up in the earth's crust. Such stresses may be due to the increased load of the overlying rocks, flow movements in the mantle, magmatic intrusions into the crust, or the expansion or contraction of some part of the Earth. When such stresses are initiated, the rocks are subjected to compressive forces that produce wrinkling or **folding** along the **lines of weakness**.



As illustrated in the diagram (a) and (b) folding effectively shortens the earth's crust, creating from the original level surface a series of 'waves'.

Fig. 2.5 Types of folding



Folding effectively shortens the earth's crust, creating from the original level surface series of 'waves'.
Up folded waves are called **anticlines.**
The troughs or down folds are **synclines.**
Fold Mountains are due to the complexity of the compression forces the folds developed much more complicated forms. When the crest of a fold is pushed too far an over fold is formed when it is pushed still further, it becomes a recumbent fold.

- In extreme cases, fractures may occur in the crust so that the part of the recumbent fold slides forward over the lower part along a thrust plane, forming an **over thrust fold**. The overriding portion of the thrust fold is termed or **nappe.**
- Since the rock strata have been elevated to great height. Sometimes measurable in kilometers, Fold Mountains can be called **mountains of elevation**. The Fold Mountains are also associated with volcanic activity especially in circum pacific.

2. **Block Mountains** – when the earth's crust bends, folding occurs, but when it cracks, faulting take place. Faulting may be caused by compression or tension, forces which lengthen or shorten the earth's crust causing a section of it to subside or rise above the surrounding level.

Diagram A and B below explains how faulting causes horsts or Block mountains and their counterparts graben or rift valleys.

In diagram an earth movements generate tensional forces that tend to pull the crust apart, and faults are developed. If the block enclosed by the faults remains as it is or rises, and the land on either side subsides, the upstanding block becomes the host or block mountains. The faulted edges are very steep, with scarp slopes and the summit is almost level, for example the Hunsruck Mountains, the Vosges and blackforest or the Rhineland. Tension may also cause the central portion to be let down between two adjacent faults blocks forming a graben or rift valley which will have steep walls.
Compression forces set up by earth movement may produce a thrust reverse fault and shorten the crust. A block may be raised or lowered in relation to surrounding areas.

Diagram B illustrates a rift valley formed in this way. In general, large-scale block mountains and rift valleys are due to tension rather than compression. The faults may occur in series and be further complicated by tilting and other irregularities. Denudation through the ages modifies faulted landforms.

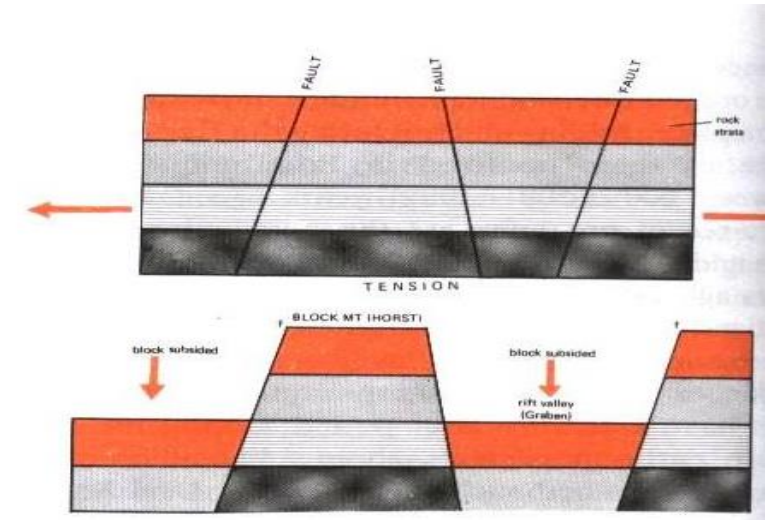


Fig. 2.7(a) Block mountains (horst) formed by tension w faults develop

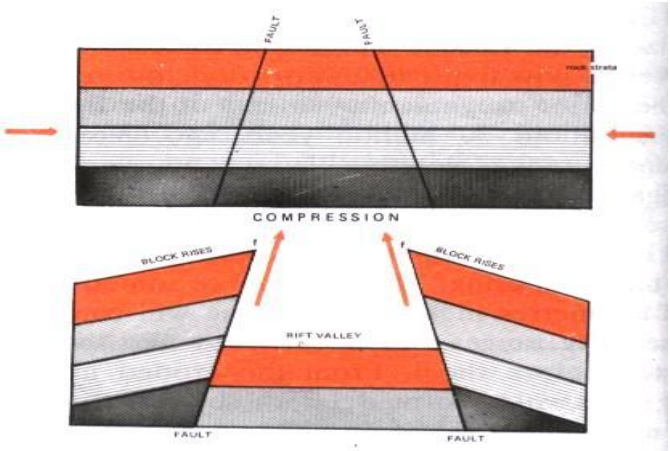
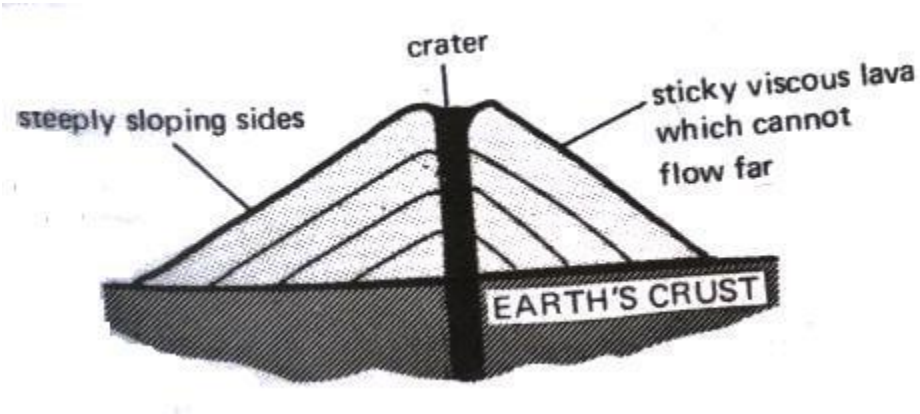


Fig. 2.7(b) Rift valley formed by compression when fa
develop

Fig. 2.7(c) Later stage when overhanging sides are w
back

3. Volcanic Mountain

These are in fact volcanoes which are built up from materials ejected from fissures in the earth's crust. The materials include molten lava, volcanic bombs, ashes dust and liquid mud. They fall around the vent in successive layers building up a characteristic volcanic cone. Volcanic mountains are often called **mountain of accumulation.** They are common in the circum – pacific belt and include such volcanic peaks as Mount Fuji (Japan) Mount Mayon (Philippines), Mount Merapi (Sumatra) e.t.c.



Volcanic Mountain

Residual Mountains

These are mountains evolved by **denudation**. Where the general level of the land has been lowered by the agents of denudation, some very resistant areas may remain and these form **residual mountains** e.g. Mt Monadnock in USA. Residual mountains may also evolve from plateaus which have been **dissected** by rivers into hills and valleys. Here the ridges and peaks are all very similar in height. Examples of dissected plateau, where the down- cutting streams have eroded the uplands into **mountains of denudation.**

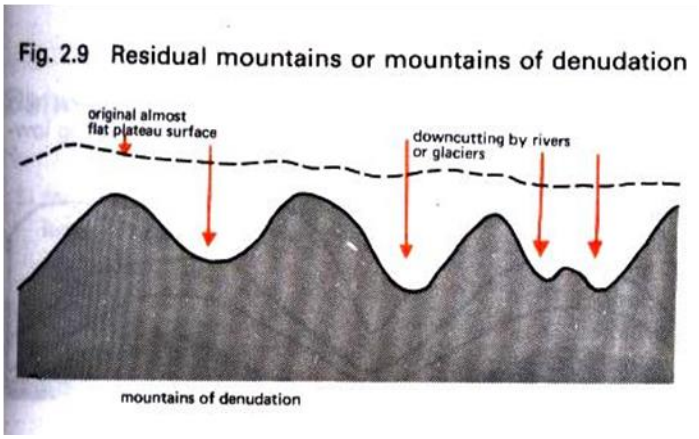


Fig. 2.9 Residual mountains or mountains of denudation

Types of Plateau

- Plateaux are elevated **upland** with extensive level surfaces, and usually descend steeply to the surrounding lowland. They are sometimes referred to as **tablelands.** According to their mode of formation and their physical appearance, plateax may be grouped into the following types.

1. **Tectonic Plateaux -** these are formed by earth movements which cause uplift, and are normally of a considerable size, and fairly uniform altitude. They include **continental blocks** like the Deccan Plateau in India. Some tectonic Plateaux may be **tilted** or faulted. When plateau are enclosed by Fold Mountains they are known as **intermont plateax** e.g. Tibetan plateau between Himalayas and Kaulum.
2. **Volcanic Plateaux** – molten lava may issue from the earth's crust and spread over its surface to form successive sheets of basalt lava. These solidify to form a lava **plateau** e.g. Columbia – Snake Plateau which covers an area almost twice as big as Malaysia.
3. **Dissected Plateau** – Through the continual process of **weathering** and **erosion** by running water, ice and winds high and extensive plateau are gradually worn down, and their surfaces made irregular. In the humid highlands, stream action and sometimes glaciations cut deep, narrow valleys in the plateau, which are then described as dissected plateau. An example is the **Scotland highlands**.

VOLCANICITY

This refers to all the various ways by which molten rock and gases are forced into the earth's crust and on to its surface. Volcanicity therefore include volcanic eruptions (the formation of volcanoes and lava plateaus and geysers), and the formation of volcanic features such as batholiths, sills and dykes, e.t.c in the crust.

Rocks below the crust have a very high temperature, but the great pressure exerted on them by the crust, keeps the rocks in a semi – solid state. Friction along rock surfaces at the boundaries of tectonic plates raises the temperature, and this, plus a reduction in pressure caused by faulting and folding associated with rocks to become molten and semi – fluid. Such rocks are called **Magma.**

Molten magma is mobile rock that forces its way into the planes of weakness of the crust to escape quietly or explosively to the surface. Molten magma comprises of solid, liquid, or gaseous materials. The form and character of the resultant land forms depends on:

a. The strength and fluidity of the magma.
b. The types of cracks, faults and joints that it penetrates.
c. The manner in which the magma escape the surface

- Magma while forcing its way up to the surface may cool and solidify within the earth's crust as Platonic Rocks, resulting in intrusive landforms.
- Magma that reach the surface and solidify form extrusive landforms. Rocks formed by either plutonic or volcanic activity are called igneous Rocks.

LANDFORMS OF IGNEOUS INTRUSIONS

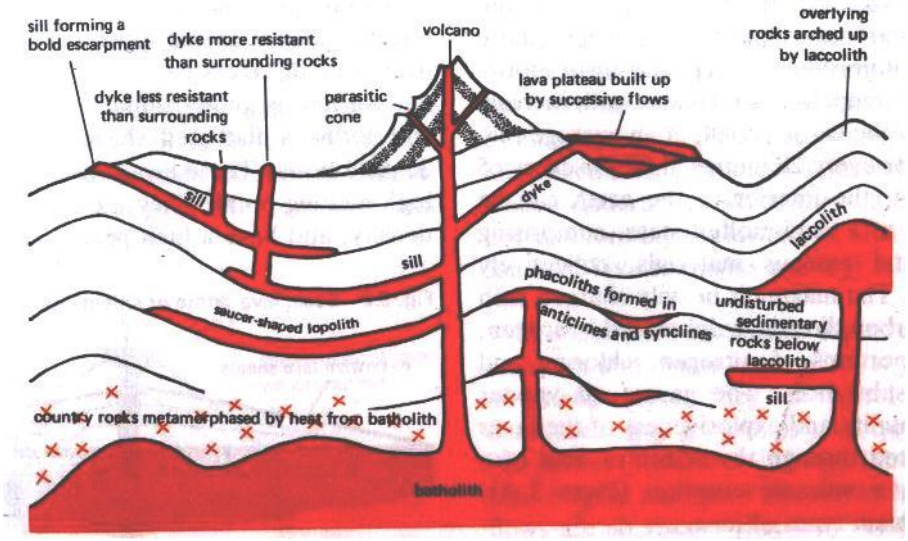
When an intrusion of magma is made along the bedding planes of sedimentally rocks, the resultant intrusion is called a **sill.** Denudation of the overlying sedimentary strata will expose the intrusion which will resemble a lava flow, or form a bold escarpment like the great When sill of north-east England. When magma solidifies vertically or diagonally, it forms narrow walls of igneous rocks called **Dykes.**

Lacolith - is a large blister or igneous mound with a dome – shaped upper surface. It arches the overlying strata of sedimentary rocks.

Lopolith – this is a saucer – shaped mass of igneous intrusion with the country rock.

Phacolith – is a lens – shaped mass of igneous rock occupying the crust of an anticline or the bottom of a syncline.

Batholith – this is a huge mass of solidified magma usually framite which after removed of the overlying rocks forms a massive and resistant upland region.



Intrusive landforms of igneous intrusions in volcanic regions

THE ORIGIN OF VOLCANOES

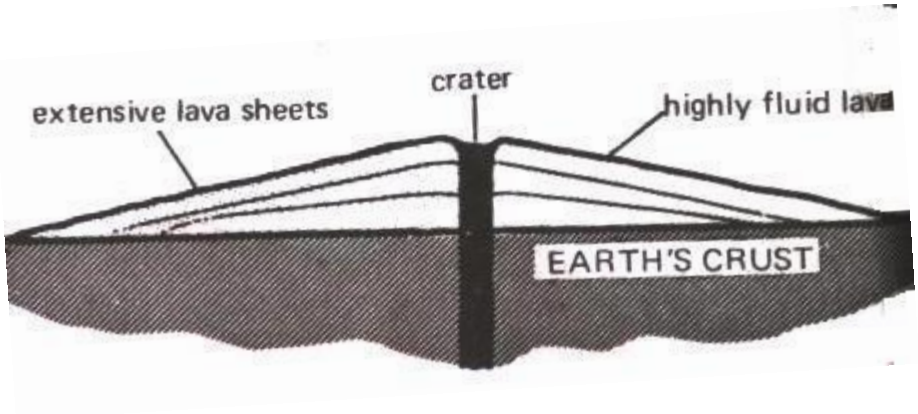
Volcanic activity is closely connected with crustal disturbances, particularly where there are zones of weakness due to deep faulting or mountain folding. Temperatures increases with depth below the earth's crusts. The interior is expected to be semi – molten state comprising solid, liquid and gaseous materials collectively known as **magma.** The gases and vapor increase the mobility and explosiveness of the lavas which are emitted through the vent of a volcano during a volcanic eruption.

There are two main types of lavas. These are:-

1. Basic lavas – these are very hot lavas about 1000^{o}c and are highly fluid. They are dark coloured like basalt, rich in iron and magnesium but poor in silica.

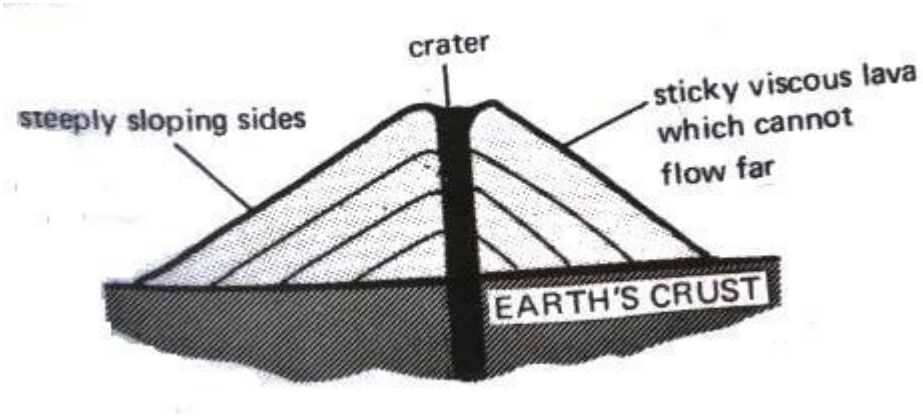
As they are poured out of the volcano, they flow quietly and are not very explosive. Due to their high fluidity, they flow readily with a speed of 16-48km per hour. They affect extensive areas, spreading out as thin sheets over great distances before they solidify. The resultant volcanoe is gently sloping with a wide diameter and forms a flattened shield or dome.

Basic lava dome or shield volcano



Acid lavas - This lava is **highly viscous** with high melting point. They are light colored, of low density, and have a high percentage of silica. They flow slowly and seldom travel far before solidifying. The

resultant cone is therefore steep-sided. The rapid congealing of lava in the vent obstructs the flow of the out-pouring lava, resulting in loud explosion, throwing out many volcanic bombs or pyroclasts. a high percentage of silica. The flow slowly and not cover great disturbances before they solidify.



Acid lava cone

The rapid thickening of the lava in the vent obstructs the flow of out pouring lava resulting loud explosions throwing out many volcanic bombs. Sometimes lavas are so viscous that they form a spine or plug.

There are three types of volcanoes, these are:-

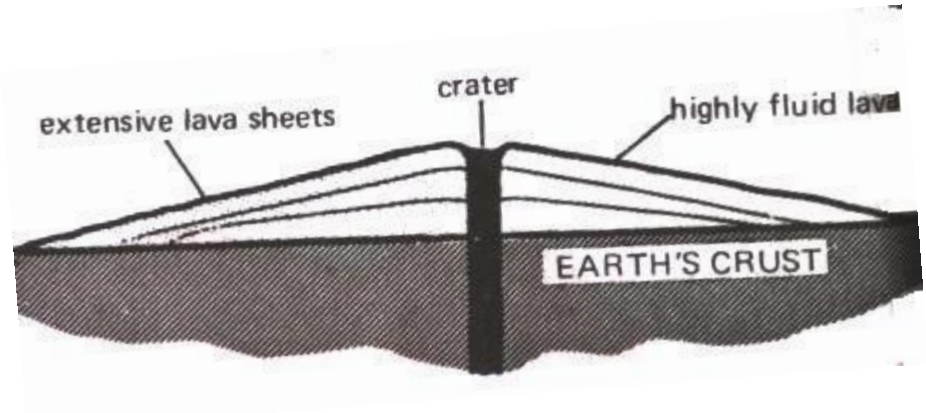
Active, **dormant** and **extinct**.

Volcanoes are said to be **active** when they frequently erupt or at least when they have erupted within recent times. Those that have been known to erupt and show signs of possible eruption in the future are described as **dormant.** Volcanoes that have not erupted at all in historic times but retain the features of volcanoes are termed **extinct**. All volcanoes pass through active, dormant and extinct stages but we can never be thoroughly sure when they thought by people to be extinct and yet both erupted most violently.

Extrusive Landforms

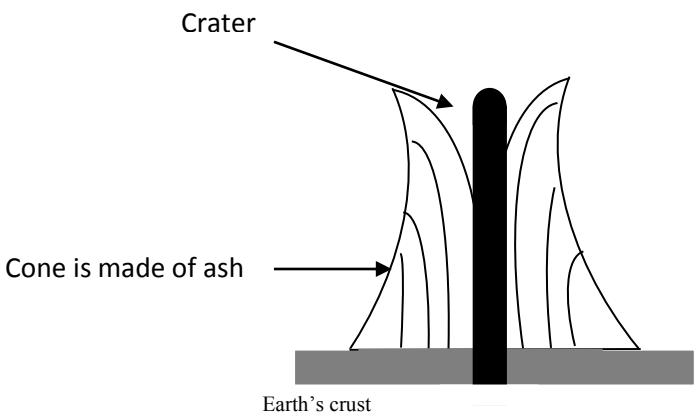
Extrusive landforms are determined by the nature and composition of the lava and other ejected materials that reach the surface of the earth.

1. **Lava planes** and **basalt plateaux**: formed from the fluid basic lava, flowing for long distances. The basalt plateaux is formed in many continents.
2. **Lava domes or shied volcanoes**: they are formed by highly fluid lava. They have gently rising slopes and broad, flattened tops.

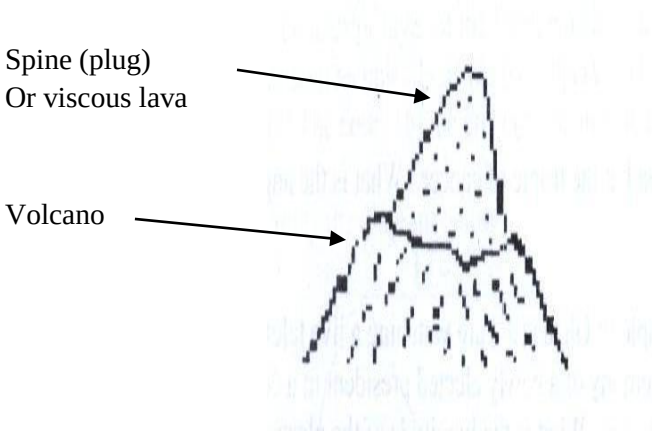


3. Ash and Cinder Cones - Formed by less fluid lava that explode more violently form. Ash and cinder cones have large central craters, and steep slopes and seldom exceeding 300 meters, such as mountain

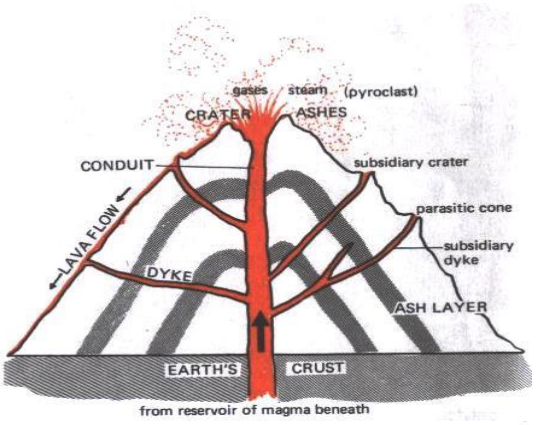
Nuovo, near Naples and mountain Paricutin in Mexico. The lava flows are so viscous that they solidify after a short distance. When they are confined in valleys they form **lava tongues** and **lava dammed lakes** when they dam a river valley.



4. Spine or plug- viscous lava gives rise to steeply sloping cones sometimes the lava are so viscous. That when they are forced out of the volcano they form a spine or plug. Spines are rare because they often rapidly break up on cooling e.g. Mount Peele.

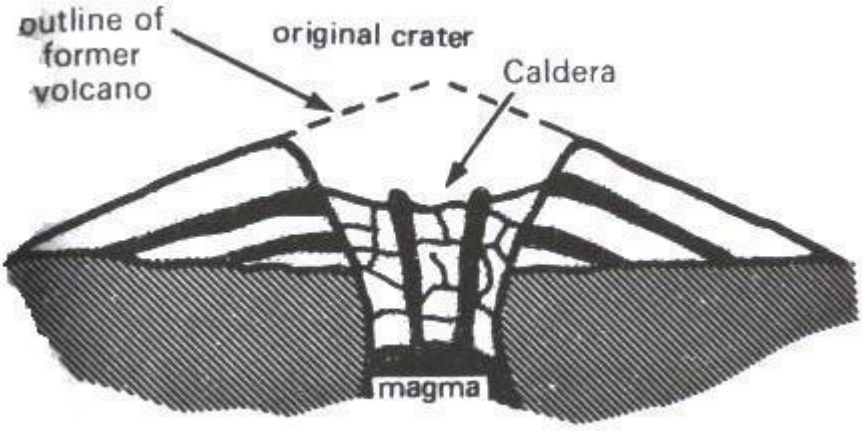


5. Composite cone – these are highest and most common volcanoes. They are called **strata – volcanoes.** The cones are built up by several eruptions of lava, ashes and other volcanic materials from the main **conduit** which leads down to a reservoir of magma. Each new eruption adds new layers of ashes or lava to the sides of the volcano, which grows steadily in height. From the main conduit subsidiary dykes or pipes may reach the surface as feeders to parasitic cones through them to the sides of the main cones e.g. Mount Etna in Sicily has hundreds of such parasitic cones.



Composite cone

6. A caldera – during an eruption, materials from the top of the cone is blown off or collapses into the vent widening the orifice into a large crater. Some volcanoes may have greatly enlarge depressions called calderas which may be several kilometers across. These are the result of violent eruption accompanied by the subsidence of much of the volcano into the magma beneath. Water may collect in the crater or the **caldera forming crater or caldera lakes** e.g. lake Toba in Sumatra.



A caldera

The Distribution of Volcanoes in the World.

Volcanoes are located in a fairly clearly defined pattern around the world, closely related to regions that have been intensely folded or faulted. There are well over 500 active volcanoes and thousands of dormant and extinct ones. They occur along coastal mountain ranges as offshore islands and in the midst of oceans, but there are few in the interiors of continents. The greatest concentration is probably that in the **circum – pacific region,** popularly termed the **'pacific ring of fire'** which has been estimated to include two thirds of the world's volcanoes.

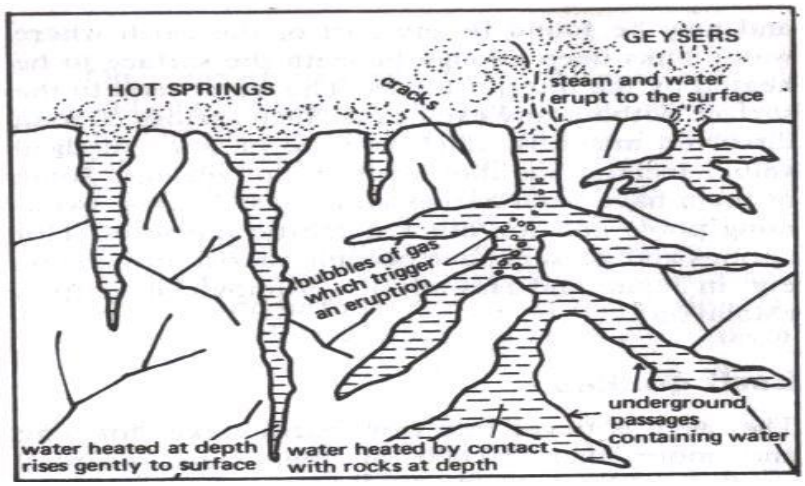
Geysers

Geysers are **fountains of hot water** and supper heated steam that may spout up to height of 45m from the earth beneath. They are associated with thermal or volcanic region in which the water is being heated beyond boiling point. The jet of water is usually emitted with explosion and is often triggered off by gases

seeping out of the heated rocks, almost all the world geysers are confined in three major areas, Iceland, Newziland and Yellowstone Part of the USA and Rotorua of district of North Island.

Hot springs

Hot springs or thermal springs are common and may be found in any part of the earth where water sinks deep enough beneath the surface to be heated by interior forces. The water rises to the surface without any explosion. Such springs contain dissolved minerals which may be of medical value. Iceland has thousands of hot springs some of them have been used to heat houses swimming pools and other domestic purposes. Hot springs and geysers have become tourist attractions e.g in Japan and Hawaii also Tambun.



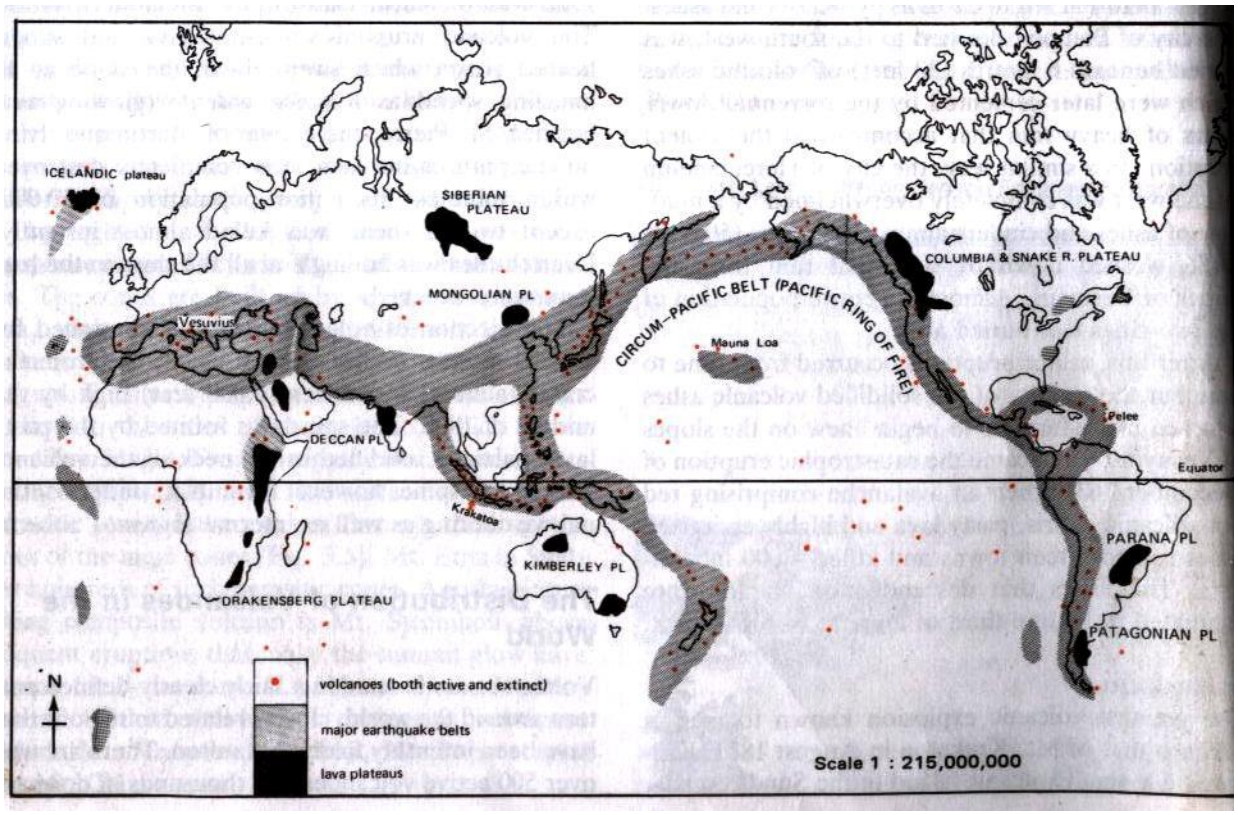
Hot springs and geysers

Earthquakes

Earthquakes are caused by movements along faults. More than 50 000 are recorded annually. Minor earth tremors caused by gentle waves of vibration within the earth's crust occur every few minutes. Major earthquakes usually caused by movement along **faults**, can be very disastrous particularly in densely populated areas. Earthquakes themselves may cause only restricted damage in the regions of occurrence, but their after effects can be very catastrophic. They produce gigantic tidal waves called **tsunamis** by the Japanese which flood **towns** and drawn thousands of people. A wave height of 7mm (a quarter of an inch) in the upheaval is sufficient to bring down most ordinary buildings. Fires break out beyond control as gas mains are shattered and buildings collapse. Roads, railways and bridges are buckled and twisted; telecommunications are cut when the cables are snapped. Hills are also shaken that landslides are widespread. Earthquakes are measured in magnitude and the scale ranges from 0 – 8.9. As the vibration thins out at the edges, like the series of waves set up by a stone thrown int the water, damage is greatly reduced. The instrument used to measure the intensity of an earthquake is called a **seismography.**

The distribution of earthquakes coincides very closely with that of volcanoes. The regions of great seismicity are circum pacific areas, with the most frequently occurrence along the pacific ring of fire.

World distribution of volcanoes, lava plateau and earthquakes.



WEATHERING MASS MOVEMENT

The earth's crust is constantly undergoing geological changes caused by **internal forces** which create new relief features. Meanwhile **external forces** are working vigorously to wear away the surface and the interaction of these constructive and destructive forces gives rise to the great diversity of present day landforms. The process of weathering away the earth causes a general lowering and leveling out of the surface. It is known as **denudation** and is carried out in four phases.

1. **Weathering**: the gradual disintegration of rocks by atmospheric or weather forces.
2. **Erosion**: the active wearing away of the earth's surface by moving agents like running water, winds, ice and waves.
3. **Transportation**: the removal of the eroded debris to new positions.
4. **Deposition**: the dumping of the debris in certain parts of the earth where it may accumulate to form new rocks.

All four phases of the denudation process are taking place simultaneously in different parts of the world at different rates, much depending on the nature of the **relief**, the structure of the **rocks** the local **climate** and interference by **man**.

WEATHERING

The work of weathering in breaking up of the rock is of two kinds, namely **chemical** and **physica**l or **mechanical** weathering but the processes involved in each are closely interrelated.

Chemical Weathering

Chemical weathering is the basic process by which denudation proceeds. It is the extremely slow and gradual decomposition of rocks due to exposure to air and water. Air and water contain chemical elements which though they may be in small quantities are sufficient to set up chemical reactions in the surface layers of exposed rocks such reaction may weaken or entirety dissolve certain constituents of the rock thus loosing the other crystals and weakening the whole surface.

Types of chemical weathering processes.

i. **Solution** – many minerals are dissolved by water especially when as with rain water, it contains enough carbon dioxide to make it a weak acid solution the most potent weathering process in limestone regions because the rain water attacks and dissolves the calcium carbonate of which the rocks is chiefly formed. Rate of weathering are also affected by climate.

ii. **Oxidation -** oxidation is the reaction of oxygen example most rocks contain a certain amount of iron, which when it comes in contact with air is changed to iron oxide familiar brownish crust or rust. Iron oxide crumbles easily and is far more easily eroded than the original iron. It is thus removed, loosening the overall structure of the rocks and weakening them.

iii. **Decomposition by organic acids** – within the soil which covers most rocks is bacteria which thrive on decaying plant and animal material. These bacteria produce **acids** which when dissolved in water help to speed up the weathering of underlying rocks.

iv. **Hydration-** Some minerals absorb water and in doing so they give rise to new compounds. For examples, hematite, an iron oxide compounds with water to give limonite, another iron compound.

Note: There is no chemical change; the rock only absorbs water and this can only be removed. For, example the water in limonite can be removed by heating.

v. **Hydrolysis** – This process involves hydrogen (in the water) combining with certain metal **ions** (in a mineral), that is the water and the mineral reacts chemically which gives rise to the formation of different chemical compounds. Hydrolysis is therefore quiet different from hydration. Felspar is broken down in this way. The hydrolysis of feldspar results in the formation of clay.

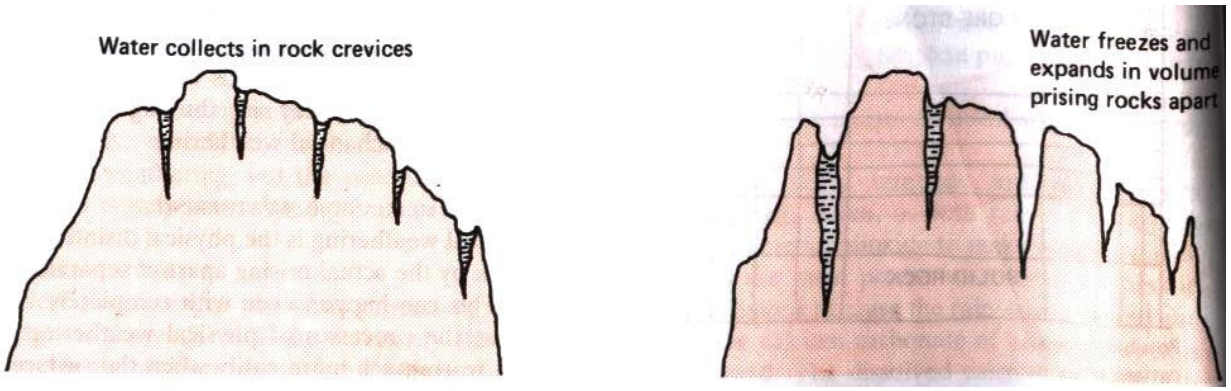
vi. **Carbonation** – This process involves the reaction of hydrogen carbonate ions with a mineral to give a soluble compound which can be carried away in solution. Hydrolysis often accompanies carbonation e.g. hydrolysis and carbonation break down a felspar into clay, soluble carbonate and silica.

Note: Usually two or more chemical weathering processes take place at the same time. Chemical weathering is most marked in wet hot – region.

Mechanical or Physical Weathering

Mechanical it is the physical disintegration of a rock by the actual rising apart of separate particles. This can happen even with completely fresh rock but the processes of physical weathering are able to work much more easily when the surface of the rock has already been weakened by the action of chemical weathering. Mechanical weathering takes place in several ways.

1. **Repeated temperature changes-** Rocks during the day are exposed to blazing sun during the day and are intensely heated. The outer layers expand much faster than the cooler interior of the rocks and tend to pull away from the rest. At night the temperature drops rapidly and Outer layers contract more rapidly than the interior setting up internal stresses. Such stresses repeated every day for months and years causes the rocks to crack and split. When the surface layers of rounded boulders gradually split off, the process is called **onion peeling**, because the various layers look like the layers of an onion peeled off one after another. The technical term for this process is **exfoliation.**
2 **Repeated wetting and Drying** - exfoliation is not confined to desert areas. Similar stresses may be set up in rocks by repeated wetting and drying of the surface layer. When rocks are melted the alter layers absorb certain amounts of moisture. When they dry this shrinks. When this happens repeatedly the outer layer splits off. This process of wetting and drying of the rocks in deserts is probably just as important as temperature changes in mechanical weathering.
3. **Frost Action** - in temperate latitudes frost is a potent rock breaker. All rock contains cracks and joints or pore space and after a shower, water or snow collects in such places. When the temperature drops at night or during the winter this water freezes. When water freezes, it expands by one tenth its volume and exerts a bursting pressure of almost 140kg per square centimeter. Repeated freezing or this kind will deepen and widen the original crack and crevices and break the rock in angular fragment.



4. **Biotic factor –** small fragment of rock loosened by either chemical or mechanical weathering lodge in cracks and crevices in the rock and plants may sprout in such crevices. As they flow their roots penetrates the rocks below usually along joints and other lines of weakness, prising them apart.

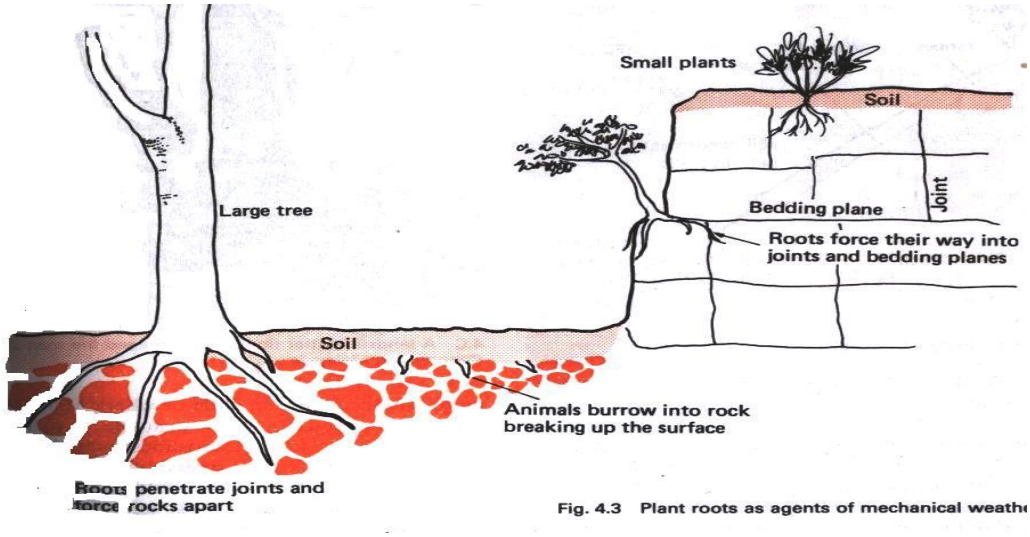


Fig. 4.3 Plant roots as agents of mechanical weath

MASS MOVEMENT

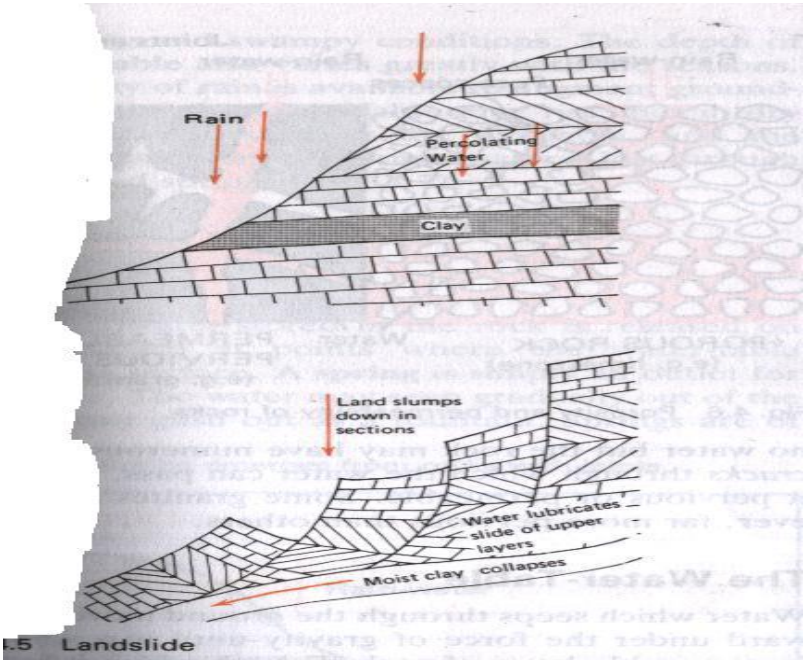
Mass movement is the movement of weathered materials down a slope due to gravitational forces. The movement may be gradual or suddenly depending on the gradient of the slope the weight of the weathered debris and whether there is any lubricating moisture supplied by rain – water several kinds of mass movement are distinguished.

Soil creep – this is a slow gradual but more or less continuous movement of soil downhill slopes. The movement is not very noticeable, especially when the slope is fairly gentle or when the soil is well covered with grass or other vegetation. Soil creep is most common in damp soils where the parent rock. It is also found where continuous tramping by animals grazing on the slopes sets up vibrations which loosen the soil and cause it to move.

Soil flow (solifluction) – when the soil is completely saturated in the water the individual particles are almost suspended the underlying rock. The soil acts like a liquid and a soil. In Ireland such flows are known as bog-bursts.

Landslides (slumping or sliding)

These are very rapid kinds of movement and occur when a large mass of soil or rock falls suddenly. Landslides usually occur on steep slopes such as in mountainous areas on cliffs or where man has artificially steepened slopes may be caused because a steep slope is **undercut** by a river or the sea so that it falls by gravity. **Earthquakes or volcanic** disturbances may loosen rocks and start off a landslide. Often landslides are caused by the **lubricating action** of rain water. Water may collect in joints or bedding planes areas of tilted strata. **Slumping** is particularly common where permeable debris or rock layers overlie impermeable strata such as clay. Water may collect at the base of the regolith because it sinks readily into the weathered materials but more slowly into the solid rock beneath. Man often enhances the possibility of landslides by clearing natural vegetation for agriculture or housing.



LANDFORMS MADE BY RUNNING WATER

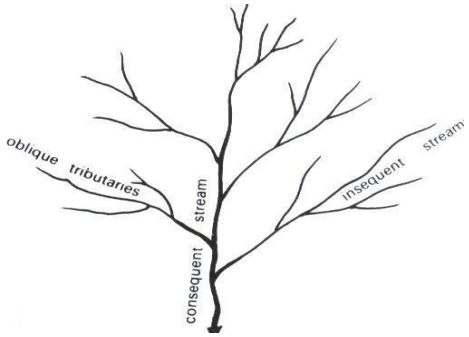
The development of a river system

Running water is the most important single agent of denudation. When rain falls, part of it the atmosphere and the rest rains off as rivulets, brooks, streams and tributaries of rivers that flow to the sea. This running water forms a potent agent for denudating the Earth's surface. Unlike glaciers and snow, which are confined to the cold and temperate latitude, waves which act only on coastlines, winds, which are only 'efficient' in deserts, the effect of running water is present running water is thus the **most important single agent** of denudation.

The source of a river may be a spring, a lake or a marsh but it is generally in an upland region, where precipitation is heaviest and where there is a slope down which the **'run off'** can flow. The uplands therefore form the **catchment areas** of rivers. The crest of the mountains is the **divide** or **watershed** from which streams flow down the slopes on both sides to begin their journey to the oceans.

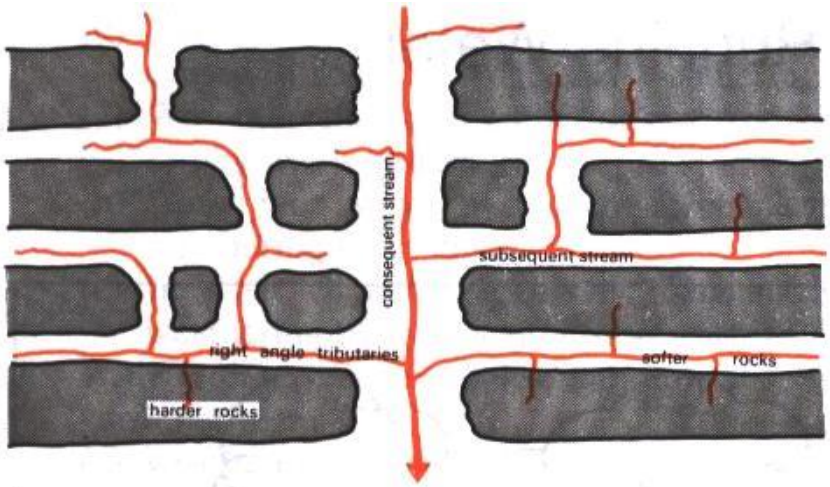
The initial stream that exists as a consequence of the slope is called the **consequent stream**. As the consequent stream wears down the surface by deepening its channel downwards, it is joined by several tributaries either **obliquely** or at right angle deepening on the alignment and the degree of resistance of the rocks. If the rocks are composed of homogeneous beds of uniform resistance to erosion, the tributaries will join the main valley obliquely as **insequent** streams.

Dendritic or tree like drainage pattern developed on homogenous rock or beds of equal resistance



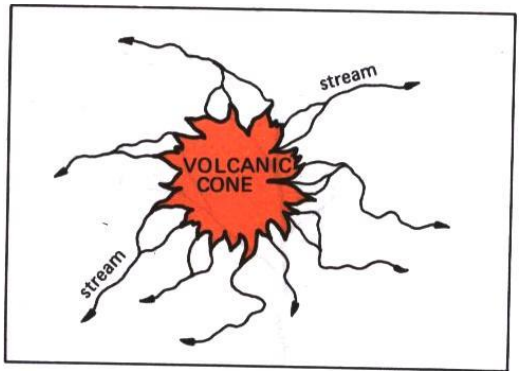
On the other hand, if the rocks are made up of alternate bands of hard and soft rocks the tributaries ten d to follow the pattern of the rock structure. The drainage pattern so development will be rectangular in shape and is called **trellised drainage**.

Trellised or rectangular drainage pattern developed on alternating outcrops of harder and softer rocks



Streams flowing outwards and down hill from a dome or volcanic cone give rise to a **radial drainage pattern** just like the spokes of a bicycle wheel.

Radial drainage pattern developed down a dome or volcanic cone



The process of river action

When a river flows, it carries with it eroded materials. These comprise the river's **load,** and may be divided into three distinct types.

1. **Materials in solution** – these are materials which are dissolved in the water.

2. **Materials in suspension** – sand, silt and mud are carried along suspended in the water as the stream flows
3. **The traction load** – this includes coarser materials such as pebbles, stones, rocks and boulders, which are rolled along the river bed.

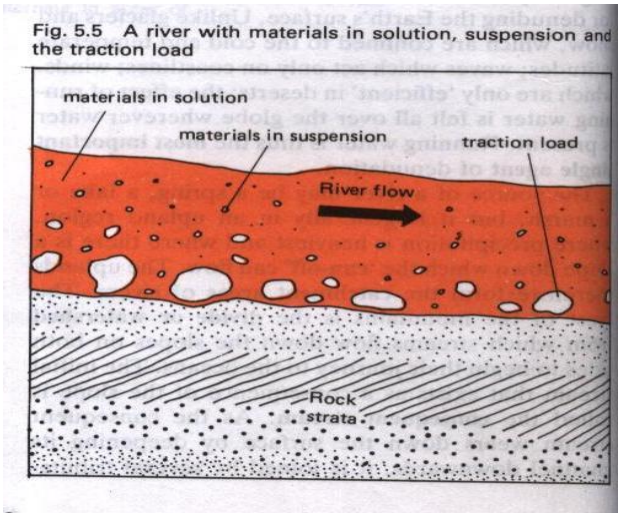


Fig. 5.5 A river with materials in solution, suspension and the traction load

River Erosion and transportation

In Rivers, erosion and transportation go on simultaneously comprising the following inter – acting process.

River erosion

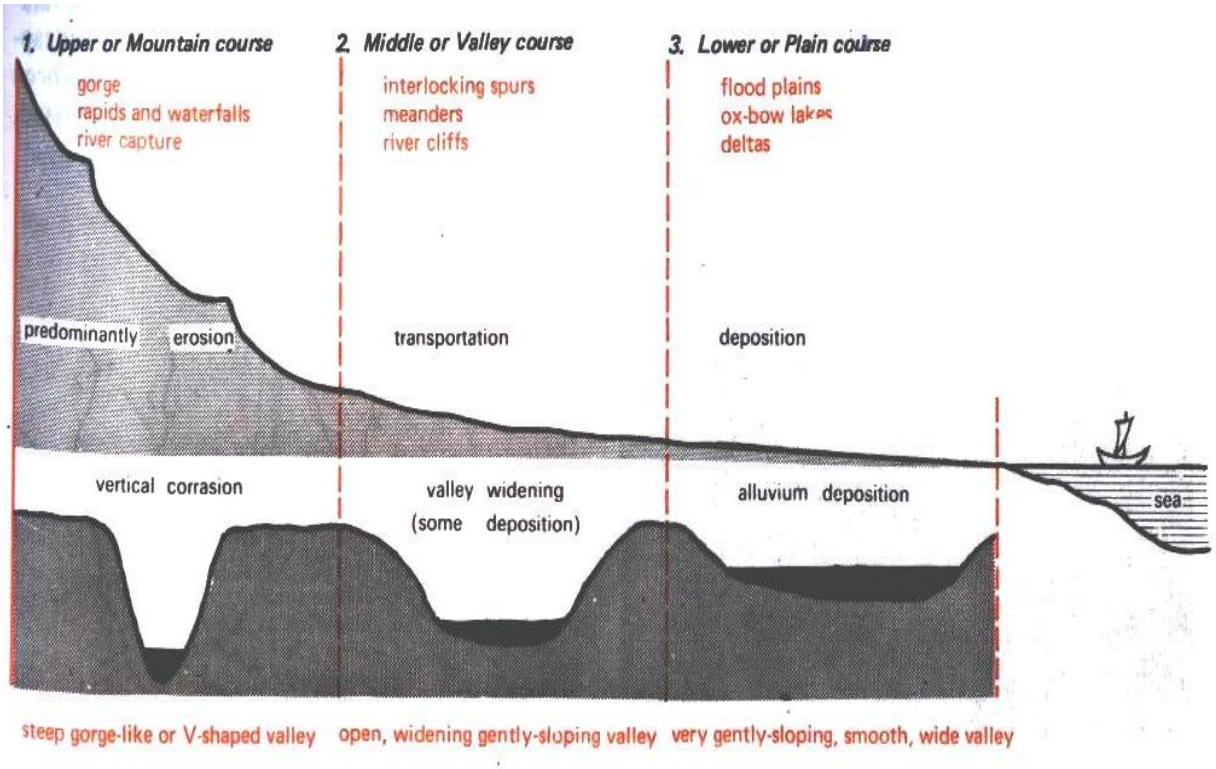
1. **Corrasion or abrasion** - this is the **mechanical grinding** of the river's traction load against the banks and bed of the river. The rock fragments are hurled against the sides of the river and also rolled along the bottom of the river corrasion takes place in two distinct ways.

a. **Lateral corrasion** - this is the **sideways** erosion which widens the V – shaped valley.

b. **Vertical corrasion** – this is the **downward** action which widens the river channel.

2. **Corrosion or solution** – this is the **chemical or solvent** action of water on solution or party - soluble rocks with which the river comes into contact for example calcium carbonate in limestone is easily dissolved and removed in solution.
3. **Hydraulic action** - this is the mechanical loosing and sweeping away of materials by the river water itself. Some of the water splashes against the river banks and surges into cracks and crevices. This helps to disintegrate the rocks.
4. **Attrition** – this is the wear and tear of the transported materials themselves when they roll and collide with one another. The coarser boulders are broken down into smaller, stones the angular edges are smoothened and rounded to form **pebbles**. The finer materials are carried further downstream to be deposited.

The graded long profile and typical cross section of a river from source to mouth



The course of a river

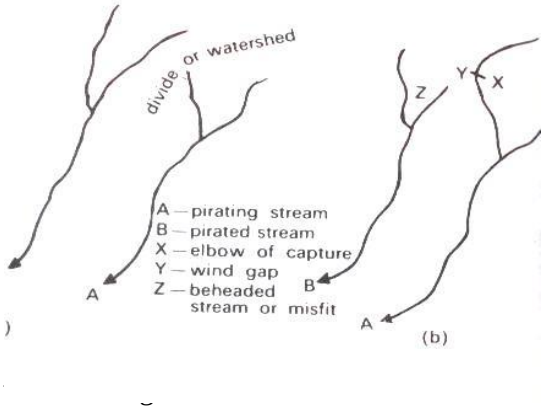
The course of a river may be divided into three distinct parts and these are the upper or mountain course. The middle or valley course (in the stage of maturity) and the lower or plain course (in the stage of old age).

The upper or mountain course

This begins at the **source** of the river near the watershed, which is probably the crest of descends the steep slopes and the predominant action of the river is **vertical corrasion.** The valley develop is thus deep, narrow and distinctively V- Shaped. Down cutting takes place so rapidly that **lateral corrasion** cannot keep pace. In some cases where the rocks are very resistance, the valley is so narrow and the sides are so steep that gorges are formed. In acid regions, where there is little rainfall to widen the valley sides and the river cuts deep into the valley floor, precipitous valleys called **canyons** are formed. Some of the more outstanding features that are often best developed in the upper course of a river include the following.

1. **River capture** – this is also known as **river piracy or river beheading**. Its development is dependent or the different rate of back – cutting (headward erosion) into divide. The bend at which the piracy occurred is termed as the elbow of capture. The beheaded stream (z) is called the **misfit.** The valley below the elbow is the **wind gap** and may be valuable abound.

River capture (a) before capture (b) after capture



are but course **2 Rapids cataracts and waterfalls**. There liable to occur at any part of the river course they are most numerous in the mountain of gradient are more abrupt and also more frequent. The **unequal resistance** of band of hard rock may cause a river to "jump" or 'fall' downstream. **Rapids** are formed. Similar falls of greater dimensions are also referred to as cataracts, of which there are five along the Nile that interrupt smooth navigation.

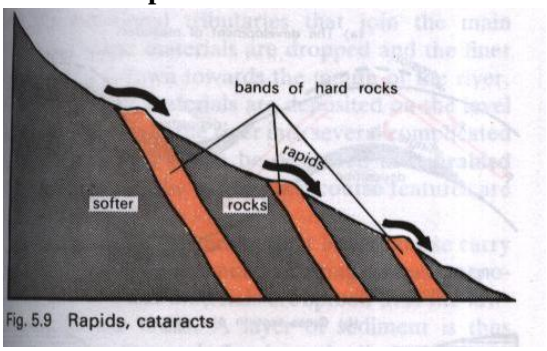
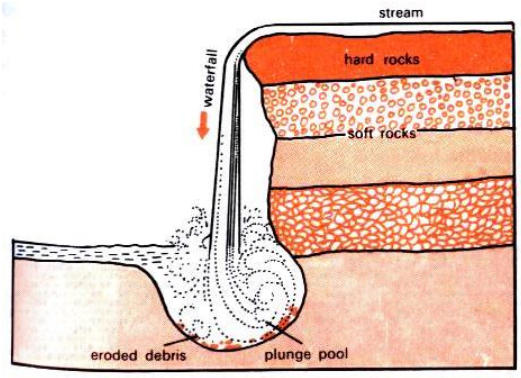


Fig. 5.9 Rapids, cataracts

When rivers plunge down in a sudden fall of some height they are called **waterfall.** Waterfalls are formed in several ways.

a. When a bar of resistant rock lies transversely across a river valley e.g Niagara falls, USA which is 50m high.
b. When a fault – line scarp caused by faulting lies across a river, e.g. Victoria falls on the river Zambezi, plunging 100 metres (360 feet).

Waterfall with plunge pool-



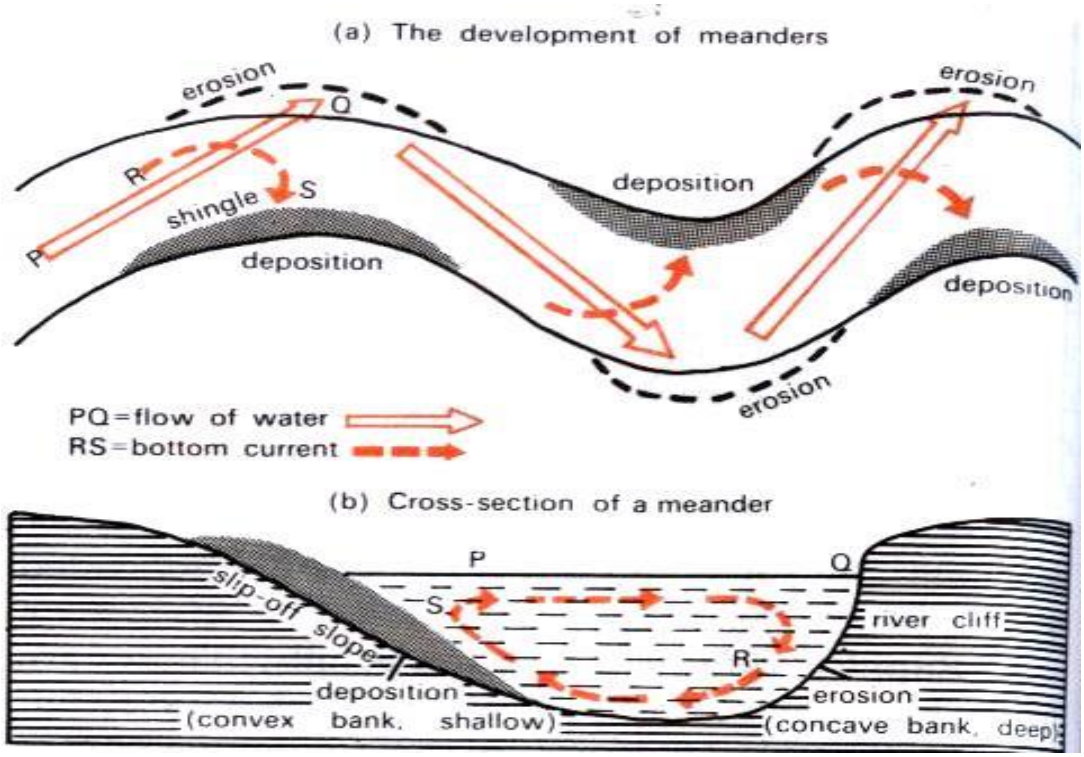
c. When water plunges down the edge of a plateau like the river Zaire which leaps for 270 meters (900 feet) through a series of more than 30 rapids as Livingstone falls.

d. Glaciation produces hanging valleys where tributary streams reach the main V – shaped valley below a waterfalls e.g. the Yosemite falls of California with a total descent of 780 metres (2, 560 feet).

Middle or valley course

In the middle course lateral corrasion tends to predominate over vertical corrosion. Active erosion of the banks widens the V – shaped valley. The volume water increases with the confluence or many tributaries and this increases the river's load work of the river is predominately **transportation** with some deposition. Downstream, the **interlocking spurs** that project from both sides of the valley are cut back into a line of bluffs. The more outstanding features associated with the valley course are.

1. **Meanders**. As water flowing under gravity seldom flows straight for any long distance, a winding course soon develops. The irregularities of the ground force the river to swing in loops forming

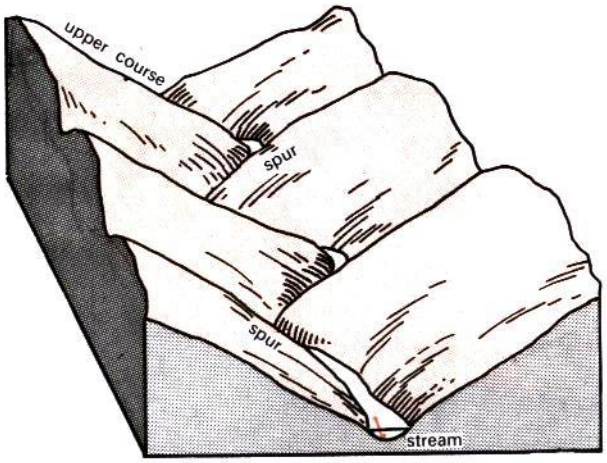


meanders, a term derived from the winding river meandere in Asia Minor.

2. **River cliffs and slip off slopes**
   When the flow of water enter to bend of the river eroding the outer bank into a steep **river cliff** at Q. The water piles up on the outside of the bend because of the centrifugal force. A bottom current RS is set up in a cork – screw motion and is hurled back into mid stream and the inner bank shingle is thus deposited here at S where the **slip off slope** is very gentle. The outer bank is therefore the bank of continuous erosion and the inner bank is the bank of continual deposition.

3. **Interlocking spurs** – as the stream flows on the meanders migrate progressively outward with the interlocking spurs alternating with the undercut slopes. At this stage meanders in the middle course are only the beginning of the downstream swing, for bends are restricted by the interlocking spurs.

Interlocking spurs



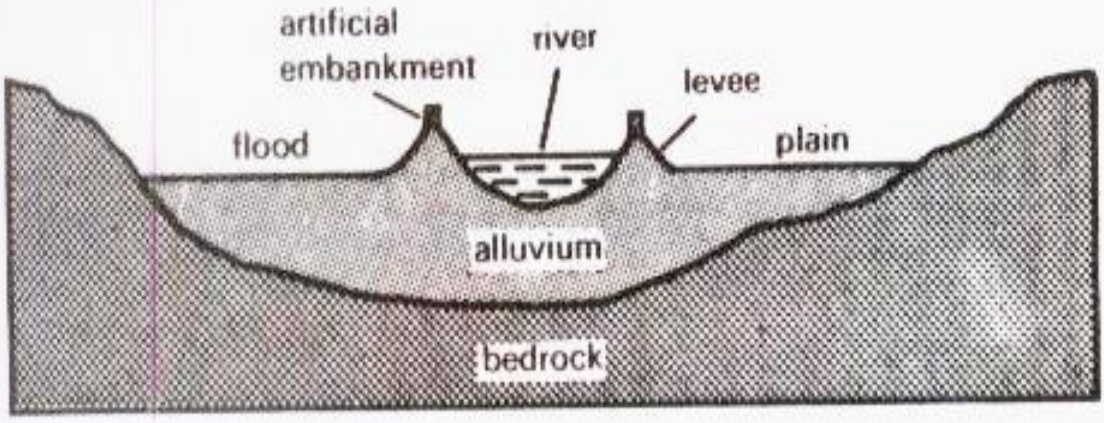
The Lower or Plain Course

The river moving downstream across a broad level plain is heavy with debris brought down from the upper course vertical corrosion has almost ceased though **lateral corrasion** still goes on to erode its banks further. The river is so slow that it can not carry so much material. Sometimes deposit it on its bed and banks. The meanders are almost complete on some places the river has broken through the narrow neck of land on the meanders to create newer straight path. Some of the major plain course features are the following.

1. **Flood plain**

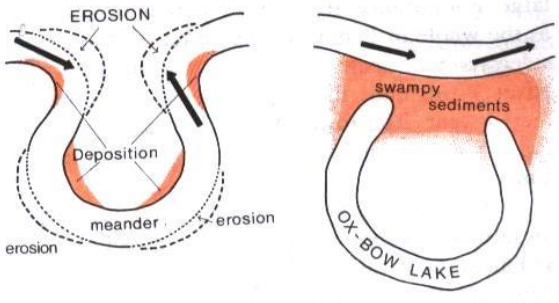
   Rivers in their lower course carry large quantities of sediments. During annual or sporadic floods these materials are spread over the low lying adjacent areas. This layer of sediment is thus deposited during each flood, slowly building up a fertile **flood plain.** A flood plain is a feature of a river in the lower course or plain stage.

Fig. 5.13 Section of a flood plain (with levee and artificial embankment)



2. **Ox-bow lake**
   Ox – bow lakes are formed when the neck of a meanders becomes very narrow. There comes a stage when the river flood heavily and also flow faster the river sweeps across the narrow neck to form a new course when the floods go down, the lake is left separate from the river.

   Formation of an ox – Bow Lake



Levees – they are formed whenever the lower course of river flows its banks in flood periods. Small amounts of deposition take on the banks. During low water periods the river deposits materials on its bed over the years both banks and river bed are built up above the surrounding plains.

Deltas

When a river reaches the sea the fine materials it has not yet dropped are deposited at its mouth, forming a fan shaped alluvial area called a delta. It is a great triangular area of very flat low lying ground seen where the river enters the sea. A delta is in fact a seaward extension of the flood plain. If there are no powerful sea currents some of the sit and mud the river is carrying slowly builds up until the path of the river is blocked so that it has to divide a flow round the obstacle. Due to the obstruction caused by the deposited alluvium the river may discharge its water through several channels called **distributaries.**

The following summarizes the conditions favorable for the formation of deltas.

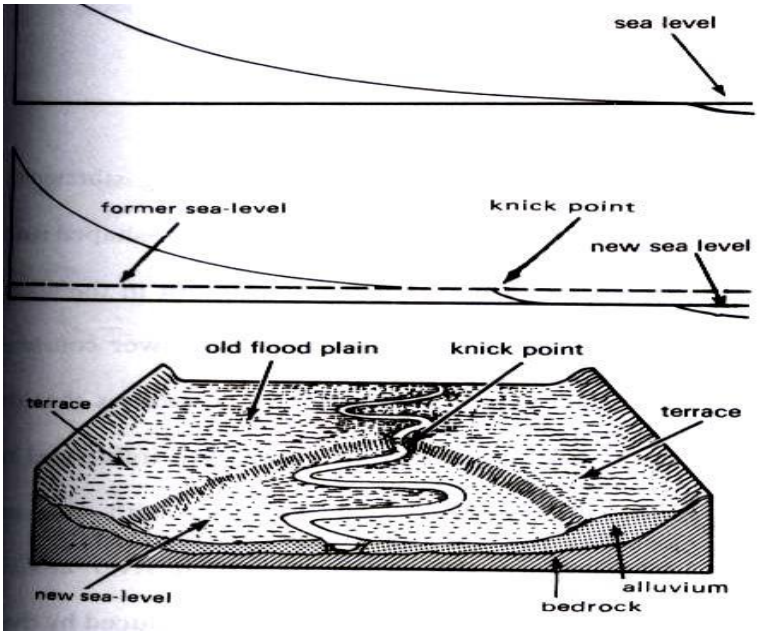
a. Active vertical and lateral erosion in the upper course of the river to provide extensive **sediments** to be eventually deposited as deltas.
b. The coast should be **sheltered** preferably tidless.
c. The sea adjoining the delta should be shallow or else the load will disappear in the deep waters.
d. There should be **no large lakes** in the river course to filter off the sediments.
e. There should be **no strong current** running at right angles to the river mouth washing away the sediments.

River rejuvenation

The earth's crust is far from stable and it is not spurring that in the course of a river's development, certain characteristic features associated with **rejuvenation**, i.e. being young again.

A **negative movement** occurs when there is an uplift of land or a fall in sea – level. This will steepen the slop so that active **down – cutting** is renewed. A fall in sea – level leaves the flood plain at an increased altitude above the sea level. The river with its renewed vigour cuts into the former flood plain, leaving behind **terraces** on both sides of the river. This point where the old and rejuvenated profile meets is called the **knick point** or **rejuvenated head.**

If rejuvenation occurs in the upper course**,** the river valleys are deepened and steep sided gorges are formed. In the middle and lower course vertical corrasion replace lateral corrosion and the existing meanders are vertically eroded by the rejuvenated stream. A distinct new inner trench is cut in the old valley and the river develops a deep valley with **entrenched or incised meanders.** The best developed incised meanders are those of the River Colarado in USA.



River terraces and knick point due to rejuvenation.

A **positive movement** occurs when there is a depression of land or a rise in sea level. This will submerge the lands along the coast, 'down' the valleys and weaken the erosive power of the river. The flow is checked and large quantities of sediment will be dropped. The lower course of the river may be partly in the sea and features of deposition are shifted upwards to the middle course. The upper course is little affected when there is a rise in sea level in many areas where the sea has risen; this was probably caused by the release of water locked up in the ice masses during the quaternary ice ages.

The human aspects of rivers

In many countries rivers forms the **chief highways** of commerce and transport e.g. river Amazon. However, some of the Parts Rivers may not be navigable because of rapids.

In the upper course rivers with steep gorges and waterfalls provide natural sides for the generation of electricity (H. E. P) leading to the establishment of other industries.

Dams constructed across rivers hold back flood water which it allowed to flow downstream unchecked may cause widespread disastrous floods in the lower course e.g. the Aswan dam in Egypt.

In regions of insufficient rainfall such as Egypt and the Chao Phraya basin in Thailand **irrigation Canals** red by the main stream enable many crops to be successfully cultivated. The upper stream develops river captures and the resultant **wind gaps** may facilitate construction of upland roads and railways. The river valleys provide a convenient means of land **communication.**

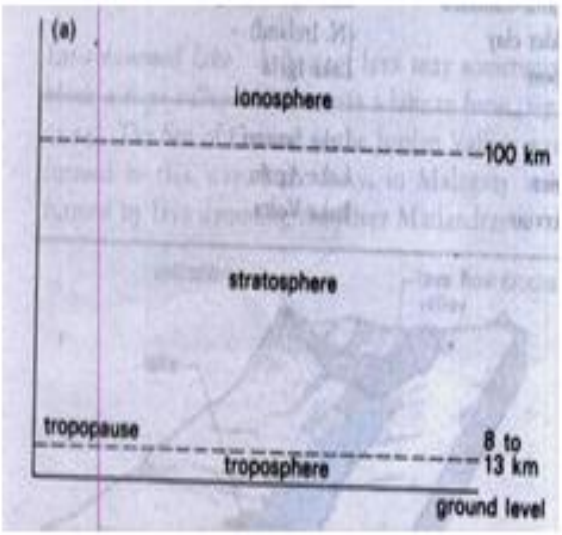
The **flood plains** of large rivers with their thick mantles of fine silt are some of the richest **agricultural** areas of the world. They may support very be strung along their banks. Many **deltas** are equally fertile.

Freshwater **fishing** is important along many rivers and lakes. The organic matter brought down by the river waters provides valuable food for fish and for spawning purposes. Rivers supply water for domestic consumption sewerages and industrial purpose. In Lancashire, the soft rivers form the **political boundaries** between many countries. The Mekong separates loose from Thailand and the yantu forms a well defined border between North Korea and the eastern U. S. S. R.

WEATHER

The earth's atmosphere

The air that surrounds the earthy is called the **atmosphere.** It is about 330 km thick and it consists of three main zones the atmosphere, the stratosphere, and the ionosphere.



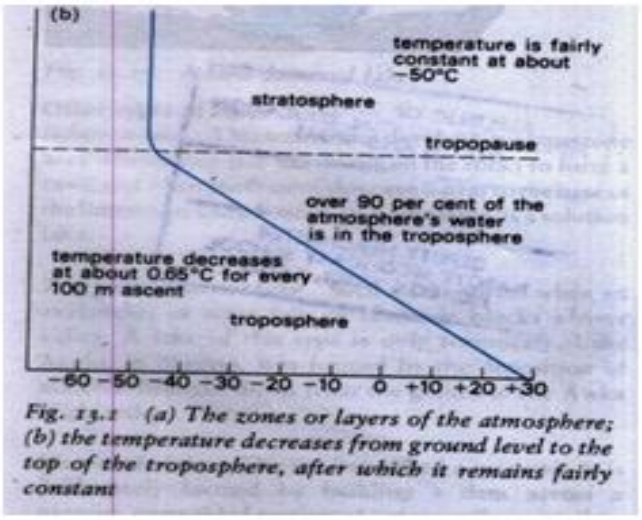


Fig. 13.1 (a) The zones or layers of the atmosphere; (b) the temperature decreases from ground level to the top of the troposphere, after which it remains fairly constant

The troposphere extents from the earth's surface to a height of between 13km at the equator to 8km at the poles. The troposphere contains about 90 per cent of the atmosphere water vapour **within it**. Temperature decreases with height at a fairly uniform rate of 6.5^{o}_{c} for every 1000 km ascent. This decrease in temperature is called the **normal lapse rate**.

The stratosphere extents from the upper surface of the troposphere called the **troposphere**; to a height of about 100 km. The temperatures of this zone are very low and fairly constant at about -50^{o}_{c}.

The **ionosphere** is above the stratosphere. This zone contains electrons and ions which influence radio waves.

The meaning of weather and climate

Weather is the atmospherics condition of a particular place at a given time. Weather also can vary tremendously over a small area. It may be sunny at your school, but rainy a few kilometers away.

Elements of weather

a. Temperature
b. Rainfall
c. Humidity
d. Pressure
e. Cloud cover and sunshine
f. Wind direction and strength.

These elements are measured and recorded at a place called **weather station or meteorological station**. A weather station is a place where the elements of weather are measured and recorded as accurately as possible. Each station has a Stevenson screen which contains for thermometers all

hung from a frame in the centre of the screen. These are the **maximum thermometer, minimum thermometer, wet bulb thermometer, dry bulb thermometer.**

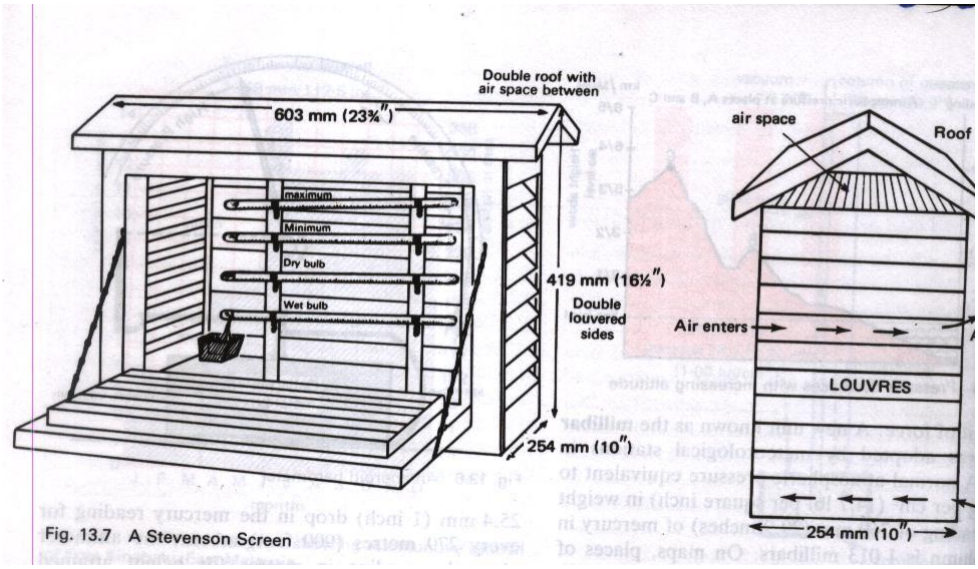


Fig. 13.7 A Stevenson Screen

The screen has the following features

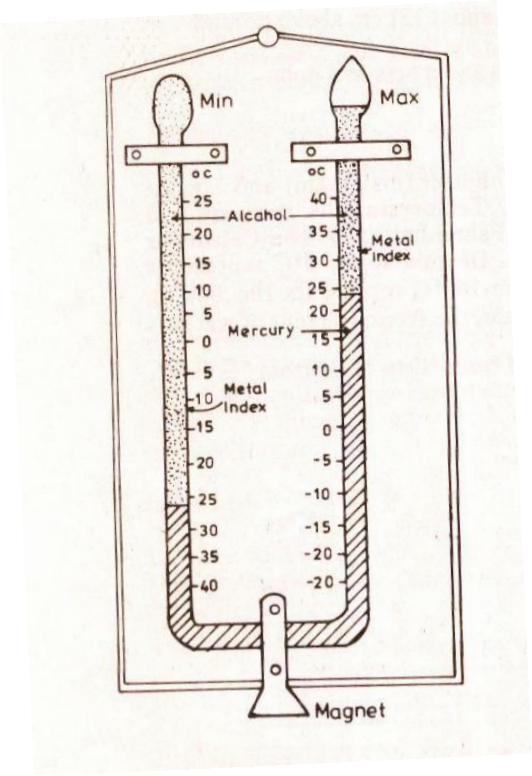
a. It is built so as to measure the shade temperature of the air.
b. It has louvered sides of allow free entry of air.
c. The roof is made of two wooden layers to form a bad conductor of heat
d. The screen is painted white so as to improve insulation.
e. The screen is placed on a stand about 121 cm above ground level.
f. One side of the screen is hinged and it acts as a door.

Atmospheric temperature

This is observed by **measure ring** the highest (maximum) and lowest (minimum) temperatures of a day. Temperature is measured in degrees centigrade (oc) or degrees fahrenheit (^oF). The Celsius or centigrade scale is commonly used on this scale 0^oC represents freezing point of water, and the 100^o represents the boiling point of water. On the Fahrenheit scale, the freezing point of water is 32^0F and the boiling point is 212^oF.

Measurement of temperature

Maximum and minimum temperatures are measured by the maximum and minimum thermometers. These are in form of separate thermometers or joined in a U – Shaped tube called a six's thermometer.



Maximum and Minimum Thermometer

To measure maximum temperature

a. Mercury in the glass tube expands when the temperature rises. This pushes the index in the right hand limb up to maximum.
b. The end of the index nearest the mercury gives the reading of the maximum temperature this is 30^oC in our example.
c. To reset the index for next day's reading; draw it back by a magnet.

To measure minimum temperature

Minimum temperature probably occurs early in the morning when temperature falls.

a. The alcohol in the left – hand limb contracts.
b. The mercury flows in the reverse direction.
c. The index is pushed up along the left hand limb.
d. When temperature rises, the alcohol flows past the index leaving it where it was pushed.
e. The end of the index farthest from the bulb gives the reading of the minimum temperature. This is 10^0C in our example.
f. To reset the index draw it back by a magnet.

Temperature Record

The following are used to keep a temperature record;

1. **Mean daily temperature** - this is the average of maximum and minimum e. g (30^oC+10^oC) ÷ 2 = 20^oC.
2. **Daily or Diurnal Range –** this is the difference between the maximum and minimum temperatures of a day.
3. **The annual temperature –** this is the difference between the mean temperature of the hottest month and that of the coldest month.

4. **The mean annual temperature –** this is the sum of mean month temperature for one year divided by 12 months.
5. **The mean monthly temperature –** this refers to the sum of mean daily temperatures for one month divided by the number of days in that month. On weather maps places having the same temperature are joined by a smooth line. Such a line is called an **isotherm.**

Rainfall

Rainfall is caused by the effect of solar radiation over land and water bodies. Solar radiation refers to the energy from sun. This energy gives rise, to various types of weather and climate. Solar radiation over sources or bodies of water causes evaporation.

The process of evaporation

Solar energy causes water to be transformed into vapour. This vapour enters the atmosphere by;

a. Evaporation from sea and land surfaces.
b. Transpiration from plants
   The combined total of evaporation and transpiration is termed **Evapotranspiration.**

The rate of evaporation depends on the following factors;

a. The temperature of evaporating surface. Evaporation is higher if the temperature of evaporating surface is higher than that of the air.
b. Relative humidity of the air evaporation is also highest if air is relatively dry.
c. Wind speed. It is also high if winds are strongest evaporation is greater in summer than in winter. It is also higher in tropical latitudes than in winter. It is also higher in tropical latitudes than in temperate and polar latitudes.

Condensation

When warm air rises, it is cooled and its capacity to hold water vapour is reduced. Condensation will occur if the rising air contains water vapour. The water molecules will pass into a liquid state and subsequently return to land and sea as precipitation, condensation may take the form of minute droplets of clouds, rain, mist dew or fog.

Water of oceans, atmosphere and land moves in a great cycle. This involves evaporation from sea and land, condensation to form clouds and precipitation in form of rain or snow. This exchange is called the **water cycle or hydrologic cycle.**

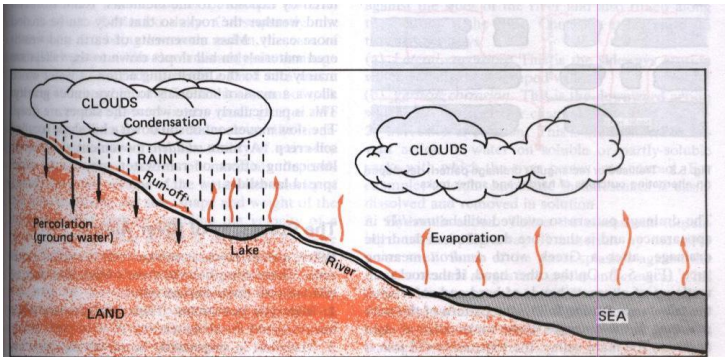


Fig. 5.1 The hydrological cycle: evaporation from sea and land forms clouds which condense into rain that falls to earth as run-off or percolates to form groundwater, or is absorbed by plants or evaporated again to form clouds. The cycle is repeated when clouds are condensed to fall as rain.

Types of rainfall

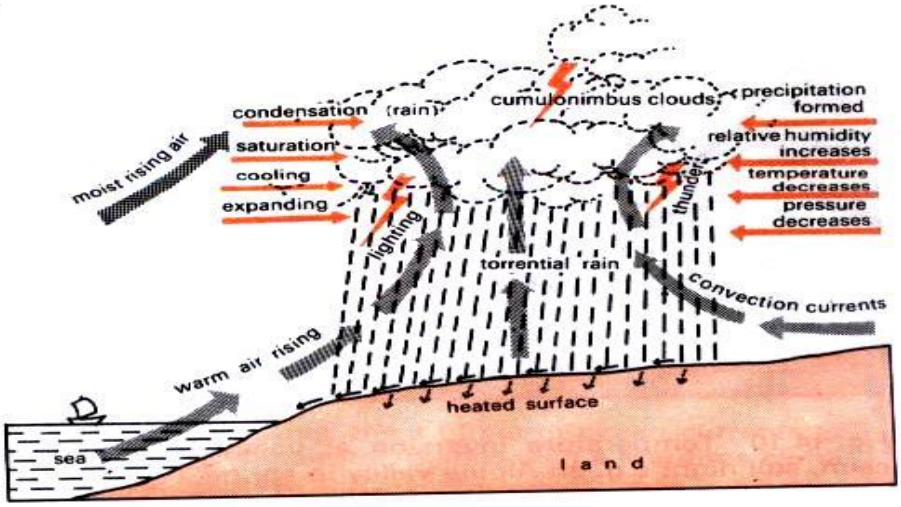
There are three major types of rainfall and these are:

1. Convectional rainfall

2. Orographic or relief rain

3. Cyclonic or frontal rain

1. **Convectional rainfall.** This type of rainfall is most common in regions that are intensely heated, either during the day, as in the tropics, or in the summer, as in temperate interiors. When the earth's surface is heated by conduction, moisture-laden vapour rises because heated air always expands, and becomes lighter. Air rises in a convection current after a prolonged period of intense heating. In ascending, its water vapour condenses into cumulonimbus clouds with a great vertical extent.
   This probably reaches its maximum in the afternoon when the convectional system is well developed. Hot, rising air has great capacity for holding moisture, which is abundant in regions of high relative humidity. As the air rises, it cools and when saturation point is reached, torrential downpours occur accompanied by thunder and lightning.



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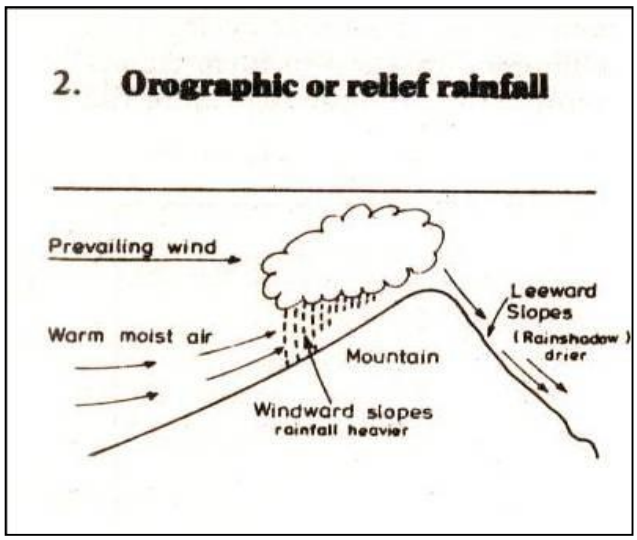
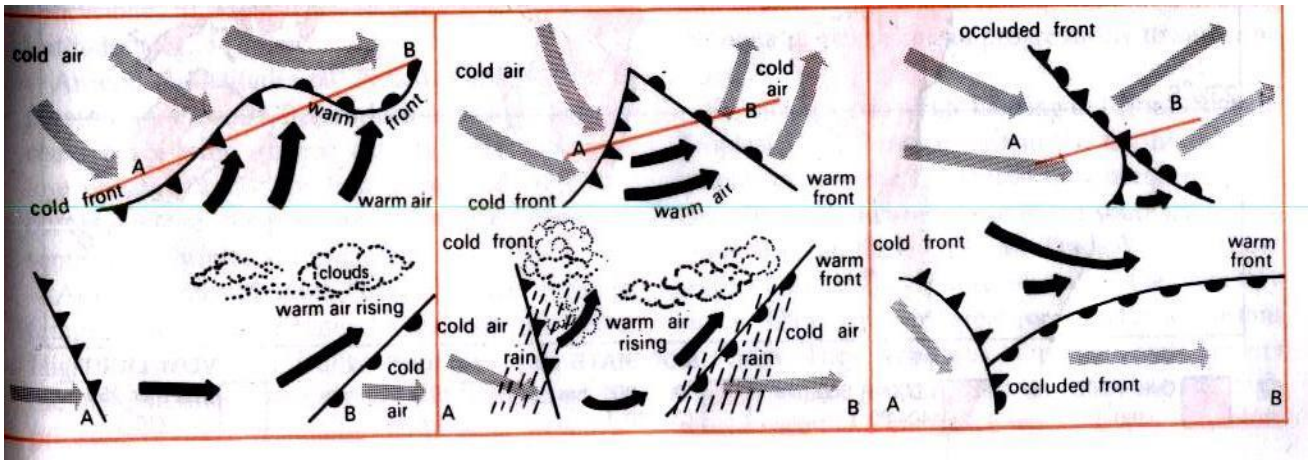
2.Orographic or relief rain – Unlike convectional rain which is caused by convection currents, orographic rain is formed whenever moist air is forced to ascend a mountain barrier. It is best developed on the windward slopes of mountains where the prevailing moisture – laden winds come from the sea. The air is compelled to rise and is thereby cooled by expansion in the higher altitudes and the subsequent decrease in the atmospheric pressure. Further ascent cools the air until the air is completely saturated (relative humidity is 100 per cent). Condensation takes place forming clouds and eventually rain. Since it is covered by the relief of the land it is also known as relief rain. The other side of the mountain where there is little or no rainfall is called the leeward slope. The wind is dry and does not bring rain. The area is termed the rain shadow e.g. the Luangwa valley in the lee of the Muchinga Escarpment.



Cyclonic or frontal rain – This type of rainfall independent of relief or convection. It is purely associated with cyclonic activity whether in temperate regions (depressions) or tropical regions (cyclones). Basically it is due to the convergence (meeting) of two different air masses with different temperatures and other physical properties. As cold air is denser, it tends to remain close to the ground. The warm air is lighter and tends to rise over the cold air. In ascent, pressure decreases, the air expands and cools, condensation takes place and light showers called cyclonic or frontal rain occur.

Cyclonic or frontal rain (depression)



Measurement of rainfall

An instrument called a **rain gauge** is used to measure rainfall. Rainfall is measured in **millimeters or inches.**

A rain gauge consists of the following parts;-

a. A metal or plastic container
b. A funnel
c. A graduate jar or measuring cylinder.

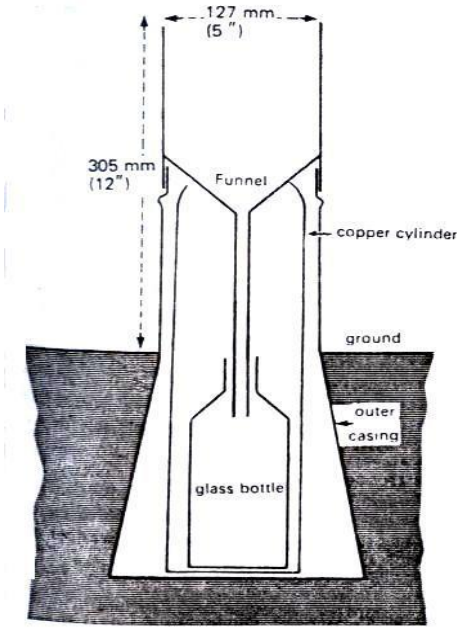


Fig. 13.1(a) A rain gauge

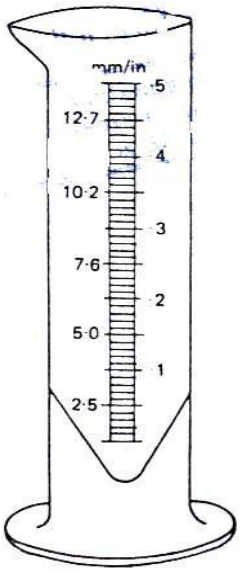


Fig. 13.1(b) An ordinary measuring cylinder

Fig. 13.1(c) A calibrated taper measure

Rain falling in the funnel trickles into the jar or measuring cylinder below.

Measurements are taken every 24 hours. The reading obtained is the depth of rain that has fallen over area equipment to the top of the funnel.

Position of rain Gauge

a. It must be sunk into the ground level. This is to prevent rain from splashing into the funnel from the g round.
b. It must be sunk into the ground to prevent excessive evaporation of rain water from the jar.
c. It must be placed in an open space. This is to prevent run - off water from buildings and trees from entering the funnel.

Recording rainfall

On weather maps all places having the same quantity of rainfall are joined by a line known as **isohyets.**

Humidity of the air

Humidity refers to the amount of water vapour that may be present in the air. This amount of water vapour varies from what air can hold at a given temperature and the actual amount of water vapour in the air is very important. This is called **relative Humidity** (R. H.). It is expressed as a percentage (%).

Example;

If R. H. is 60% a temperature of 30^{o}C, then air is only holding 6/10th of the water vapour it could hold at the temperature.

There is a limit to the quantity of water vapour that can be held by the air. This limit is known as the **saturation point.** This means that the air is saturated when the R. H. is 100%.

Humidity and temperature

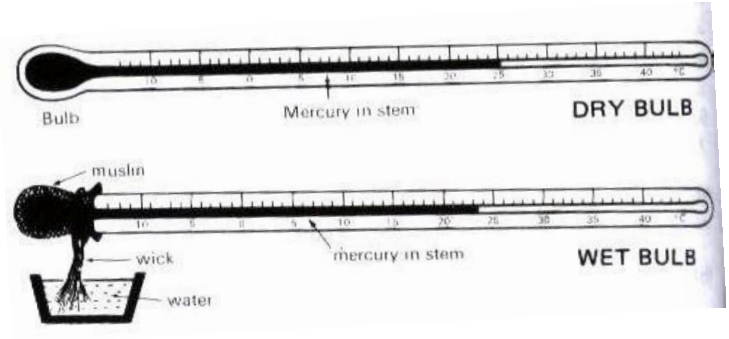
The amount of water vapour air can hold depends on temperature. When temperature rises air can hold more vapour. When temperature falls it cannot hold as much wate4r vapour. When relative humidity is at 100% the air cannot cont6ain excess water vapour. Any further addition will cause condensation to occur. Condensation may take the form of;

a. Minute droplets of clouds
b. Rainy mist
c. Dew or fog

The critical temperature at which the air is fully saturated is called the **dew point.** Below this point condensation will take place.

Measurement of humidity

An instrument called a **Hygrometer** is used to measure Humidity. This consists of a wet bulb and dry bulb thermometers.



The hygrometer

When air is not saturated water evaporate from the container and the muslin become wet. This cools the wet bulb and caused the mercury to contract.

The dry bulb is not affected and so the two thermometers show different readings.

The difference between the readings of the two thermometers is an indication of humidity in the air.

Thermometer reading	**Amount of Humidity**
Large difference	low humidity
Small difference	High humidity
No difference	air is saturated

Atmospheric air pressure

Air exerts weight on the earth's surface. This weight is called atmospheric pressure. A column of air 1sq cm in cross sectional areas extending from the sea level to the top of the atmosphere weights 1. 034 kg. Hence at sea level the atmospheric pressure is 1.034 kg per sq cm or 14.7 ibs per sq in.

Pressure is made up of a number of mixed gases and has weight. It therefore exerts a pressure on the earth's surface which varies from place to place and from time to time. On the maps places of equal pressure are joined by lines called **isobars.** Atmospheric pressure varies with both temperature and altitude.

Temperature and air pressure

High temperature causes air to rise. This lessens pressure acting on the surface. Hence;

a. High temperature areas are associated with **low pressure** (e.g. Equator belt). Regions of continuous low pressure belt are known as **doldrums areas.**
b. Low temperature areas are commonly associated with high pressure. This is because air is always descending.

Altitudes

Air is compressible; Air which lies lowest is most greatly compressed, and is therefore densest. Upwards both density and pressure fall rapidly

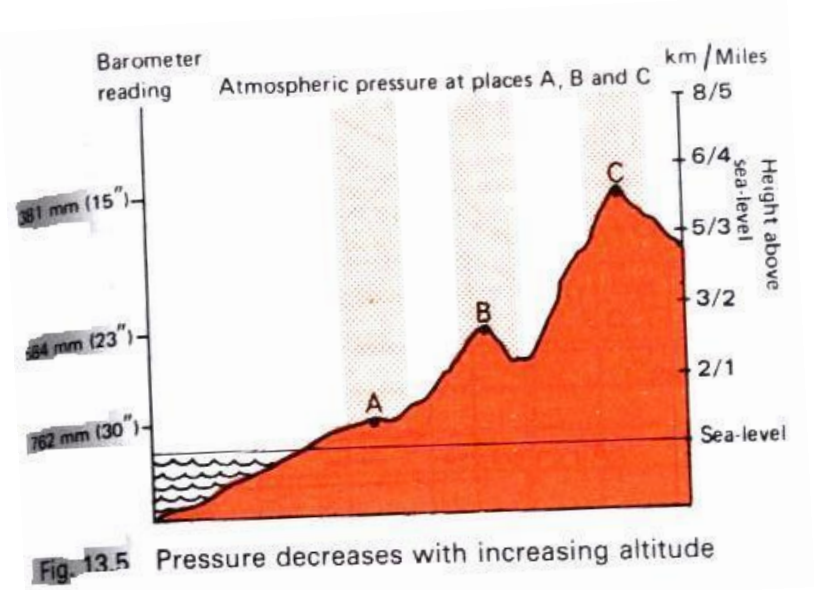


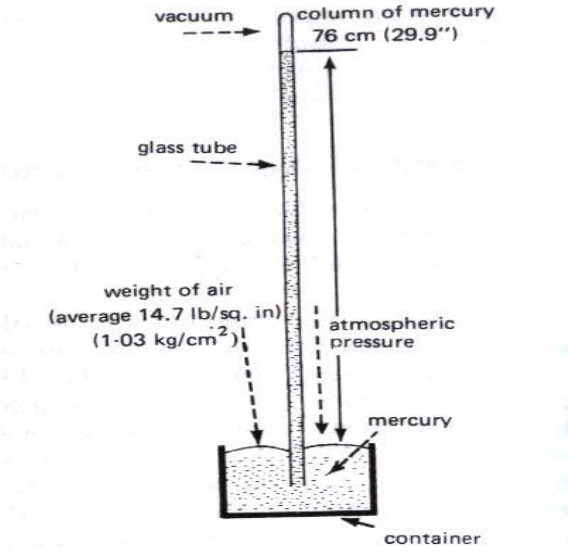
Fig. 13.5 Pressure decreases with increasing altitude

Measurement of pressure

Air pressure is measured in a unit known as the **millibar (mb)** and instrument that measures atmospheric pressure is a **barometer.** These are two types of barometers

The Mercury barometer

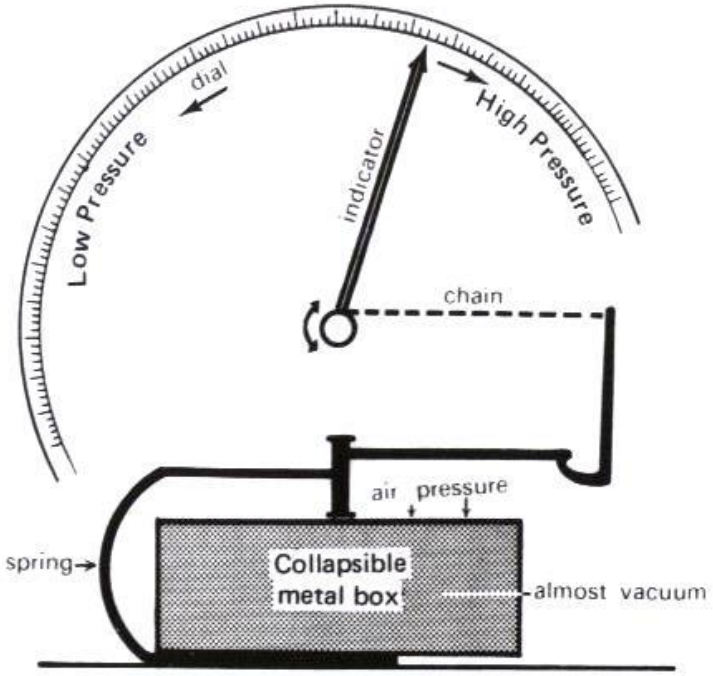
This is a very accurate although cumbersome instrument. In this instrument pressure is read in inches or in height of mercury in the glass tube balanced by the atmospheric pressure.
At sea level this is 29.92 inches or 76 cm (760 mm) in metric units.



Mercury Barometer

The Aneroid Barometer

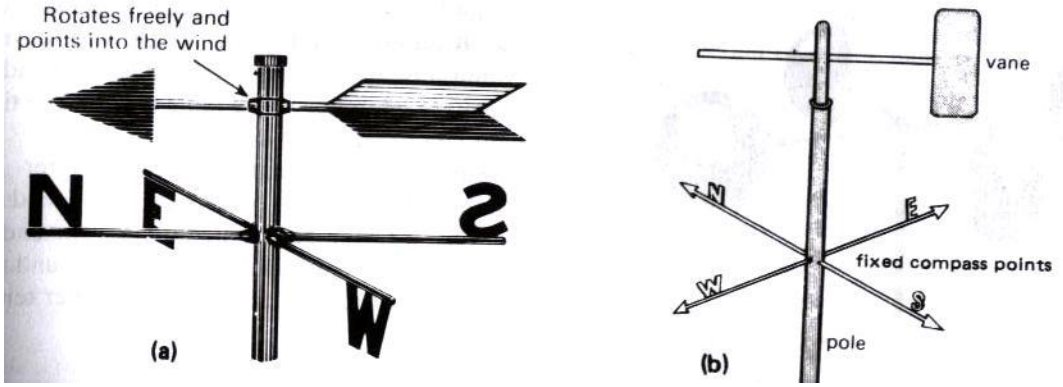
This instrument consists of a hollow metal box which contains very little air. The top of the box is flexible so that it expands and contracts according to changes in atmosphere pressure outside the box. This movement operates a hand which is read against the graduated circular dia.



Aneroid barometer

Wind direction and speed

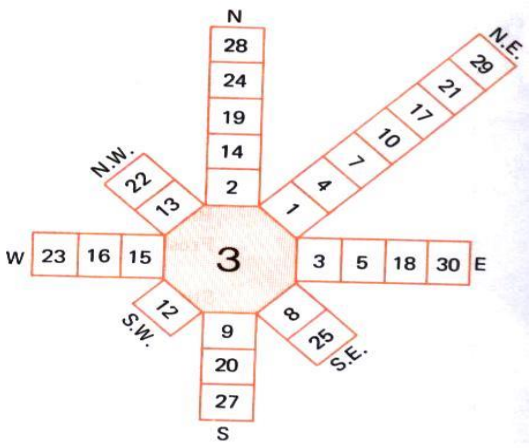
Wind is air in motion and has both direction and speed. The instrument widely used for measuring **wind direction** is a **wind vane** or **weather cock.** As wind direction is always deflected by trees and tall buildings weather cocks and wind vanes need to be created in an exposed position to get a true direction. It is made up of top two parts. One part is an arrow or vane on the top, which is free to move with the prevailing wind. The other part with the four compass points is stationery and shows in which direction the wind is moving winds are always named from the direction they blow; an east wind is one that blows from east to west and a south –west wind is one that blows from the south to west.



Wind vane

Wind rose

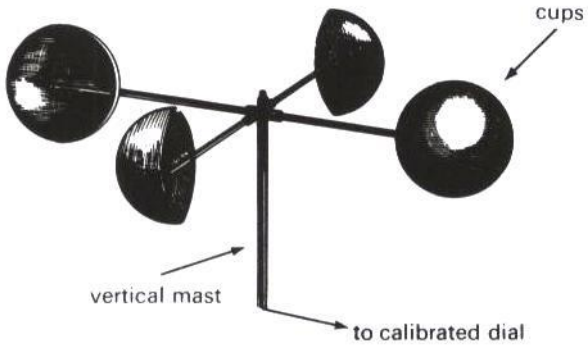
It is used for recording the direction of prevailing winds of a place over a period of a month. It consists of an octagon with the eight compass points. Each of the rectangles represents the date in which the wind comes from that direction (e.g.) on the fourth of the month, the wind is north east. These days which are without any wind is recorded in the box of the **calms,** and the number of calm days are indicated in the centre of the octagon e.g. 3 days in that month.



A wind rose

Anemometer

It is used to measure the speed of wind. It consists of three or four semi – circular cups attached to the ends of horizontal spokes mounted on a high vertical shaft. Metal cups are fixed to the ends of the arms, and they do rotate when there is wind. The movement operates a meter which records the speed of the wind in km per hour.



Anemometer

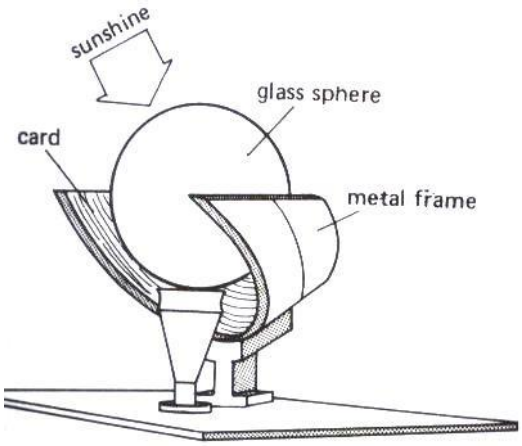
Since an anemometer is not easily available, a little practice of local wind observations will help us to asses the speed can be said about the strength of winds. The best guide is obtainable from the Beaufort wind scale.

Beaufort Scale No.	Arrow Indication	Wind Description	Speed Km/h (mph)	Effects (a guide to observation)
0		Calm	Less than 1.6 (1)	Smoke rises vertically
1		Light air	1.6–5 (1–3)	Wind direction shown by smoke-drift but not by wind-vanes
2		Slight Breeze	7–11 (4–7)	Wind felt on face; leaves rustle; vanes moved by wind
3		Gentle Breeze	13–19 (8–12)	Leaves and twigs in constant motion; winds extend light flags
4		Moderate Breeze	21–29 (13–18)	Raises dust and loose paper; small branches moved
5		Fresh Breeze	31–39 (19–24)	Small trees in leaf begin to sway; crested wavelets form on inland water
6		Strong Breeze	41–50 (25–31)	Large branches in motion; whistling heard in telegraph wires .
7		Moderate Gale	51–61 (32–38)	Whole tree in motion; walking inconvenienced
8		Fresh Gale	63–74 (39–46)	Twigs broken off trees; progress generally
9		Strong Gale	75–86 (47–54)	Slight structural damage occurs, chimney pots removed
10		Whole Gale	88–101 (55–63)	Considerable structural damage, trees uprooted
11		Storm	103–120 (64–75)	Widespread damage, very rarely experienced
12		Hurricane	More than 120 (75)	Widespread devastation, experienced only in tropical areas

The Beaufort Wind scale

Sunshine

The amount of sunshine a place receives depends on the seasons a factor determined by latitude and by the position of the earth in its revolution around the sun. In the tropics sunshine is abundant and at the poles there is less or no sunshine in the metrological station, sunshine duration is recorded by a **sun dial,** 102 mm (4inches in diameter, through which the sun's rays are focused upon a sensitized card graduated in hours. An instrument which is used to measure sunshine is called **sunshine recorder.** On the maps places with equal sunshine duration are joined by **isohels.**



Sunshine recorder

Clouds cover

When air rises, it is cooled by expansion. After dew point has been reached cooling leads to **condensation of water vapour** in the atmosphere. Tiny droplets of water vapour which are too small to fall as rain or **snow** will be suspended in the air and float as **clouds.** Their form shape, height and movements tell us a great deal about the sky conditions and the weather we are likely to experience. The amount of cloud cover in the sky is expressed in **eights or oktas** (e.g. $^{2}/_{8}$ is quarter covered $^{4}/_{8}$ is half covered; $^{6}/_{8}$ is three quarters obscured and $^{8}/_{8}$ is completely overcast). On the maps places with an equal degree of cloudiness are joined by lines known as **isonephs.**

Basic cloud cover

The classification of clouds is based on a combination of **form height and appearance.** Four major cloud.

a. **High clouds:** mainly cirrus of feathery form at 6100 – 12200 meters above ground.
   i. Cirrus (Ci). This looks fibrous and appears like wisps in the blue sky; it is often called 'mares' tails'. It indicates fair weather and often gives a brilliant sunset.
   ii. **Cirroculus** (Cc). This appears as white globular masses forming ripples in a 'mackerel sky'.
   iii. Cirrostratus (Cs). This resembles a thin white sheet or veil;, the sky looks milky and the sun or moon shines through it with a characteristic 'halo'

b. **Medium clouds;** mainly alto or middle height clouds at 2100 – 6000 meters.
   iv. **Alto cumulus** (alt –cu). These are woolly bumpy clouds arranged in layers and appearing like waves the blue sky. They normally indicate fine weather.
   v. **Altostratus** (alt – st) these are denser, grayish clouds with a 'watery' look. They have a fibrous or striated structure through which the sun's rays shine faintly.

c. **Low clouds**

   Mainly stratus or sheet clouds below 2 100 metres (7, 000 feet).

vi. **Stratocumulus** (st–cu) this is a rough bumpy cloud with the waves more propounded than in altocumulus. There is grant contrast between the bright and shaded parts.

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

viii. **Nimbostratus** (Ni –st) this is a dark dull cloud, clearly brings continuous rain snow or sheet.

d. **Clouds with great vertical extent** – mainly cumulus or heap clouds with no definite height 6100 – 9000 meter).

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

x. **Cumulonimbus** (cu – ni) – this is in fact an overgrown cumulus cloud extending for a tremendous vertical height from a base of 600 metres to over 9000 metres. Its black and white globular cauliflower top often spreads out like an **anvil.** This is frequently seen in tropical afternoons. It is also referred to as a **thunder – cloud** and brings convectional rain, accompanied by lighting and thunder.

Other elements pertaining to visibility

Other elements affecting visibility include **haze mist and fog.**

a. **Haze** – this is caused by smoke and dust particles in industrial areas or may be due to unequal refraction of light in air of different densities in the lower atmosphere. The term is usually used in connection with the **reduction of visibility** in region of **lower humidity** less than 75 per cent.

b. **Mist –** the condensation of water vapour in the air causes small droplets of water to about forming clouds at ground level.

Fog – ordinary fog is due to water condensing on dust and other particles like smoke from houses and factories. In industrial areas, like those of the Black Country and northern England very thick **smoky fog** called **smog** is formed. Fogs that occur on hills are called **hill fogs.** The lower layers of the air are chilled and water vapour in the atmosphere condenses to form **radiation fog** or **land fog**. When the cooling surface is over the sea or when a warm ocean current is brought into contact with a cold current as off Newfoundland, **sea fog** is formed.

CLIMATE

This is the average atmospheric weather conditions of an area over a long period of time. A minimum period of 30 years is taken for climatic observation.

Important elements of climate are

- temperature
- precipitation
- pressure
- wind

The sun's energy is called isolation or solar radiation and this turns into heat energy at the earth's surface.

Importance of temperature

-Temperature influences the actual amount of water vapor present in the air and thus decides the moisture-carrying capacity of the air.

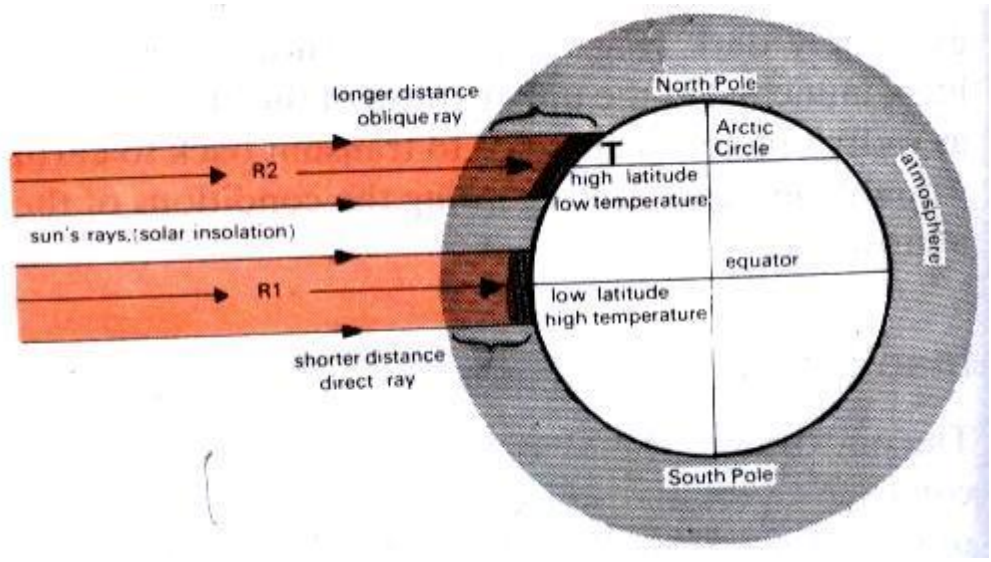
-It decides the rate of evaporation and condensation, and therefore governs the degree of stability of the atmosphere.

-As relative humidity is directly related to the temperature of the air, it affects the nature and types of cloud formation and precipitation.

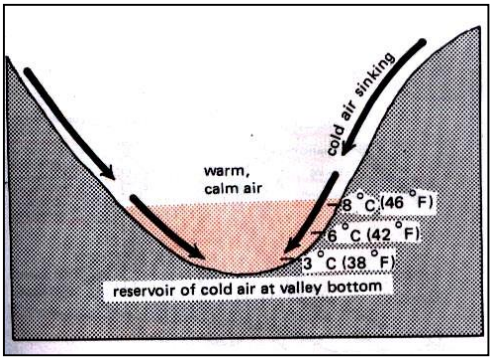
Factors affecting temperature

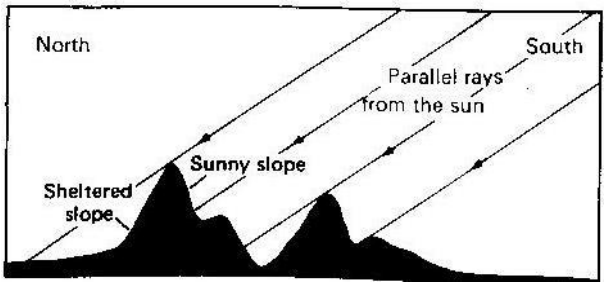
The temperature of a place is dependent on some or all of these factors**: latitude, altitude, distance from the sea, cloud cover and humidity, slope, shelter and aspect, length of the day, ocean currents.**

Latitude - The sun is overhead within the tropics only and hence high temperature is experienced. The area over which the sun is overhead directly will have higher temperatures than any other area on earth. This is because the distance from the sun to the ground is short than anywhere else. The sun rays will reach other areas at an **oblique** angle. There by covering a large surface area. The distance covered by the sun rays at oblique angle is longer hence less heat reaching such areas. So as one move towards the poles from the equator there is a decrease in temperature, but temperature increase towards the equator.



Slope, Shelter and Aspect- A steep slope experiences a more rapid change in temperature than a gentle one. Mountain ranges that have an east-west alignment like the Alps show a higher temperature on the south- facing "sunny slope" the north-facing "sheltered slope". The greater isolation of the southern slope is better suited for vine cultivation and has a more flourishing vegetable cover. Consequently, there are more settlements and it is better utilized than the "shady slope". In highly areas a hot day followed by a calm, cloudless night during which the air cools more rapidly over the higher ground may induce cold, heavy air to flow down the slope and accumulate at the valley bottom pushing the warmer air up wards. The temperature may then be lower in the valley than higher up the slope shown in the diagram. This is called a **temperature inversion.**





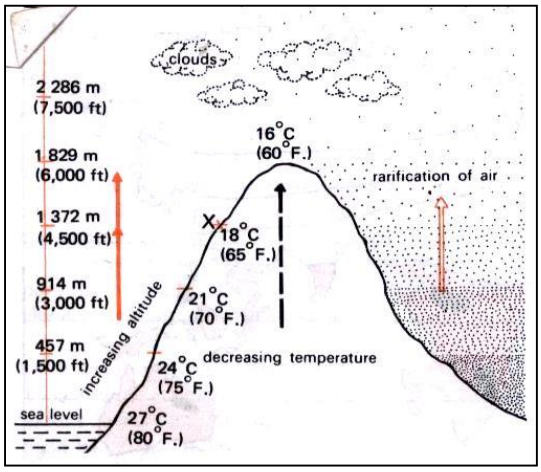
South-facing slopes are more sunny

than north facing slopes

Temperature invasion at valley bottom on

calm, still night. e.g alpine valley in spring

Altitude-Water vapor and dust in the air prevent heat formed at the surface of the earth from rapidly passing back into space. But at high altitude e.g. on the tops of high mountains, the air is rarefied and it contains very little dust or water vapour. The heat from the earth`s surface therefore rapidly escapes, and the air remains cold



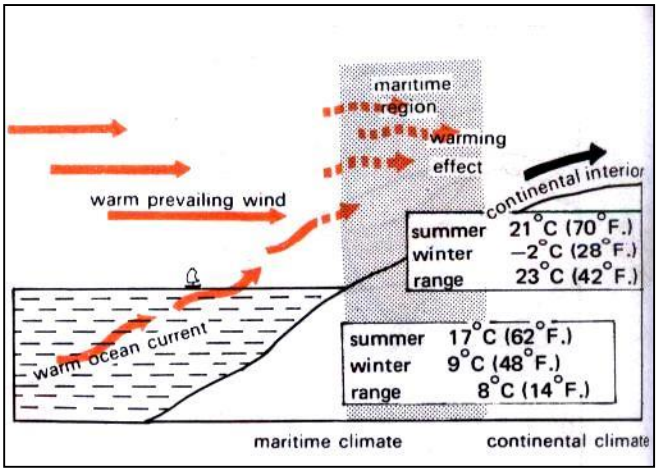
The lapse rate: the effect of altitude on mean

annual temperature in a tropical area.

Length of day- The length of day increases as latitude increases in the northern hemisphere, during the northern summer, and increases in the same manner in the southern hemisphere during the southern summer .Clearly, the average daily temperature of a place having 18 hours of day light is likely to be higher than a place having, say, only 10 hours of day light.

Distance from the sea- Land surfaces heat and cool more quickly than sea surface .In other words, water heats more slowly but it returns its heat for longer periods than does land. These characteristics have a marked influence on temperature, especially in temperature latitudes where the sea warms costal regions in the winter, but cools them in the summer. The warming influence is confined to a narrow coastal belt because the sea air rapidly loses its warmth to the colder land .Air temperature decreases from the coast inland. Climates whose temperatures are influenced gently by the sea are called maritime, or oceanic, or insular climates .These occur in coastal regions which lie under prevailing on shore winds.

Ocean currents and winds- Both ocean currents and winds affect temperatures by transporting their heat or coldness into adjacent regions.

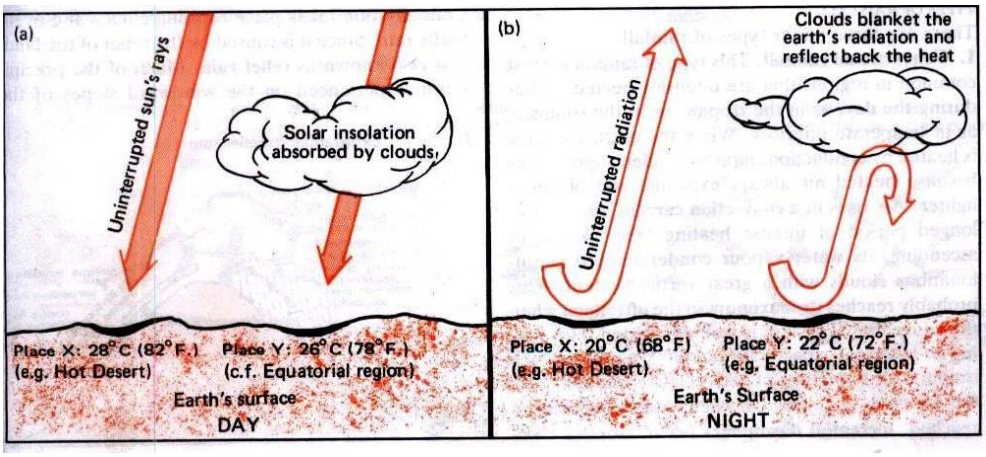


The warming effect of warm ocean currents are prevailing

Winds on coastal regions with a Maritime climate in temperature latitudes

Cloud cover and humidity- Clouds reduce the amount of solar radiation reaching the earth`s surface, and the amount of earth radiation leaving the earth`s surface .When there are no clouds, both types of radiation are at a maximum. In most parts of equatorial Africa there is a fall in temperature during the rainy season .This is because the extensive covering of cloud reduces the amount of solar radiation reaching the earth`s surface.

The effect of cloud covers on temperature.



Natural vegetation and soil- There is a definite difference in temperature between forested regions and open ground. The thick foliage of the Amazon jungle cuts off much of the incoming isolation, and in many places sunlight never reaches the ground. It is in fact, cool in the jungle and its shade temperature is a few degrees lower than that of open spaces in corresponding latitudes.

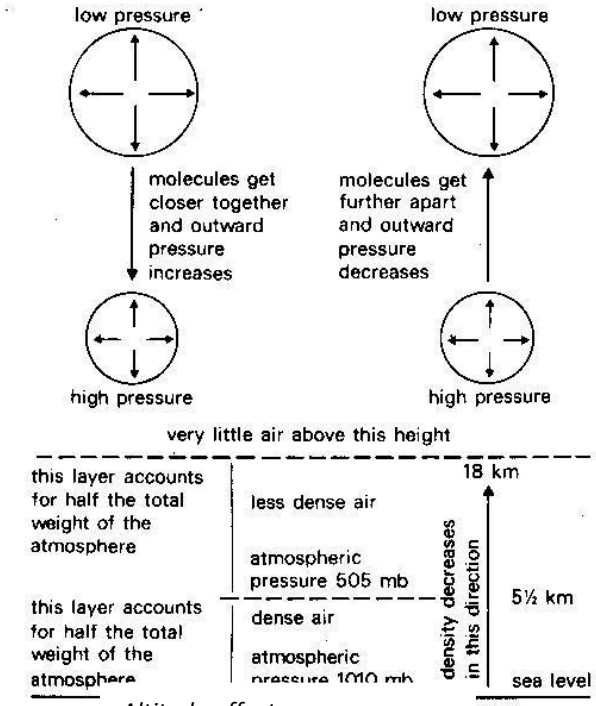
PRESSURE AND WINDS OF THE ATMOSPHERE

Pressure-origin and types

Air has weight and it therefore exerts pressure called **atmospheric pressure**, on the earth`s surface. The pressure is not the same for all regions, nor is it always the same for any one region all the time, i.e. in some regions the pressure is higher for one part of the year than it is another part of the year, Atmospheric pressure is affected by altitude , by temperature , and by earth rotation.

Influence of altitude on pressure

Air pressure at sea level is higher than it is at the top of a mountain. This is because at sea level air has to support a greater weight of air than does air on the top of a mountain. The molecules of the air at sea level push outwards with a force equal to that exerted by the air above it whereas the molecules of the air at the top of a mountain push outwards with much less force because the weight of the air above it is less. This explains why **air pressure increases when air descends.** When it descends volume decreases but the number of molecules in it remains the same. The outward pressure of these molecules is spread over a smaller area. Similarly when air rises, its volume increases and the outward pressure of its molecules is spread over a larger area and its pressure decreases.



Altitude affects pressure

Influence of temperature on pressure

1 .When air sinks its pressure increases because it becomes compressed. When air becomes compressed its molecules move more quickly and heat is produced. **The temperature of air rises when its pressure rises.**

2 .When air rises its pressure decreases because it expands. When air expands its molecules move more slowly and heat is used up .**The temperature of air falls when its pressure falls.**

3. When air is heated it expands and when this happens, the outward pressure of its molecules is spread over a large area. This means that the pressure of the air decreases

The pressure of the air falls when its temperature rises.

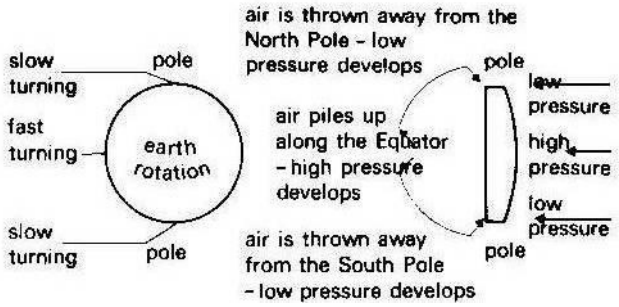
4. When air is cooled, it contracts and when this happens, the outward pressure of its molecules is spread over a smaller area. This means that pressure of the air increases. **The pressure of the air rises when its temperature falls.**

If only temperature affected pressure , there would be a belt of low pressure pattern of the atmosphere around the earth at the equator, and two belts of high pressure, one cover each pole. But because altitude, temperature and earth rotation all affect pressure, the pressure pattern is not as simple as this.

Influence of rotation on pressure

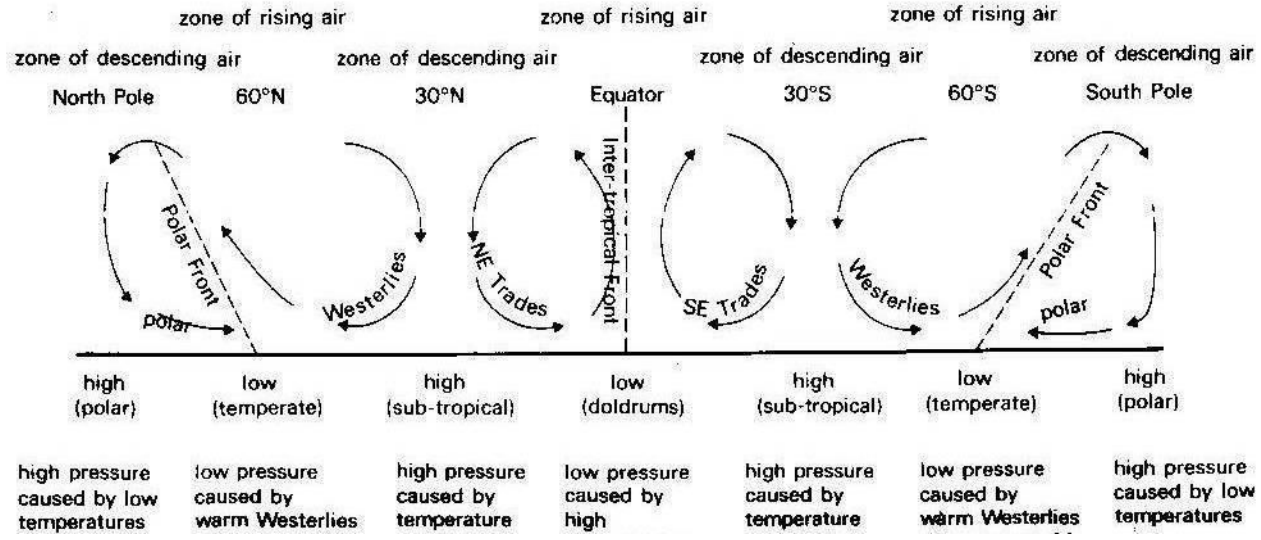
The rotation of the earth causes the air at the poles to be throne away towards the equator. In theory, this should result in air piling up along the equator to produce a belt of high pressure, whilst at the poles low pressure should develop. But what actually happens is much more complicated and we must examine how temperature and rotation together affect the pressure pattern.

Temperature – Low temperatures at the poles cause the air to contract, and high pressure develops. High temperatures along the equator cause the air to expand hence causes low pressure, called the **doldrum low pressure**, develops.



Rotation – Air blowing away from the poles crosses parallels that are getting larger and it spreads out to occupy greater space; i.e. it expands and its pressure falls. These low pressure belts are noticeable along 60 degrees north and 60 degrees south. They are known as the temperate low pressure belts. As the air moves away from the poles, more air moves in from higher levels to take its place some of this comes from the rising low pressure air along 60 degrees north and 60 degrees south.

Air rising at the equator spreads out and moves towards the poles. As it does so, it crosses parallels that are getting shorter and it has to occupy less space. It contracts and its pressure rises. This happens near to 30 degrees north and 30 degrees south, and in these latitudes the air begins to sink where it builds up sub–tropical high pressure belts, sometimes called the **horse latitudes**. Some of the high pressure air in latitudes 30 degrees north and 30 degrees south moves over the surface towards the equator, and some of it moves towards the poles. The air that moves towards the equator replaces the air that rises there. The air moving towards the poles reaches latitude 60 degrees north and 60 degrees south where it replaces the air that rises there.



rising over cold **and earth** **temperature** **and earth** **rising over cold**

polar air **rotation** **rotation** **polar air**

The pressure and patterns over the earth surface from the north pole to the south pole

Pressure belts and winds

The planetary wind system are caused and controlled by the major pressure belts that have already been examined. The diagram below shows the distribution of the pressure belts, together with the wind systems, as they would appear on an earth that had a uniform surface, i.e. all land or all sea, and that did not rotate.

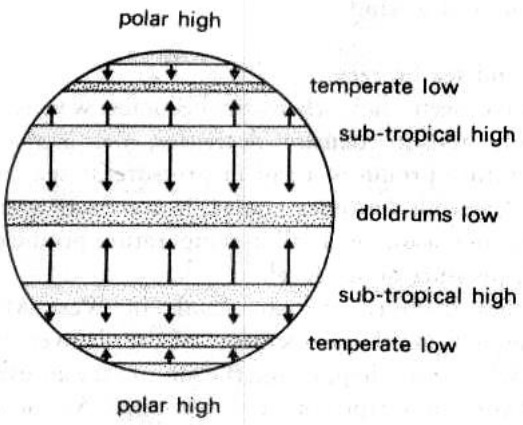
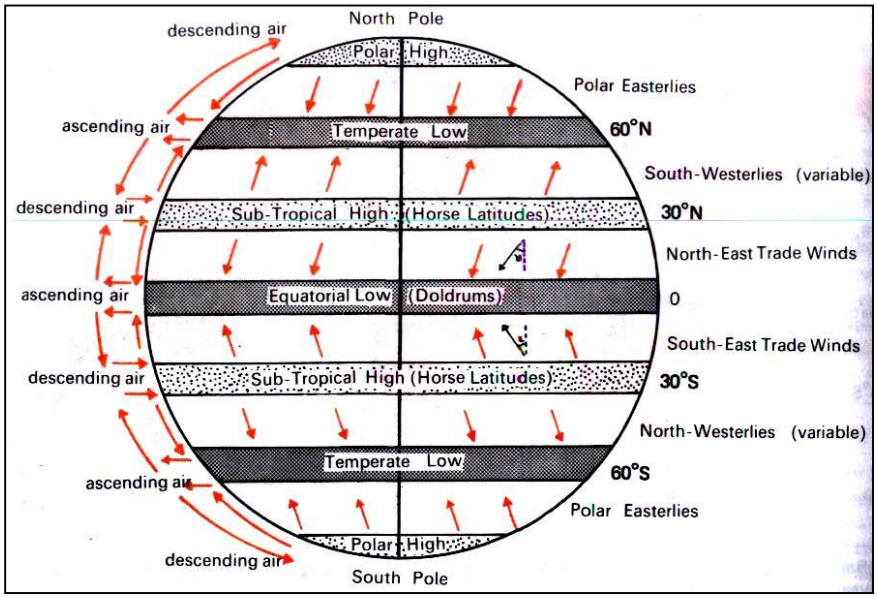


Fig. 15.9 What the pressure and wind patterns would be like if the earth did not rotate and if its surface was uniform

The diagram below shows the same pressure belts and wind systems as they occur on the earth , but remember that parts of the pattern of pressures and winds change seasonally because of seasonal changes of temperatur[illegible]e of pressures and winds.



Distribution of world pressure belts and planetary winds

The main difference these two diagrams is that the winds on a rotating earth are deflected to the right in the northern hemisphere, and to the left in the southern hemisphere.

Planetary winds are sometimes called **prevailing winds** because they blow more frequently than most other winds. Winds are usually named after the direction from which they blow. There are three major wind systems in each hemisphere. These are:

Northern hemisphere

North East Polar Winds: blow from the polar high pressure towards the pressure in latitude 60 degrees north.

South West Wind: below from the sub–tropical high pressure, in latitude 30 degrees north, towards the temperate low pressure.

North East Trade Winds: blow from the sub–tropical high pressure towards the doldrums along the equator.

Southern hemisphere

South East Polar Winds: blow from the polar high pressure towards the temperate low pressure in latitude 60 degrees south.

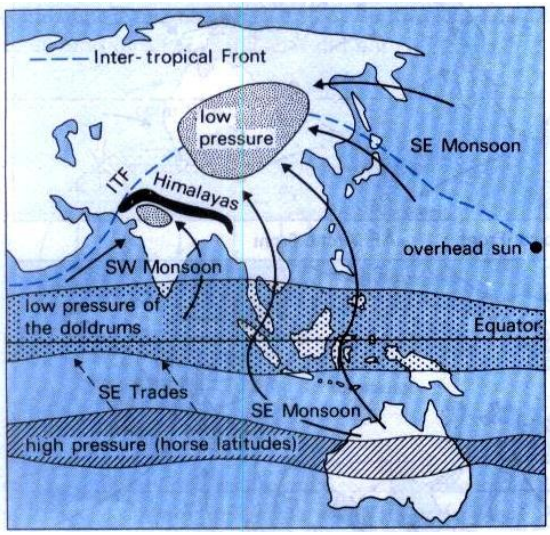
North East Winds: blow from the sub–tropical high pressure, in latitude 30 degrees south, towards the temperate low pressure.

South East Trade Winds: blow from the sub–tropical high pressure towards the doldrums along the equator.

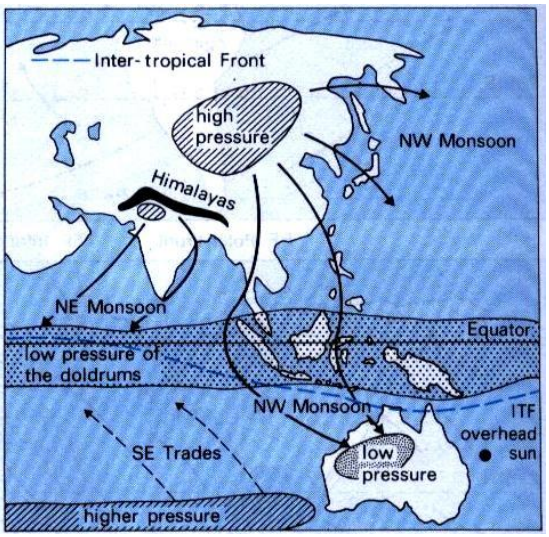
Note: The seasonal changes to the pressure pattern are accompanied by changes to the pattern of winds.

Monsoon winds

Monsoon is derived from an Arabic word mausim meaning season, and this is given to winds whose direction is completely reversed from one season to the next. The reversal is caused by a reversal in pressure systems. Monsoon winds are best developed in Asia [Japan, china, south East Asia and the Indian sub-continent] and to a lesser extent along the coast of West Africa and over northern Australia.



The monsoon wind pattern of Asia and Australia for July



The monsoon wind pattern of Asia and Australia for January

Air masses

An air mass is a large volume of air whose temperature and humidity are fairly uniform, and which covers an extensive surface area. An air mass only develops over an area which is extensive and which is uniform in build and shape e.g. a desert surface such as the Sahara, or central Australia, or an ocean surface. The characteristics of an air mass are derived from the region where it forms, and generally these charecteriscs are formed by air mass when it moves away, even to considerable distances from its source.

Some air masses are warm and moist, some are cold and dry. There are four types of air mass:

Equatorial: This forms over the equatorial oceans. This air mass is hot and unstable. **Tropical:** This forms near the sub-polar low-pressure belt. These air masses are cool to cold.

Arctic and Antarctic: which form respectively over the ice sheet of Green land and Antarctic. These air masses are very cold and stable.

The Inter-tropical Convergence Zone [ITCZ]: The climate of Africa is greatly influenced by the movement of air masses [maritime and continental] which differ in moisture content and stability. The zone where these air masses meet is called the ITCZ.

LOCAL ATMOSPHERIC DISTABURCES

Cyclonic Activity

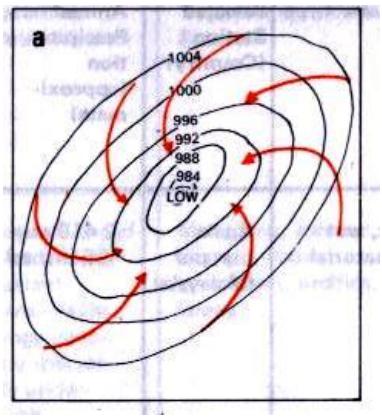
TROPICAL CYCLONES, TYPHOONS, HURRICANES AND TORNADOES all these are different kinds of tropical cyclones. They are well developed low pressure system into which violent winds blow. Typhoons occur in the China sea; tropical cyclones in the Indian ocean; hurricanes in the West Indian islands in the Caribbean; tornadoes in the Guinea lands of west Africa and the southern USA in which the local name of *whirl wind* is often applied, and *willy-willies* occur in north-western Australia.

Typhoons occur mainly in regions between six degrees and twenty degrees north and south of the equator and are most frequent from July to October. In extent, they are smaller than temperate cyclones and have a diameter of only 80 to 320 km [50-200 miles] but they have a much steeper pressure gradient. Violent winds with a velocity of over 160 km per hour are common. The sky is over cast and the torrential downpour is accompanied by thunder and lightening. In the wake of the typhoon, damage is wide spread.

Hurricanes have calm, rainless centers where the pressure is lowest but around this "eye" the wind-strength exceeds force 12 of the beau fort scale [120 kw.p.h. /75m.p.h.]. Dense dark clouds gather and violent stormy weather lasts for several hours.

Tornadoes are small but very violent tropical and sub-tropical cyclones in which the air is spiraling at a tremendous speed of about 800km.p.h. A tornado appears as a dark funnel cloud 75 to 425 metres in diameter. As a tornado passes through a region, it writhes and twists, causing complete devastation within the limits of its passage. Tornadoes are most frequent in spring but can occur at almost any time.

Cyclones – These are better known as depressions and are confined to temperature latitudes. The lowest pressure is in the centre and the isobars, as shown in climatic charts, are close together. They remain quite stationary or move several hundred kilometers in a day. Winds blow inwards into regions of low pressure in the centre, circulating in anticlockwise direction in the northern hemisphere and clockwise in the southern hemisphere.

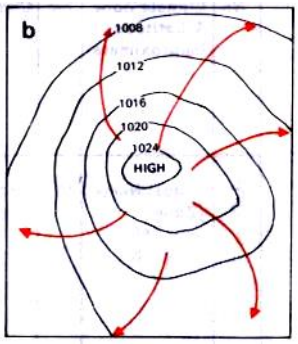


A cyclone in the northern hemisphere (close isobars, anti-clockwise winds

Anticyclone

This is an area of high pressure which, when shown on a map, has an oval or circular shape of closed isobars. The highest pressure is near the centre.

An Anticyclone develops in a region where the air is descending, and the winds associated with it blow outwards in a clock wise direction in the northern hemisphere, and an Anti-clockwise direction in the southern hemisphere. The direction of the winds is caused by the rotation of the earth.



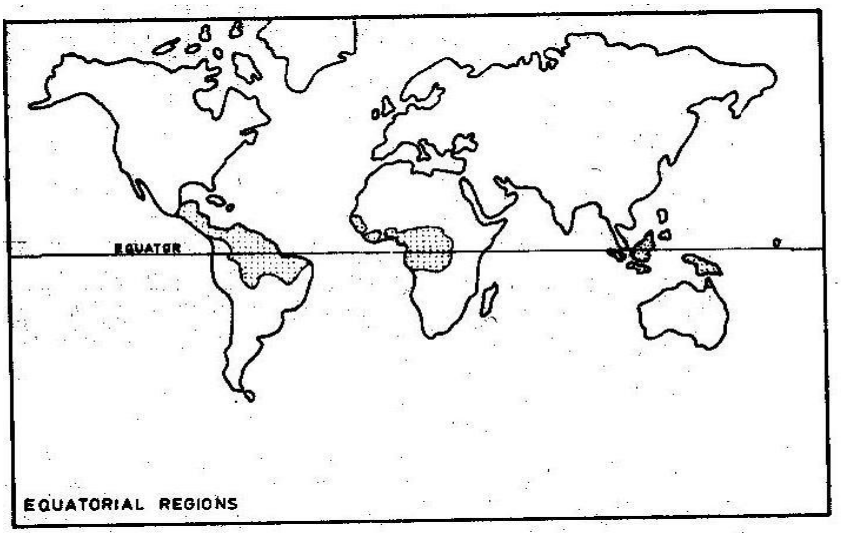
An Ant-cyclone in the northern hemisphere (well shaped isobars, winds blow in clockwise direction

An Ant-cyclone often remains stationary for long periods; sometimes it moves very slowly. Often it covers a large area, sometimes affecting a whole continent.

THE HOT, WET EQUATORIAL CLIMATE

Distribution

The equatorial, hot, wet climate is found between 5 degrees and 10 degrees north and south of the equator. Its greatest extent is found in the lowlands of the Amazon, Malaysia and East Indies .Further away from the equator, the influence of the on–shore Trade winds gives rise to a modified type of equatorial climate with monsoon influences. Within the tropics, the equatorial highlands have a distinctively cooler climate, modified by altitude, such as the Cameron highlands in Malaysia, the Northern Andes, and the Kenyan Highlands in East Africa.



Climate

Temperature – the most outstanding feature of an equatorial climate is its great uniformity of temperature throughout the year. The mean monthly temperatures are always around 27 degrees Celsius (80 degrees F) with very little variation. There is no winter. Cloudiness and heavy precipitation help to moderate the daily

temperature, so that even at the equator itself, the climate is not unbearable. In addition, regular land and sea breezes assist in maintaining a truly equable climate. The diurnal range of temperature is small, and so is the annual range.

Months	J	F	M	A	M	J	J	A	S	O	N	D
Temp. °C	26	26	27	27	27	26	26	26	26	26	26	27
Rainfall mm	170	170	236	279	216	127	144	157	185	276	257	231

Precipitation

Precipitation is heavy, between 1,524 mm and 2540 mm (60 inches and 100 miles), and well distributed throughout the year. There is no month without rain, and a distinct dry season like those of the Savanna or the Tropical monsoon Climates, is absent. Instead, there are two periods of maximum rainfall, in April and October as shown in the diagram above which occur shortly after the equinoxes. Least rain falls at the June and December Solstices. The double rainfall peaks coinciding with the equinoxes are characteristic feature of equatorial climates not found in any other type of climate.

Due to the great heat in the equatorial belt, mornings are bright and sunny. There is much evaporation and convectional air currents are set up, followed by heavy downpours of convectional rain in the afternoons from the towering cumulonimbus clouds. Besides the convectional rainfall, mountainous regions also experience much Orographic of relief rain. In addition, there are some intermittent showers from cyclonic atmospheric disturbances caused by the convergence of air currents in the doldrums. The relative humidity is constantly high (over 80 per cent).

Natural Vegetation

Equatorial regions support a luxuriant type of dense vegetation – the tropical rain forest because of the very heave rainfall (over 2032 mm/80 inches) and uniformly high temperature (27 degrees C / 80 degrees

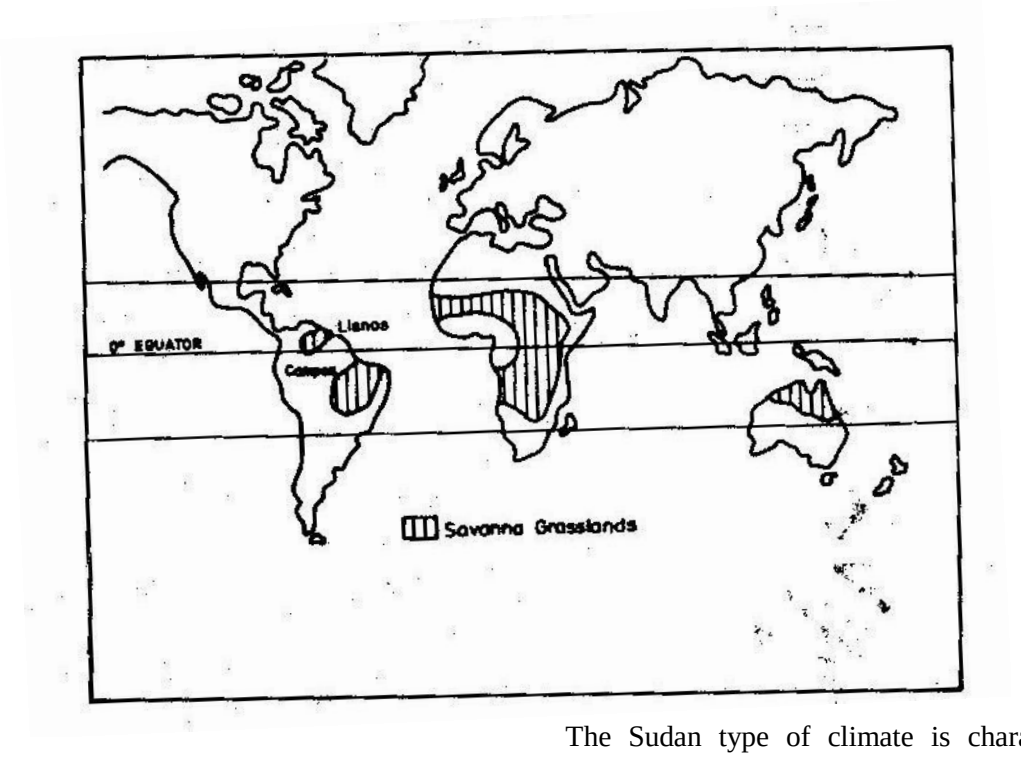
F).Plant growth is continuous throughout the year-seeding, flowering, fruiting and decaying do not take place in a seasonal pattern.

1. A great variety of vegetation. The equatorial vegetation comprises a multitude of evergreen trees that yield tropical hardwood, e.g. mahogany, ebony, greenheart, cabinet woods and dyewoods. There are smaller palm trees, climbing plants like the lianas or rattan which may be hundreds of meters long and epiphytic and parasitic plants that live on other plants. Under the trees grow a wide variety of creepers, ferns, orchids and lalang.
2. **A distinct layer arrangement.** From the air, the tropical rain forest appears like a thick canopy of foliage, broken only where it is crossed by large rivers or cleared for cultivation. All plants struggle upwards for sunlight resulting in a peculiar layer arrangement. The tallest trees attain a height of 45 metres.
3. **Multiple species.** Unlike the temperate forests, where only few species occur in a particular area, the trees of the tropical rain forests are not found in pure stands of a single species. It has been estimated that in the Malaysia forests as many as 490 species of trees may be found in a hectare of forest.
4. **Forest clearing.** Many parts of the virgin tropical rain forests have been cleared either for lumbering or shift cultivation. When these clearings are abandoned, less luxuriant secondary forests, called belukar in Malaysia, spring up. They are characterized by short trees and very dense undergrowth. In the coastal areas and blackish swamps, mangrove forests thrive.

THE SAVANNA OR SUDAN

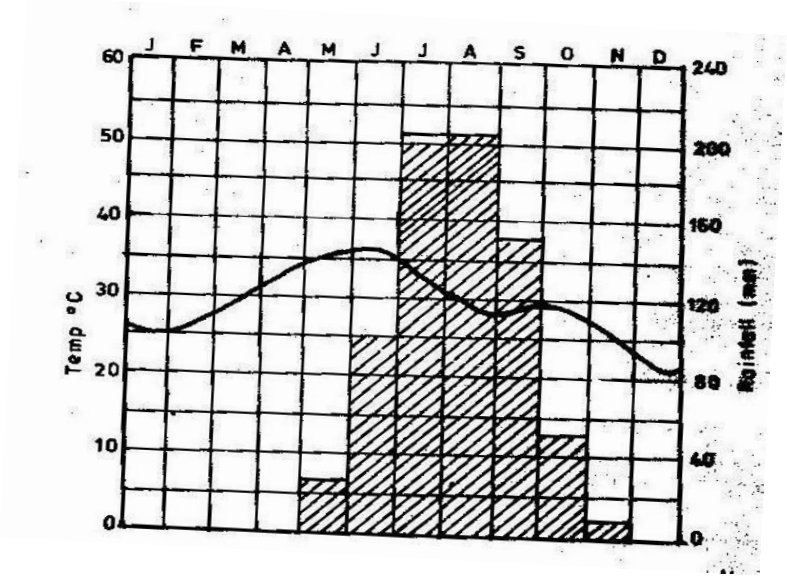
Distribution

The savanna or Sudan climate is a transitional type of climate found between the equatorial forests and the trade wind hot deserts. It is confined within the tropics and is best developed in the Sudan where the dry and wet seasons are most distinct, hence its name the Sudan climate. The belt includes West Africa Sudan, and then curves southwards into East Africa and Southern Africa north of the Tropic of Capricorn. In South America, there are two distinct regions of Savannas north and south of the equator, namely the Llanos of the Orinoco basin and the Campos of the Brazilian Highlands. The Australian Savanna is located south of the monsoon strip running from West to East, north of the Tropic of Capricorn.



Rainfall

The Sudan type of climate is characterized by an alternate hot, rainy season and cool, dry season, as shown in the diagram below. In the northern hemisphere, the hot, rainy season normally begins in May and lasts until September. The amount of rainfall varies from 1219mm (48 inches) at Bathurst, in Gambia on the Coast to only 127mm (5 inches) at Khartoum, in Sudan in the interior. In the Southern hemisphere, the rainy season is from October to March (the Southern summer) as shown in the diagram (b) below. The annual precipitation of Salisbury of 812 mm (32 inches) also varies much from year to year.



Temperature

The monthly temperature hovers between 21 degrees C (70 degrees F) and 32 degrees C (90 degrees F) for lowland stations. An annual temperature range of 11 degrees C (20 degrees F) is typical, but the range increases as one move further away from the equator. There is a distinct drop in temperature in the rainy period, due to the overcast sky and the cooler atmosphere.

Natural Vegetation

The savanna type of vegetation, typified by tall grass and short scattered trees is the product of a tropical wet – dry climate, transitional between that of the hot desert and the tropical forest. The term '**Parkland**` or `**bush veld**` are used to describe the landscape of savanna better.

Equator-wards, the trees increase in size and density due to an increase in annual rainfall and less distinct dry-wet climatic rhythm. But desert-wards the vegetation merges into scrub and thorny bushes.

Trees and plants adapt themselves to the Savanna climatic rhythm of long winter drought and short summer rain. Both trees and plants are therefore deciduous in nature, shedding their leaves in the cool dry season to prevent excessive loss of water through transpiration and lying dormant during the long drought. They have long roots (e.g. acacias) to search for ground water or broad trunks (e.g. baobabs and bottle trees) to store up excessive water. Trees are mostly hard, gnarled and thorny and may exude gum (e.g. Gum Arabic). Many trees are Umbrella- shaped to shied their roots from the scorching heat and to expose only a narrow edge to the strong trade winds that blow all year round. Palms which cannot withstand the drought are confined to the wettest areas or long rivers.

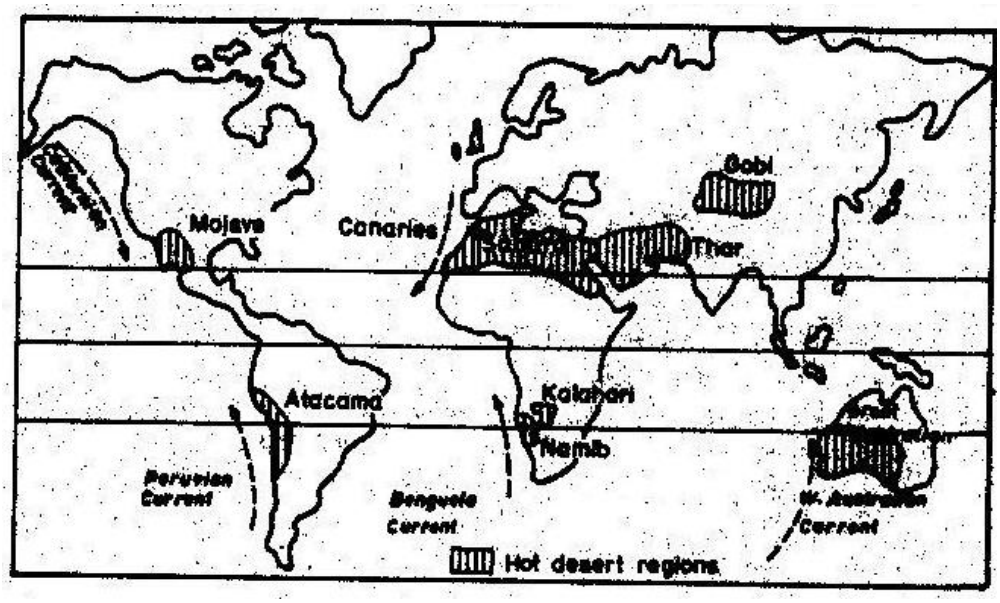
In true Savanna lands, the grass is tall and coarse, growing 2 to 4 meters high. The elephant grass may attain a height of 5 meters. The grass which grows in compact tufts has roots which reach deep down in search of water. The appearance of the savanna vegetation changes rainy season, but turns yellowish-brown and parched with the ensuing dry season.

TROPICAL MONSOON REGION

This is the most densely populated region in the world. Highly densely populated areas are the river valleys of this region.

Monsoon lands include:

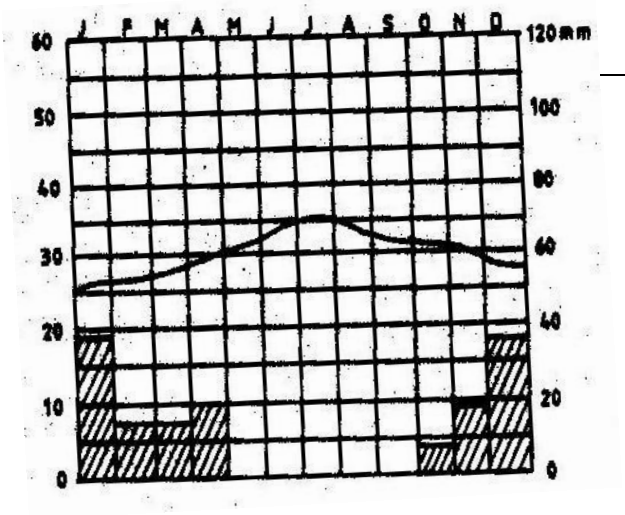
a) The Indian sub continent d. Burma g. Vietnam
b) Pakistan e. Thailand h. Parts of China
c) Bangladesh f. Kampuchea i. Koreaj. Japan



Climate

The word monsoon means season winds. It is because of the great influence of seasonal winds in the area that that the region is known as monsoon. The figures below show the distribution of temperature and rainfall in this region.

MONTH	J	F	M	A	M	J	J	A	S	O	N	D
Temp C	24	24	27	28	30	29	27	27	27	28	27	25
Rainfall	2	2	0	6	8	505	610	368	269	48	10	0



The main characteristics features of monsoon climate are:

a) **Wet on-shore south west winds in summer**
b) **Dry off-shore north east winds in winter**

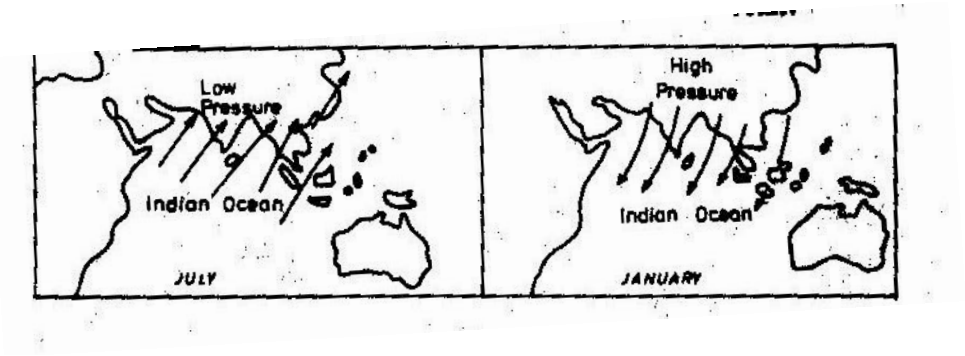
Temperature

i.) Very hot summers with average temperature of 30%
ii.) The hottest months of the year are usually April and May
iii.) Winters are warm to hot with average temperature of 24^{o} C

Rainfall

i.) Rainfall is brought by wet on-shore south west winds I summer
ii.) Rainfall varies according to locality. It is heaviest on windward sides of mountains

The basic cause of this type of climate is the unequal heating and cooling of the Asian land mass and the Indian Ocean.



Summer conditions

a) Central Asia is greatly heated
b) Low pressure develops over the Land
c) The Indian ocean remains cool
d) Winds are drawn to the land by the low pressure i.e S.W. monsoon winds
e) These winds are wet and the bring rainfall to the land.

Winter Conditions

a) The land is very cold while the Indian Ocean remains warm
b) High pressure develops on the land
c) Winds blow out from the land as dry North-East monsoon
d) No rain except S.E India and Sri Lanka.

In the monsoon region, three seasons can be distinguished. These seasons are:

1. **The Hot Dry Season**

This season lasts from March to June. The season is marked by a sharp rise in temperature. Day temperatures of 35 º C are usual. India Sub-Continent. Dust storms are frequent in the season.

2. The Hot West Season
   This season is marked between June and October. The South-west monsoon winds blow on-shore. Torrential downpours occur as this is the region's rainy season.

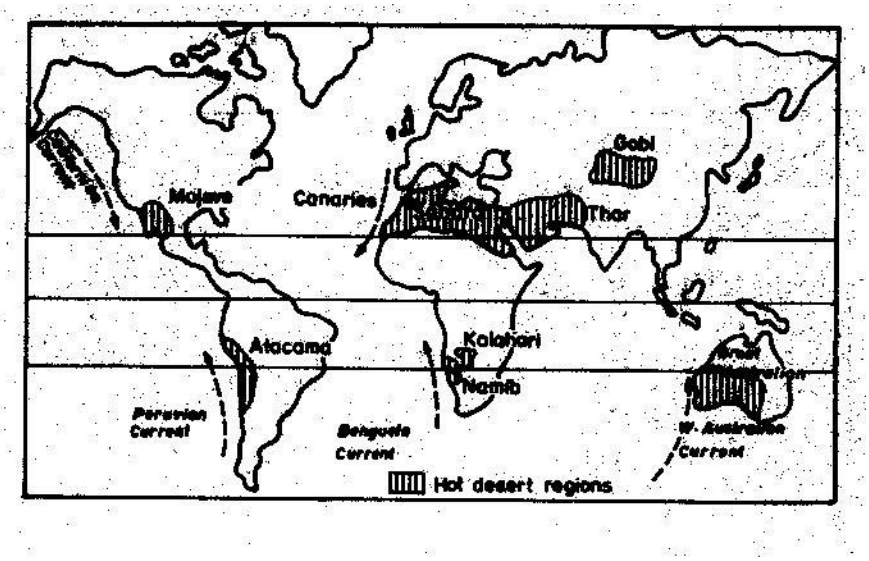
3. The Cool Dry Season
   The season lasts from October to March. Temperatures are low, averaging around 24 º C . A high pressure belt develops over the sub-continents, and dry north-East off-shore winds blow. There is no rain in the region.

DESERT AND MID-LATITUDE DESERT CLIMATE

Distribution

Deserts are regions of scanty rainfall which may be hot like the hot deserts of the savanna type; or temperate as are the mid – latitude deserts like the Gobi. The aridity of the hot desert is mainly due to the effects of off-shore Trade winds; hence they are also called Trade Wind Deserts. The temperate deserts are rainless because of their interior location in the temperate latitude, well away from the rain-bearing winds.

The major hot deserts of the world are located on the western coasts of continents between latitudes 15 degrees and 30 degrees north and south as shown in the figure below. They include the Sahara Desert, the largest single stretch of desert (5,150 km from east to west and at least 1600 km wide. The other hot deserts are Australian Desert, Arabian Desert, Iranian Desert, Thar Desert, Kalahari and Namib Deserts. In South America, the Atacama or Peruvian Desert is the driest of all deserts with less than 13mm (0.5 inches) of rainfall.



Rainfall

Few deserts whether hot or mid-latitude have an annual precipitation of more than 250mm. Some deserts, for instance, parts of the Sahara and the mid-Atacama, have practically no rain. The reasons why there is less rainfall are as follows:

1. Hot deserts lie in high pressure belts where air is always descending. In such conditions rainfall does not develop.
2. The prevailing winds across desert areas are the South East Trade Winds and the North East Trade Winds. These winds blow off-shore and have a very low relative humidity. Condensation is impossible and hence there is permanent drought.

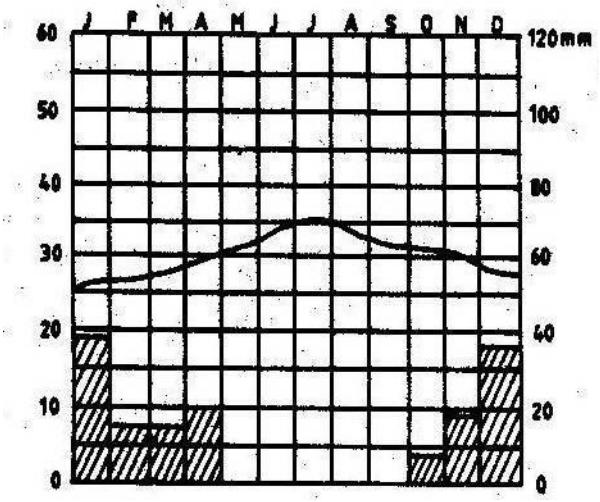
Off-shore South East Trade Winds across the Kalahari and the Namib deserts coasts of the hot deserts are washed by cold ocean currents for example the cold Benguela current.

Temperature

The deserts are some of the hottest spots on the earth and have high temperatures throughout the year. There is no cold season in the deserts and the average summer temperature is around 30 degrees C. The reasons for the high temperatures are: cloudless sky, intense isolation, dry air and a rapid rate of evaporation.

Coastal deserts by virtue of their maritime influence and the cooling effect of the cold currents have much lower temperatures. The desert interiors however experience much higher summer temperatures and the winter months are rather cold. The diurnal range of the temperature in the desert is very high due to the great difference between day and night time temperatures.

	J	F	M	A	M	J	J	A	S	O	N	D
Temp.	26	26	27	29	31	33	35	34	33	32	30	27
Rain	38	15	15	20	0	0	0	0	0	8	18	36



Natural Vegetation

Desert vegetation does not appear green and fresh all the time. Most vegetation lies dormant in the soil awaiting rainfall. Hot deserts have scant vegetation due to intense heat and low rainfall. The dormant vegetation of the hot desert regions are:

(a) Xerophytic plants-these are drought resistant plants such as cacti and dwarf acacias.
(b) Halophytes-These plants are adapted to survive in saline or salty soils of hot deserts caused by intense evaporation.

Most desert vegetation has developed characteristic adaptations to their environment. The following are the common characteristics of desert vegetation.

i. Long roots to search for ground water
ii. Few or no leaves to reduce transpiration
iii. Waxy, leathery, hairy or needle shaped leaves to reduce loss of water through transpiration.
iv. Thick succulent stems to store-up water for long droughts.
v. Their seeds have thick though skins as protection while they lie dormant during very long dry periods.

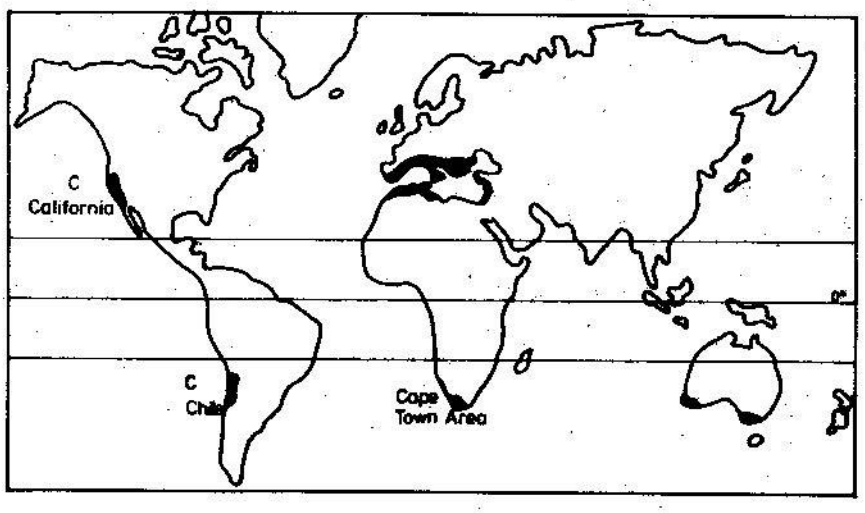
THE WARM TEMPERATE WESTERN MARGIN (MEDITERANEAN) CLIMATE

Distribution

Mediterranean lands are located on the western side of the continental land masses. They occur between latitude 30 degrees and 45 degrees north and south of the equator. The basic cause of this type of climate is the shifting of the wind belts. This type of climate is found in the following areas.

(a) The area around the Mediterranean Sea. This region is named after this sea.
(b) Central Chile

(c) Central California around San Francisco
(d) The Southern and South-Western Australia
(e) The area around Cape Town in South Africa



Climate

Mediterranean regions have a peculiar climate characterized by very distinctive climatic features.

1. A dry, warm summer with off-shore trades winds.
2. Summer temperatures are moderated by the coastal location of these regions.

Mediterranean region of South Africa

i. Prevailing winds are dry off shore trade winds
ii. No rainfall due to dry winds.

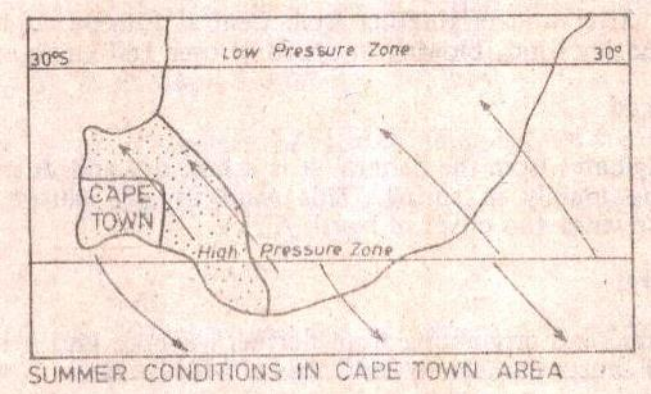
Temp	7	8	11	18	22	22	24	22	21	17	12	8	°C
RAIN	81	69	74	66	56	41	18	25	64	127	112	99	mm
	J	F	M	A	M	J	J	A	S	O	N	D	

Summers

a) Warm and dry summers with dry offshore trade winds
b) Summer temperatures are moderated by the coastal location of these regions.

Mediterranean of South Africa

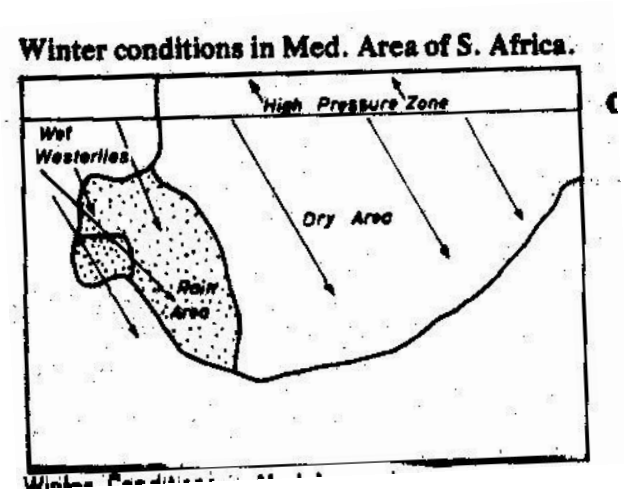
i.) Prevailing winds are dry offshore trade winds
ii.) No rainfall due to dry winds



Winters

(a) Mild and wet winters
(b) Prevailing winds are wet on shore westerly
(c) The westerly winds bring the following conditions.

i.) Rainfall to Mediterranean lands in winter a peculiar characteristic of this region
ii.) Moderate temperatures of these regions to about 10 degrees C. The winters therefore are **mild and wet.** Winter conditions in Mediterranean Area of South Africa



Conditions

- Warm wet on shore westerly winds
- Warm winds raise the winter temperature to around 10 degrees C
- Rainfall over area around cape town

The Mediterranean lands around the Mediterranean Sea are usually affected by local winds of varying strength and directions. These local winds affect the lives, crops and activities of the people of this region.

Natural Vegetation

(a) Plant growth is not luxuriant due to moderate rainfall, and high evaporation rate.
(b) Trees have small broad leaves and are mainly spaced
(c) Mainly trees are Xerophytic i.e. drought resistant due to dry air, excessive evaporation and prolonged drought.

The vegetation types are as follows:

1. **The Mediterranean evergreen forests**
   (a) The trees of these are:

   i. Cork oaks of Spain and Portugal

   ii. Red wood or giant sequoia of Central California

   iii. Eucalyptus of Mediterranean Forests of Australia

   iv. The jar rah of S.W Australia

   (b) These trees are evergreen with small leathery leaves and widespread root system to search for water.

2. **The Evergreen coniferous Trees**

(a) These evergreen trees include:

Pines, Cedars, Firs, Cypresses

(b) The trees have needle shaped leaves to lessen transpiration.

3. Bushes and shrubs

(a) These are the most common in Mediterranean areas

(b) Most bushes are strongly scented. They include: Lavender, Laurel, and Myrtle

(c) Shrub vegetation has emerged in many areas due to man's exploitation of this vegetation.

This is known as

i. Macchia in Italy and Chaparral in California

4. **Grass vegetation**

(a) Grasslands are found in few places

(b) Climatic conditions do not suit grass-rain comes in winter when vegetation growth is slow

(c) Due to poor grassland vegetation, livestock farming is less important

Human occupation in Mediterranean lands may often be traced to the following economic activities.

(a) The growing of fruit

(b) Cultivation of cereals

(c) Development of agricultural industries e.g. wine making

(d) Tourism

Fruit cultivation

Mediterranean climate is ideal for fruit growing. The long dry sunny summers enable the fruits to ripen and be harvested. Mediterranean lands account for about 70 per cent of the world` export of Citrus fruits. Mediterranean lands are known as the Orchard lands of the world. Citrus fruits cultivated include:

(a) Orange (b) Limes (C) Lemons (d) grape fruits

TEMPERATE GRASSLANDS /Continental Climate

Distribution

This climatic region occurs in the interior of continents and therefore has no maritime influence. Regions with this type of climate include the following:

(a) The steppes of Eurasia

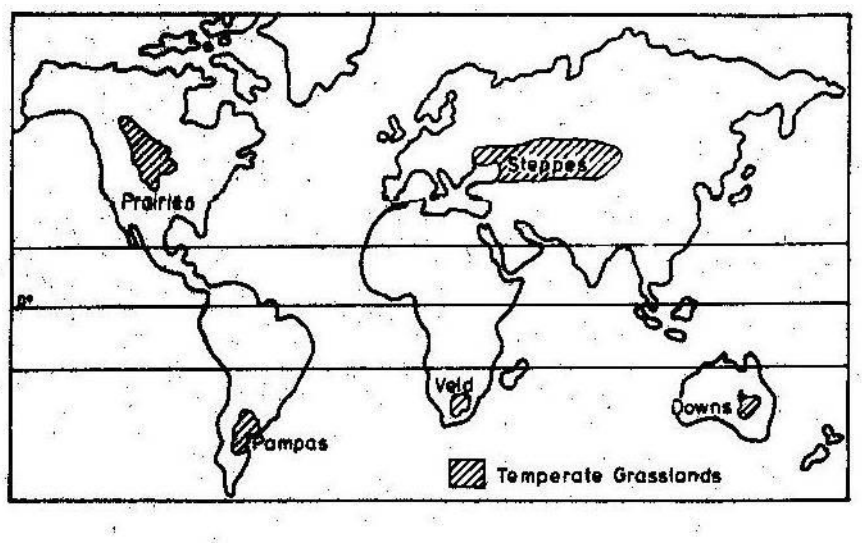
(b) The prairies of North America

(c) The pampas of Argentina

(d) The high geld of South Africa

(e) The Downs of Australia in the Murray Darling Basin

(f) The Canterbury plains of New Zealand



CLIMATE

Temperatures

a. Summers are very warm to hot. Temperatures rise to 26 degrees C in many parts.

b. Winters are very cold, usually below 0 degrees C and reaching 20 degrees in many parts.

c. The grasslands of the Northern Hemisphere are very cold. This is because they are located very far from the sea.

d. Grasslands of the Southern Hemisphere have mild temperatures. This is because they are narrow and the sea's influence is present.

Precipitation

The annual precipitation is very light due to continental location. The average annual rainfall is about 508mm.

a. In the Northern grasslands, rainfall is of convectional type occurring in summer.

b. In winter precipitation is in form of snow.

c. The Southern grasslands have higher rainfall, because of maritime influence. There are warm ocean currents near these grasslands.

Climatic Characteristics

MONTHS	J	F	M	A	M	J	J	A	S	O	N	D	
TEMP	-20	-18	-9	3	11	17	19	18	12	5	-6	-14	°C
RAIN-	23	18	30	36	51	79	79	56	56	36	28	23	mm

Natural Vegetation

These grasslands are almost treeless, extending as far as the eye can see. Poor climatic conditions such as extreme cold and scanty rainfall discourage tree growth. The main vegetation characteristics are as follows:

a. Tall and nutritious grass is found in moisture regions, such as the black earth regions of the Ukraine and the prairies.

b. Grasses are shorter, tougher and less nutritious in drier regions such as the Asian steppes.

c. Grass withers in summer and new leaves form in spring.

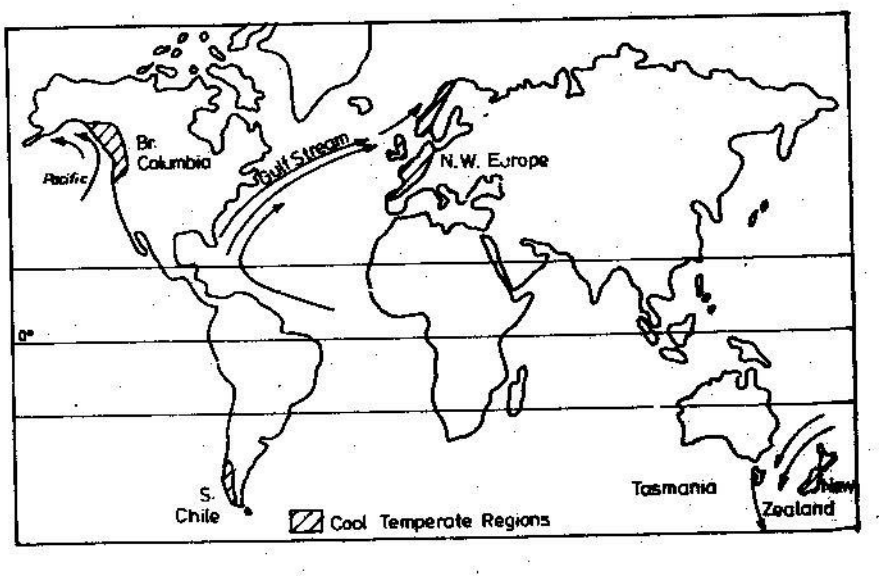
d. A few trees such as poplars, willow and alders grow in damp soils near water courses.

THE COOL TEMPERATE WESTERN MARGIN (BRITISH TYPE) CLIMATE

Distribution

Areas with this type of climate are located on the Western side of land masses. They are also under the permanent influence of on shore westerly winds all year round. Their shores are washed by warm ocean currents flowing towards the poles. Regions characterized by this type of climate include:

a. Britain
b. The lowlands of North West Europe
c. British Columbia in N. America
d. Southern Chile
e. Tasmania
f. New Zealand



Climate

Climate of this region is known as insular or maritime. This is because of the influence of oceans on both temperature and precipitation.

Climate Characteristics

a. **W**esterly winds blow from ocean all year round.
b. Westerly winds are warm and wet and they bring rainfall throughout the year.
c. The westerly winds raise the temperature of the land in winter and lower the temperature in summer.
d. Warm ocean currents also help to raise the temperature in winter.

Temperature

Moderately warm summers And fairly mild wind winters. Summers are warm with temperatures more than 18 degrees Celsius. Winters are mild and temperature does not fall below the freezing point. This is due the warm ocean currents and the prevailing westerly winds.

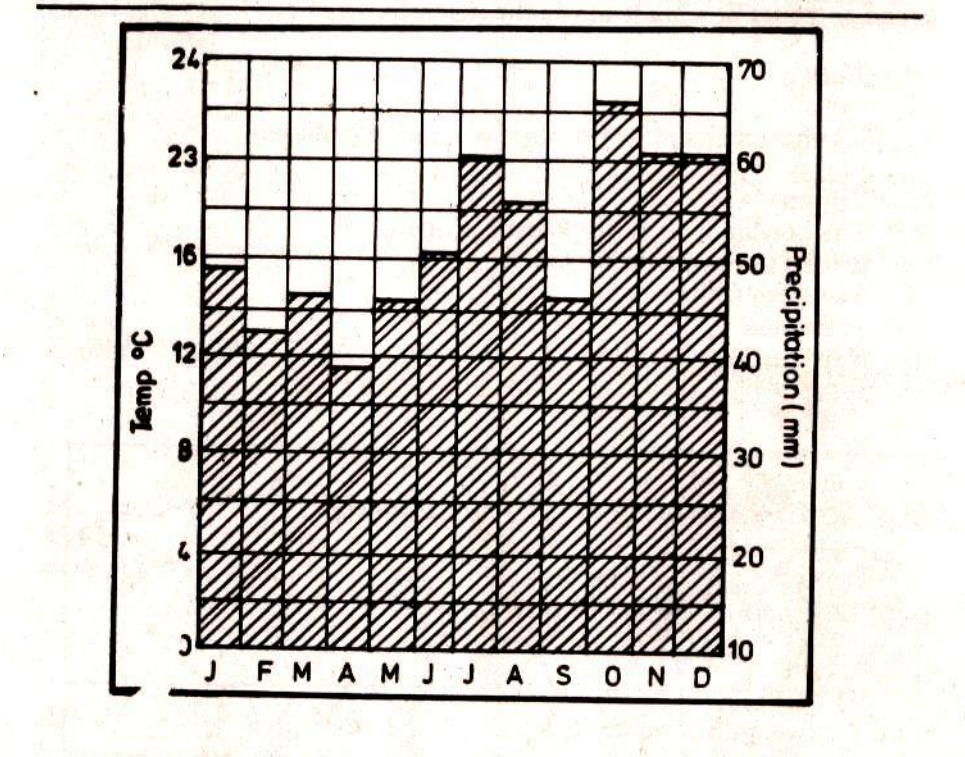
Precipitation

There is adequate rainfall throughout the year ranging from 508 and 1016mm. rainfall is brought by the in-shore westerly. The amount of rainfall decreases eastwards with the increase in distance from the sea. Relief also causes differences in the total amount of rainfall. Seasons

This climatic region has four distinct seasons.

a. winter
b. Spring. This is the most refreshing season when plants become green again.
c. Summer
d. Autumn

Months	J	F	M	A	M	J	J	A	S	O	N	D
Temp. °C	4	4	16	8	12	15	17	17	14	10	7	4
Rain mm	48	43	46	38	46	51	61	56	46	66	61	61



Natural vegetation

The climate of this region supports deciduous forests. However, grass lands and coniferous forests occur in cooler areas. The following characteristics can be observed.

a. forests consist of broad leafed trees.
b. Deciduous trees drop their leaves in winter as the protection against snow and frost.
c. Frosts are less luxuriant and trees occur in pure stands.
d. Trees yields valuable temperate hard wood, good for fuel and industrial purposes.

Common tree species

Broad leafed trees include:

Oak, Poplar, Ash, Birch, Elm.

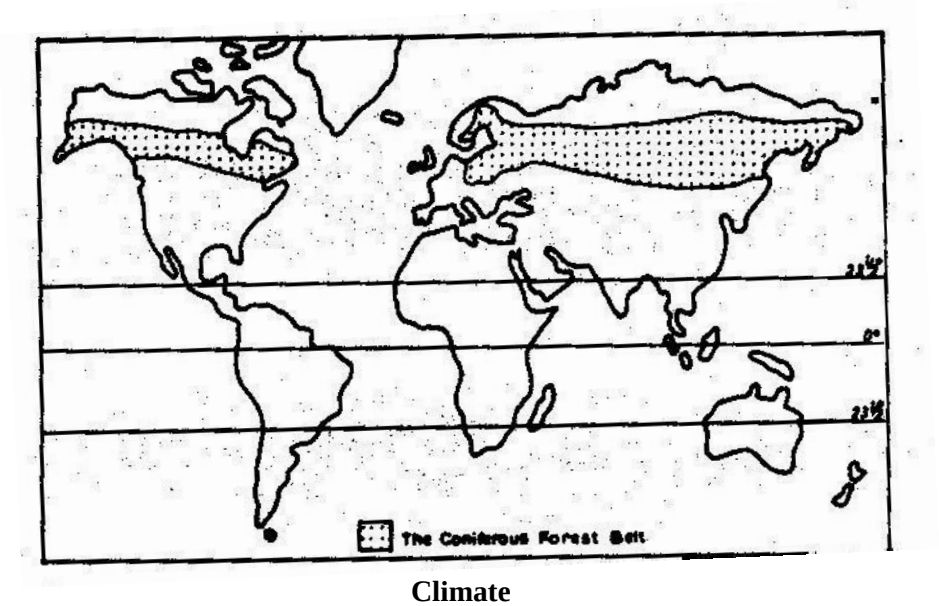
Willows grow wetter areas

THE COOL TEMPERATE CONTINENTAL CLIMAT

(CONIFEROUS FORESTS)

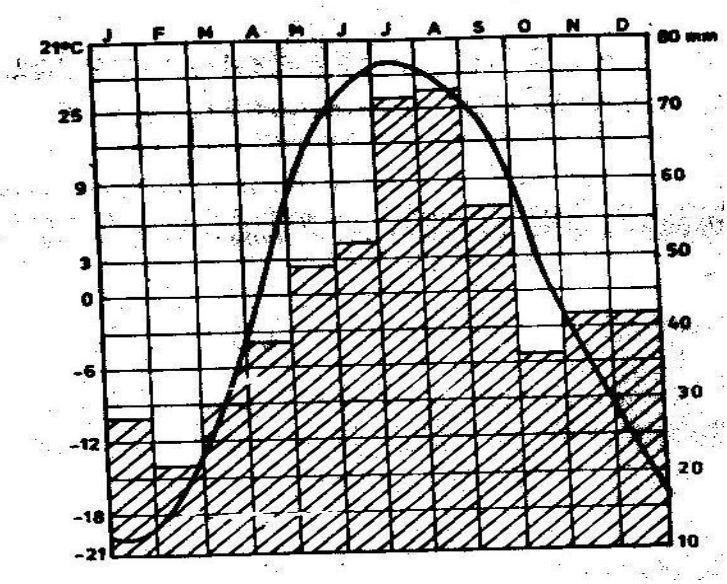
Distribution

This region is only found in northern hemisphere between latitudes 35 degrees-60 degrees north. In the south, there are no land masses within similar latitudes. However, this type of climate is found on high mountains in the southern hemisphere.



Climate

Climate of this region is one of extremes as the result of the distance from the sea. Summers are hot with temperatures around 20 degrees Celsius. Winters are very cold usually below 15 degrees Celsius. Rainfall is light averaging about 240mm to 360mm.



Climatic Characteristics

	J	F	M	A	M	J	J	A	S	O	N	D
Temp. °C	-20	-17	-9	0	11	16	19	17	14	5	-5	-16
Rainfall mm	28	23	30	38	48	51	71	74	56	36	41	41

a. Winters are long and bitterly cold.
b. Summers are cool and brief.
c. Autumn and spring are brief and transitional periods.

Temperatures

a. Winter temperatures are always below the freezing point. (average -11 degrees) (Mackenzie valley in Canada -57 degrees Celsius).
b. Heavy snow fall and frost occur in winter.
c. Lakes and rivers in this region are frozen in winter. The chief rivers of Siberia (USSR), the Ob; jeni sey and lena are ice covered for seven months. They flow north into an ocean which is frozen for nine months.

Winds

Very cold polar winds sometimes blow across the coniferous forests from the North. These winds greatly reduce visibility due to snow flakes blown in the lower atmosphere these winds are:

a. Blizzards of Canada with temperatures of -28 degrees Celsius and blowing at the speeds of about 80km per hour.
b. The buran of Eurasia is a bitterly cold and violent wind.

Precipitation

a. annual precipitation is very light remoteness from oceanic influence (380-635mm)
b. Precipitation is well distributed through out the year, with summer maximum.
c. Rainfall is of conventional type in summer.
d. Winter precipitation is in the form of snow.
e. Relative humidity is always high as overall temperature is low and there is lesser evaporation.
f. The total amount of rainfalls determined by other factors such as altitude and latitude.

Snow is heaviest in the north of this region. In summer frozen rivers thaw causing extensive floods. Snow provides moisture for the vegetation when it melts in spring.

Natural vegetation

The vegetation consists of unbroken stretches of ever green coniferous forest. The coniferous forest of Russia is called Taiga. The principle trees of this forest belt are various species of:

a. Pine such as white pine, Scots pine est.
b. Fir, such as Douglas fir, balsam fir and silver fir.
c. Spruce, such as Norway spruce and stika spruce.
d. Larch, a hard deciduous tree found with conifers.

These trees store their food reserves in the wood due to severe winter sun light rainfalls. There is little undergrowth in the coniferous forests because:

a. The ground freezes to a depth of one meter, and shallow rooted plants would perish.
b. Prevailing darkness of these forests limit under growth. (Absence of direct sunlight and short duration of summers).
c. The leached, acidic, podzolic, soils discourage under growth.
d. There is little leaf fall for humus formation.

Over wide stretches of these forests, the trees are found in pore stands that are (trees of the same species growing together). Trees grow straight and tall to the height of about 30m. This makes timbering easier. These forests are the richest sources of soft wood used in building construction, furniture, matches, paper and pulp.

The USSR and the USA, Canada and Scandinavian countries.

Adaptation to climate

Trees have developed mechanisms to survive the severe climatic conditions of this region.

a. they are conical in shape
1. the sloping branches prevent snow accumulation which may break the branhes
2. the shape offers little grip to the strong winds

b. Leaves are small, thick, leathers and needle shaped. This is to check transpiration especially in summers.

c. Trees are ever green. This is due to a low annual temperature. The same leaves remain on a tree for as long as five years.

d. Reserves of food are stored in the tree trunks due to severe winters and low rainfall. Their barks are thick to protect themselves from excessive cold.

These forests become widely spaced towards the tundra. Coniferous forests are also found in other climatic regions where altitude reduces the temperature. The best examples are the mountain regions of East Africa.

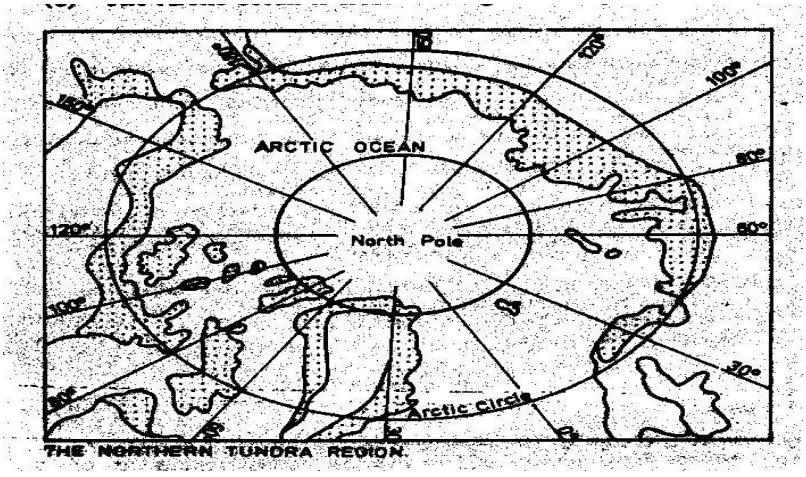
THE COLD DESERTS OR TUNDRA REGION

Distribution

1. This climatic region is found in the north of the Arctic Circle (66 ½ degrees N)

a. The Arctic Ocean is surrounded by snow covered polar lowlands. These lowlands are known as Tundra. They are very cold and ice-covered for about nine months of the year.

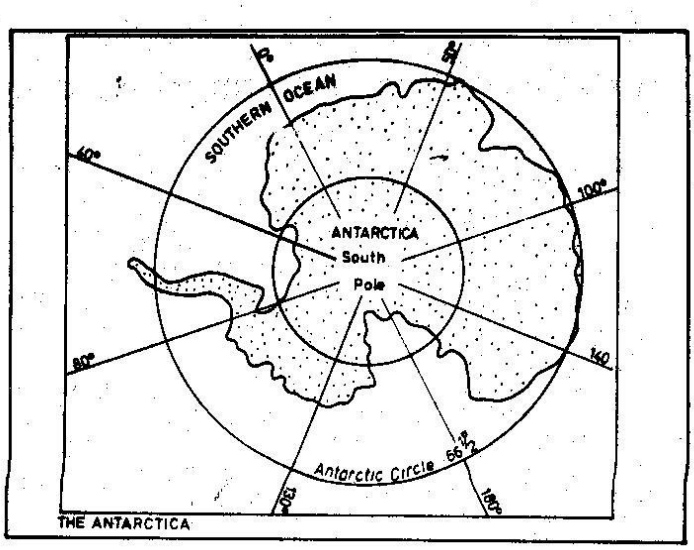
b. The Arctic Ocean is frozen throughout the year.



South of the Antarctic Circle (66 1/2S)

This area is an uninhabited continent buried beneath an ice sheet. It is encircled by frozen seas.

The continent is covered by an ice-cap to the depth of hundreds of meters.



Climate

This region has a low mean annual temperature. The sub soil is permanently frozen (permafrost).

Frosts occur and violent wizards are very common. Thick fogs occur in coastal districts where warmer water meets cold land.

Winters – these are long and very severe, with temperatures usually below -18 degrees Celsius. There is very little daylight. There are weeks of continuous darkness lasting to sis months at the pores.

a. Summers- summers are short and cool, with temperatures of about 10 degrees Celsius. Days are longer with little heating power since the sun is at a very low angle.

Precipitation

This is light, not more than 300mm. In winter precipitation is in form of snow. This is usually drifted about during blizzards. Precipitation is at maximum in summer, and it is in form of rain.

	J	F	M	A	M	J	J	A	S	O	N	D
Temp. °C	-22	-22	-21	-4	2	5	5	1	1	-4	-10	-17
Prec. mm	10	13	18	18	15	13	13	28	28	28	28	13

Natural vegetation

Due to cold and frozen nature of the ground, only the lowest form of vegetation can be supported. There are no trees. The following forms of vegetation are found:

a. Masses, clichés and sedges grow in thick masses and dump ground.
b. Stunted birches and dwarf willows are found din sheltered valleys.
c. Hardy grasses cover the ground during summer.
d. Berry –bearing bushes and arctic flowers bloom during the short summers.

WORLD POPULATION DISTRIBUTION

The world's is unevenly distributed, which leads to the problem of overpopulation. Less than 20 per cent of the world's surface is habitable, and within this area are striking contrasts in population density. Some areas are very densely populated e.g. Singapore island had an average density of 2800 people per sq km in the 1990`s, today, it has over 6747 persons/km squared while others are very sparsely populated e.g. Australia has only about 2.7 persons km squared e.t.c.

Year	1650	1750	1800	1850	1900	1950	2000	2050
World Pop.	545 Mil	971 Mil.	978 Mil.	1.262 Bil	1 650 Bil	2.556 Bil	6.073 Bil	9.300 Bil
%Distribution								
Africa		13.4	10.9	8.8	8.1	8.9	13.1	20.3
Asia		63.5	64.9	64.1	57.4	56.2	60.7	59.0
Europe		20.6	20.8	21.9	24.7	21.4	12.0	7.1
Latin America & Caribbean		2.0	2.5	3.0	4.5	6.5	8.6	5.3
North America		0.3	0.7	2.1	5.0	8.6	7.9	7.9
Oceania		0.3	0.2	0.2	0.4	0.5	0.5	0.5

FACTORS WHICH INFLUENCE POPULATION DISTRIBUTION

a. **Climate** – this is probably the greatest deciding factor, which in turn influences the type of vegetation (desert, grassland or forest), the kinds or crops that can be cultivated, the animal kingdom and the overall suitability of the region for human habitation.
b. **Physical relief** – From your regional studies of the world, you should have already noticed that most of the lowlands and river valleys support the greatest number of people. Their levelness leads to ease of communications, cultivation and overall development. The world's most densely populated districts are, in fact, the coastal plains and the basins and alluvial deltas of great rivers that are usually served by a good network of communications. The mountainous interiors, unless they are rich in minerals, are very sparsely inhabited. Even if they have some minerals, their altitude and difficulties in communications reduce their capacity for population. The few mining communities may be separated from one another by high mountains, or dense forests.
c. **Soils** – A well-developed, mature soil in either the tropics or the temperate regions with fair balance of precipitation and evaporation is suitable for agriculture, which in turn supports the peasant population. The soils of the temperate deciduous forests and those of the tropical monsoon lands are intensively tilled and supported large populations.

Excessive leaching in the equatorial regions, intense evaporation in the deserts and perpetual freezing in the Polar Regions impoverish the soil.

d. **Mineral resources** – Mineral deposits are very unevenly scattered over the globe. Their presence in commercially exploitable quantities either in the form of metallic ores (e.g. tin, copper, zinc, lead, aluminum, iron) or fuel (coal, petroleum) is a vital factor in the location of industries which in turn support a high population density.
e. **Other minor factors** – These usually affect only limited areas and are of varying significance. They include government policy in immigration and redistribution of settlers, and other factors which maybe historical, cultural, social, economic or medical.

The pattern of World Population Distribution

1. **The very sparsely populated parts of the world** – these include the cold polar lands of the Arctic and Antarctic, the hot deserts and the virtually uninhabited jungles.
2. **The moderately populated parts of the world** – This covers large areas of the cool temperate forests, the tainga of Eurasia and the Canadian coniferous forest. Lumbering districts normally do not need main people. Similarly, in the temperate and tropical grasslands where pastoralist and large – scale mechanized farming predominate; only a moderate population is found.
3. **The very densely populated parts of the world** – These are found on the industrial west and the agricultural East and include:

a. Industrial North – West Europe – Great Britain, France, West German, Denmark and Benelux e.t.c.
b. Industrial North Eastern U.S.A: Stretching from the shapes of the great lakes through Pittsburg to New York and the Atlantic seaboard.
c. Agricultural Monsoon Asia: the largest area of continuous high population density includes: China, Japan, India, Sri Lanka Bangladesh, Indonesia (Java), and the coastal and Deltaic regions of continental South East Asia.
d. The Nile Valley and Delta: It is an agricultural high populated area where the annual flooding of the Nile River enables the practicing of Basin irrigation.

Some Basic Population Problems

Food shortage – this is greatest in China, India, Pakistani, Bangladesh and Indonesia, where there are far mouths to be fed than there are crops to be harvested.

Clothing – There are million in Asia and Africa going about clad only in rags.

Housing problem is often acute, especially in fast growing towns and cities. Many families are crammed into small houses, badly ventilated and unhealthy. Many are pavement dwellers and some spend their whole lives on boards.

Illiteracy – is still high in many parts of the world. There are literally millions who cannot read and write

Poverty- a condition of having insufficient resources or income. In its most extreme form poverty is a lack of basic human needs, such as adequate and nutritious food, clothing, housing, clean water, and health services. Many developing nations experience severe and widespread poverty, often leads to disease epidemics, starvation and deaths. In the past few decades, millions of people have starved and died as a result of famine in such countries as Bangladesh, Ethiopia, North Korea, Somalia, and Sudan. As 1998, almost one person out of four (23 per cent) residing in developing countries lived on less than 1 Dollar a day.

Ways of solving World Population Problems

1. **Cut down the rate of population increase** – this is done through family planning or birth control, which is now widely practiced throughout the world.

2. **Increase food yields** – World population of foodstuffs and raw materials can be increased either by opening up new lands for agriculture or by raising the crop yields of the existing farm lands. New techniques can be developed to obtain higher yields per hectares through such processes as plant breeding and experimentation, increased application of fertilizers, farm mechanization, elimination of weeds and insect pests and more intensive use of land. Many lands that were once considered wastes can be made productive by drainage or irrigation schemes. Drought-resistant crop varies can be grown in semi-arid regions. Reforestation helps to conserve one of the richest natural resources-timber.

3. **Migration** – This may not reduce the total population of the world, but it does help to relieve the socio-economic problems caused by overcrowding in certain parts of the globe.

4. **Illiteracy** – can be eradicated through constructing of schools, training teachers and provision of teaching materials.

Factors influencing Agriculture

There are several factors which affect the types of crop cultivated and the methods of cultivating them. Some of these factors are:

a. **Climate –** this includes the general temperature, rainfall and wind pattern of a particular area. The climatic requirements are so exacting for some crops that they are found naturally only in certain climatic zones. It is entirely a question of climate when apples fail to mature in Malaysia or cotton cannot be grown Lancashire.

b. Relief – The lowland are the most suited to a wide range of crops such as wheat, coconuts, rubber, sugar-cane, and padi and an increase in altitude will exclude most of them.

c. Soil – Soil in different parts of the world vary tremendously in their structure, composition and fertility. Weathering processes produce soils of varying mineral composition so that soils contain varied amounts of iron, aluminum, calcium, potash and silica which affect their fertility. Soil fertility is further influenced by the presence or absence of organic matter or humus, which is derived from the decay of leaves, plants, roots and living organisms. Soils rich in humus give heavy yields of crops, but need to be replenished when they become exhausted.

d. Biotic factors- the presence of biotic agents such as weeds, parasitic plants diseases and insects-pests damage crops and hamper farming in many parts of the world. Weeding, application of chemicals and insecticides can control them.

e. Economic factors- The cost of running a farm involves much expense which has to be met by the sale of the crops either locally or by export overseas. Land values are becoming very high especially where agricultural land use is in competition with industrial and urban use in the developed countries. There are also many expenses that a farmer may have to meet, including marketing expenses, storage costs, government tax e.t.c.

f. Other factors-farming practices are everywhere determined by local conditions such as the type of farm ownership and land inheritance, social and religious influences, the availability of farm hands, efficiency of transport network and fluctuating demand for various crops.

WOLRD FARMING TYPES

Different parts of the world are suitable for different parts types of agriculture. Hence agriculture is divided in seven (7) parts.

1. **Shifting Cultivation**: this is the type of farming in which fields are rotated rather then crops to preserve fertility. It is done by the primitive people of the, equatorial and savanna lands, it is the most easy but wasteful type of farming. It involves:

- Cutting and after drying, burning down a section of the forest.
- sowing seeds in a mixture of ash and soil
- Use of small range of primitive tools e.g. axe, hoe, sticks etc.
- Movement to a new area after 2-3 years when crop yields decline.

Intercropping: This is the growing of different corps in the same field alternating rows. Crops grown include maize, dry padi, yams cassava, pumpkins, sweet potatoes, beans foe consumption. However, soils are rapidly leached and exhausted, so fields are abandoned every after a few years.
Disadvantages

- Organic matter is destroyed by burning
- Humus and bacteria are destroyed by fire.
- It creates a danger of soil erosion
- It causes soil leading
- It takes even 25 years for woodlands to regenerate.

2. **Nomadic Pastoralist**: This type is found in areas having a low density of population and low average rainfall of 250mm per year. These areas include:

- Desert area – small case allows pastures grow.
- Semi-desert areas – poor pastures are sufficient to allow wondering herds of animals feed.
- Areas near cold deserts – animals feed on leaves of bushes which survive under snow.
- **Mountainous areas** – pastures are used when snow melts in summer.

This system cannot change to commercial because areas are far from main centers of populations and due to poor climates. People who practice nomadic pastoralist include:

- The Masai of East Africa – cattle, sheep, goats etc
- The Tavregs of North Africa – camels, donkeys, sheep and goats etc.
- The Klurghric of North East Afghanistan- horses, camels, sheep, goats etc.

In recent days, development has led those people to a settled way of life.

3. **Plantation Farming**: This is the growing of tropical crops i.e. large estates of plantations. Plantations are usually self-contained with their own shops, clinics etc. they concert rated on cash crops for export etc. rubber is the chief crop of Malaysia/Indonesia. Cotton in East Africa, Cocoa and oil palm in west Africa especially Ghana and Nigeria, coconut, sugar cane, mainta hemp in Philippines, tea in India /sirl-anka, coffee in Brazil and bananas in Jamaica.
4. **Commercial Livestock farming** – large scale commercial livestock farming is found mainly in the temperate grassland areas of North American, Argentina, Uruguay, Australia and New Zealand. Sheep are kept in millions for wool/ meat or both. Cattle also reared (both dairy and beef cattle). Refrigeration has made the grasslands t be leading suppliers of beef in the world.

Beef farming – western parries of the U.S.A, pampas of Argentina Uruguay, Argentina is the world's beef exporter (35% of the world's beef exports)

Sheep Rearing – Australia and New Zealand are the chief producers of mutton and wool. Others are Africa, Uruguay and Argentina. Australia has the largest number of sheep in the world. It produces up to 42% of the world's wool exports and 16% of mutton.

New Zealand slaughters up to 13, 000,000,000 animals each year for export mainly to the UK which accounts for 72% of the world's lamb an mutton exports.

5. **Intensive Rice Cultivation** – rice is the most important staple crop for the world's population. It is suited to areas with a hot monsoon type of climate. It mainly raised on the basis of intensive subsistence farming e.g. Chinese peasants grow wet padi (swamp rice) in flooded field and this involves an endless labour. Rice is cultivated on flood plains, river deltas, coastal districts well watered lowlands, irrigated fields and terraced uplands.
6. **Extensive Mechanized cereal (wheat) cultivators**- extensive mechanized wheat cultivates is a typical of lands with a temperate continental climate e.g. Canadian, the USA, Argentina Australia and parts of Russia. Farms are so large from 240 to 1600 hectares that all stages of cultivation from ploughing and sowrning to harvesting are done by machines, hence mechanized farming. Temperate grasslands from the "granaries of the world" The main features of these types of farming are:

- Large farms 240 hectares or more
- Large amounts of methods of farming are used to the full.
- Harvesting is a very specialized job by combine harvesters
- There is a large compels and efficient organization for collecting and distributing the wheat.
- There is continuous research to develop new and better types of seed.
- Farms are characterized by low yield per hectare but high yield per mass.

7. **Mixed farming**- this is a combination of arable farming and animal husbandly – cereal, root crops, vegetable, and fruits are raised side by side with cattle, sheep, pigs and poultry. Mixed farming usually leads to the development of different forms of agricultural specialization:

   Arable framing – concentration on the growing of citrus fruits such as organs, lemons, limes, citron and grape fruits.

   Market gardening (truck farming) – growing of small fruit or horticulture crops (vegetables and salads)

SOURCE OF FUEL AND ENERGY

COAL

Types of Coal

There are three basis types of coal.

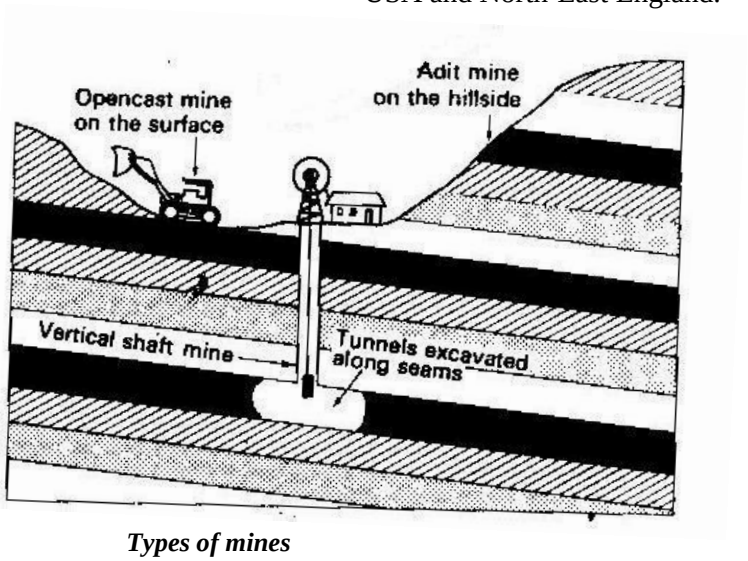
1. **Lignite Or Brown Coal** – it has a carbon content of les than 4% and which gives out only moderate amounts of heat. It is used mainly for the production of thermal electricity.
2. **Bituminous Coal** – it is has a carbon content of between 45 and 80%. Because of this it gives off more heat than lignite. Some bituminous coal has high gas content. This is called gas coal and it is used for making gas. Another type of bituminous coal is used for making coke which is used in blast furnaces. This type is called coking coal.
3. **Anthracite** – is a very hard coal which has at least 90% carbon content. This enables it to born with great heat, and little smoke.

The Mining of Coal

The methods use for mining coal depends upon the distance of the coal seams below the surface, and whether the seams are horizontal or tilted. Three basic methods are used.

1. **Shaft Mining** – This method is used when the coal seam lays several hundreds of meters below the surface, and it involves the sink-seams. Horizontal tunnels, called galleries are formed from the shaft as the coal seams are dug out. This is the most common types of mining.

2. **Open cast mining**- when the coal seams lie near to the surface, say, at depth not exceeding 50 meters, the rock layers lying on top of the coal seams are removed, and the coal 13 then quarried by mechanical excavators.
3. **Adit or drift mining** – this method is used to extract coal from horizontal, gently slopping seams that outcrop along the sides of valleys. Ti is used in the valleys of the Appalachian coalfield, in the USA and North-East England.



Types of mines

IMPORTANT COAL – PRODUCING REGIONS

Coalfields of the USA

The main coal mining regions of the USA lies in the eastern part of the country, and it is known as the Appalachian coalfields. There are four parts of this, as shown in the map.

1. The Pennsylvania coalfield – this occupies the northern part and it centre's on pittsbury.
2. The North-east Appalachian coalfield – the coal seams of this field are heavily faulted and mining is more difficult. However, the coal is excellent anthracite.
3. The West Virginia coalfield – this lies in the central part of the Appalachian coalfield its coal is of very high quality.
4. The Alabama Coalfield – this field centers on Birmingham, which is one of the largest iron and steal centers of the southern states.

Other important Coalfields

These are the central and western interior fields but the coal of these is inferior to that of the Appalachian coalfield. Coal from the central coalfield is mainly used for developing power for Chicago.

Coalfield of the Russia

Russia is the second largest producer of coal, and most of is coal comes from two main areas.

1. The Donbass coalfield – this is located between the river Donetz and the sea of Azov, in the area known as the western steppe.

2. The interior Coalfields – these are located in Siberia. The Kuznetsk, or Kuzbass coalfield, which centers on novi-kuznetsk, is the most important of the interior coalfields.

Other Coalfields of Russian

The region around Tula produces lignite which is used mainly for generating thermal electricity, as does the Vorkuta coalfield, which is located in the tundra belt of Russia.

COALFIELD OF THE EUROPEAN ECONOMIC COMMUNITY (EEC)

The E.E.C.B is comprised of the U.K, Holland, Luxembourg, Belgium, West Germany and Italy. There are three main coalfield regions in the E.E.C.

1. Coalfields of UK. There arte several coalfields in the U.K. but the most import are in Yorkshire, Nottinghamshire and Derbyshire in Northumberland and in South Wales.
2. Coalfield or West Germany – most of its production comes from the Ruhr coalfield.
   Other world coalfield – include India, South Africa and Argentina.

Uses of Coal

i. Fuel: for domestic heating
ii. Sources: Sources of power for driving steam engines in power stations to drive dynamos which produce thermal electricity.
iii. Raw material: the two chief carbonation products are released in the process.

- Coal far: used for making fuel, oils, disinfectants, antiseptics, air line dyes (plastic performs) etc
- Benzole: used to make motor spirit, weed killers, aspirin, saccham and sulphonamide drugs.
- Sulphate of ammonia: used to make fertilizers insecticides, soap, explosives and chemicals for use in refrigerators.

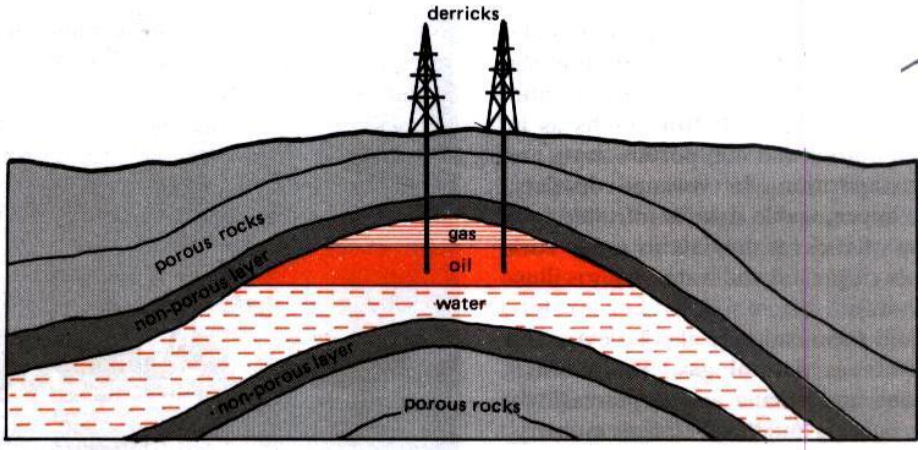
PETROLEUM

Petroleum is mineral oil, organic in origin, and occurs in the pore spaces of sedimentary rocks. It is derived from the decomposing of marine or vegetative matter. It normally occurs in dome-shaped anticlines between two layers of non-porous rocks. The oil is usually trapped in the crest of the anticline with gas above and water below.

Besides it is liquid form, oil may also be extracted in its gaseous sate as natural gas. This consists of mainly methane and ethane and is increasingly used for heating, lighting and the chemicals industry. America, Europe, Russia and New Zealand natural gas is pumped through pipe for use in house holds and industrial plants.

Oil Drilling

Once a drilling site is decided, a steel derrick about 30 meters (100 feet) high will be erected and equipment for drilling brought in steel tubes are interested in the bore-hole and , once the drill reaches the oil bearing strata, oil gushes out through the bore-hole and keeps flowing for weeks or even years. When it cease to flow naturally, it is pumped to the surface.



Oil Transportation

Pipelines – it is the cheapest and the most efficient method of transporting crude oil overland for great distances. This involves the construction of pumping stations at intervals ad the installation of pipes, hundreds or thousand of kilometers long. The initial cost may be high but the long run, it is very economical. It saves time, money and labour and the operation is very simple.

Oil trucks and rail wagons – they are use for the conveyance of refined petroleum products locally.

Aircraft-it is used for military and emergency requirements,

Oil tankers – for sea transport. They are often extremely large.

Oil Refining

Crude oil has little use unless it is refined in oil refineries it is broken down into grades of oil petrol. In doing so a number of by-products area also produced e.g tar, fertilizer etc there are three methods of refining.

a. **Fractional Distillation**: oil is plit into its various groups of temperatures. Each fraction is extracted when it reaches its boiling point. Thus lighter fractions (petrol, kerosene, benzene) are evaporated and condensed first and temperature below 38ºC Heavier fractions(diesel lubricating and fuel oils like Vaseline, wax and asphalt are left as residue. Fractional distillation is the most universal form of oil refining but only 155 of motor fuels is distilled yet there is a rising demand for light fuels by the auto-mobile industry.

b. **Thermal cracking**: a process by which the heavier fractions are heated too much at higher temperature until they break down or "crack" into the lighter fractions.

c. Catalytic cracking: a process by which a catalyst such as powdered platinum is added to speed up the cracking process. Thus more motor fuels are extracted. Polymerization is the process by which has a greater molecular weight than the original oil can be produced.

Use of Oil

a. Motor fuel- this is the greatest use of oil it drives almost trains in then developing world.

b. lubricant petroleum – petroleum in a form of grease is used to reduce friction in machine parts.

c. Source of power- mineral oil is burned in heaters, boilers, etc to produce power in factories and generate thermal electricity.

By-Products

- Kerosene as domestic duel for cooking, heating and lighting.
-Bitumen or asphalt – for roofing, road surfacing and water proofing purposes.
- Paraffin and wax as illuminants and lubricants and for manufacture of candles, seals and polishes
- other by-products – petroleum forms the basic raw materials for industrial, items such as insecticides, pharmaceutical and organic chemical products such as drugs, varnishes and solvents.

World Oil Production and Distribution

The world pattern of oil productions is in continuous charge as new fields are being discovered. However, the middle-East has about 70% worlds' oil reserves. As individual countries, the former is the largest producer accounting for 19% of the world's total Saudi Arabia is the second 15% USA 13%, Iran 9.5% other producers are Venezuela, Iraq and Mexico.

ELECTRICITY

Electricity is the cheapest power resource. It is not exhaustible like coal or petroleum but us renewable. There are two different sources of electricity. That which is derived from water sources (steams, glaciers, natural waterfalls or man-made dams) by hydro-turbines is referred to as hydro-electricity. When it is derived from generators driven by turbines by burning coal oil or natural gas is called thermal electricity. The former is best developed in the mountainous regions of temperature latitudes where precipitations is adequate and there are idea sites for the location of hydro-electric power stations. The latter is widely scattered allow the world wherever mineral fuels are available for burning in the thermal –power stations. Large quantities of water are also necessary for cooling purposes in thermal plants.

Use of Electricity

- Hydro-electric power is the chief source of motive power.
- It is usually an alternative especially to places deficient of coal.
- There are a number of industries that can only be successfully undertaken with a very cheap supply of H.E.P especially the smelting of aluminum (from bauxite), and the production of nitrates and calcium carbides.
- It is used in homes to produce light and heat.

Advantages

- It is clean-unlike electricity not give out smoke and it is never dirty.
- Its unlimited degree of divisibility – by the use of simple mechanical devices such as transformers electrical energy can be adjusted from a fraction of a Walt to thousands of waltz per hour.
- It is thus indispensible in modern complex manufacture where the control of speed in machines or in furnaces is precise to a fraction of a second.

Convenient transport – unlike coal or petroleum, electricity needs neither trucks nor pipes. By means of only wires and plugs, electric energy can be transported to consuming points over great distance and with the greatest ease.

BASIC REQUIREMENTS FOR HYDRO-ELECTRICITY DEVELOPMENT

- **Heavy capital outlay**- modern multi-purpose H.E.P schemes need very large amounts of capital for setting the plant. The initial cost of setting a dam 1350, great that it is undertaken by government, but the may have multiple uses such as H.E.P, irrigation, flood control and navigation.
- **It requires steep gradient or slopes** - to facilitate the rivers and streams to plunge down swiftly to turn the H.P. E turbines. Hence, countries located in flat regions or areas with weak relief as coastal areas and plains cannot have unless artificial (man-made) dam and plunge ports are created. Natural rapids and especially waterfalls are advantageous.
- **Sufficient and constant volume of water is required**- This condition only favours regions with a heavy precipitation from either rain or snow throughout the year. Large dams invented of special types of cement and the development of hydro turbines and electrical dynamos enable large scale hydro-electricity schemes to be established. Artificial lakes created by the election of dams hold water for use during periods of low precipitation.
- **Needs large domestic and industrial market** – for a dam to be worth constructing, there must be a fairly large market to make use of the H.E.P generated. The cost of installing power plants, transforming station, storage reserves and transmission lines is so great that a reasonable market must be assured. The growth and decline of domestic and industrial uses will directly affect the profit made by H.E.P stations.

World Production and Distribution

Over $^{2}/_{3}$% of the world's electricity supply comes from thermal plants mainly from industrial areas. As for H.E.P it makes *'A* of the world's electricity supply. The temperate lands of Europe and North America have in fact the greatest out-put of developed water power. In terms of individual countries, U.S.A leads with 23%, Canada 15% and Japan 14%. Others include France, Sweden, Norway, U.S.S.R and Switzerland. By continent, North America is first, followed by Europe, then Australia and New Zealand, thereafter comes Asia, Africa and last South America.

OTHER SOURCES OF POWER

WIND ENERGY

Wind Energy, energy contained in the force of the winds blowing across the earth's surface. When harnessed, wind energy can be converted into mechanical energy for performing work such as pumping water, grinding grain, and milling lumber. By connecting a spinning rotor (an assembly of blades attached to a hub) to an electric generator, modern wind turbines convert wind energy, which turns the rotor, into electrical energy.

Modern wind energy systems consist of three basic components: a tower on which the wind turbine is mounted; a rotor that is turned by the wind; and the *nacelle*, which houses the equipment, including the generator, that converts the mechanical energy in the spinning rotor into electricity. Location is critical for maximizing the electricity wind turbines can produce. Maximization depends on wind speed. This exponential relationship between wind speed and wind energy makes location extremely important. A site with high average wind speeds can provide considerably more wind energy than a site with only slightly lower wind speeds.

Wind energy is a promising source of electrical power because it is a clean and renewable resource. However, because wind speed varies by time of day, season, and even from one year to the next, wind energy is an intermittent resource. At windy sites it is common for wind turbines to operate 60 percent of the year

THERMAL & GEOTHERMAL POWER

Thermoelectric energy - is the electricity produced by heat or burning. In a thermal power plant, steam is produced and used to spin a turbine that operates a generator. In a conventional thermal power plant, coal, oil, or natural gas as fuel is used to boil water to produce the steam that drives the turbine. The electricity generated at the plant is sent to consumers through high-voltage power lines.

Geothermal energy - is the **heat energy from hot ground water:** energy in the form of heat obtained from hot circulating ground water. Geothermal reservoirs within about 5 km (about 3 mi) of Earth's surface can be reached by drilling a well. The hot water or steam from wells can be used to turn turbine generators to produce electricity. A power plant that uses this natural source of hot water or steam is called a geothermal power plant.

Geothermal energy provides about 1.6 percent of the world's total electricity, serving the electricity needs of about 60 million people, mostly in developing countries. About 2.5 percent of the electricity produced in the United States came from geothermal power plants. The electricity produced from geothermal power in the United States represented about 37 percent of the world's output of electricity from geothermal power. The United States, the Philippines, Italy, Mexico, Indonesia, Japan, New Zealand, and Iceland are the largest producers of geothermal energy. There are three types of geothermal power plants: flash steam plants, dry steam plants, and binary plants.

SOLAR ENERGY

Solar Collecting Panels on a rooftop collect energy from sunlight and convert it directly into electricity. The solar panels contain semiconducting materials. When light strikes the material, electrons move from one layer of the material to another, forming an electric current.

Other sources of Sun-derived electricity involve high-technology options that remain unproven commercially on a large scale. Photovoltaic cells (solar battery and converter), which convert sunlight directly into electricity, are currently being used for remote locations to power orbiting space satellites, gates at unattended railroad crossings, and irrigation pumps.

BIOMASS

Fuels from biomass encompass several different forms, including alcohol fuels, dung, and wood. Wood and dung are still major fuels in some developing countries, and high oil prices have caused a resurgence of interest in wood in industrialized countries. Researchers are giving increasing attention to the development of so-called energy crops (perennial grasses and trees grown on agricultural land). There is some concern, however, that heavy reliance on agriculture for energy could drive up prices of both food and land.

NUCLEAR ENERGY

While some countries, such as France and Japan, depend heavily on **Nuclear energy** (energy produced by atomic fission, or splitting of the atom), it is still not a major energy source. Excessive production costs, serious safety

concerns, and problems with the handling of the dangerous radioactive wastes have virtually eliminated it as a viable energy source in the United States.

In addition to using alternative energy resources such as solar and wind power, energy conservation measures include improving energy efficiency. For instance, transportation accounts for most of the oil consumption in the United States. Encouraging the expansion and use of public transportation systems and carpooling dramatically increases energy efficiency. In the household, energy can be conserved by turning down thermostats, switching off unnecessary lights, insulating homes, and using less hot water.

MANUFACTURING INDUSTRY

The Rise of the Manufacturing Industry

Man's universal demand for food, clothing, shelter and other comforts of life has prompted the creation of many new things. Modern homes have telephones, television sets, refrigerators, washing machines and other luxuries. Few people ever realize that all the changes have come about only within the last 200 years beginning with the industrial Revolution of the 18th century. Two great developments; the burning of coal for steam power and the smelting of iron to make steel have ushered in a new phase in human history, the age of science and technology. A host of raw materials such as such as cotton ad timber can be converted into manufactured goods of great utility like shirts, paper types etc. The manufacturing industries penetrate deeply into the life of everybody.

The industrial growth once greatest in Western Europe and North America is spreading fast into other continents and to the less developed countries.

GROUPS OF INDUSTRIES

The range and complexity of modern manufacturing industries are so great that it is by no means easy to classify them but most of them fall into the following eight groups.

1. **Iron and Steel Industry:** the iron and steel industry forms the basis of all the ferrous metallurgical industries. It is the most important of all industries known. Without the steel bars, blooms, bullets, slabs and wires supplied by the iron and steel mills, other industries cannot survive. The existence and prosperity of the automobile industry, metallurgical industry, shipbuilding and aircraft industry and the mineral extracting industry is directly linked to that of the iron and steel industry.

2. **Fuel and Power Industry:** this branch of the industry deals entirely with the **generation, extraction or refining** the various sources of power: steam power (mainly from coal), hydro-electricity (from water) thermal electricity (from burning of other fuels) petrol and oil (from the refining of petroleum). In addition to these are natural gas and nuclear power.

3. **Mineral extracting industry:** this includes the concentration, smelting and alloying of minerals and the smelting of non-ferrous metals e.g Copper, Tin aluminum, lead, Zinc and other alloyed metals such as brass and bronze.

4. **Metallurgical Industry:** this section refers to machinery instruments, equipments and tools that are manufactured from metals. It includes iron and steel works, mechanical engineering, electrical engineering, shipbuilding, automobile, aircraft etc.

5. **Chemical Industry:** this is the production and development of a chain of scientifically devised materials of highly specialized nature and is encroaching into almost every branch of industry. Some of the most important products of this branch of industry include acids, alkalis, gases, paints, varnishes, detergents, fertilizers, insecticides, pharmaceuticals (drugs and medicines), paper and pulp, synthetic fibers and synthetic oils.

6. **Textiles:** this is one of the oldest and the wide spread industries. It is the spinning and weaving of textiles materials from Cotton, Wool, flax (Linen), Silk, jute, hemp and hairs.

7. **Food Processing Industry:** this is the preparation of food stuffs for human consumption form both animal and vegetative sources and includes flour milling, oil milling, sugar refining, meat packing, brewing and the preparation of a whole range of food stuffs like fish, fruits, vegetables and other products.

8. **Rest of the Consumer and Good Industries**: this branch loosely cores all the rest of the manufactured goods consumed or used by man. They include miscellaneous industries such as foot wear, furniture, pottery, printing, cement, toys, cosmetics, jewelry and other luxury goods.

Factors Affecting Industrial Location

1. **Raw Materials:** raw materials are the basic requirements of every industry. No factory can turn out goods unless it has some raw materials to begin with. They may be in form of metals, ores, rocks, cereals, fibers, beverages or any other economic products.

2. **Power or Fuel:** the greatest concentration of industries is around the major coal fields. During the industrial revolution, coal was the only available fuel to generate stream power to run the machinery, hence industrial sites had to be located near coal fields. Almost all the major industrial sites areas of the world are based on coal fields' e.g. Ruhr, Pittsburg, Midlands, Donbas, Kuzbas, Jamshedpur, Sydney and many others. However, with the coming of Electricity which is easy to transmit, modern industrial plants using electricity don't consider power a significant factor anymore. Further, its great bulk and high transport cost and its low energy output have all contributed to the **declining importance of coal.** Though petroleum is extensively used in industries as a form of power, it is seldom a factor of location.

3. **Transport:** the function of transport is to move the raw materials to industrial sites and to convey finished product to the consuming districts. Among different types /modes of transport, **water transport** is the cheapest (due to its ability to carry bulky cargo and on very long distances), **then Rail** for similar reasons as water transport, followed by **Road transport** and finally **Air transport** which is the most expensive but the fastest of all. Where expensive overland routes by road or rail add t the cost of the production, people tend to specialize in high grade articles that are less bulky but fetch a higher price.

4. **Market:** economic production is entirely based on demand. Unless there is a promise of reward in monetary terms, industrialists will hesitate to invest no matter how good the location is. Industrial regions are therefore established near consuming areas or areas with heavy concentrations of people although the nature of raw materials and other factors may also matter (example to be given in class). The densely populated regions of North America and Western Europe are thus important industrial areas as well. But dense population alone is

not enough but without the **purchasing power.** Hence, countries like china, Indo-Pakistan and Indonesia which were densely populated still did not have proportionate amount of industrial development.

5. **Human Resources:** this comprises the inventor, the manager and the worker. In economics, effort necessary to satisfy human needs is called labour. It is one of the three leading elements in production; the other two being land (natural objects) and capital. Factories are run by people and the numbers needed are determined by the size of the factory. Many factors of labour have to be considered, **the availability, technical diversity, reward etc.**

   In industry, labor has a great variety of functions, which may be classified as follows: production of raw materials, as in mining and agriculture; manufacturing in the widest sense of the word, or transformation of raw materials into objects serviceable to humans; distribution, or transference of useful objects from one place to another, as determined by human needs; operations involved in the management of production, such as accounting and clerical work; and personal services such as those rendered by physicians and teachers.

   Researches are carried out all the time to improve the production and efficiency of existing means of production. In the past when small machines were used, a large number of factory hands were needed

   To operate them. This required a large cheap but relatively unskilled labour force. But conditions today are different because large sophisticated machines can be managed by only a few skilled workers. More and more stages of production are becoming mechanized. Hence, abundant labour force is not always a location advantage unless it is skilled and efficient.

6. **Capital**: for the setting-up and continuation of an industry, capital is indispensable. Fortunately, capital is a very mobile factor. Where the industrial potential is good, even in adverse geographical areas, financiers will invest, e.g in Chile are copper smelting and nitrate extracting industries are flourishing in the desert. Gold mines in the great Australian desert etc. Today, it is not exaggeration to state that the majority of tropical plantations, mines, and large firms are in the hands of the foreigners because these are the people with capital. This is also very evident particularly in Zambia both in the mining (initially Anglo-America but now more of Chinese), manufacturing, and large business firms (Shoprite, Spar, Game Pep stores etc).

7. **Other Factors**: some of the world's minor industrial areas will reveal that several other local factors have influenced industrial location. These complex factors may be physical, social, political or historical.

   - **A Natural site** such as a sheltered coast or a strategic junction may be the key factor to the sitting of a certain industry.

   - **Stimulating Climate** like that of the temperate zone is much more comfortable to work in than that of the tropics. For example, the on-shore westerlies were partly responsible for the rising of the Lancashire cotton textiles industry because a humid atmosphere is conducive for cotton spinning.

   - **Political /Government Stability** provides an enabling environment for foreign investment, e.g. Zimbabwe today is struggling to restore the confidence (which had been lost due to the political instability that wrecked the country earlier in the decade) of overseas investors.

   - **Economic, Military and Political Reasons:** in the former U.S.S.R, a dispersed pattern of industrial location was established in the belief that putting all eggs in one basket was far too risky. Zambia also in the political independence times saw the setting of several industries in every province for based on its government policy. For example were set with, the Motor vehicle/Fiat assembly in Livingstone, Mansa Batteries, Luangwa Bicycle assembly, Kawambwa tea estate, etc. Similar efforts were and are still being made in the United Kingdom to encourage industrial under takings in the **depressed "Development Areas"** such as the

North West (Lower Lea Valley in England) etc. As an inducement to potential investors, very favorable terms are usually offered such as lower local rates, low cost lands, interest free loans, tax holidays, government assistance and other preferential treatment.

Whatever advantage an industrial site may have, there is no guarantee that that the advantage will be permanent. There is always risk in business and one must be very subjective when analyzing the factors that affect industrial location at any one time. Iron is the commonest, cheapest and most versatile of all metals. It is the basis of most modern industrial complex. About 90% of the world's iron ore is used in the making of steel. A host of secondary industries are based on iron and steel including mechanical, construction, shipbuilding, the making of rails, automobile, aircraft, bridges, machines and other equipments.

Nature and Properties of Iron

- **It** is **magnetic** thereby making it indispensable in electric engineering e.g used in dynamos, motors, telephones, radio and other electric appliances
- **Has high ductility strength** and can be drawn into bars or wires of varying size without snapping/breaking.
- **Great strength and toughness** make it elastic and to withstand great stresses without any appreciable distortion.
- When **alloyed** with other metals like nickel and chromium increase its resistance to **heat, shock and abrasion.**

TYPES OF IRON

Magnetite it**:** has the richest metallic iron content (70%) with high magnetic qualities, excellent for the electrical industry. It is made from igneous rocks and mainly black in colour. Kiruna in Sweden has the best magnetite Iron ores.

Hematite: another high grade iron ore with metallic content of 50 - 65%. It is mainly from sedimentary rocks and is reddish in appearance. Most of the iron from Lake Superior region is hematite.

Limonite: the commonest of the commercially workable iron ores. Its metallic content is less than 50% and is heavily charged with impurities. It is brown in colour formed from other decomposing iron -bearing minerals. It occurs in lakes and swamps and is called **bog iron ore.**

Siderite: one of the low grade iron ores with a metallic content of 20 to 30%. It is residual ore deposited as sediment when other rock materials have been eroded and carried away. Important deposits of siderite ore are found in Cleveland and around Scrunthorpe in England and Lorraine in France where the ore contains a high proportion of phosphorous.

Properties of Iron and Steel

1. Great strength and toughness

2. Great elasticity -withstand great stress

3. High ductility- can be drawn into bars, tubes, wires or plates without snapping.

4. Cheap metal- found almost everywhere

5. Easy of production- once processed with coke and limestone, its easily made into various qualities

6. Alloy ability- easily alloyed with other metals, e.g. Manganese, vanadium, chromium, cobalt, nickel, tungsten, copper, molybdenum etc. this gives rise to wide range of steel products.

Iron smelting and steel making

Stage one: The essential ingredients for the manufacture of iron and steel are: **iron-ore, coke and limestone.** They are smelted in a blast furnace at a temperature of over 1 650° C. The oxygen in the ore and the carbon in the coke combine to form a gas (oxide of carbon) while the impurities in the ore combine with the limestone to form slag. The molten iron is then drawn off from the furnace base and led into moulds to solidify as **Pig iron.**

Stage Two: from pig iron, the following iron products are obtained as a result of further processing.

a) **Cast Iron:** is made by re-heating the pig iron with steel scrap and then pouring the heated materials into sand or metal moulds. It contains impurities and is brittle and snap under pressure.

b) **Wrought Iron**: made by re-smelting pig iron and removing the impurities and carbon by the pudding process. T is strong and tough and resists rust. It is expensive too and is used for making ornamental gates and fences. Steel: is made by reheating pig iron in converters to remove the impurities and adding *c*ontrolled amounts of carbon (0.3 -2.2%) and ferro-alloys as earlier stated.

Factors affecting the location of iron and steel industry

Among the most important steel making areas are locations in **Western Europe, North-east** U.S.A and **Japan.** The main factors influencing the location of these industries include the following:

(i) Raw materials

(ii) Fuel (e.g. Coal, H.E.P)

(iii) Water

(iv) Transport

(v) Market

(vi) Capital

(vii) Human resources

World Production and Distribution

Two countries, the **U.S.S.R** and the **U.S.A** are the leading producers both of iron and steel. Other parts of **Europe** have more coal than iron. In a similar sense, the world's three greatest steel producers are: the U.S.A, former **U.S.S.R and Japan.** Western Europe also accounts for good quantities through the contribution of countries like Germany, U.K, France, Italy and Belgium.

A settlement may be defined as a group of buildings with people living in them. It is a unit or organized group of men, women, and children making a living out of their surrounding environment. There are always reasons why a group of people should have chosen to live in a certain place but even more reasons why one settlement should grow from an isolated one family farmstead to a sizeable village eventually becoming a town or even a city.

TYPES OF SETTLEMENTS (Settlement Patterns)

Basically, the main types of settlements, dispersed/isolated/scattered, nucleated/clustered settlements and Linear Settlements.

1. **Dispersed/Isolated/Scattered Settlement:** these are residences scattered about in isolated places or apart from one another. They are separated from one another by open country or by geographic barriers. Life for the settlers is simple, quiet, with little opportunities for gatherings and much the same all year round. Dispersed settlement is most typical of rural areas e.g. the Central province and North Western provinces of Zambia have more often dispersed settlements through farms and farming blocks.

2. **Nucleated or Clustered Settlements:** these are groupings of several family residences arranged in such a way that houses are close together. There are collective amenities to serve the communities like shops, markets, schools, places of worship and of entertainment and a transport network. The settlement is **compact, concentrated** and distinguishable by certain well developed features. Nucleated settlements are called by different names according to their sizes and functions. They may be **village, ports or cities.**

3. **Linear or Ribbon Settlement:** in this type of the settlement, buildings are built in a line along a road, river or stream. The buildings appear in a line form and this is usually planned but not always. Examples of this type are the settlements along the main tarred road in Luapula Province; parts of Kafue town built along the Kafue Road etc. What other Zambian examples can you think of that can be classified under villages, town, port or city?

Factors influencing the Location of Settlements

A close look at towns and cities in Zambia and other parts of the world will reveal that they have certain advantages of **site** and **position or situation** which have enabled them to grow. The site of a town is the specific topographic location in the immediate neighborhood while situation is the relative location within a region. The following are some of the factors that have to the establishment and growth of settlements:

a. **Fertile alluvial Soils:** the basic pre-requisite of human existence in flood and water. A fertile alluvium plain crossed by rivers is the best for raising food crops and maintaining a secure water supply. It is easy for transportation of people and goods. It is a potential center of trade, communication and administration, e.g. Paris in the intensively cultivated basin drained by the river Sein; Lyon by the Saone and Rhone Rivers, Amsterdam drained by Amsterdam River, Zurich by Lake of Zurich, Mazabuka etc.

b. **Coastal Low Lands:** where narrow coastal plains are bounded on the landward side by mountains, agriculture, transport and settlement have all to be concentrated on the lower land. Durban on the foot of the Drakensburg Mountains is an example.

c. **A natural focus of routs:** these are also called **nodal towns.** By virtue of their geographical location in relation to the region, many towns assume prominence as centers of road, rail and water communication. People congregate to provide commercial and social services that passing travelers can make use of**. Chicago is an ideally located route town in the mid-west of the U.S.A. Road and rail routes converge on Chicago from the west, east, and south while water routes on Lake Michigan lead north giving it an outlet to the Atlantic through the great Lakes.** Lusaka is another node town originally sited at the junction of the Great North Road linking South Africa to the Mining region in Rhodesia, the rail extending from Salisbury (in today Zimbabwe **partly from the cape to Cairo plan of Cecil Rhodes'***)* to Lubumbashi in today Congo D.R. Today, Lusaka is the meeting point of the Great East Road, Great North Road, Mumbwa-Mongu Road, Kafue Livingstone Road, International air routes and the rail route.

d. **Mineral Wealth:** many settlements have grown to considerable sizes purely because of the presence of minerals. Even in the desert or high in the mountains, valuable minerals have will attract investors and men to work in the mines. For example, Johannesburg the "Golden city" whose growth was initiated by the discovery of gold in the Witwatersrand plate. Kitwe, Ndola, Mufulira, Chingola etc are many examples of Copperbelt towns established on the basis of the availability of minerals.

e. **Good sites for Defense:** this was a deciding factor in the ancient times when defensive strategy executed at the right moment could save the whole community. Many cities are known today as having been built for defense e.g. Great wall of China for Beijing, Edinburgh Castle for Scotland, Jerusalem wall etc.

f. **By- the Side of Lakes:** lakes provide fish, water, and a means of inland transport. Some of the best known tourist centers are located on or near lakes because of their scenic beauty and recreational facilities.

g. Sites for Generating H.E.P: waterfalls are natural sites for generating H.E.P. Where such a site occurs, the availability of cheap power attracts industrial concerns.

In a nutshell these factors can be summarized as including Relief, Water, Climate, Soils and Economic, Social, Political and Religious factors.

FUNCTIONS OF SETTLEMENTS

All settlements perform certain useful functions to justify their continued existence. Lusaka with its over 1.3 million people has many functions. It is an **administrative centre** (being the capital of Zambia and having the National assembly), **financial centre** (having the Bank of Zambia as the central bank of the nation*),* **an industrial centre** (having so many manufacturing industries compared to other towns) and as **cultural centre** (having the University of Zambia, Museums, theatres etc) while the rest of the towns and cities only have one or so dominant function classified as:

Market Towns: e.g. Kumasi (Ghana), Norwich (U.K), Nakonde and Chirundu (Zambia) **Industrial Towns:** e.g. Leeds (U.K), Pittsburgh (U.S.A), Ndola and Kafue (Zambia) **Commercial Towns:** e.g. London, New York, Frankfurt, Luxembourg etc **Mining Towns:** e.g. New Castle (Coal),

Mamba (Coal), Chingola (Copper) etc **Administrative Towns:** e.g. most national and international capital cities.

Cultural and Educational Towns: All cities with renowned Universities and High institutions of learning

E.g. Cambridge, Oxford and London in U.K.

Ecclesiastical Towns: e.g. Mecca, Jerusalem, Varanasi

Royal Towns: e.g. these are traditional residences of monarchs i.e. Kings, queens, Sultans and their

Consorts.

Holiday Resort Towns: Livingstone, Venice, Rome etc

Port Towns: Rotterdam, Amsterdam, Antwerp, Oostende, Maputo, Durban, Port Elizabeth etc

URBANIZATION AND TOWN GROWTH

Settlements grow in size and complexity with passage of time. In recent years, many towns have experienced a rapid population increase from large numbers of people who flock into towns for one reason or another. Large towns all over the world seem to be places of great excitement to rural folk, with many attractions that make life worth living. Many move in from distant villages without any idea of how they are going to make a living and end up with problems both for themselves and the concerned urban authorities.

Problems of Urbanization to the Towns

Unemployment-unless urban growth is paired with commercial and industrial development, many people will remain unemployed in many cities.

Shortage of housing -Leading to rise of squatter/unplanned/slum settlements **Urban congestion-large** cities with their millions of inhabitants who have to live, work, and move about invariably suffer from congestion on roads especially during rush hours, e.g. Situation in Lusaka, Hanoi Dakar etc **Environmental Deterioration-** overcrowding always leads to a drop in living standards. A large population in a small area puts a tremendous pressure on such everyday matters as disposal of sewage and garbage, water supply, electricity, social and recreational amenities etc. smoke from the kitchens, factories and cars pollutes the air and increases health hazards.

Increase of crime-some people in the towns who cannot find jobs become criminals. They steal while others get involved in vices such as selling drugs and prostitution.

Pressure on educational and Health facilities-the town population grows at faster rates than the provision of such services as education, health. This puts so much pressure on the medical facilities mainly nurses, Doctors, clinics, hospitals and schools.

Problems of Urbanization to the Rural Areas

- Rural depopulation (rural area left with very few people)
- Reduced agricultural production (food insecurity)
- Rural underdevelopment (only few educated people are left in villages)
- Scarcity of Labour (all able bodied men and women go to towns in search for jobs)
- Inefficient utilization of rural resources
- Family break-ups

Other key words to note

Urban Sprawl*:* outward spread of built-up areas caused by their expansion. It is the result of urbanization, e.g. city overspills and extensions. Unchecked urban sprawl may join cities into conurbations.

Conurbation*:* large continuous built-up area formed by the joining together of several urban settlements. Conurbations are often formed as a result of urban sprawl.

Urbanization*:* shift of population from rural areas to cities, and the resulting growth of urban areas. When certain settlements grow at the cost of their surrounding countryside

Central Business District *(*CBD*):* The centre of a town with a number of shops, business centers and offices. The CBD for Lusaka is the area between Cairo and Lumumba road.

Metropolis, city, town, village, and hamlet*:* types of urban agglomerations depending on their size, population and services provided. Others include megalopolis, metacities (hyper City), and Super city (e.g. Tokyo with 30 million people).

Suburbanization or exurbanisation*:* is defined as the movement of people from the central and inner areas to the surrounding residential areas. It happens when the urban ring (commuter belt) grows at the cost of the urban core (physically built-up city).It has taken place in MEDCs as transport has developed, enabling people to commute to their place of work and is characterized by lower building densities.

Disurbanisation or counter urbanisation*:* when the population loss of the urban core exceeds the population gain of the ring, resulting in the agglomeration losing population overall.

Reurbanisation: when either the rate of population loss of the core tapers off, or the core starts regaining population with the ring still losing population.

RELIEF FEATURES OF ZAMBIA

Zambia lies on the Great African Plateau, which stretches from East Africa to South Africa. The African Plateau in Zambia can be separated into three different levels created by river erosion and earth movements.

1. **below 900 meters above sea level**

This includes the valleys of the Luangwa River, a tributary of the Zambezi, and the Lake Tanganyika Basin in the north.

- All these lowlands are bordered by steep slopes known as escarpments.
- The country side along the escarpment is broken by many hills and winding tributary valleys.

2.**Land between the highland watershed areas and the lowland river valleys (900-1200 meters)**

- These areas can generally be described as gently undulating plateau, with large areas of flat surface cut into by the Zambezi and its tributaries in the south and west and the Congo system in the north.
- The Zambezi -Zaire Divide along the Muchinga escarpment separates the Luangwa basin from a large, shallow depression of lakes and swamps. This depression was formed by a slight warping (bending) of the land surface.
- Lake Mweru depression is partly the results of faulting. The Luena and Kafue flats are due mainly to the rainy season flooding of very flat basins. The gently sloping surface of this region is broken only by patches of high land such as those around Kalomo, Choma and Lusaka. Rivers that flow from this level to the lower level have cut deep valleys with very steep sides called gorges.

3.Over 1200 meters above sea level

There are two highland areas at this level.

- The first area separates the Luangwa and its tributaries from the rivers that drain into Lake Malawi.
- A highland region that separates two drainage basins is called a **divide.**
- The area that stretches from the Mafinga Hills southwards along the Zambia/Malawi border is the Luangwa- Malawi divide.
- The Mafinga Hills from part of a high plateau that stretches eastwards into Malawi.
- The second area separates the Congo River system from the Zambezi and its tributaries.
- The average height of these highland areas is 1200 to 1500 meters above sea level.

- The surface is flat to gently undulating over large areas.
- Higher areas as the Mbala Highlands are very hilly.
- The divides are also the areas where rivers begin as small streams.

The Highlands which forms the mafinga Hills and the Makutu Mountains are the highest part of Zambia, rising to 2148 meters above sea level.

DRAINAGE

Rivers: Zambia has four large rivers: the Zambezi and its tributaries, the Kafue and the Luangwa in the south, and the Luapula- Chambeshi in the north.

Lakes: a lake is a body of water that collects in a hollow inland area. Lakes can be formed in different ways and these are, depression and tension.

Examples of depression lakes- Bangweulu (largest lake basin), Lake Mweru (shallow depression) but it occupies partly faulted basin.

An example of a Rift valley lake is: Lake Tanganyika. It is the second deepest lake in the world. (758 meters above sea level)

Erosion- lakes may be formed by rivers, wind, underground water and glacial erosion.

Artificial lakes- Dams built across streams and rivers result in lakes of varying sizes. Most commercial farms have small lakes or ponds formed this way for purpose of irrigation or to water their cattle.

Temperature and rainfall

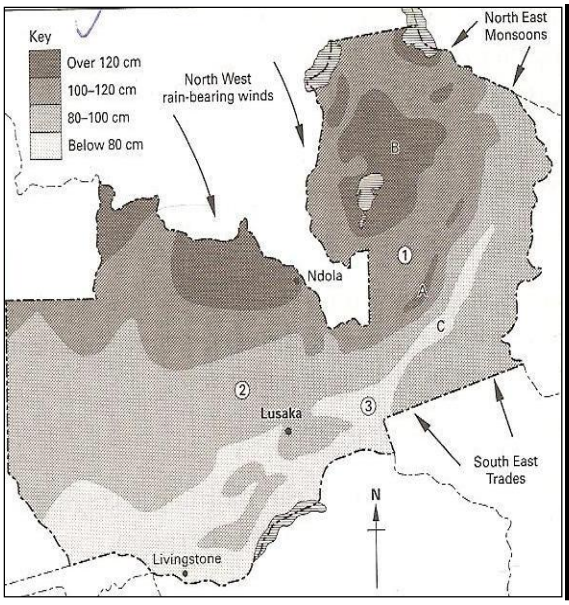


Fig. 2 Annual rainfall

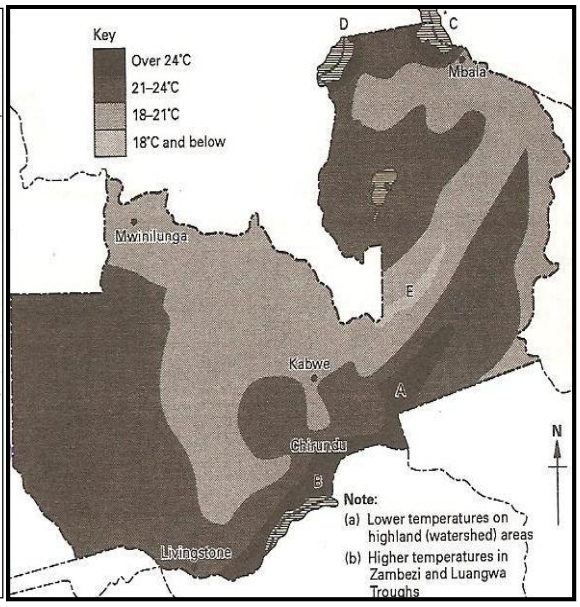


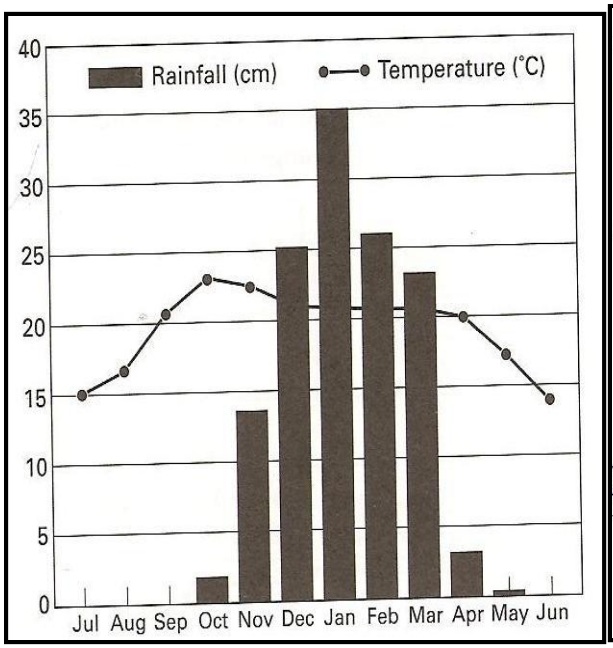
fig. 2.1 Mean annual temperature

We can generally divide Zambia into two regions:

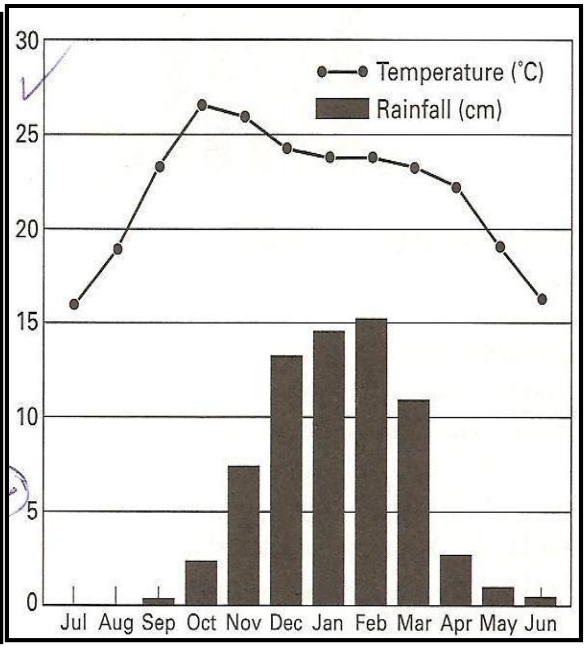
1. Hot, low summer rainfall-highland region.
2. Warm, high summer rainfall-highland region.

The hot lowland region has about eight months with maximum temperatures of over 26°c. There is a very short period of cool weather. The hot season usually has very hot days and warm nights. The temperatures decrease a little during the rainy season but with high humidity it becomes very uncomfortable. The average annual temperatures range from 21°c to over 26°c.

The warm highland region has a pleasant, healthy climate. Most of the towns in Zambia are in this region. The average annual temperatures range from 18°c to 21°c. Rainfall is heavier than in the lowland region. Study the climate graph for Ndola and compare it with the graph for Livingstone.



Climate graph Ndola



Climate graph Livingstone

The maps below show the prevailing winds during July and January.

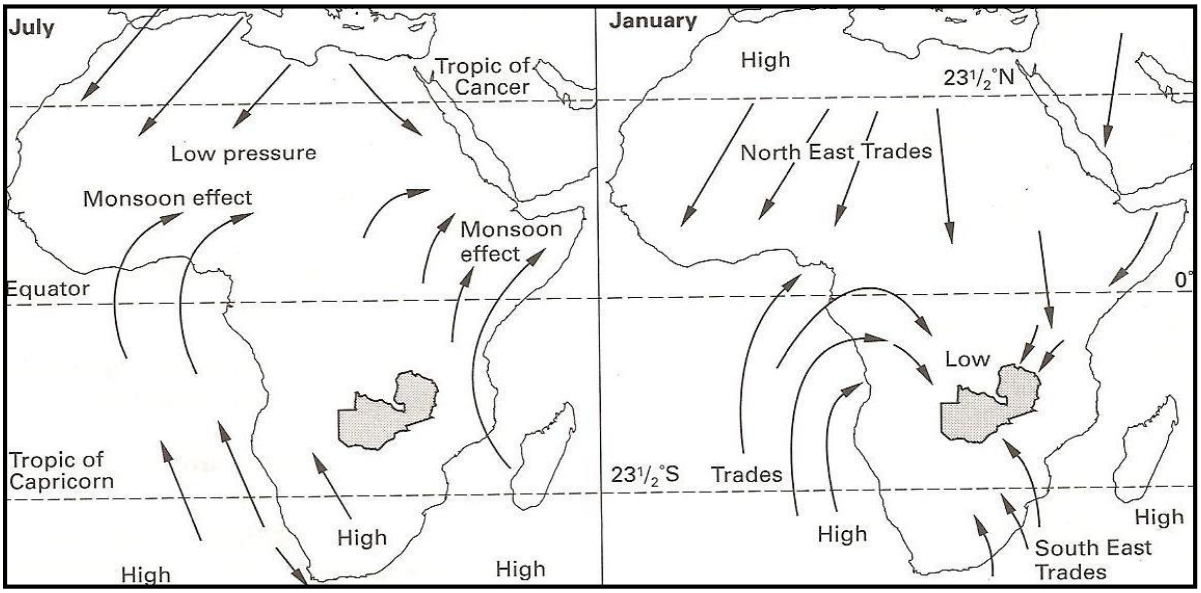


Fig. 2.3 African winds

The winds blow over the land in winter, so they do not carry much moisture. The winters are therefore dry from September to October. Pressure over southern Africa weakness because temperatures are higher, and most of the air moving into Zambia is from the north east. The winds

that cross the Indian ocean into the east-central Africa carry a great deal of moisture and result in thunderstorms. During the summer, winds from the north-east meet over Zambia. The meeting (converge) point of these air masses is called the intertropical convergence zone (ITCZ). In Zambia it is produced at the zone where the north-west winds(moist Congo or Zaire masses) meet the south East Trades(moist air mass from the Indian ocean).

VEGETATION

Zambia has about 70% of its land area under forest cover. The natural vegetation is savannah which is generally characterized by tall grass and scattered trees. The vegetation here can be generally divided into two groups and these are closed forests and open forests.

1. Closed forests without grass

This covers about 5% of the country and is made up mainly of forests. The types of forests depend upon the amount of rainfall. Some of the examples of the closed forests are;

a) Evergreen forest – these forests are called evergreen because although the trees lose their leaves all the time, there is enough moisture in the ground for new growth all the time, so the forests appear green all the year round. These forests are found only in the areas of high rainfall. The livunda forest is an example. Trees grow to a height of 25-30 meters with a lower tree layer, 10-15 meters in height. Creepers called Lianas tangle from tree to tree. Examples of trees found in evergreen forest are Mukwa, kayimbi and mupundu.
b) Deciduous forest- these forests are found in the areas where there is a period of very little moisture, during which most of the trees lose their leaves. Beneath the tree layer is a layer of shrubs called mutemwa. These forests include stands of mukusi or tea.
c) Montane forests- are found on highlands
d) Swamp forests- occur in small patches on the edges of swamps or areas that are seasonally flooded.

2. Open forests

a) Miombo woodland- areas where the trees open out and do not form a closed canopy and therefore allow grass and shrubs to form a thick covering on the ground called woodland. This woodland is called miombo because of the miombo trees (Bemba,

Ngoni) that are found here. A few of the other trees that are also found here are mutondo, mutobo, museshe and musaka. This woodland covers about 70% of the country.

b) Kalahari woodland- it is found in the Kalahari sands region. It consists of trees with a dense undergrowth of grass. Trees here include muzoule, museshi and kayimbi.
c) Munga woodlands is open park- like deciduous woodland with mainly acacia thorn trees, chilusa and chilobo trees and coarse grass. It is found in the driver areas where droughts are common.
d) Mopane woodland- is found along hot dry valleys. Mopani tree is fire resistant. It is found mixed with the baobab tree.

Grasslands

Grasslands are of two types:

a) Grasslands of dambos, swamps and flood plains, where trees are absent because soils are waterlogged.
b) Grasslands of the higher plateaus of the higher plateaus of the Nyike and Mbala Highlands, where trees have been destroyed by fire and replaced by grass.

The importance of forests

- Construction materials for homes and public buildings like schools and hospitals.
- Wood timber for railway sleepers, furniture, telegraph and electricity poles.
- Grass and fibers for making ropes, mats and baskets, building houses and shelters.
- Firewood for cooking and heating.
- Protection of the catchment areas from soil erosion.
- Protection of the soil from drying up.
- Reliable water supply by acting like a sponge which holds water and releases it gradually throughout the year.
- Food for both beings and wildlife.
- Shelter to wildlife.
- Source of medicines.
- Good scenery especially in highland areas.

- Raw materials for industries such as saw mills, pulp and paper, boat building aand floor tiles.
- Water vapour which contributes to the formation of rain.
- Purified air by absorbing carbon dioxide during the day and releasing oxygen. Forests therefore act as 'lungs of nature'.

Impact of human activities in Zambia on the natural vegetation

- Large areas have been cleared of trees for commercial farming.
- Shifting cultivation has been responsible for the large clearance of forests and woodlands.
- Population growth demands that more forests and woodlands are cleared for timber, farming, building of houses and wood fuel.
- Forests and woodlands near large urban centres have been cleared for firewood and charcoal.
- The construction industry is responsible for the clearance of many trees. Timber is needed for building houses, public buildings and many others.
- Commercial exploitation of timber has led to large areas being cleared of trees. Areas like Kataba, Mulobezi, Sesheke and Kalulushi have experienced deforestation because of this.
- Overgrazing contributes to forest and woodland degeneration. In some cases trees are cleared to make way for the grazing of animals as cleared land supports better pasture.
- Young and old trees are adversely affected by bush fires.

The general effects of deforestation

- Shortage of wood fuel.
- Wildlife such as animals and birds lose homes when trees are cleared.
- There is reduction in the quality of the environment. An area without vegetation has less scenic beauty than one with plenty of vegetation.
- Reduction in the amount of rainfall and water supply. Low rainfall Is received due to less transpiration.
- Areas experience falling yields in forest products such as timber, fruits, charcoal and many others.
- Marked changes in climate. Areas experience reduced rainfall and increase in average.

- -There is general destruction of bio diversity.
- Several soil erosion with the consequence that the land becomes less fertile and may turn into a desert.

Conservation of forests

Forests can be conserved through the use of:

- Alternate renewable sources of energy such as solar energy, wind hydro- electricity and biomas.
    - Restricting species and types of trees to be cut.
    - Fire control.
    - Regularly trees cutting techniques like trimming of stumps.
    - low sulphur containing coal in the form of briquettes (coal chips) (if made popular, coal chips can be used in place of firewood and charcoal).
- Practicing agro forestry. (This is a system of agriculture which involves the planting useful trees with crops. The trees would provide wood, fuel, fruits and timber).
- Educating communities on the importance of carry for forest resources in their respective areas.
- Introduction of tree planting projects at school and community levels.
- Afforestation and re- aforestation programmes.

Utilization and management of forests and woodlands

A Provincial Forestry Action Programme (PFAP) was launched in 1994. It was a pilot programme undertaken by the Forest Department covering the three provinces of Central, Copperbelt and Luapula. The program was funded by the Zambian Government with some funds and technical assistance from Finland. The programme aims were to

- Assess the extent of the existing forest and woodlands in the three provinces
- Estimate the potential of the forests in the three provinces in terms of timber and other forest products.
- Assess the levels of the current use of existing forests in the area.

- Recommend ways of utilizing and conserving these resources so that they could be used on a sustainable basis.
- Find ways of rehabilitating degraded areas.

What has the government done to protect the forests?

It has formulated policies to protect and conserve the forests. This began in 1949 with the establishment of the forest Department, which was given the following responsibilities

i. To create and protect forest reserves in the watershed areas against deforestation and soil erosion.
ii. To promote forest programmes like aforestation reforestation, and research with a view of achieving self-sufficiency in forest products.
iii. To promote the training of manpower so as to enhance the forest department's contribution to the country's economic and social development.
iv. To conserve indigenous forest by controlling deforestation and re-aforestation programmes.

Problems faced in forest management

- There are many problems faced by those charged with this responsibility and some of these are:
- Although the country has large tracts of land under forest, pressure from population growth, the need for farmland, firewood and charcoal has led to widespread deforestation in many parts of the country, as a result, the country is losing its forest at the rate of 0.5% per year, which translates to about 6.6 million cubic meter of forest per annum.
- The need for the establishment of the forest plantations had diverted the attention of forest department from paying attention to the conservation of indigenous forest.
- Re-afforestation programmes are not undertaken as vigorously as in some neighboring countries.
- While the government has paid some attention to sectors like agriculture and industry, attention to forest industry has been less.

AGRICULTURE IN ZAMBIA

Agriculture is one of the oldest occupations on earth, it produces crops and livestock. It yields food and raw materials for industry.

Agriculture is important because it:

- Provides food for people and livestock
- It is a source of income for the majority of people in rural Zambia. (About 60% of people live in rural areas of the country).
- Produces raw materials such as cotton, soya beans, and sugar cane for industry
- Generates 22% of the Gross Domestic Products (GDP) in Zambia and is the sector with the greatest potential to impact on food security, incomes and economic growth.
- Brings in foreign exchange through exports such as tobacco and cotton.

The main agricultural systems operating in the country are;

i. Traditional
ii. Emergent
iii. Commercial

These systems depend largely on rainfall. Irrigation is possible as the country accounts for 45% of the sub-region's resources. The commercial farming system is slowing developing irrigation farming and the government is giving incentives for this.

Traditional agricultural systems

There are three types of traditional agriculture systems in Zambia and these are;

- Lozi system
- Chitemene system of the Bemba
- Mambwe- Lungu- Namwanga system

Lozi system

The seasonal movement of the Lozi people and their animals from the flood plain when it gets flooded to the upland and back is referred to as **transhumance.** The Lozi transhumance system is perhaps the most sophisticated and intensive in Zambia. This is so because the Zambezi flood plain

and the edge of the forest (upland) that meets the plain, dry out at different times with varying soil types allowing for:

- growing of variety of crops throughout the year
- growing of a variety of crops
- Rich and productive grazing land for cattle throughout the year.

The sophistication of the farming system also lies in the understanding of the flood plain environment represented by:

Lipata- large shallow depressions

Mazulu- moulds lying above flood waters

Lishanjo- gardens at the edge of the plain

Matongo- lower slope of the upland meeting the flood plain.

Mateina- plateau area where soils are sandy and infertile

These varied features offer opportunities for growing crops, cattle grazing and fishing

Chitemene system of the Bemba

Although there is chitemene in North-western, Western, Copper belt, central, Luapula and Northern provinces , the chitemene system of the Bemba was the most developed and well documented. The Bemba lives in a forested plateau with shallow, acidic soil of low fertility. Chitemene which means 'cot-over area' was evolved by the Bemba as a means of enriching this poor soil for growing a variety of crops.

Features of Chitemene

Chitemene involves

- Cutting of branches of trees from May to about August by men.
- Pulling dried tree branches to a central place where they are heaped in large circle y women from about September to November.

- Burning dried branches in October\ November at the onset of the rains and
- Sowing\planting in November and December.
- In a forested region with tree growing close together and employing simple tools like axes and hoes, chitemene was perhaps the best system of farming because it:
- Avoided stumping which was slow and time consuming
- Never disturb the soil much by deep ploughing
- Made constant weeding unnecessary as most plant seeds were burnt.

The main crops grown under chitemene

-Millet (which is the main food crop), maize, pumpkins, myungu, cowpeas, cassava, groundnuts and beans.

Disadvantages of chitemene system

Chitemene system of farming has been condemned as a bad method of farming by the Zambian Government because:

- it is very wasteful of trees
- it encourages soil erosion
- useful soil bacteria are destroyed where branches are heaped and burned because of the intense heat that is generated
- Although a large area is cleared and so much labor is invested in making chitemene, the yields of crops obtained are low.

Mambwe- Lungu- Namwanga system

It is practiced in the northern and north- eastern parts of Zambia.

This system of farming involves

- Making moulds towards the end of the rainy season between May and April. (A grassy patch is usually chosen so that the covered grass can serve as manure)
- Opening up the mounds and spreading the manure soil at the beginning of the rainy season (November/December).

- Sowing of millet which is the main food crop interspersed with Maize, pumpkins and Myungu in November/ December.

Some form of crop rotation was practiced whereby a field had different crops grown on it continuously for some five to ten years.

Advantages of the system

This system of farming was favored and because important even among the Bemba because it

- Was not wasted of trees as fields were made over grassy patches and it utilized grass as its fertilizer.
- Allowed for intensive cultivation of crops such as millet, cassava, beans and groundnuts. Which
- Maintained soil fertility through grass maturing and crop rotation.
- Required minimal or no use of chemical fertilizers permanent basis.

Commercial Agriculture

Commercial agriculture is the growing of crops and raising of livestock for sale. The former's motive is to produce more and sell the produce at a profit. Commercial agriculture consists of **conventional mixed farming plantation agriculture, horticulture, livestock rearing and intensive market gardening.**

Mixed farming produces crops like maize, wheat, soya beans, horticultural produce, flowers and livestock. Plantation agriculture specializes in producing trees and grass crops like tea, coffee and sugar cane.

Production is helped by the use modern methods of crop and animal production such as crop rotation, use of hybrid seeds and artificial fertilizers. Commercial farming additionally uses machines. Production is therefore generally higher in commercial agriculture than in traditional farming systems.

As commercial agriculture is driven by the profit motive, most of this activity takes place along the line of rail. Areas like those near Livingstone, Choma, Monze, Mazabuka, Lusaka and Kabwe have well developed commercial farming. Others are the Copperbelt and the Mkushi area. it is in

these areas that large quantities of Maize, Wheat, Tobacco, Flowersand other crops are produced. Other conditions which favour commercial farming besides transport are:

- The presence of large urban markets
- There is suitable climate for farming as the areas experience moderate temperatures of between 15°c to 24°cand an average annual rainfall of about 1,000 mm.
- Much of the line of rail area is a plateau and is free from tsetse fly infestation.
- Soil fertility along the line of rail is good as the area has loam soils.
- Availability of hydro- electric power reduces the cost of farm production.

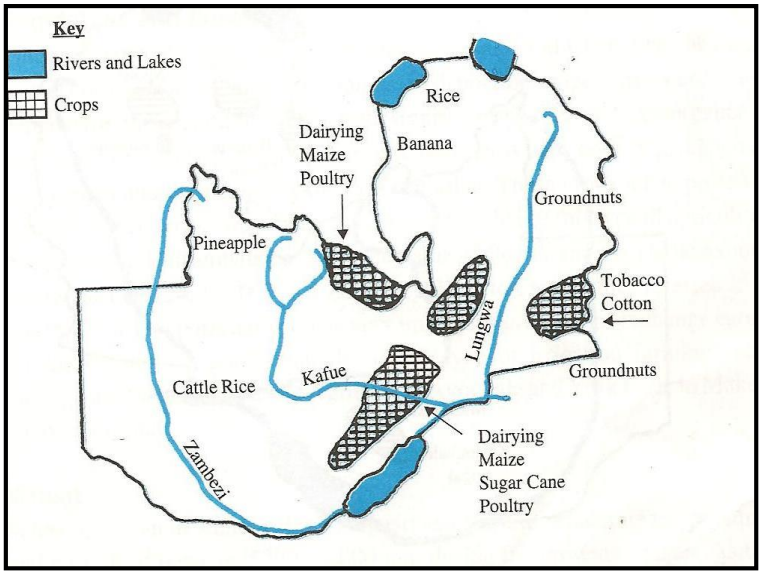


Fig. 3 Commercial farming areas and major crops

Estate farming

Estate farming is concerned with growing tree crops by firms or companies for the local and export markets. Most of these plantations were started by the government. The major estates include Nakambala sugar Estate in Mazabuka, Kawambwa Tea Estates in Kawambwa, Ngoli and Kaleshi coffee Estates in Kasama and Mununshi Banana Scheme in the Luapula valley.

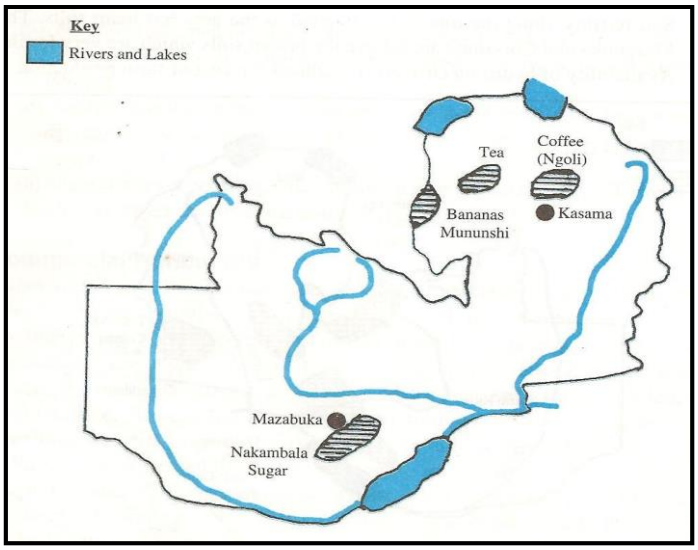


Fig. 3.1 plantation crops

Irrigation agriculture

Irrigation which is the growing of crops in the dry part of the year by supplying water to crops from rivers, boreholes and reservoirs is one way of intensifying the use of the land.

It enables the farmer to use a piece of land to produce crops two to three times in a year.

Areas of irrigation

The methods of irrigation are canal, flood, sprinkler and overhead irrigation. Important areas of commercial irrigation are:

a. Around Lusaka for green maize, vegetables, flowers and wheat.
b. Chisamba area for green maize, vegetables, wheat and flowers.
c. Mpangwe area mainly for wheat but also coffee.
d. Mazabuka area for wheat and sugar cane.

Effects of irrigation

- Irrigation transforms bare land into areas of green vegetation.
- The negative effects of irrigation include salination, increased water related diseases and eutrophication of rivers.
- Irrigated lands may become saline and little or nothing grows well on such lands.
- Fertilisers used on agriculture lands next to the river under irrigation will be washed into the river.

Problems facing commercial farming

- High cost of inputs such as fertilizers, seeds and energy which make the produce uncompetitive on the export market.
- Liberalisation of the economy has led to the influx of agricultural produce from Zimbabwe and South Africa which have depressed the market for local produce.
- Government policy of withdraw from participation in the marketing of produce and the provision of credit and inputs has retarded commercial farming.
- Fluctuation of the value of the Kwacha coupled with its low value (depreciation) has made planning for commercial farming difficult. It has also made the payment of credit difficult as debts keep growing.

Livestock farming

The most important livestock raised in Zambia are cattle followed by poultry, sheep, goats and pigs. Western and Southern provinces are the leading cattle rearing provinces with moderate numbers in Eastern and Central provinces. Small numbers of cattle are kept in Northern and North- Western provinces while some parts of the country have insignificant numbers.

The factors restricting cattle rearing in Zambia are;

- The presence of tsetse fly that carries trypanosomiasis which kills cattle.
- The absence of pastures in some parts of the country.
- Absence of the tradition of cattle keeping among some ethnic groups such as the people of the Luapula province.

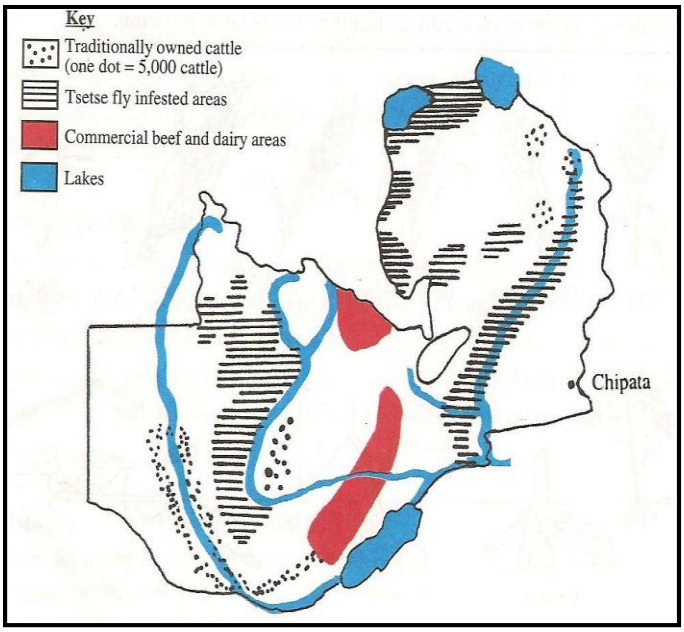


Fig. 3.2livestock farming areas in Zambia

Factors favouring commercial cattle farming

- The presence of rich pastures along river floodplains like the Zambezi and Kafue flats.
- Absence of tsetse fly and open grassland with scattered trees.

The concentration of commercial cattle ranching and other livestock production along the line of rail is mainly due to the

- Presence of a large market for meat, dairy products and poultry and poultry products.
- Efficient transport for quick movement of produce to the markets.
- Presence of electricity which makes preservation of fresh foods and processing of meat products possible.
- proximity to manufacturing and processing industries which provide improved livestock feeds such as molasses, cotton seed, ground nut cake, food additives and livestock drugs and
- Favourable climatic conditions.

Problems facing commercial cattle farming

- Diseases such as foot and mouth and east coast fever ravaged the two leading cattle rearing provinces of Southern and Western province.

- A cattle rustling is a serious problem that needs to be checked. Rustling has led to loss of life (both cattle owners and rustlers)
- Pricing mechanism needs to be monitored so that cattle owners receive economic prices for their animals.

WILDLIFE AND TOURISM

Wildlife

Wildlife is any wild animal, bird or any kind of natural vegetation.

Why should we protect Wildlife

- a tourist attraction
- provide meat and other products (skins, horns)
- balance of nature- food chain
- future children can see them
- create employment

What the government has done to protect wildlife

- The government has set up national parks. There are 19 national parks in Zambia.
- The government established botanic gardens to protect flowers e.g Munda Wanga
- It has trained game rangers to protect forests.
- Historical sites and museums.

Tourist attractions

Zambia has various tourist attractions. They include:

- Plateaus such as the Nyika plateau and Tonga Plateau.
- Mountain ranges like Muchinga mountains, Mafinga and Makutu mountains.
- Waterfalls which include the Victoria falls, Kalambo, Chishimba and Mambilima.
- Game parks such as the North and South Luangwa, Kafue and Liuwa national park.
- Lake beaches provided by lakes Kariba, Bangweulu, Mweru and Tanganyika.

- Traditional ceremonies such as Kuomboka, Umutomboko, Likumbi Lya Mize, Ncwala and many historical sites.

  Besides the above attractions, the country has a warm sunny tropical climate and a friendly people.

The Victoria Falls

- The Victoria falls is the Largest tourist attraction in Zambia.
- One of the seven wonders of the world in Zambia.
- 1,700 meters wide and 100 meters deep.
- Pouring over nine million liters of water per second to the gorge below when the river is in full flood.
- Generating a continuous spray from the falling water and at full flood, tourist wear raincoats to avoid being drenched by the spray.
- Well advertised world wide.

Besides the falls, there are other attractions nearby and these are:

- Game viewing in the Musi-O-Tunya National Park
- The Livingstone Museum.
- The Railways Museum.
- The Mukuni Village.
- Sundown cruises on the Zambezi aboard the Makumbi Boat.
- Bungi jumping and white water rafting.

The lakes and beaches

Zambia has a number of lakes which include Kariba, Bangweulu, Mweru, Mweru-Wa-Ntipa and Tanganyika. Most of the lakes do not have facilities for tourism except lakes Kariba and Tanganyika.

Siavonga- A lake Resort

- Is built on a hilly and picturesque coast overlooking the lake.
- Has easy access to the sandy beaches to the west and the early iron age site (Ingombe Ilede)

- Has access to Kariba Dam.
- Offer boat cruises, fish angling and access to the Kariba Dam.
- Offers spectacular views during annual opening of spilling water gates.

How it has disadvantages

- Limited sandy beaches.
- Crocodiles pose danger to swimmers.
- There is no airport or airstrip for easy access.
- There is no game park nearby.

Kasaba Bay- Lake Resort

- Located on the shore of lake Tanganyika.
- Has extensive fine sandy beaches extending a distance of 80km.
- Is found within sumbu National park.
- Has annual fish competitions.

The traditional ceremonies

1.The kuomboka ceremony.

- celebrated by the Lozi of Western province
- Takes place in February, March or April every year.
- The Litunga moves from his summer capital, Lealui, to his winter capital Litunga when Lealui becomes flooded.
- The Litunga travels in the royal barge called the Nalikwanda.
- The journey takes the whole day.
- There is traditional dancing and singing at Limulunga arrival which attracts the people.

2. The Umtomboko

- Celebrated by the Lunda of Mwata Kazembe in Luapula province.
- The ceremony marks the successful crossing of the Luapula river in the 18^{th} centuary.
- feasting and dancing culminating in the senior chief's victory dance.

The impact of tourism

- Provides foreign exchange to the country.
- Provides employment in hotels, lodges and National parks e.t.c.

Advantages

- Tourism generates income for the country.
- Provides employment in hotels, transport and National Parks.
- Creates a market for local produce e.g farm products, curious, crafts.
- Encourages handicrafts industry in the production curious e.t.c
- Tourism encourages the development of infrastructure- roads, airports, hotels.
- Tourism raises income and living standards of local people.
- Promotes the preservation of culture.
- Promotes international understanding.

Disadvantages

- Hotels, airports, roads spoil the natural beauty of the land.
- Employment is seasonal.
- Loss of foreign exchange through importation of luxury goods like vehicles.
- Borrowed money to build infrastructure increase the National debt.
- Tourism promotes prostitution and crime.
- Promotes disrespect for local customs, dress and language.

Problems

- The problems brought about by wildlife: depletion and deforestation impact negatively on the success of the tourism industry.
- The government casual approach to developing tourism casual approach to developing tourism gives anxiety to the industry. ZNTB is insufficiently funded and roads to tourism areas are poorly maintained. The tax regime is also too high.
- The foreign debt impacts negatively impacts negatively on tourism as the country is not able to develop the infrastructure needed for tourist development.
- A long distance between tourist attractions is another problem.

- Source regions for tourists in Zambia are distant. The country is unable to attract many tourist.
- Stiff competition for tourists within the region.
- Lack of a national airline makes the industry depend on foreign carries whose schedules may not be the best for the industry.

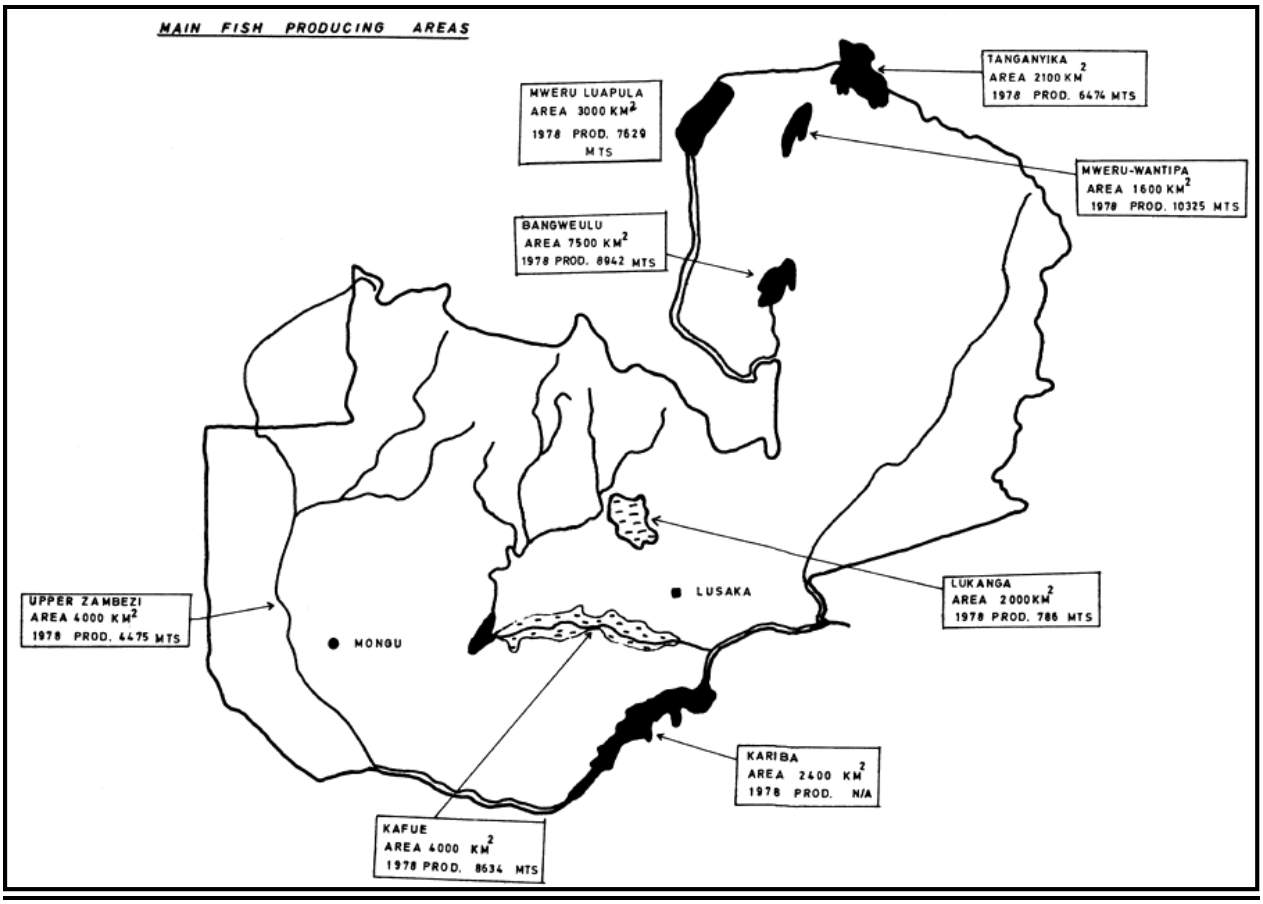
FISHING

Importance of fishing

- Fish is a source of 60% of the animal protein consumed in Zambia.
- Fishing provides employment to fishermen, traders, transporters, over 300,000 are employed so it is a source of income to many people.
- Fishing as a sport is a great tourist attraction e.g Zambia National Competition at Kasaba bay.
- It has stimulated industries such as boat making, net making, ice block manufacture, fish canning.
- It has led to the development of infrastructure e.g roads, harbours, rest houses.
- Fish farming (aqua culture) helps the country to use available water resources e.g irrigated area water storage reservoirs.

Fishing area (fisheries)

A fishery is a place where fish is caught e.g. lake, swamp or fish pond. Chief fisheries in Zambia are Lake Tanganyika, Lake Kariba, Lake Bangweulu and swamps, lake and swamps of Mweru Wantipa, lake Mweru, Luapula river, Kafue flats, Lukanga Swamps, the mid Zambezi river (Bulonzi, flood plain) and the Luangwa river.



Lake Tanganyika fisheries

- There are individual fishermen and commercial fishermen. Scoop nets are used to catch Kapenta. Gill nets are used for Nile perch (Buka Buka). A training school is at mpulanga.
- The problem faced by the fishery is distance to the market, Lusaka and the copper belt.

Bangweulu Fishery

- Gill nets are used mostly. Also seine nets lines, spears and baskets are used.
- Fish caught: Breams, Bull dog, Tiger fish, Barbell. Poor transport makes fish to be dried either by fire or sun. There is little trade in fresh fish.

Mweru – Luapula fishery

- Gill nets are the most common lines and traps are the most common, scoop nets, lusenga nets are used for type of Kapenta called Chisense.
- Fish caught – bream, snout fish, tiger fish, muafish, barbell. Most of the fish is sold fresh. There is an ice plant at Kashikishi.

Lake Kariba fishery

- Gill nets are used for bream tiger fish and scoop nets for Kapenta. A fishing training centre is at sinazongwe where they make and repair nets, boat making and servicing engines.

Kafue Fishery

- Gill nets are the most common method of fishing. Seine nets are banned.
- Fish caught in the Kafue fishery is; pike bream, Barbel, Bull dog, bottlenose.
- Fresh fish has great demand in urban centres of Lusaka, kabwe and Ndola

Other fisheries include lukanga swamps, Luangwa and fish farm ponds.

Fish Farming

. Fish farming is becoming increasingly important throughout the country.

- Quite a good tonnage is caught in the fish ponds which are found in chipata, Isoka, mpika etc.

Fish production

Overall production is declining because of

- Over fishing in many areas
- Water pollution from industrial wastes
- Destructive methods of fishing e.g use of seine nets etc
- Increased number of fishermen due to increase in population.
- Artificial conditions (man made dams) disturb natural breeding patterns of fish.

The Fisheries Department

The department has its headquarters in Chilanga, South of Lusaka. It makes the rules that help control and improve the fishing industry. Its job is to:

- To enforce fishing regulations such as banning the use of destructive fishing methods, observing the closed fishing season to allow fish to spawn and build up stock, controlling the amount of fish caught from each fishery.
- Provide special facilities to train local people and improve their fishing methods. Eg. Training schools at mpulungu on Lake Tanganyika and Sinazongwe on Lake Kariba.
- Study and setup fish ponds to grow fish in areas where ponds can provide fish for both subsistence and commercial purposes e.g at Mwekera, Chilanga.
- Teach people not to overfish and to protect fishing areas, e.g. discourage the use of poisons.

The processing and marketing

Fish is processed as frozen, fresh caned, smoked or sun dried. Frozen fish is common where refrigeration equipment is available e.g Kashikishi, Sinazongwe, Kafue and Lusaka.

Most of the fish is marketed locally because there is high demand.

Most fish from Lake Bangweulu and Mweru is marketed on the Copperbelt, fish from Kariba, Kafue upper Zambezi is marketed in Lusaka.

However, fresh kapenta and Buka fish are exported to Congo D.R, Zimbabwe, Namibia and Swaziland. Dry fish is also exported to D.R Congo.

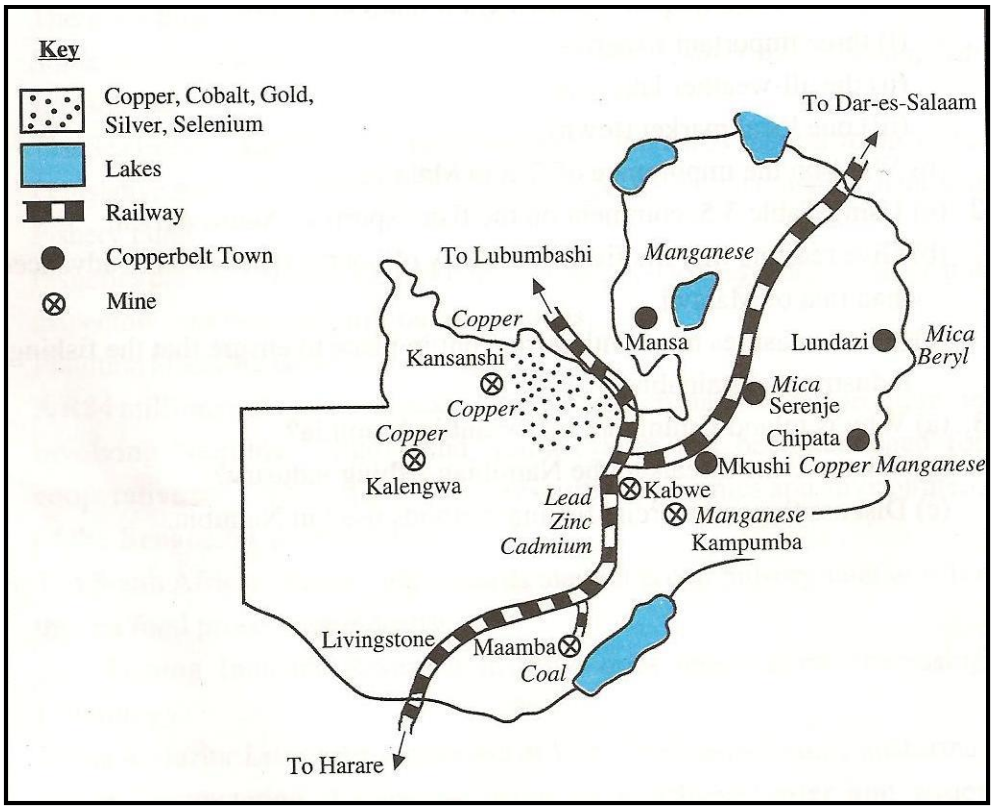
Problems of the fishing industry

- Poor transport system in some fisheries.
- Lack of storage facilities in most fisheries
- Lack of capital among fishermen
- Lack of modern fishing skills among many fishermen
- Danger to fishing – overfishing-

MINING IN ZAMBIA

Copper is Zambia's most important mineral and is the country's leading export by value. The country's immense mineral wealth also consists of major deposits of cobalt, coal, Lead, zinc, emeralds, aquamarine, Amethyst and tourmaline. In addition smaller quantities of selenium, manganese, tin, nickel, iron, uranium, diamonds, gold and silver have been found. Other deposits

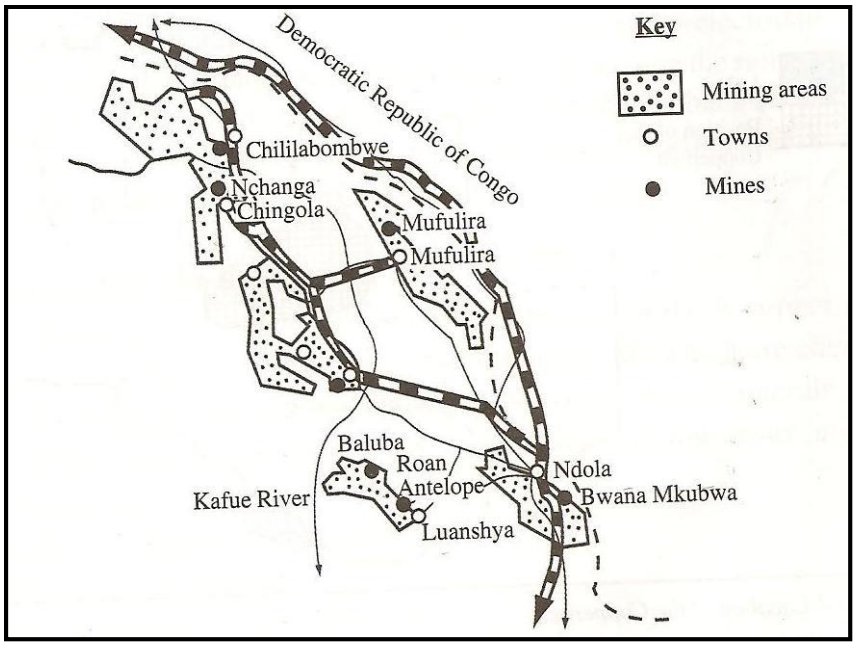
include talc, fluorspar, graphite, barite, clays, sand and limestone. The figure bellow shows Zambia's mineral deposits



Mineral deposits of Zambia

The copper mining areas of Zambia

Although Zambia boasts of copper deposits in several parts of the country, copper + mining has been concentrated on the copper belt. The figure below shows the main copper mining areas in Zambia



Copper mining areas of Zambia

Advantages of copper mining

- It attracts the railway lines from the south for the transportation of minerals, especially copper, lead and zinc.
- There was a large population increase as copper mining created employment.
- Social development inevitably followed. Hospitals, schools, markets and recreational facilities sprung up, leading to massive infrastructural development.
- Mining led to the development of thermal and hydro- electric power stations in the country. This power has led to the development of the entire nation in general as grids criss- cross the country to many towns.
- Manufacturing industries such as Zambia metal fabricators (Zamefa) developed to support mining activities.
- When the wind of independence was blowing across Africa. It was not surprising that political consciousness started on the copperbelt in 1935.
- They have provided a large market for hydro electricity power e.g in 1990 copperbelt mines consumed 68% hydro electricity power produced in Zambia.

Mining methods

There are two methods of mining used in Zambia and these are open pit and shaft or underground mining.

Open pit mining

- it is used when the copper ore lies close to the surface.
- The over- burden is removed by bull dozers and the ore is then mined by excavators.

Examples of open pit mining are; Lumwanga mine and Nchanga mine (the world's largest open pit

Mine).

Shaft or underground mine

- It is the used when the copper ore is found very deep in the ground,
- Deep shafts are sunk and fitted with lifts to carry both workers and machinery underground and bring up the ore. Examples of shaft mines are Nkana, Mufulira, Albidon and Kansanshi.

Uses of copper

- As a good conductor of electricity copper is used in the electrical industry.
- It is used for making alloys such as brass and bronze.
- It is used in electrical wiring- telephone wire, radios, television sets and vehicles.
- Copper is also used in making a lot of other things, among which are ornaments, roof materials and water pipes.
- Car radiators, bullets and ornaments are also made from copper.

Copper is exported to markets from Zambia by:

- Rail to Tanzania (Tanzania- Zambia Railway) to the part of Dar- es- salaam

- Road through Mozambique to the parts of Maputo and Berra.
- Rail to South Africa ports of Durban and East London.

Lead and Zinc

Lead and zinc in Zambia is mined in Kabwe at Kabwe Broken Hill Mine. The mine started production in 1904. It first started as the open pit method and the by shaft mining.

Qualities of lead

Lead is a soft and dense, grey metal. It is malleable (can be rolled or hammered into thin sheets).

Uses of lead

Lead is used

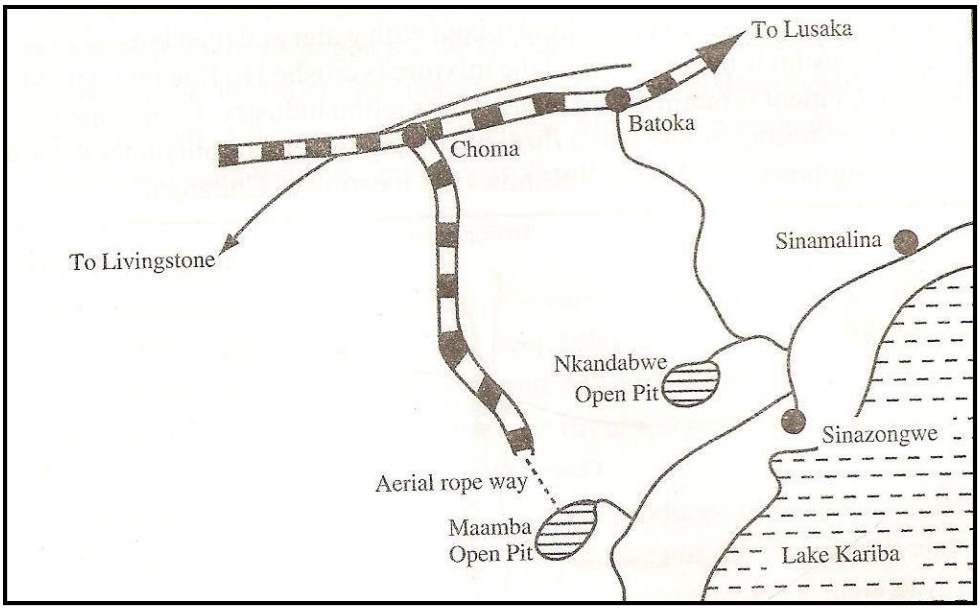
- In making electric strong batteries.
- As a protective shield against radiation.
- In the chemical industry as a lining for acid storage tanks.
- In makin lead oxide for paint.
- In covering cables
- In bullets
- For making roofing materials
- In alloys and it can be mixed with line to make solder
- In piping

Properties of zinc

Zinc is a soft, white metal. It is malleable. It resists rust.

Uses of zinc

Zinc is used in roofing, toothpaste tubes, casings for dry batteries, pipes, paints ,antiseptic, ointment s, in galvanizing iron and for making alloys.



Location Maamba Coal mine

Coal

Coal is mined in mamba in the Gwembe valley. It is an open pit mine. The mine has reserves estimated at 78million metric, is transported by an aerial ropeway up the escarpment to the railhead of the branch line from Choma.

Uses of coal

Coal has many uses and some of them are:

- To produce thermal electricity
- In cement production
- Provide power in the processing of metallic ores
- Produce tar and benzole
- In foundry

Limestone

Limestone quarries are found at Shimabala south of Lusaka and Ilawa swamps near Ndola. Limestone is used in the manufacturer of cement at Chilanga and Ndola.

How cement is made

Limestone and clay are crushed and mixed with water and then burned in large ovens. Gypsum is then added and the mixture is crushed to fine powder called cement.

- Gypsum is mined at Lochinvar in the Kafue Basin

GEMSTONES

The rich variety of zambia's gemstones consists of emaralds, amethysts, aquamarine, garnet, diamonds, malachite, tourmaline and others.

Emarald deposits are found near Kafubu River in Kafue Emarald Belt. Amathysts are nined in the Kalomo area, Aquamarines and tourmalines are fond in Serenje. Almandine garnets are mined in Chipata.

Physical impact of mining in Zambia

Although mining is an important industry in Zambia, it has some impacts on the mining areas

- Mine dumps scar environments of mining areas and take up valuable space. The Kabwe mine dumps are being processed to recover Zinc. The Bwana Mkubwa dumps are also being processed by first Quantum.
- Scrap metal heaps are also a common sight in mining areas. The new mine owners have setup programmes to clear this metal heaps.
- Open pits could be dangerous and possibly be the source of disastrous landslides like at Nchanga in 2001.
- Air pollution is another common problem in mining areas. Smoke from Nkana smelters is seen as one enters the mining Zone. Air pollution can lead to dental, eye and chest problems. Noise is another irritant in mining towns.
- Vegetation is affected by acid rain. In Kankoyo (Mufulira), roofs were corroded by acid rain. In Kabwe, deforestation was being accelerated by mining activities.
- Water can be polluted by mining activities as was the case in Kafue.
- Bio- diversity is destroyed by chemicals, digging, dumping, water and fibres.

ENERGY

Major energy resources in Zambia include wood fuel, coal, and Hydro-electric power.

Wood fuel

About 80%of Zambia's population uses wood fuel or charcoal for heating and cooking and this has serious implications on the environment. The country is quickly becoming deforested.

Coal

In Zambia, coal occurs at Nkandabwe (closed) and Mamba in Gwembe valley. It has been used in smelting metallic ores, foundry work, processing of limestone and generally thermal electricity.

Hydro- electric power in Zambia

Zambia produces its own hydro- electric and she is a major producer of this in the sub- region. The following are Zambia's major hydro- electric power (H.E.P) stations and their generating capacity:

- Kafue Gorge- 900 mw
- Kariba North Bank- 600 mw
- Victoria Falls- 108 mw

Zambia's minor H.E.P stations include Mulungushi (20 mw), Lunsefwa (18mw), Lusimasi (12 mw), Chishimba falls (6 mw) and Musonda falls (8 mw).

The power is used in industries for lighting, driving machinery, processing and manufacturing.

In homes (domestic) it is used for lighting, cooking, and operation of electrical appliances. In commercial establishments it is used for lighting, operating tills, e.t.c

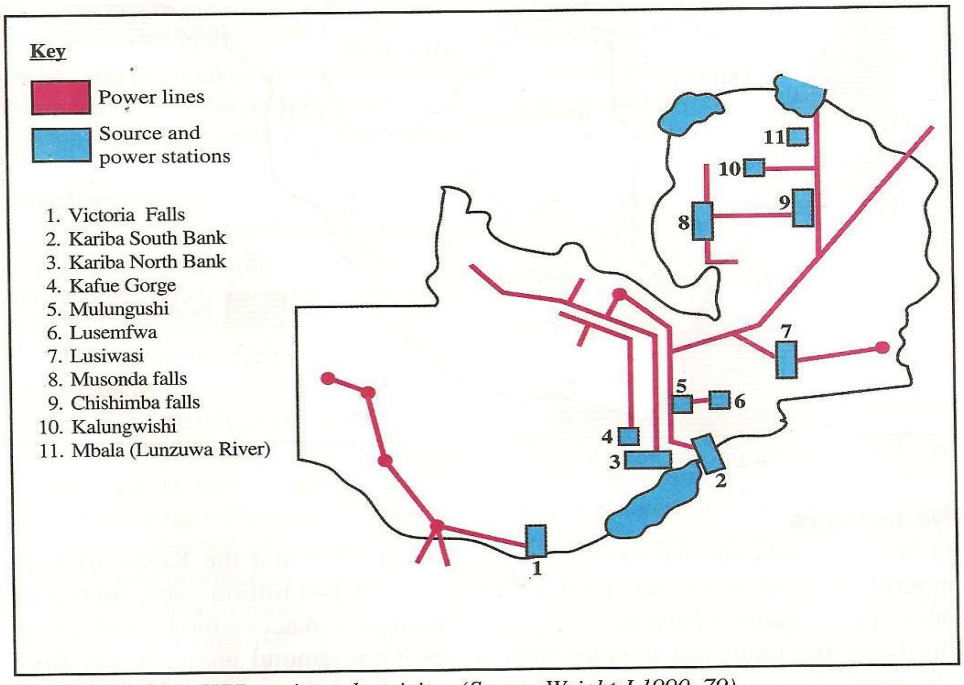


Fig. 5.5 Zambia's HEP stations electricity. (Source Wright J 1990, 79)

SOLAR ENERGY

It just requires a few solar panels to be mounted on the roof. It is cheaper than H.E.P because it does not require expensive infrastructure such as the pylons and high tension wires.

Trade in energy within the region

The southern Africa Development Community (SADC) has been working towards intergrading the national electric power grids of member countries into one regional power grid. This would link up all power generating units within the region by a system of pylons and high tension wires.

Already, power grids of South Africa, Namibia, Botswana, Zimbabwe, Mozambique, Zambia and Congo DR are inter linked. The Zambia- Tanzania inters- connector project will link Zambia and Tanzania with 200 mw of power from Zambia. Zambia will supply this power by a 220 kv 0r 330kv transmission line and will earn an estimated US$153 million per year.

Threats to sustainable energy production

There are many threats to sustainable energy production. The main ones among these are as follows:_- -Uncontrolled increase in human population- for many countries in the southern African region, national populations have been growing at a very fast rate. This growth if it remains uncontrolled could easily lead to depletion of the regions resources including energy. This is so because rapidly growing human populations create immense pressure on food

production, provision of housing at an ever increasing rate, provision of clothing, provision of ever increasing quantities of water for domestic use and demands for quantities of fuel and power.

Lack of long term planning- hydro power plants and their sustainability should be planned on along term basis. Long term plans should be made, for example on;

- Maintenance of generating machinery such as servicing, complete overhaul and replacement.
- How to increase the discharge of tributary rivers into the main river.
- How to hold and store floodwaters in order to increase generating capacity in dry months and maintain high water levels in reservoirs.
- **Inability to put aside financial resources to support maintenance and replacement of equipment**- lack of funding for maintenance of Hydro- Power plants and for replacement of equipment and spare parts greatly threats sustainability of Hydro- power plants.

Problems

There are many problems associated with energy production and provision in the region. The major ones are:

- Inaccessibility to electricity by a large number of rural people even in countries where surplus power has been produced.
- Electricity grids of SADC countries are not all connected and this makes it difficult for countries with power deficiency to access power from those that have surplus.
- Southern Africa countries have little access to cheap crude petroleum produced in the region (e.g. Angola) because of contractual arrangements with energy mining companies buy most of the crude oil.
- Lack of technical know- how prevents countries that have known deposits of natural gas to exploit them to meet the local demand for energy.
- Political interference.

PROCESSING AND MANUFACTERING INDUSTRIES

Types of industries

- Primary industries- these are industries which rely direct on the environment e.g. farming, fishing, lumbering and mining.
- Processing industries- this is a branch of manufacturing industries as they prepare primary produce before these products can be used or exported.
- Manufacturing industries- these are industries which are involved in the process of making goods like clothes, sugar, steel and furniture. So manufacturing is not the actual making of a product but it is rather assembling a product.

NOTE: Both processing and manufacturing industries are called secondary industries.

- Tertiary or Service industries- These are industries which offer services to other industries so that production can be facilitated e.g banking and insurance.

Factors affecting the location of manufacturing industries

1. **Raw materials**: when a factory uses bulky raw materials such as clay, timber or sugar cane, the factory will be located at the source of raw materials to cut on transport costs. Perishable raw materials attract the factory to the source of raw materials.
2. **Transport**: it is cheap and efficient transport that attracts investors. In Zambia, rail transport is the cheapest. In other countries, it is water transport. Locations near the railway are therefore regarded as advantageous in Zambia.
3. **Power**: cheap power is offered by hydro electricity (H.E.P). Towns connected to Kariba and Kafue Gorge H.E.P stations will have least energy cost and adequate power supplies.
4. **Market**: with regard to market, the following questions are asked.

- What kind of people will buy the finished product?
- Are there enough of them to absorb the factor's output?
- Is the market likely to expand?

5. **Labour**: this factor determines whether adequate skilled and unskilled labour will be available within reach of the proposed site. Labour however is mobile and can be recruited from distance places.
6. **Government policy**: government encourages the establishment of industries in certain locations through low land tax and duty rates. Government policy ensures equitable

development of industry to all parts of the country. Livingstone, Ndola and Luanshya have been declared tax free Zones so that industries can develop in these towns.

The problems faced by manufacturing industries in Kafue

- Stiff competition from imported goods.
- High duty on imported raw materials.
- High energy costs increased local production costs and made locally manufactured goods uncompetitive.
- Fluctuating currency exchange rates which made planning difficult.
- High bank interest rates which made capital borrowing expensive.
- The foreign debt has impacted negatively on industrial development as there is limited foreign exchange to pay for imported inputs. Foreign debt is the main cause of frequent devaluation of local currency making it weak.
- The long routes to the sea have hindered industrial development as transport cost for machinery, spare and raw materials are more expensive than in neighboring countries like Tanzania, Mozambique, South Africa or Zimbabwe.
- Weak currency promotes increased domestic exports as local goods are lowly priced.
- Government policies, although sometimes offering good facilitation, have sometimes hindered the development of industries in the country. The policy of liberation adopted in 1990s has created uneven playing field for local industries making it difficult for them to compete on both the domestic and foreign markets.

POPULATION STUDIES IN ZAMBIA

DEFINATION OF TERMS

Population: is the number of people living in an area at a given point in time.

Census: counting of the people in an area. Information such as employment status, age, sex, housing, education, agriculture and material status are also collected.

Population growth rate: this is the rate at which population is increasing or decreasing in a given year due to natural increase, migration and other factors.

YEAR	POPULATION IN ZAMBIA
1963	3.5
1969	4.1
1980	5.7
1990	7.8
2000	10.3
2010	13.4

Zambia Census results

Population growth is influenced by demographic processes such as fertility, mortality and migration, birth rate, death rate and life expectance.

Birth rate

Birth rate is the number of births per 1,000 people per year in the population. If more babies are born per 1,000 people, the population is likely to grow, for example, if 30 births occur this will mean

30/1000 x 180= 3%

This is considered as a high birth rate.

Death rate

This is the number of people who have died in a year out of every 1,000 people. From the birth rate and the death rate we can find the natural rate of increase of the population. The natural

increase will indicate how fast or slow the population is growing. So the natural rate of growth is the difference between the birth rate and death rate expressed as a percentage (%)

Birth rate – Death rate = Natural rate of increase

For example, when birth rate is 70 and death rate is 50 then natural increase is 70 – 50 = 20. The difference is divided by 1,000 and multiplied by 100 t0 get a percentage.

This means that

20 ÷ 1,000 x 100 = 2%

Usually birth is higher than death rate. However, the above figure is considered as high.

Fertility rate

Fertility is the actual reproduction performance of an individual, a couple, a group, or population. Total fertility rate (TFR) is the average number of children that would be born alive to a woman during her lifetime if she were to pass through her childbearing years (15 to 49). Statistics indicate that since 1969 the level of fertility has remained relatively high and is likely to remain so far in the future unless concrete interventions are undertaken.

Mortality rate

Mortality rate is the number of deaths in a given population. The levels of mortality, which declined considerably between 1963 and 1980, have been rising since 1980. The crude death rate declined from 19.7 to 16.7 in 1980 and rose to 18.3 in 1990. The decline in mortality rates was probably due to improved standards of living and adequate provision of health services.

Infant mortality rate is the numbers of deaths of children under one year of age every 1,000 children born alive. The increase in infant mortality rates could be attributed to the HIV/ AIDS pandemic and other diseases such as malaria, pneumonia, T.B and diarrhea.

Migration

Migration is the movement of people from one area to the other. This could be within the country (internal) or between countries (international). Migrations can either lead to increase or decrease in the population.

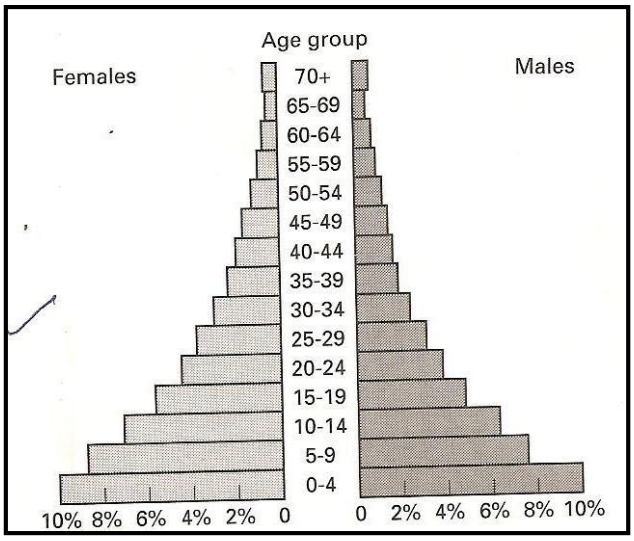
Life expectancy

This is average number of years a person is expected to live from birth to death. Life expectancy is affected by several factors such as the prevailing mortality trends and the standard of living of the people.

Structure of the population

Population is made up of people of different ages and sex. It comprises of males and females, babies, men, women, boys and girls. This composition is known as **the structure of the population.**

The age- sex structure is the composition of a population determined by the number of males or females in each age group. The number of males and females can be presented in an age **sex pyramid** as shown below.



Population pyramid

In Zambia the trends in fertility and mortality have led to a population that is young, with a median age of 15.2 and 16.8 years in 1980 and 1990 respectively. A young population is one with a relatively high proportion of children, adolescents and young adults with a low media age. This

type of population has a **high potential growth rate** known as in- built population momentum. The media age is the age which divides a population into two equal groups where half the people are younger than this age and half are older. In 1990 nearly half of Zambia's population (45.2%) was under 15 years of age. The age will shown whether a population is young or ageing, for example, Britain has an ageing population with a median age of 34.

Sex ration

This is the number of males per 100 females in a population. The sex ration for Zambia shows that there are more females than males.

Dependence ration

This is the number of dependants (those under 15 years and 65 years and above per every 100 economically active persons). The economically active people fall in the range of 15 to 64 years. The dependence ratio determines the economic status of any society.

$$\text{Dependence ration} = \frac{\text{population under 15 + population aged 64 and above}}{\text{Economically active population (15 to 64 years)}}$$

Population distribution

Population distribution is how people are spread over an area. On the average, Zambia is a very sparsely populated country. This means there are few people living in a given area. However, there are some densely populated areas, with more people. **Population density** is the number of people found per square kilometer in a given area.

$$\text{Population density} = \frac{\text{Number of people in an area or country}}{\text{Unit of area}}$$

Over population and under population

Every country has an optimum population.

Optimum population- this is the size of population which is felt to be the most desirable for the full utilization of its natural resources and which produces the highest standard of living.

Under population- these are the countries or areas where a high population could be supported without any fall in living standards.

Over population- this is when a country or area has a higher population than its resources can adequately support.

Factors influencing population distribution

- Population distribution is influenced by many factors some of which are **natural** (physical), **social- economical** and **political factors**.

Natural factors

The natural factors which influence population distribution include relief features, climate, Availability of water, soil and forests.

Relief features

Very few people live in Hilly areas and Rift Valleys because these places are mostly composed of stony soils which are not suitable for farming. Most people live on relatively flat land for example areas around the line of rail are densely populated while places like the Zambezi and Muchinga Escarpments have very few people.

Climate

Most people in Zambia have settled in areas where the climate Is favorable. Such areas receive adequate rainfall and temperatures are moderate. People are able to grow a variety of crops, for instance on the Tonga plateau, Mkushi area and other parts.

Availability of Water

People tend to settle where there is readily available water. For example near bamboos, river valleys, marshes and lake areas.

Soil

Fertile soils attract people due to farming. Generally, soils in Zambia are poor as a result they are not suitable for cultivation.

Social- Economic factors

Some areas tend to attract a number of people due to the economic activities that take place in those areas. People go to such areas to look for employment. For example along the line of rail where there is concentration of industries and commercial farms.

Political factors

Settlement patterns were to a large extent determined by the colonialists who came up with administrative boundaries. Certain areas were reserved as forests or game areas have very few. many people in the 1950s were shifted to the lower Zambezi to pave way for a game park.

Factors contributing to High population Growth

- Demographic factors e.g. declining Mortality rates, high fertility rate, and migration.
- Social, cultural factors.
- Social security- children are mostly regarded as an investment. In most African societies, children are expected to look after the aged parents by providing financial, moral and emotional support.

Implications of Rapid Growth

The rapid population growth of Zambia has demographic, social, economic and natural resources implications.

Demographic implications

Zambia has young population as almost half the population comprises young ones. The momentum for growth is already built into the young age structure of the population due to the fact that the number of young females entering the reproductive age is much larger than the number of adult females who are moving out of the reproductive age range. Even if these younger women were to have fewer children each, their total number of births would be much larger resulting in an increase in the future population.

Social Implications

Due to high population growth rate and the economic recession, real per capital expenditure on the provision of social services such as health, education and housing has declined.

Health

The expenditure on Health care has declined over the years resulting in reduced expenditure on primary health care. This has in resulted in high infant, child maternal mortality rate, increase in malnutrition, a breakdown in health infrastructure and inadequate supply of medicines. This situation has been worsened by the advent of the HIV/ AIDS.

Education

Although, the Zambia Government recognized Education as a basic human right, per capital expenditure on education has declined over the years. The government is facing problems in providing adequate education facilities due to high population growth.

Housing

Housing is seen as one of the basic human needs as its availability and adequacy is a determinant of human development. However, in Zambia, the provision of adequate housing has declined, for instance more than half of the urban population lives in shanty townships. Such populations have little or no access to basic infrastructure and services such as good roads, piped water and sanitary facilities. This situation has greatly contributed to low health status.

Measures to Address Population Problems

The government has come up with some measures to address population related problems. The following are some of the measures put in place:

- Formulation of the National Population Policy
- Provision of family planning and health services in order to reduce fertility level and improve the health status of the people.
- Implementation of programmes addressing population issues such s HIV/AIDS and Reproductive Health, Family life Education for both in school and out of school youths.
- Promotion of sensitization of the public on population related issues such as the inter relationship between population, environment, and economic resources.
- Provision of adequate social services though this has been hampered by the fast population growth rate.

- Improving agricultural production to promote food security.

Tea Production in Malawi

- Malawi is the oldest tea growing country in the sub-region.
- Tea growing areas are Shire Highlands, Mulanje District (makwasa Tea Estate), Thyolo, and Nkhata Bay.
- Tea is the most important export crop and it is followed by tobacco.
- Malawi rank second in tea output in Africa.
- Much of the tea grown in Malawi is exported to Europe.

The main requirements for growing tea are:

- A warm climate that is not excessively hot with mean annual temperature of between 15 to 20 degrees Celsius
- A fairly heavy rainfall of 1, 000mm to 1,500mm which is well distributed
- A deep, light and well-drained loam soil
- A good supply of cheap labour for picking the leaves and
- A good network of transport.

Problems and Prospects

- The high density of population in the Southern Province of Malawi poses a problem as land shortage for tea growing is acute.
- Tea growing depends on seasonal rainfall and production is affected if annual rainfall is lower, especially during drought.
- Lack of knowledge and capital by small scale producers. This limits expansion of production among the small scale producers.
- Fluctuating prices for tea on the world market.

Plantation farming in South Africa

- South Africa has a highly developed commercial agriculture.

- -High demand for agricultural produce from the large population within the country and the export market help helped to develop commercial farming.
- There are several plantation crops grown in south Africa but we shall just look at one

- Fishing in Malawi

Fisheries

Malawi has many fisheries where both subsistence and commercial fishing are carried out

The four main fisheries of Malawi are as follows

Lake Malawi- the southern parts of Lake Malawi have plenty of plankton on which fish feed. As a result, these areas are heavily fished. Other areas of commercial importance on the lake are the shallow parts like Nkhata Bay, Nkhota Kota Bay and around Likoma Island.

Lake chilwa- located on the south eastern border with Mozambique, Lake Chilwa is a shallow lake with a lot of fish food, which attracts plenty of fish.

Lake Malombe- this is located at the southern parts of Lake Malawi and has similar conditions those of the southern parts of Lake Malawi.

The Lower Shire River - this are is mainly important for subsistence fishing especially in the Ndindi Marsh south of Nsanje and Elephant Marsh near Chiromo.

Types of fish found in Malawi

- It is estimated that Malawi has over 400 species of fish. The main types are bream, nchila, and utaka.
- The catfish or mlamba is caught for consumption and can weigh as much as 30 kg.
- The usipa, a small, is commonly caught in the northern part of Lake Malawi.
- Other species include the small mbuna (a tropical aquarium fish), cichlids, sungwa (a type of perch), mpasa, sonjika, mcheni, kamango and vumbu.

Production

Fish production in has steadily been on the increase. The main reasons for this are

- Expansion of large scale fishing in the south eastern part of Lake Malawi
- The establishment of the Blantyre nylon net making factory enables many fishermen catch ore fish.
- Introduction of motor powered boats has meant faster transportation of fish
- Development of fish farming in southern Malawi has meant more fisheries and more fish
- Many dams have been built and stocked with fish, once again increasing production
- Improvement of communication through refrigerated vans and the establishment of an ice making plant

Marketing

- Most of the fish caught by subsistence fishermen are either sun-dried or smoked
- Refrigerated vans take fresh fish to storage facilities where vendors then buy and resell accordingly.
- A small percentage is sold to neighboring countries such as Zambia and Mozambique.

Measures and prospects

Fishing in Malawi will continue to increase in importance but this will be in proportion to the measures put in place. Some of the measures are

- Fishing is controlled especially in November and December when breams bread.
- Ring netting is prohibited and the size of meshes is controlled
- Introduction of trawl fishing in the lake has increased the catches
- The all- weather road along the lake has made transportation faster
- During the rainy season, over 20 per cent of the catch is spoiled due to infestation by blow- flies. (The cold storage company has managed to greatly reduce this wastage)
- Poisoning of fish is prohibited.

Fishing in Namibia

Types of fish

About 99% of fishing in Namibia is marine based. Namibia is well-known for many species of fish. Some of the most important commercial types are

- Orange roughy- Highly prized deep water fish caught at Gendor, world's leading Orange roughy exporting town
- Hake- Plentiful in Namibia waters. Stokes have greatly increased
- Pilchard- Pelagic species adversely affected by environmental conditions of the early and mid 1990's. in 1998, Total allowance catch (TAC) was 65, 000 tonnes
- Horse mackerel- TAC denied from 1994 to 1997. By 1998 however, 1,900,000 tonnes were recorded

Types of Fisheries

The main and most important fisheries of Namibia are

- Demersal - specializes in hake, monk, king lip, sole
- Midwater - Targets horse mackerel
- Purse sein – Pilchard and horse mackerels are caught
- Deep water – Mostly orange roughly and alfonsino are caught
- Tuna – varieties fished here include albacore big-eye, yellow-fin and skip-jack
- Rock Lobster – Based in Luderitz and brings live lobsters ashore daily
- Crab – uses, traps to catch deep sea crabs
- Monk – Monk production is declining. Normally fished as a by- catch of hake

Production patterns

- In 1992-1993, and 1995 and 1997, there was a decline in fish production. This was because of the adverse environmental conditions. The temperatures were not good for breeding.

- Well articulated resource management policies by the government also led to a systematic recovery of fish stocks in Namibia
- It has been observed that the fishing industry faces short and long term changes every decade due to the Benguela warm water events termed as the **Benguela Ninos**. These Ninos occurred in 1963, 1974, 1984, and 1995.

Constraints to the fishing industry in Namibia

Among the many issues that challenge fishing in Namibia are the following

- **El Nino-** the impact of the 'El Nino' in 1995 heated the waters beyond average temperature for fish to live in.
- **Pollution-** if not closely checked pollution, especially oil spillages, can be destructive to aquatic life.
- **Depletion-** the total amount of fish cannot be expected to increase indefinitely since the demand is getting bigger.
- **Company structure**- large company structures are not always the best and most profitable because they may lead to irresponsible destruction and over- exploitation of resources.
- **Accidents**- Aging machinery cause accidents when not properly maintained, the most common being sinking of the vessel.
- **Fires**- Fires are hazards that cause a lot of damage to human life, fishing vessels, fish and the environment.
- **Fires and accidents**- these are more dangerous when they occur offshore in hostile marine environments where there is little help.

Solutions to Problems

- **Climate**- the ministry of fisheries and Marine Resources is trying to develop the scientific capability to monitor and receive precise forecasts of weather and climates.
- **Pollution** – this has been done by monitoring potential sources of pollution, including foreign vessels on their waters.
- **Depletion** – in order to guard against depletion of fish, there must be greater emphasis on value added fisheries which will continue bringing in high quality fish which could still fetch a lot of money in spite of the quantity going down.

- **Company structure** – Namibia should maintain small and medium sized companies which are mostly locally owned. There is more concern on sustainable fishing and utilization of the resource. Smaller companies enhance accountability.
- **Injuries, fires, sinking and aging machinery** – the ministry monitors safety standards and enforces strict adherence to Namibia fishing regulations.
- **Accidents** – these can be controlled to some extent by ensuring that fleets and other fishing vessels have fitness certificates. Such actions will improve the safety and standards of fleets.
- **Flags of convenience** – the use of flags of convenience on fishing vessels should be closely monitored by the Ministry of Fisheries and Marine Resources
- **Limited access** – Limited access the Namibian government uses the limited access to the fisheries method which cuts down on the numbers of participants within any given fishery.

National policies and measures

- Tight monitoring, control and general surveillance of the fishing activities
- Namibia undertook the reclaiming of its waters from Spaniards and Russians after independence.

The Ministry of Fisheries and Marine Resources is working towards

- The promotion and regulation of sustainable utilization of marine ecosystems
- The establishment of a conducive environment for the fishing industry which in turn would increase the national revenue of the country.

Sugar production in South Africa

The main sugar producing region of South Africa is Natal.

The narrow coastal belt of Natal is not the best area to grow sugar can. This is because of the following;

- Sugar cane needs an area receiving annual total rainfall of between 1, 800mm to 2500mm.the Natal area receives only 1,000mm to the south of Durban rising to 1,500mm

north of Durban. Sugar can survive in this area because of its high water table and supplementary irrigation.

- Temperatures are much lower than what is ideal for sugar cane growing. However, in Natal temperatures are kept high by the warm Mozambique current and this current makes it possible to grow the cane for beyond latitude 30 degrees south.
- The soils are variable. They range from alluvium along river valleys on the coast to granitic and sandy soils in the interior. Soil fertility is maintained by artificial fertilizers, the planting of legumes.

Mining in South Africa

- South Africa is one of the world's richest countries in terms of mineral wealth.
- It has the largest reserves of gold, manganese, platinum, chromium and vanadium
- It also has large deposits of iron ore, coal, diamonds, uranium and nickel.
- Mining and mineral processing are at the heart of the South African economy, employing over 500,000 (3.8%) of the total economically active population.

Uses of Gold

- Jewellery, Ornaments, in dentistry, coins, Medals
- It is also used as a standard against currency.

In recent years, gold production has declined in South Africa. This is because of

- Depressed world commodity prices
- Domestic inflation rate
- Unfavourable exchange rates and
- Very high production costs leading to lower profitability

Gold Mining Methods

- Drift mining

- Open cast
- Alluvial, using powerful water hoses or dredgers
- Underground

Diamonds

- South Africa is the fourth largest would diamond producer.
- It is the largest producer of gen diamond.

Mining in Zimbabwe

Iron ore mining and the iron and steel industry in Zimbabwe is based at Redcliff

MAP

Factors that have influenced the location of the iron and steel industry at Redcliff

- There is high grade iron ore (hematite) with about 60% iron content near Redcliff
- There is also high quality limestone near Redcliff.
- The broad valley allows for the expansion of the industry.
- The central location allows for the distribution of products and there is excellent transport by both road and rail.
- Water for cooling is obtained from a near-by dam at cactus poor t and additional water comes from kwekwe.
- Manganese comes from Dam
- Coal (bituminous) is railed from Hwange

The iron ore is mined at open cast mines

Importance of Zimbabwe Iron and steel company (ZISCO)

- Jobs (employment) creation
- Development of transport and infrastructure
- Establishment of several industries like the two in Kwekwe which produce wires of all kinds and rods for reinforcing buildings
- At Gweru, Pig iron is used in the production of cast iron piping

- In Bulawayo and Harare, ZISCO iron and steel products are widely used in engineering industries

Tourism in Kenya

Kenya is reported to be the most visited country in the Sub-Saharan in Africa

National parks and Reserves of Kenya

- Among the animals found in the game parks are game reserves are elephants, buffaloes wild beests, impala, cheetah and Monkeys.
- The biggest national park in Kenya is the Tsavo National Park.

Reasons why tourism has developed on a large scale in Kenya are:

- There is great variety of scenery to see in the country e.g. highlands, volcanic mountains, the rift valley with its extensive escarpments and the lakes.
- The abundant wildlife available in the country.
- Kenya has a sea coast which is a tourist attraction (300km of coastline).
- The Kenyan Governments active promotion of tourism since 1955 (Kenya Tourist Development corporation)
- Well developed infrastructure such as hotels, roads of high stands and good airports

Sources of tourists of Kenya

Most of the tourists in Kenya come from the United Kingdom, German, France and Switzerland. This is so because of the following reasons:

- Kenya is on the major east-west air rout from Europe and the country is nearer to Europe than Zambia or Zimbabwe
- Nairobi is well served by international airlines. A total of 30 airlines land at Jomo Kenyatta international Airport in a week
- Intensive advertising programmes through TV, magazines and newspapers target the European market.

Tourist Activities in Kenya

Viewing Wildlife

- This is the greatest attraction in Kenya.
- The country is known for its rich wildlife
- There are 50 national parks and game reserves in Kenya with the most popular one Tsavo, A mboseli, Meru and Masai-Mara.

The typical activities on a game viewing trip include:

- Going on safari (a journey for the purpose of game viewing)
- Game viewing where tourists are free to take photographs of animals, birds and scenery
- Riding in the hot air balloon to view game from the air
- Buying artifacts from the Masai or other local people
- Watching traditional dances for example those of the Masai

Coastal resorts

- The developed beach attraction is restricted to the Indian Ocean Coast.
- The country has 300 Kilometers of developed coast
- Lake Victoria beaches are less developed and do not attract many tourists

Tourist attractions are centre around the following areas.

- The coast south of Mombasa. There is the beautiful Diana Beach served by 13 hotels
- Mombasa with beautiful and sand beaches, marine features and many other attractions. It has the famous historical site, Fort Jesus, Mombasa is the nerve centre for all coastal resorts. Services include hotels, airport, entertainment and car hire.
- Watama north of Mombasa and near Malindi. It has sandy beaches, water sports and fishing
- Other costal resorts such as Malindi and Lamu

Scenic attractions

- There is great variety of scenery in Kenya.
- The country has some of the most spectacular sceneries in African
- The highlands, the Rift Valley, the extensive escarpments and the volcanic peaks make up the scenic attractions.

The Masai

- Even though the Masai are culturally nomadic herdsmen, they are not allowed to herd their animals in the national parks.
- They are moved away from their traditional grazing areas and this forced many of them to become sedentary.
- They also earn a bit of money through traditional performances
- The government gives them some of the money earned from tourism and this enables them to pay for such things as housing water supply and their education.
- The Masai resent being seen as cultural objects