# POSITION BEHAVIORS AND STRUCTURE OF THE EARTH:

**GLOBE** Is the model of the earth

**Earth** Is ball of rock partly covered by water, land, air and living organism

**Origin of the earth (cosmological theories)**

1) **Creation theory** – This theory is also called biblical or religious theory. Creation theory maintains that in the beginning God created the heaven and the earth and God said let there be light in the expense of the sky to separate sky from night and let them serve as signs to mark seasons, days, and the years and let there be lights in the expenses of the sky to give light to the earth. To meet all these god created two great lights, the greater light ( the sun) to govern the day and the lesser light ( the moon) to govern the night and also make the stars god set them in the expense of the sky to give light on the earth, to govern the day, the night and to separate light from darkness. This text is found in genesis, the book of the bible in the 1st chapter.

## 3.1 ATMOSPHERE

**The Outer Part of the Earth**

1. **The atmosphere**: Is a thin layer of air /gases which envelopes the earth. It extended to the surface to about 1000km above atmosphere is held to the earth by force of gravity.

**This atmosphere is medium of weather and climate.**

**Vertical structure of the atmosphere**

Two major divisions i) Homosphere (below)

ii) Heterosphere (beyond)

## I.) HOMOSPHERE

This is the lower part of the atmosphere runs from 0 -80km

Above the surface the hemisphere is divided into 3major or parts.

**a) Troposphere -Lower**

**b) Stratosphere – Medium**

**c) Mesosphere – Upper**

### a)TROPOSPHERE

- This is the lowest part of the atmosphere.

- Ranges from 0-15 km above the ground.

- It is characterized by frequency weather changes.

- And it is in this part where meteorologists concentrate.

- There is a lapse rate of temperate where by temperature decrease with increase in altitude(environmental lapse rate).

- This layer has got the largest content of $H_2O$ vapour and solid particles.

- The air is mixed up.

- The upper limit is called tropopause.

- The tropopause is higher near the equator and is lower at the poles

### b) STRATOSPHERE

-This is the intermediate layer between troposphere and mesosphere

-It extends from 15-50 above the earth surface

-The air is not mixed up; it is in layers (the ozone layer is found here)

-Temperature remains constant or increases with altitude (**temperature inversion** this is due to the ozone layer which observes ultra violet rays from the sun which are harmful).

-Pressure decreases with altitude because there is less air

-Less water vapour

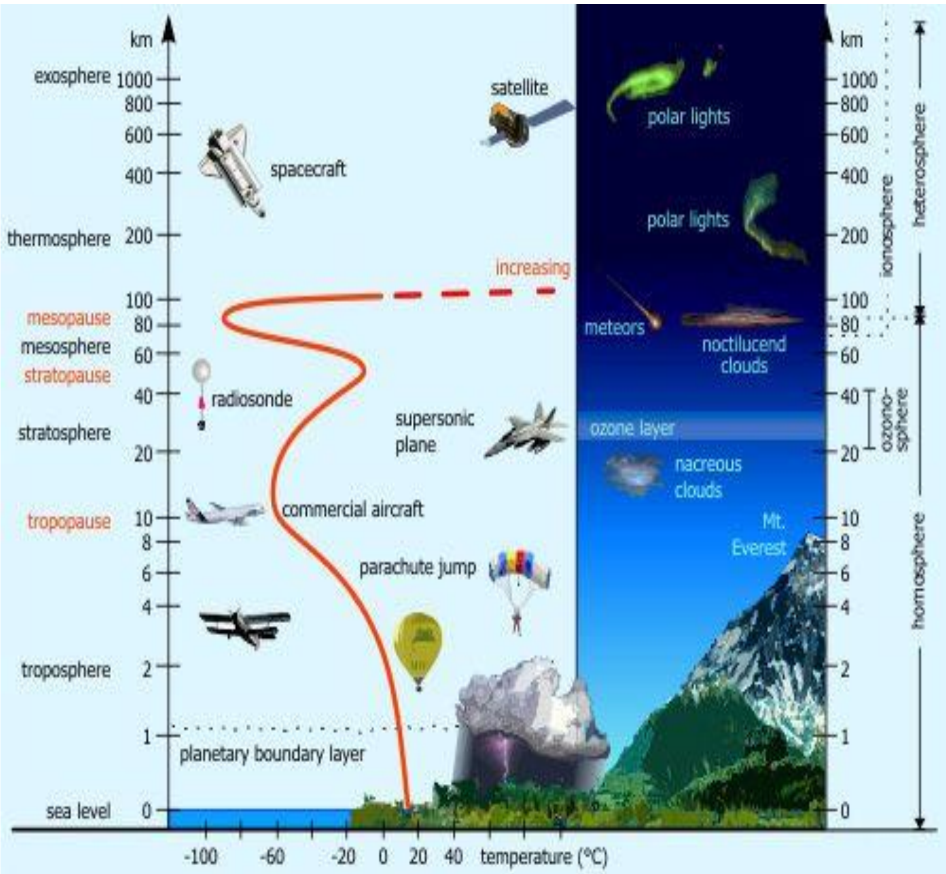
-The upper limit is stratopause.

c) **MESOSPHERE**

It is the layer above the stratosphere Range from 50-80 km above the earth surface

There is temperature decrease with increase in height or altitude.

This is where the temperature are lowest may go lower to -90C and the regions has the strongest wind nearly 3000km




**ABOVE IS THE GRAPH SHOWING THE VERTICAL STRUCTURE OF THE ATMOSPHERE.**

**Homosphere;**

1.) Troposphere.

2.) Stratosphere.

3.) Mesosphere.

**Heterosphere:**

1.) Thermosphere

2.) Exosphere.

**The constituents /composition of the atmosphere**

All states of matter are found in the atmosphere.

1. **Gases**
2. **Liquid**
3. **Solids**

**1) GASES**

| | NAME | PERCENTAGE | IMPORTANCE |
|---|---|---|---|
| i) | Nitrogen | **78.09%** | needed for plant growth. |
| ii) | Oxygen | 20.95% | respiration for human and plant. |
| iii) | Argon | 0.93% | |
| iv) | Carbon dioxide | 0.03% | used by plant for photosynthesis |
| v) | Ozone | 0.00006% | absorbs incoming ultra violent |
| vi) | Hydrogen | **0.0005%** | used in filling balloons |

**2) LIQUIDS**

Water vapour-The liquid form of $H_2O$ in terms of gaseous state 3-4% which various with latitude and altitude

- The volume of $H_2O$ vapour varies with latitude and altitude
- Lower altitude is around the equator
- Source of $H_2O$ vapour at the atmosphere is the hydrological cycle ($H_2O$ cycle)

**SOURCES AND IMPORTANT OF WATER ($H_2O$) VAPOUR**

i) Source of clouds and precipitation

ii) Reflects /absorbs incoming radiations

iii) Keeps global temperature constant

iv) Provides majority of natural 'green house effect'

v) Essential for life on earth

vi) Can be stored as ice /snow

## 3) SOLIDS.

Small solid practices which are also found in the atmosphere E.g Dust,Ashes.

**Source of solid particles in the atmosphere**

1. Wind- source of dust in the atmosphere
2. Volcanic eruptions – Solid particles are through at a great high to the atmosphere and some remain there for years
3. Industrial pollution – (e.g. Twiga cement) the smoke is released to the air which contains some solid particles.
4. Bomb (explosion)- During wars
5. Burning of trees rubbish producing 'soot '
6. Combustion – Smoke from car engines

**Uses**

1) Scatter of incoming radiation
2) Form condensation nuclei information of rainfall

**NOTE**

**Concentrations of the atmospheric component are below 30km above the surface (99 % of these components).**

- Carbon dioxide is not constant component at the atmosphere, increase in altitude with decrease in carbon dioxide. It is more in low latitude and decreases towards the pole (not evenly distributed)

→ Amount of carbon dioxide has been increasing tremendously because of human activities.

Atmospheric problems

(i) **POLLUTION (ATMOSPHERIC/AIR)**

→ Introduction of contaminants into the atmosphere which affects the atmospheric air (lowers the quality of air) whereby it endangers the life of living thing & also non-living things

**Sources of pollutants**

a) **Natural causes**
b) **Human causes → result from human activities**

| **Natural causes** | **Human causes** |
|---|---|
| - Volcanic eruption | - Industrial pollution |
| - Wind | - Bomb explosions |
| - Pollen grains | - Burning of trees |
| - Combustion | - Removal of gas |

**Effects of air pollution**

1. Cause diseases such as air borne diseases [asthma].
2. Global warming, It is a recent phenomenon caused by human activities.

- It is a gradual increase in temperature of the world. This was discovered /started during the 19th century during the industrial revolution period.

- Human activities result into green house gases.

## Major Green house gases

**Gas**

1. Water vapour
2. $CO_2$
3. Methane $CH_4$
4. Nitrous Oxide
5. CFCS

**SOURCES**

1. Evaporation from the sea/ocean, evapotranspiration from land
2. Burning of fossils, fuel (powerhouses, industry, and transport) burning rainforests, and respiration.
3. Decaying vegetation (peat and swamps), farming (fermenting animal dung& rice- growing), and sewage disposal and landfill sites.
4. Vehicle exhausts, fertilizer, nylon manufacture, power stations.
5. Refrigerators, aerosols sprays, solvents and foams.

**How do green houses gases cause global warming.**

'Green houses effects'

(Importance of ozone layer, it absolves the dangerous ultra-violet rays/radiations and prevent them to enter the surfaces). Destruction of the ozone layer leads to more penetration of the ultra-violet rays hence increase in temperature.

**EFFECTS OF GLOBAL WARMING**

1. Melting of ice. (Ice masses) e.g. ice cap on the Kilimanjaro Mountain.
2. Rising of the sea level. – Submergence
3. Deaths – May lead to disappearing of some species due to higher temperature and deaths of humans.
4. Diseases – Skin cancer.
5. Discomfort ability
6. Prevalence of droughts conditions in various parts of the world affecting food production.
7. Cold areas have become warm such that tropical areas are grown successfully
8. Leads to migration of people and animals due to floods and droughts.
9. Decline in production has contributed to increase in poverty and prevalence of famine.

**CONTROL MEASURES OF GLOBAL WARMING.**

Anthropogenic (mainly caused) for **Human activities which causes global warming.**

**I. CONTROL POLLUTION**

-Afforestation and Reforestation – The plants will absorb the $CO_2$

-Alternative sources of energy which is less pollutant. (Solar, wind and etc)

-Control human behavior (e.g. the uses of bomb and activities industrial pollution).

-Creating international laws which control pollution (strict).

-Environmental education should be provided

-Recycling of wastes should be encouraged rather than burning.

## Global climatic changes

i) EL Niño – Over rainfall
ii) Changes pattern of agricultural belts (desertification).

**SHAPE OF THE EARTH**

-Misconception of the shape of the earth.

-The earth thought to be flat.

Truth - The earth is round.

-Sphere like – Spherical in shape. But not the perfect sphere why? We look at dimensions.

-Equatorial diameter – Is longer than polar diameter (12,762 kms)

-Polar diameter – Is shorter than equatorial diameter (12,722 kms)

-Equatorial circumference – Is longer than polar circumference (40085 kms)

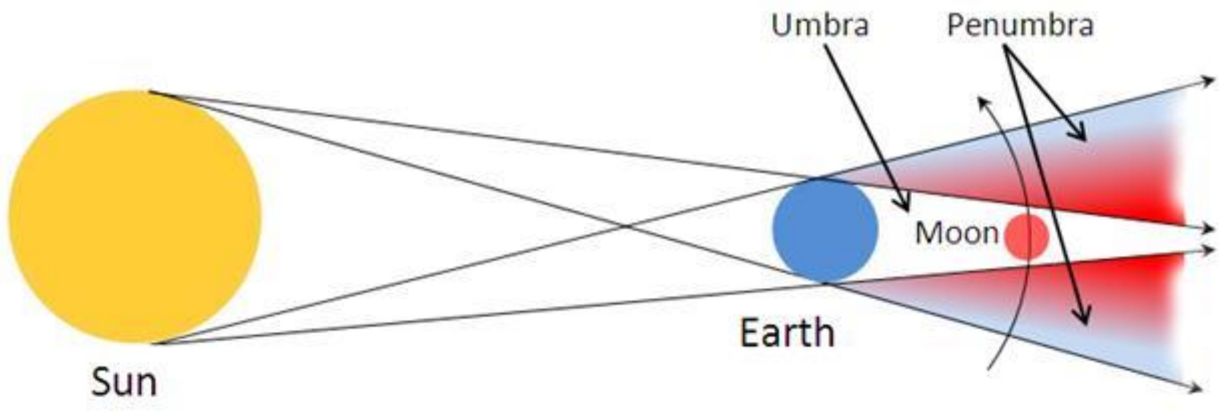
-Polar circumference – Is shorter than equatorial circumference (39,955kms)

The earth bulges at the equator and slightly flattered at the poles. This shape is called GEOID.

*Proofs of the earth's shape*

1) **AERIAL PHOTOGRAPHS** – Photographs taken by satellite at great distances from the earth all shows that the earth's surface is curved. They show the curvature of the earth.

2) **LUNAR ECLIPSE** – When there is an eclipse of the moon the shadows of the earth which is thrown on the moon is always round. Only a sphere can cast a shadow which always circular. The position of the sun, moon and earth, in an eclipse of the moon are;



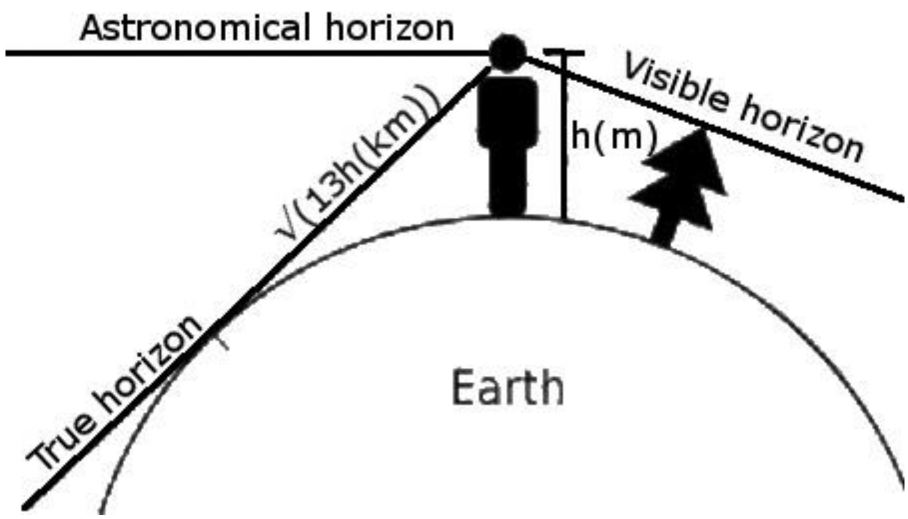

3) **CIRCUMNAVIGATION OF THE EARTH** – If you travel across the world along a straight path in a fast flying plane without stopping anywhere, you would come back to the same place from where you started. This is called circumnavigation. The fact is valid as the earth has shown circumnavigated for many times and finding the voyage ending to the original point. For example; voyage made by the Portuguese navigator called Magellan between 1519 & 1522 proved that, the earth is round and not flat as the voyage ended to the point of origin (land, air, water).

4) **SUNRISE AND SUNSET** – The earth rotates from west to east through $360^0$ in 24 hrs. This means that people living east see the sun earlier than people living in the west. If the earth could be flat all people over the earth would experience sunset and sunrise at the sometime. This provides a fact that the earth is spherical in shape.

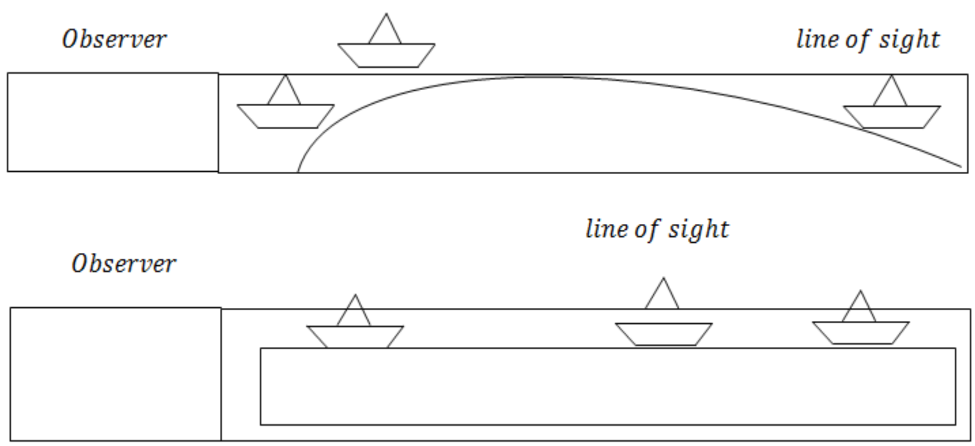
The appearance of sunrise and sunset on the earth's curved surface and what the appearance would be like if the earth's surface us flat.


5) **<u>EARTH'S CURVED HORIZON</u>** – The earth's horizon when seen from a ship, a plane, or a high cliff appears curved. The curved horizon widens as the observers altitude increases until it becomes circular.

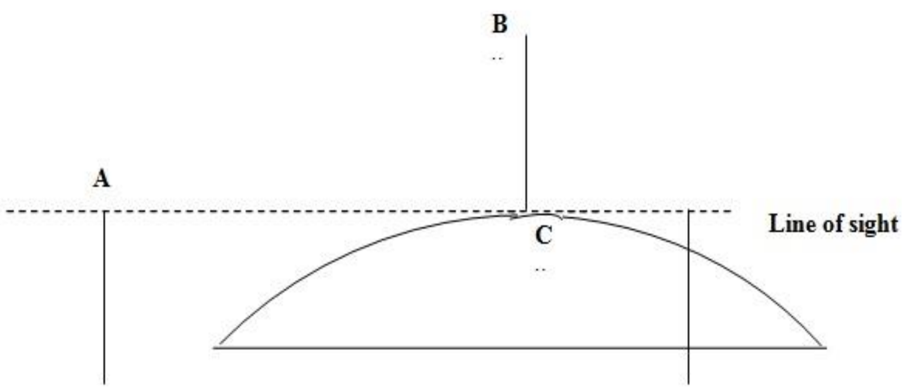
If the earth were not spherical, there would be no circular horizon. The curvature of the horizon is influenced by the curvature of the earth's surface.




6 **A SHIP'S VISIBILITY** – When a ship is approaching the coast land from a distance at the sea smoke is first seen at the horizon. As it comes nearer, the most appears and finally the whole ship is seen, this gradually appearance of the ship provides a fact that the water body of sea overlie the surface which is not flat, but spherical in shape , hence the earth is spherical in shape. Also when 2 ships on the same line of observation are coming towards the observer while maintaining a considerable distance, the front ship will be seen before the ship at the back. If the earth's surface were flat, both ships could be seen at the same time.

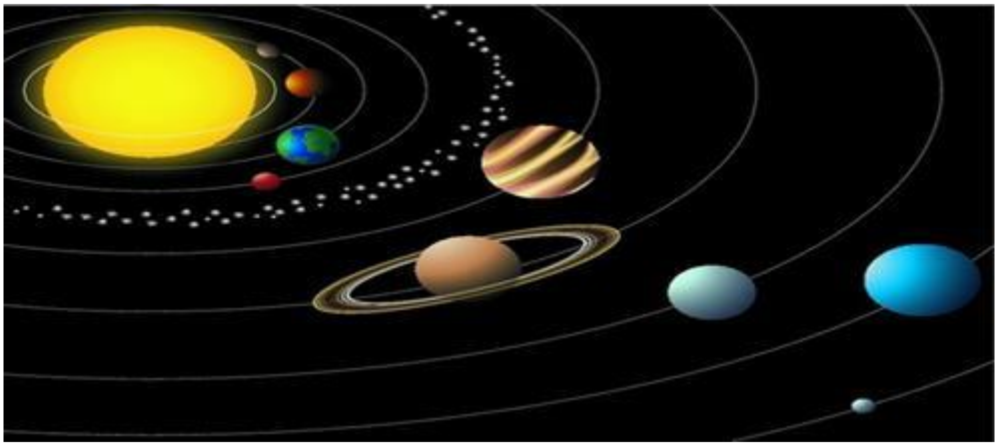


7 **SURVEYING WITH POLES ON LEVEL GROUND** – When the poles of the same length are driven into the level land, at equal intervals do not give a perfect level. The pole in the center usually projects above the level of the other poles at either end. This is caused by the curvature of the earth's surface. If the earth were flat all the poles would lie on the line of sight.




8 **THE CHANGING ALTITUDE OF THE SUN**- In the morning and evening the sun observed to be at low level while at noon the sun obs erved to be at a high level. So long the sun is at constant position in the sky; this provides a clear clue that the earth planet is spherical in shape.

9) **THE SHAPE OF OTHER HEAVENLY OBJECTS IN THE UNIVERSE BEING. CIRCULAR**: – Other objects in universe like the sun, moon & planets are also observed round in the sky. So long the earth's among of the heavily objects provides plausible evidence that it is also spherical in shape.



## 10) <u>OBSERVATION OF THE POLAR STAR</u>

As one goes polar wards the level of the polar star tends to increase and as one goes away from the polar the level of the polar star becomes lower and lower. If the earth's surface were flat, the level of the polar star could be the same.

**3.3 THE INTERNAL STRUCTURE OF THE EARTH & ITS COMPOSITION**

-When the earth is divided into 2 hemispheres you will see concentric rings.

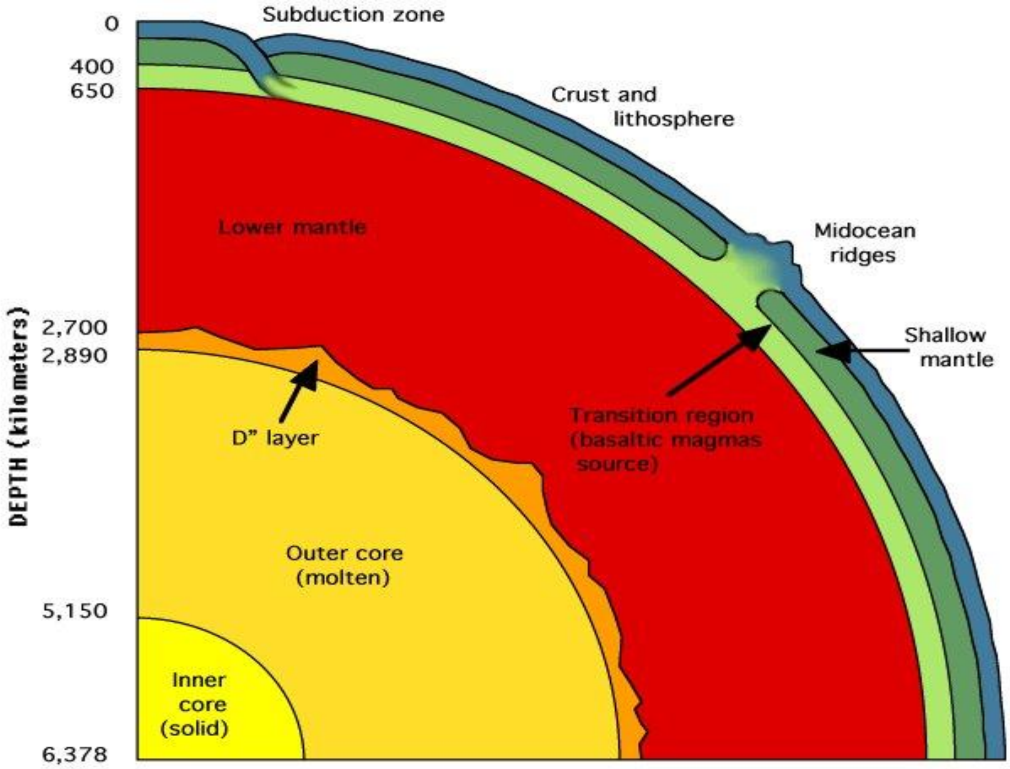
-A section through the centre of the earth reveals concentric rings of various depths.

**These can be subdivided into 3 major zones/layers.**

a. **Crust**

b. **Mantle**

c. **Core**




**A. THE CRUST**

-Is the outer most layer of the earth

-It is the thinnest layer. The depth varies from 8-50 km

**Divisions**

Has two parts : continental crust (sial)

: Oceanic crust (sima)

## a) Continental crust

-Is made up of light rocks of density 2.5g /cm $^3$ of such rocks are granite sand stone +shale. It rests on continental platform

-Chemical composition mainly of SILICA (Silicon Dioxide) And ALUMINA (Aluminium Oxide) ($AL_2O_3$).These are collectively called SIAL

The rock is acidic in nature

### b) **Ocean crust**

-Found beneath oceans.

-Made up of heavier rock density 2.8-3.0g/Cm $^3$

-Composition of SILICA (Silicon dioxide) and Magnesium (magnesium oxide) and iron

The rocks are collectively called **SIMA**

**The rocks are basic in nature (basaltic**)

### Mohorovicic (Moho) discontinuity

This is a thin layer /transitional thin layer of about 6km thick which separates the crust from the mantle

This layer was named after the scientist who discovered it in 1909 by the name Mohorovicic .is in between the crust and mantle

## B. THE MANTLE

The second major layer of the earth (intermediates layer) it is thicker /deeper than the crust about 2800 km deep.

It is also divided into two parts:

i) **The upper mantle**

**ii) The lower mantle**.

The upper mantle is rigid and combined with the crust to form **LITHOSPHERE**

-Density of mantle rock 3.3-5.7g/cm$^3$

-Temperature is higher at this zone and they can reach 5000 °C because of pressure of overlying rocks. The rocks are in a semi –plastic (**semi –molten nature of rocks**) can allow slight movement

Composition of silica, magnesia (SIMA) and iron

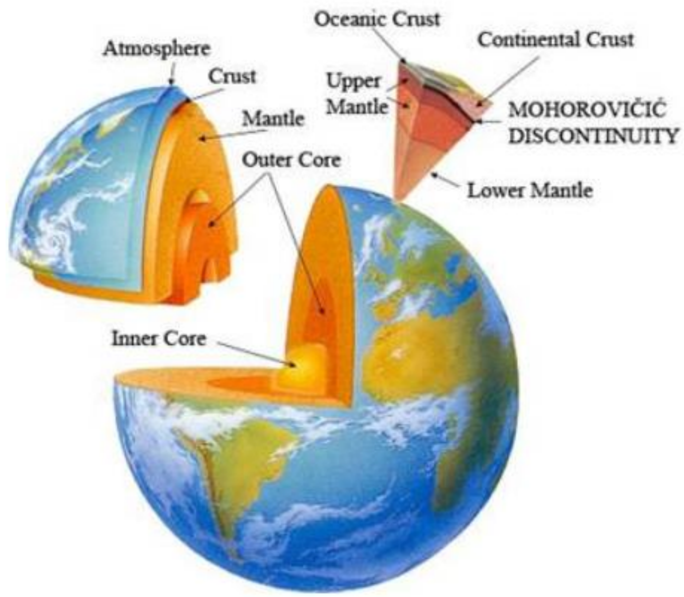
**Gutenberg discontinuity**

Transitional layer which separates the mantle from the core

**C.THE CORE**

- The inner most layer of the earth
- It is the thickest layer
- The depth is about 3470km
- Divided into inner and outer core
- Made up of very heavy rocks density 10-16g/$cm^3$
- Inner core is in solid states due to high pressure
- Outer core is in liquid states due to high temperature

- Composition iron & nickel (NIFE)




**How do we know about the interior of the earth?**

1.Drilling: Mohole project by Americans 270 km

Kuril – by Russian

This was a very expensive venture

2. Materials from the interior on the surface during volcanism (molten magma)

3. Study of seismic waves (seismologists) found in the interior of the earth

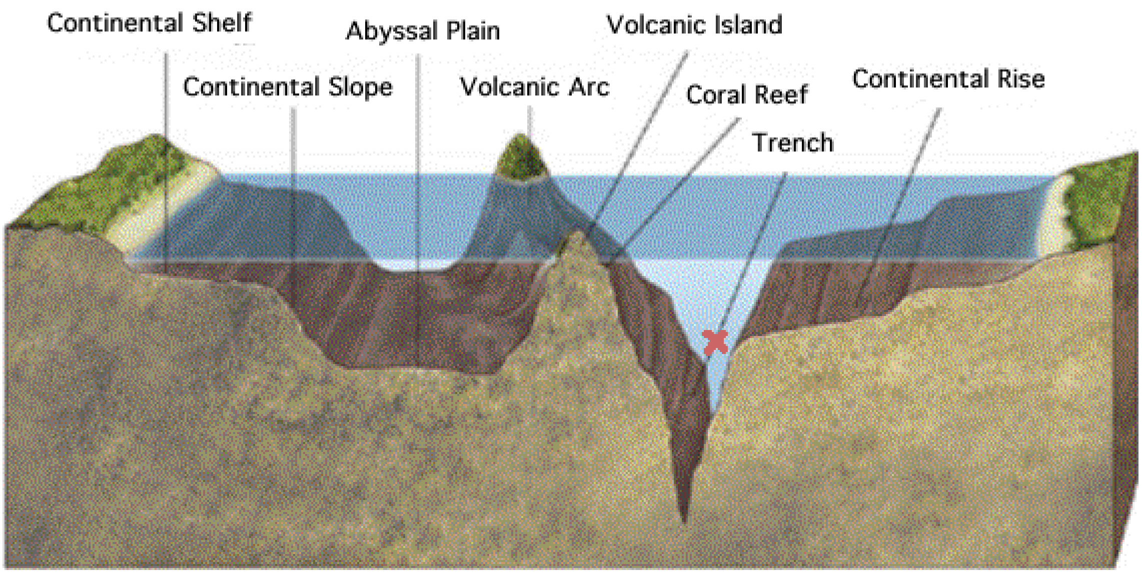
**<u>Relief feature on the earth's crust</u>**

The surface of the earth has a continental crust and oceanic crust .Continental crust is not flat but has various relief features which is plain, hills, valleys, mountains etc

On the oceanic plat forms there are also relief feature examples of relief feature on the ocean floor are continental shelf, continental slope, deep ocean plains, ocean ridge, ocean trenches /ocean clips.

**Note**: **The relief features can be explained by internal or external force / the relief features on the surface of the earth are a result of internal and external process**

**THE NATURE OF THE OCEAN FLOOR**




**The continental shelf:** A gently sloping platform which extends from the continental landmasses terminating abruptly in a slope of steep gradient called the continental slope .The depth of the water covering the shelf is about 180m. Some of the best **fishing grounds** are located in the water covering continental shelves because the shallowness of the water allows the sun rays to reach the shelf floor they by providing excellent condition for growth of **plankton** on which fish feed.

**CONTINENTAL SLOPE:**

A steep slope that extends from the edge of the shelf to the deep sea plain

**DEEP SEA PLAINS**

The wide gently undulating or fairly level surface which has a depth of between 2000m and 3000m.

**OCEAN RIDGE**

This takes the form of either a ridge or a plateau e.g. the mid Atlantic ridge and the albatross plateau which rise up from the deep sea plain and some of them rise above the surface to form oceanic islands (narrow)

**OCEAN DEEP**

A steep side trench plunging from the deep sea plane to depths of 10,000m or more.e.g.the Mariana trench 11km (11035m) of the island of Guam.

Ocean deeps occur on the edges of continents especially those bordered by Fold Mountains e.g. the Atacama trench of the coasts of Chile and Peru.

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# TOPOGRAPHICAL MAP INTERPRETATION

**INTRODUCTION TO A MAP**

What is a map?

Map is a scaled conventional representation of the whole or any of the earth's surface on a flat body.

Or

A scaled conventional visual representation usually on a plane surface of a region of the earth.

Flat body into which maps, established include, a piece of paper , blackboard, wall, wood, cloth and others of the same consideration.

Maps are the most valuable and powerful equipments in Geography as used for providing geographical details of varied areas represented. They are geographical details of varied areas represented. They are also used for storing the geographical details of areas represented. Some of the geographical facts which can to depicted by maps about areas represented include; climate, relief, human activities, soils, drainage system, vegetation, settlement, settlements, communication and others of similar consideration. It is thus; maps are so useful for making geographical facts description about the respective areas represented. Other useful tools apart from maps which also enhance geographical studies; graphs, globes, globes, ground photographs, aerial photographs and the satellite images.

**CATEGORIES OF MAPS**

Maps used in geographical studies are extremely varied and belong to different forms. They are classified by considering the following categorizing factors.

- heir varied functions
- Scale size used
- The degree of accuracy

**Maps according to functions**

Classification by function, it is taken into consideration of what a particular map shows. Maps portray varied geographical facts and thus are of different functions depending on what shown. With respect to this, map are broadly categorized into four and include the following.

(a) Topographical maps

(b) thematic maps

(c) Statistical maps

(d) Cadastral maps

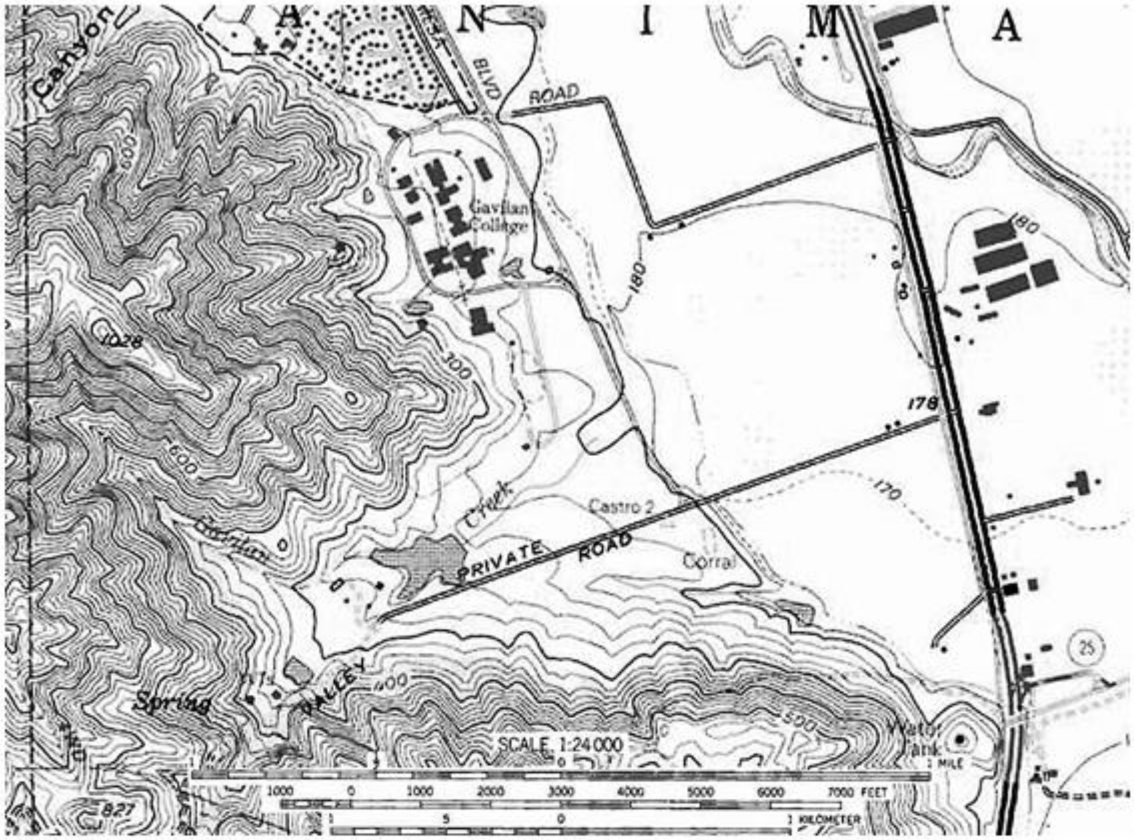
## TOPOGRAPHICAL MAPS.

The maps are named with the world '*topography*' which has been derived from a Greek world of 'Topos' The word topos means the actual appearance of a place by its natural and artificial features.

Or
. The map which has been designed to give a general future (description) of the landscape of a very limited part of a country by showing both natural and artificial features.

Or
Map whose principle purpose is to portray and identify the features of the earth's surface as faithfully as possible with in the limitation imposed by scale.

Topographical maps considerably to their future of function are also known as general maps.




Characteristics of topographical maps

- Show both natural and artificial features of areas represented.
- They are drawn on their medium or large scale depending on the size of the area represented.
- Represent small or limited parts of a country
- They are more detailed as represents small parts on large scale.

**Thematic maps**

These are the special maps which concentrate on showing the spatial distribution of a single geographical phenomena among the several of areas represented.

Or

Types of map especially designed to show particular theme connected with specific geographical areas. i.e. they show the distribution of only one geographical fact among the several of a particular region. These can portray physical, social, political, economic, or any other espects of a city, state, region, continent and world at large.

Thematic maps are differently named according to the nature of content (details) of an area represented and include the following:-

- Relief maps:- These show the physical appearance of areas represented by giving the major land forms.
- Political maps:- They show political boundaries of administrative for regions represented.

- Geological maps: The maps concentrate on showing the geological nature for the regions represented.
- Soil maps: The ones which show the spartial variation of soil nature for areas represented.
- Economic maps: These show the spatial distribution of chiefs crops, animals, industries, minerals and others.
- Historical maps: show the distribution of the historical sites.

**Statistical maps.**

These are the geographical maps which show the distribution of certain geographical phenomena in values of phenomena of interest in geographical studies lie temperature, population density, movement of goods or people and others of related. With the use of statical maps, one can make quantitative analysis of a phenomena for the area shown on the map.

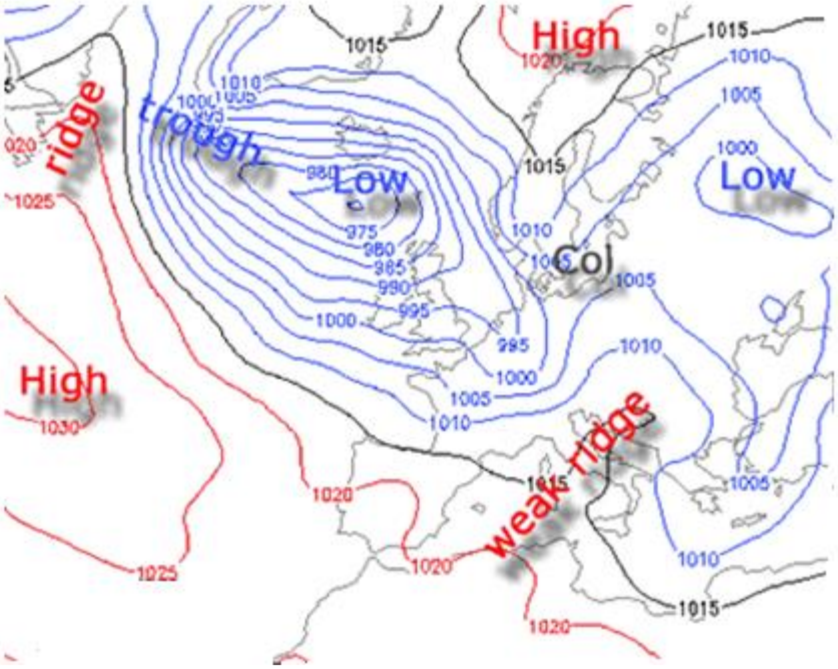
Statistical maps are further differentiated by considering the means used to show the values of distribution on the map face. Owning to the consideration, statistical maps include the following:-

Isopleths maps.

These statistical maps which show the distribution of a certain geographical phenomena in quantitative manner by of lines. The lines are established on a map face to join points with equal amount of distribution with reflection to an actual area on the earth's represented.

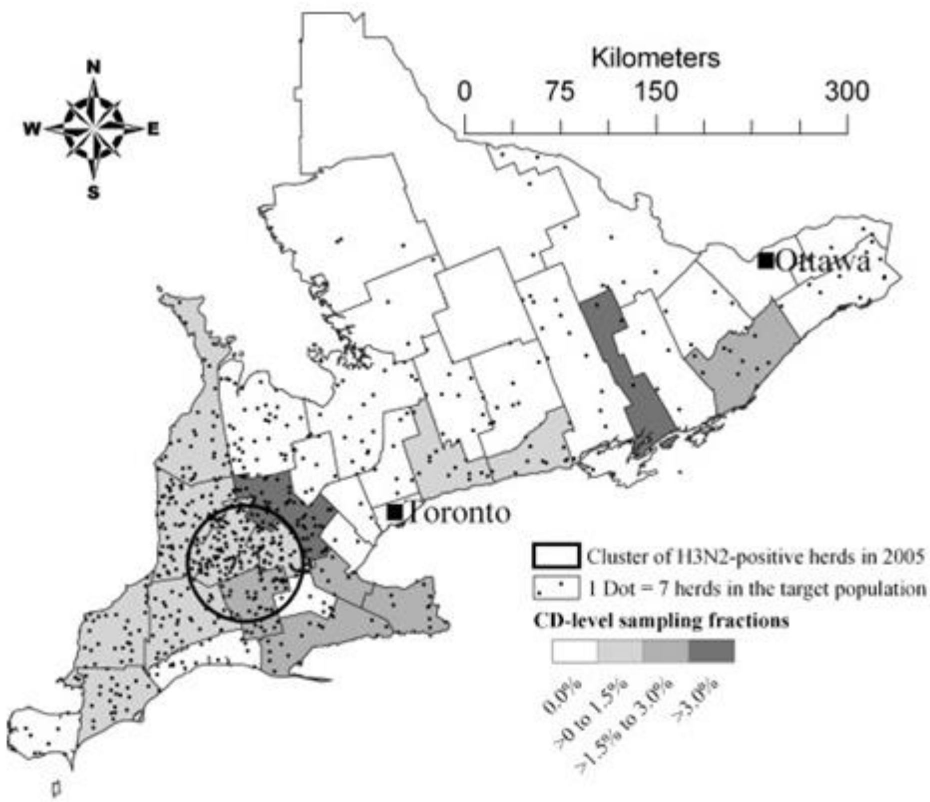
The used lines have special names depending on a nature of phenomena shown on the map.

- Isohyets: for rain fall
- Isotherms: for temperature
- Isobars: for atmospheric pressure
- Isohaline: for salinity
- Isobaths: for ocean depth




Dot maps.

Such statistical maps designed to show values on spatial distribution of a certain geographical phenomena by means of fixed size dots as inserted on a map face. Each dot on the map carries equal values similarly to others.

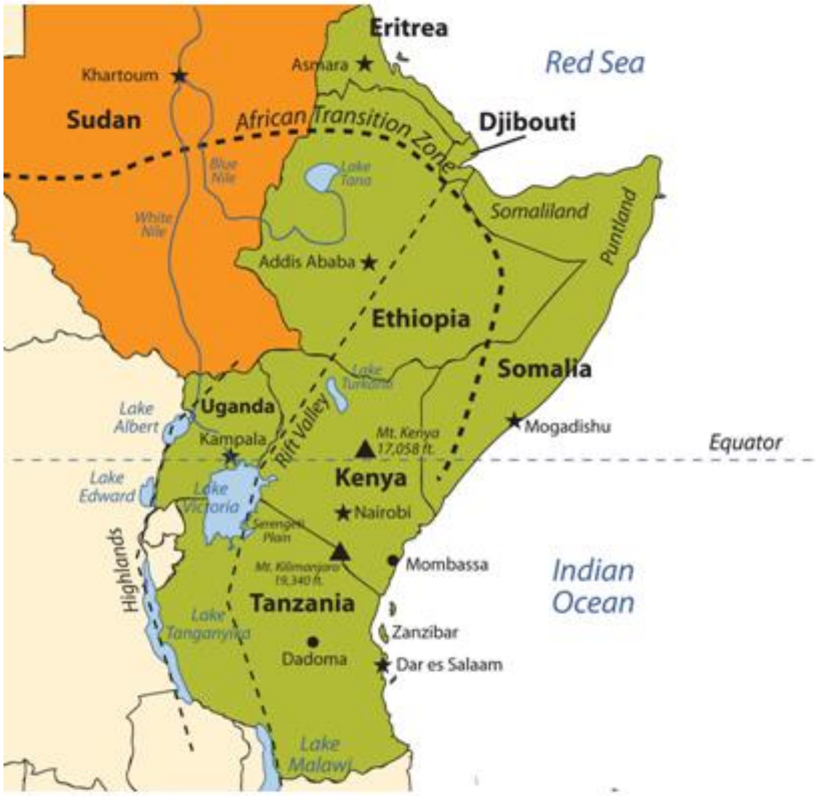



<u>Choropleth maps.</u>

These statical maps are designed to show values on the distribution density of a certain geographical phenomena like that of population by means of varied shade texture. The map is established to have a key to interpret the categories of quantitative values represented by the varied shades.


Flow line maps:

These are designed to show the quantitative values on movement of certain geographical phenomena like passengers or goods from one place to another through an established route way of like: a d, railway, water way and others by means of flow lines of varied width. i.e. the amount on movement reflected by the width of the flow lines.

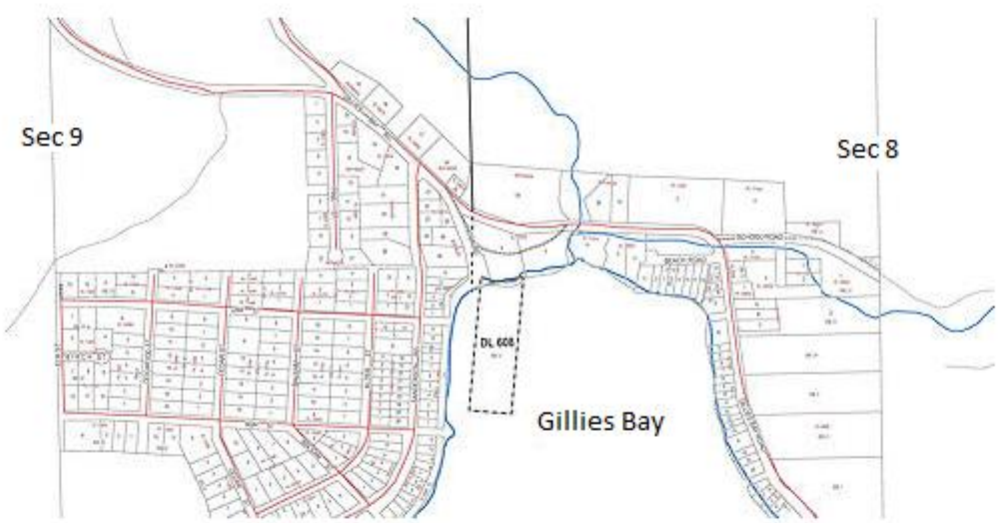



**Cadastral maps**

They are the maps of large scale which show more Clearly the layout and boundaries of features of a very small size represented. i.e. The maps show precise locations and names of the features of the area represented.

Cadastral maps are mostly designed for ownership purpose. These maps may show the layout of features in a village, part of a town, industrial area, school compound, home steady and others of the same reflection.

Cadastral maps are commonly designed after the boundaries of the features in the area to have been accurately surveyed. The type of survey that concentrates on taking the actual measurements of features boundaries is known as cadastral survey. It is thus the maps are named in basis of the technique used to get details that appear on the map.




**Maps according to scale size.**

Maps being much smaller in size compared to actual areas represented, are precisely designed up on distances to grounds represented. However the maps size of the ground and amount of details shown, Being drawn up on varied scale size, makes maps appear extremely varied and this becomes another important categorizing factor of maps. It is thus, maps according to scale size categorized into the following types.

- Large scale maps
- Small scale maps
- Medium scale maps

**Large scale maps.**

These are drawn on large size to give larger representation of limited parts of a country like a town or village. These commonly established on large spaces of flat bodies.

**Characteristics of large scale maps**

- They are drawn on large scale size e.g. 1:10,000, 1:20,000 etc.
- The maps give larger representation of areas portrayed.

- They represent very limited parts of the country
- They are more detailed.

**Small scale maps.**

These are the geographical maps drawn on small scale representing larger area size of the earth's space of the body.

**Characteristics of small scale maps:**

- They are drawn on small scale e.g. 1:1,000,000, 1:10,000,000 etc.
- The maps give smaller representation of the areas of the earth's surface.
- They commonly represent very huge parts of the earth's surface like a country, continent or the whole of the earth's surface.
- The maps are more selective and thus, show less details of represented due to the limitation of map space.

**Medium scale maps.**

These are the maps drawn on medium scale size to represent parts of the earth's surface.

**Characteristics of the medium scale maps**

- They are drawn on the medium scale size E.g. 1:100,000,1:25,000,1:150,000 and others of the same consideration.
- Both the map and ground represented are of medium size.
- The maps show moderate level of details.

**Maps according to degree of accuracy.**

Cartographers try to their level best to make maps most accurate in order to reflect the reality of areas portrayed. They employ varied techniques to make maps be of reasonable accuracy, However, with respect to this consideration, some maps are made accurate, while others not accurate and thus: maps differ in the degree of accuracy and this also taken as maps according to the degree of accuracy broadly classified into two types and include:

- Outline maps
- Accurate maps

**Outline maps.**

These are the simple maps which not accurately designed as drawn not up on scale. They are commonly shown in text books to make simple illustration of the geographical facts. Moreover, they are commonly printed or copied for personal or classroom uses.

**Accurate maps.**

These are the ones which have been precisely designed as drawn with the use of correct measurements of the area, its features as well as the map itself. i.e. the maps accurately designed with up on scale. Commonly on the map, the represented area and the features made to have correct size.

Accurate maps are subdivided into two depending up on the technology used o maintain the accuracy.

**Surveyed maps.**

These are the maps made accurate taken by actual measurements on distance, area represented. Most of the topographical maps correspond to this category.

**Project maps**

These are the maps which show the accuracy of the earth's surface curvature (spherical shape) on their faces maintained by the cartographic technique of projection.

**USEFULNESS OF MAPS**

- Maps provide good basis for making orderly geographical facts description of regions represented. i.e. The geographical facts of an area such relief, drainage, settlement, communication,vegetation and others easily recognized and described from the topographical map.
- They provide ideal insight into significant relationship between geographical f variables. I.e. They are considered to establish the relationship between the geographical variables . E.g and soil,relief and vegetation, climate and vegetation etc.
- In connection to above point, maps are so powerful tools for making spatial analysis of geographical facts for areas represented. i.e. from map , the determinant factors for spatial variation of geographical phenomena detected.

- They are so potential for field studies.
- Maps are useful for traveling purpose. They guide people to reach points of designation· Maps are useful for locating the position of geographical features .It is achieved by a wide range of methods mostly, grid reference, place naming the use of latitudes and longitudes bearing and distance.
- Maps make storage of the geographical facts of areas represented. Hence the give insight to the previous appearance of areas.
- Maps can be used to make quantitative analysis of certain geographical facts like size, distance, gradient, drainage density in response to scale consideration.
- Maps are used for military purpose. i.e. they used to develop military strategies by providing vital details to military troops.
- Maps are used in the conduct of a wide range of projects like: population census, land use planning, building design, construction of roads and others of the same reflection.

**SET BACKS OF USING MAPS.**

- Maps are convention, and thus do not give the morphology of features represented. Features on maps appear by means of convention signs, symbols and abbreviations.
- Maps are selective. It is not possible for all details to appear on the map. Hence: with the use of maps in geographical studies, we lack some of the details.
- The features shown on the maps may not be all maintained on a constant scale. It is thus, uses may get distorted measurements of the features from the map.
- Maps may provide the outdated details about the respective areas represented. It is automatically set as details in actual areas may change with time while maps once designed remain unchanged. Moreover, it becomes difficult to update the map that has already been designed.
- The reading and interpretation of maps needs high and perfect skill.
- Maps are not capable to record and keep instant data

EXERCISE

Qn. Briefly explain any five merits of such topographical map to a map user (NECTA 2000 – The extract map of madukani series 742)

Qn. Outline the strengths and weakness of using topographical maps in geographical studies. Mock –

**CONTENT OF MAPS**

Map content refers to a body of information inserted on a map with reflection to the actual area represented. i.e. the details shown on a map which reflect the nature of the area represented or what generally contained on the map.'

The content established on topographical maps are so varied and thus ; classified into three categories of the following:-

- Natural contents:-The features which are distinctive from man made. They include: relief features, drainage features, vegetation features and others.
- Artificial contents: These are considerably to the features of man made such as cemetery, roads, railways, settlements, airfield and others of the same reflection.
- Supportive contents: These are the marginal details established to make well defined. Some of the supportive details include: scale, heading, key, date of compilation, northern direction and others of the same reflection.

**FACTORS WHICH DETERMINE CONTENT OF MAPS**

Most of the maps do not show (have) similar content i.e. details are considerably varied from map to maps. For instance: a map of Africa observed to show political boundaries of the countries, while the other shown physical appearance of the continent. Moreover: a map may appers more detailed; while the concluded that, variation of details on maps occurs as functioned by certain of details on maps occurs as include the following:-

- Objectivity of the map drawn
- Scale size of the map used
- Date of compilation
- The nature of the area represented
- The nationality of the cartographer

**1.Objective of the map drawn**

This largely depends on the aim of the cartographer (map maker). Usually maps are selective as it is difficult for all surface details to appear the map. Hence any map reflects its purpose.

**2.Scale size of a map used**

Maps are drawn on varied scale size depending on the size of the ground and size of the map it self. It has to be taken into consideration that, scale size of a map is what determines the amount of details of an area to be shown on the map, in common, a map drawn on a small scale is made to have limited space and less details would have been shown on it. Conversely to a map drawn on large scale , is made to have large space and very possible to display a lot about the represented area.

3.**Date of compilation**

Date of compilation refers to a period of time when a map was designed. It has to be taken into consideration that, land details are dynamic over time. With respect to this, a map is likely to show details which were present by the time of its designation. It is likely to have variation in details.

**4.The nature of the represented area**

A map shows what is found in the represented area and not otherwise. Therefore, maps which details.It is thus, a map reflects the reality of the area represented.

5.N**ationality of the cartographer.**

A map to represent part of the earth's surface can be constructed by the foreigner or local cartographer. The two maps may differ in content due to the fact that, the foreigner cartographer might not to include some surface details because of being not familiar with the area. Moreover the foreigner cartographer may misname the places on the map of the region represented.

EXERCISE

Q. (a) What factors affect the content of topographical map?

(b) Classify the features that are commonly shown on topographical maps. (NECTA 1991)

Q. Explain the factors that affect that affect the content of topographical maps. (NECTA 2008)

**CARTOGRAPHY**

Cartography is an art or a science of designing a map to represent either the whole or any part of the earth's surface in scaled and conventional form.

There are noticeable contrasts between maps and the whole or parts of the earth's surface represented as follow:-

·Map is flat, while the earth's surface or part of the earth's surface is not flat.

· Maps are much smaller in size, while the whole earth or a part of the earth represented is much larger in size.

With this the map makers use a cartographic technique to maintain the accuracy of the earth's shape and size on maps. The technique is known as map projection. It is thus; the cartographic technique is associated with map projection. It is thus; the cartographic technique is associated with map projection as a sole means of maintaining accuracy of areas on maps.

**MAP PROJECTION**

The earth's surface can be wholly represented with reasonable accuracy on a globe. But globes are not as convenient as flat maps to use. Globe can not depicts much details like transportation system of a city, or the location of very small towns or villages. With this, maps have to be produced to facilitate geographical studies.

To make the maps so accurate, a cartographic technique of map projection is defined **as the cartographic technique of transforming the shape of the earth's surface or part of the earth's surface more accurately to a plane surface to develop a map that can be easily worked with less distortion**. i.e. It is the cartographic technique of maintaining the accuracy of an area on a map.

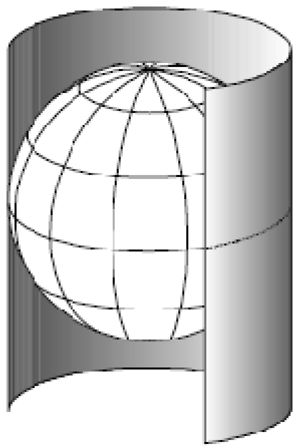
The cartographic technique of map projection is recognized be of varied types as flat bodies into which maps developed differently projected. This develops **cylindrical, conical and plane map projections**

The cartographic technique of map projection is recognized be of varied types as flat bodies onto which maps developed differently projected. This develops cylindrical,conical and plane map projections. More over;on a map, the features are made to have accuracy on different respects. This also develops the types of azimuthal, gnomic and stereo graphic map projections.

**Cylindrical projection**

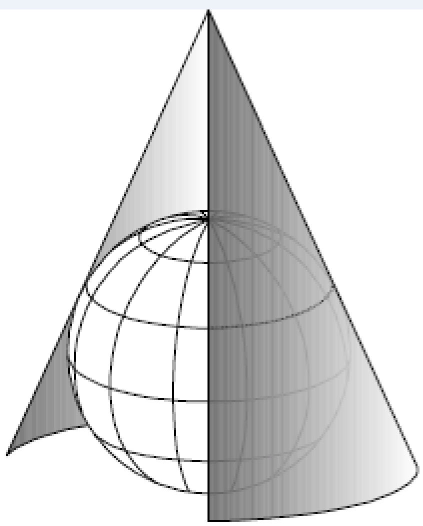
By cylindrical projection, the shape of the earth's surface is accurately maintained as a frat body onto which a map would be drawn, projected to a shape of the earth's surface is maintained and then the cylindrical projected body is cut to develop flat map onto which the whole earth surface appears.

Cylindrical projection is alternatively known as mercators projection.



**Conical projection**

It is a considerable form of map projection, by which, the shape of the earth's surface is accurately maintained as a flat body onto which a map would be drawn is projected to a conical shape. Over the surface of projected conical body, the shape of the earth's surface is maintained then the conical body is cut to develop a flat map onto which the whole earth's surface or part of the earth surface appears.



**Plane projection**

By plane projection, the area particularly of a limited size whose accuracy is directly maintained on a flat body os a piece of paper.

**Azimuthal projection**

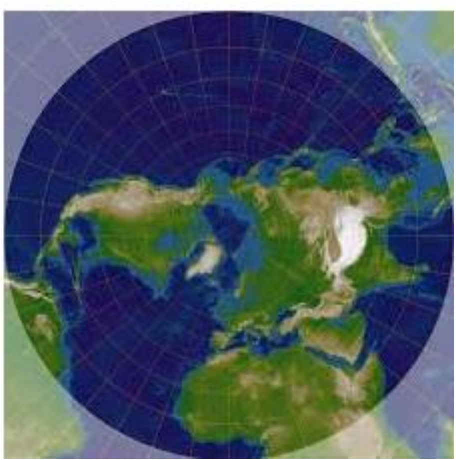
It is a type of map projection which mostly used to maintain the correct distribution of the surface features on a map by being maintained in true directons and distance relatively to one another with reference from the centre of a map and up on the actual area on the earth's surface. By this, all bearings are laid off correctly from the central point of the map, so that all points on the map and up on the area on the earth's surface are true in distance and direction from the centre.

**Gnomic projection**

It is alternatively known as equi-distance projection. This is used to maintain the accuracy of ground distances on the map with respect to the used scale by regarding the relative bearing of the features in the area.

**Streographic projection**

It is a cartographic technique of preserving the correct shape of earth's surface features on a map. Preservation of the features is maintained by taking into consideration of the satellite images and aerial photographs.



**FACTORS INFLUENCING CARTOGRAPHIC PROCESS**

**(KEY ISSUE CONSIDERED IN MAP MAKING)**

I n a process of map making a present a certain part of the earth's surface, the following should be taken into consideration as guides to map maker.

- The size of the actual area to be represented on a map. The size of the area is revealed by making survey or by examining the vertical photograph that represents the same area.
- Size of the plane surface of a piece of paper onto which a map would be designed.
- ·Map scale. The scale is determined by relating the corresponding distance between the map and ground. Scale is what determines the amount of details about the area appear on the a map.
- Methods of projection as means of maintaining the accuracy of the map.
- Nature and amount of the features to be shown on a map. This largely depends on a type of map would be designed under plan and chosen scale size.

**PROCEDURE IN MAP MAKING**

The construction of a map involves the following important steps:-

(a) the cartographer has to make overall plan of a kind of map to be designed. The plan depends on what is intended to appear on the map about the area. i.e. the plan can be design : topographical map[, statistical map, thematic map or cadastral map.

(b) Collection of data from the area to be mapped. The nature of data to be collected depends on a type of map to be prepared. For instance; if the plan is to prepare a topographical map, the cartographer would have to collect the general geographical details of both natural and artificial features present in the area.

Data can be collected by involving the following methods.

- Making of the field survey in the area.
- By examining the respective vertical aerial photographs.
- By examining the respective satellite images.
- Data can be delivered from the existing sources like books and other maps.

(c) Choice of a scale. This has to take into consideration of both, size of the flat body of a sheet of paper and the size of the ground to be mapped. The scale is determined by relating the corresponding measurements on distance between the map and ground.

(d) Representation of the data or details on the map. The data can be represented by means of the conventional symbols, varied colours, varied shade textures, writing the names of features or places and other important means.

(e) the map should be given with the supportive details to make it well defined. These include; title, key, north directions, scale, date of compilation and others of the same importance.

**LIMITATIONS IN MAP MAKING.**

(a) Determination of the map scale; by relating the corresponding distances between the map and ground. The uses scale might have been assessed by using wrong measurements between the map and ground. For instance; the surveyed ground distance to be related to map distance might have been subjected to errors accumulation.

(b) **Difficulties in cartographic representation**. It is much based to the representation of the features on a map. The problem a rise on the following.

· What to be shown on a map regarding that, a map is selective in nature. i.e. It is more difficult to make all details appear on a map.

· Representation of the data of the map by inserting the name of the features, conventional signs and symbols, colors and shades. All these require high skill.

· Dynamism problem. Areas mapped subjected to changes. This makes maps appear outdated. Moreover; it becomes much difficult to update the map.

· It becomes much difficult for all features maintained on a constant scale of the map.

(c) Human problems

(i) technology

The designing of maps requires higher technology. This makes most of the maps designed manually and become not exactly accurate.

(ii) Financial problems

The making of a map is a expensive process. This makes maps not recurrently produced.

(iv)Poor communication

This greatly hinders the process of data collection in areas that would be mapped.

EXERCISE

Q. Write briefs notes on map projection (DSM – Mock 2003)

Q.

(a) Differentiate between thematic and topographical maps.

(b) Outline the problems encountered in a process of map making. MOCK – Qn.)

**ESSENTIAL OF MAP**

These are the supportive details given on a map to make it well defined with reflection to an actual area on the earth's surface represented. Such details make the map well understood and interpreted to recognize clearly the geographical facts of the area represented. The are usually given on the map border. Absence of these on the map, makes difficulties in map reading and interpretation.

The main essentials of maps include the following.

(1**) Title**

It is a heading of a map designed. The significance of it is to tell what the map is for about. This is commonly indicated at the top of the map; and on other maps appear at bottom.

Map title is of two forms depending on what the map shows and include:-

General title

It is given to a map that shows the general geographical details of an area represented. It is established by writing only the name of a region represented. This form of title commonly appears on a topographical map. E.g. MOROGORO.

Specific title,

This is made to appear on a map that shows specific content among of the several about the represented area. Specific title mostly appears on thematic and statistical maps. E.g. MOROGORO LAND TRANSPORT LAYOUT.

(2) **Key**

It is the list of all conventional symbol, signs and abbreviations together with their meaning on the map border. Maps are conventional in nature as represent land features by means of conventional symbols, signs and initials or abbreviations. It is therefore significantly potential, in order to make a map well defined and understood, it should be established with a key to show what the conventionas symbols, signs and abbreviations or initials stand for.


(3) **Scale**

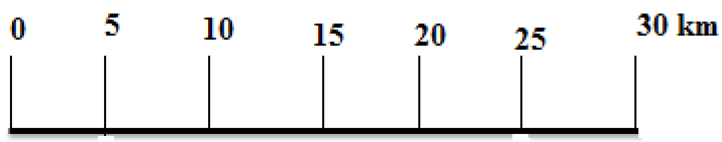
A map is much smaller in size compared to the actual area represented which is much larger in size. It is thus, maps are accurately designed up on scales.

It is therefore important for the used to appear on a map in such a way map user may take into consideration of it for futher assessment.

Scale on a map enables the users to understand the relation ship of distance to ground, which then helps to understand the bigness of the area represented and other ground measurements of interest like distance and gradient.

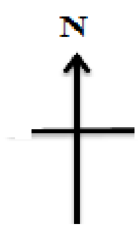
Scale on the map is expressed in three varied ways and these include:-

- In representative fraction. E.g. 1;50,000
- In statement (verbal expression) eg, 1 cm on a map represents 2kms on the ground.
- Graphically; e.g.




(4) **Indication of north direction**

Any map should be indicate with north direction. On topographical map is commonly indicated by the following conventional sign.




The significance of north direction indication on a map is to enable the map uses to recognize readily the north direction and other important directions of like; North west, East, North east etc, of the represented area. Beside to this; the indicated north helps and features on the map and up on the respective area represented on the earth's surface.

It has to bear in mind that, bearing of an observation line between two points is measured clockwise from north direction of $000^0$

(5) **Margins**

It is the frame work of the map designed. The role of a margin is to show the end of the represented area; and also makes the map impressive and attractive to the users.

(6) **Date of compilation.**

It is a date of map publication. It is very important for a date of compilation to appear on map. The enables the users to realize the following:-

· Whether the map is updating or outdated relatively to the actual appearance of the respective area represented.

· The changes which have occurred in the area. This can be realized by comparing the latest map to other maps or the given map to the current appearance of the area.

· To calculate magnetic variation of a place by taking into consideration of the rate of changes per annum. Be side to this, it may also help to calculate the new magnetic bearing of an observation line from a place to another place.

(7) **Grid lines and latitudes and longitudes.**

Grid lines are the vertical and horizontal lines drawn on a map face crossing at right angles giving so perfect squares. The lines are numbered to make eastings and northing.

Latitudes and longitudes are the imaginary angular distance lines drawn on the face of map and given with the degree numbers as have been measured more accurately from the centre of the earth's surface. These represent the angular distance of the area on the earth's surface from the centre.

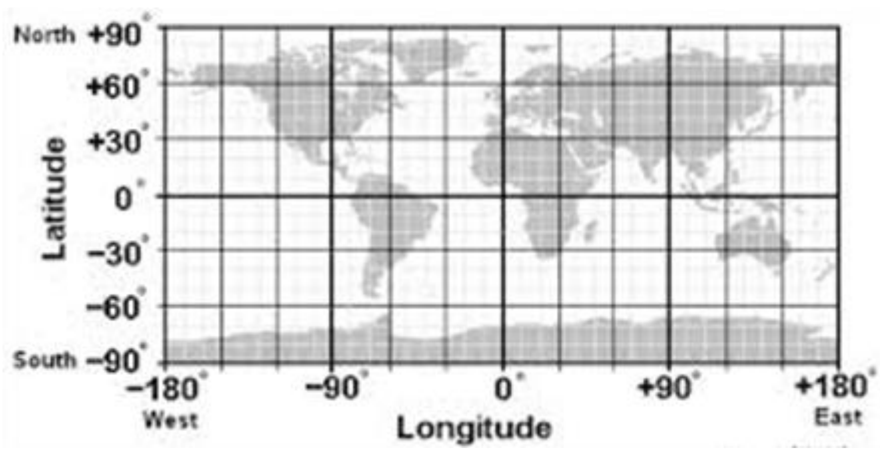
Grid lines, latitudes and longitudes in general, have a potential significance of enabling people using map to locate position of geographical features on the map with reflection to actual areas represented.

Moreover; the latitudes and longitudes enable map mapped areas from the centre of the earth.

Note.

The grid lines are commonly established in more details on large scaled maps as they represent small areas. While, the latitudes and longitudes are widely printed on small scaled maps as they represent wider parts of the earth's surface.


Grid reference




(8) **Map identification details**.

These included both; serial number and sheet number of the map. The are potentially significant in recognizing easily the maps and also make clear distinction map to maps.

(9) **Publisher and copy writer owner.**

It is important that, to any map the name of the cartographer or institution constructed the map has to appear. This may help the map users to make necessary consultation with the cartographer or institution constructed the map has to appear. This may help the map users to make necessary consultation with the cartographer or institution to have more clear details about the area which has been mapped.

## MAP SCALE

Maps are all generally, much smaller in size as it an be compared to the actual areas represented which are much larger in size. Hence; a map scale is a relationship of map distance to ground represented. This is what understood as map scale. It is thus ; map scale defined as the constant relationship between the shorter lengths on the map and larger ground distances represented.

Or

The ratio of distance between the map and the actual ground represented and the fundamental application for this is as follows:-

$$\boxed{\text{Map scale} = \frac{\text{Map distance}}{\text{Ground distance}}}$$

## CATEGORIES OF MAP SCALES

Scales of maps are not all the same. They are extremely varied in size, expression methods and units of corresponding distance expression. It is thus; map scale are classified according to such terms of variation.

## MAP SCALES ACCORDING TO SIZE.

**Large scale :-**

It is a type of scale which gives larger representation on a map and permits limited details to appear.

**Small scale:-**

This makes smaller representation of very wider part of the earth's surface on a map permit limited details to appear.

**Medium scale:-**

This provides a medium representation of a part of the earth's surface on a map and permits details in moderate level to appear.

There is no general agreement of the quantitative limits of the terms, small, large and medium scales. However most of the cartographers agree that:-

- A map with reduction ratio 1;50,000 or less would be large e.g. 1:25,000
- A map with reduction ratio of 1:500,000 or more is considered as small scale e.g. 1:1,000,000.
- A map with reduction ratio of in between of the two above, considered medium scale. E. g. 1:200,000.

**Scales according to the forms of expression.**

It is widely considered on how a scale has been indicated on the map. This generates three types of scales and include the following.

**Statement scale.**

This is also known as verbal scale. It is considerably to a scale that is expressed on a map by being stated in words. E.g. 1 cm on a map represents 1 km on the ground.

**Representative fraction scale:-**

It is considerably to a expressed on a map in ratio or fraction with numerator and denominator appearing in a similar smaller unit e.g. 1:50,000

**Linear scale.**

This shows the ratio of distance between the map and ground along the line.


Map scales according to expression units used

Scale according to this consideration, broadly categorized into two and include the following.

**Metric scale.**

It is a scale system in which the units of expression for the corresponding distances between the map and ground are of metric e. e. 1 cm represents 5km.

**Imperial scale:-**

It is scale system in which the units of the corresponding distances between the map and ground are of imperial. E.g. 1 inbch represents 2.5 miles.

**SCALE SIZE OF MAPS**

Scale size varies considerably from map to maps as some drawn on large scale, while others may be drawn on medium or small scale. Variation in map scale size is made by some determinant factors.

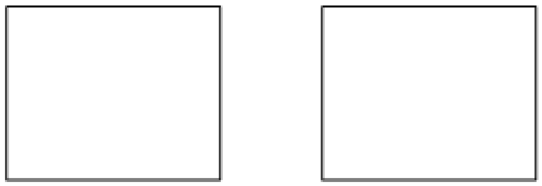
The main determinant factors for map scale size include:-

- Size of the ground represented by the map
- The size of the map drawn
- Amount of the ground details shown on the map

**Size of the ground represented.**

Maps which represent varied grounds in size differ in scale size. Smaller ground is made have larger representation on a map and thus; the map is subjected to have large scale. Conversely; wider area is made to have smaller representation and thus; the map subjected to small scale.

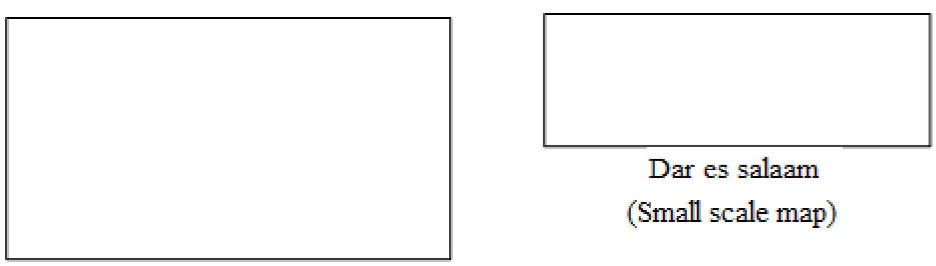
MAP A : Dar es salaam　　MAP B : Africa



Map A; is of large scale as the represented area is smaller in size; while map B is of small scale as much wider area represented.

2. **Size of the map**.

Maps of varies size differ in scale size. A map of large size makes large representation of an area and thus, subjected to large scale size. Conversely to a map of small size makes smaller representation of an area and thus; subjected to small scale.

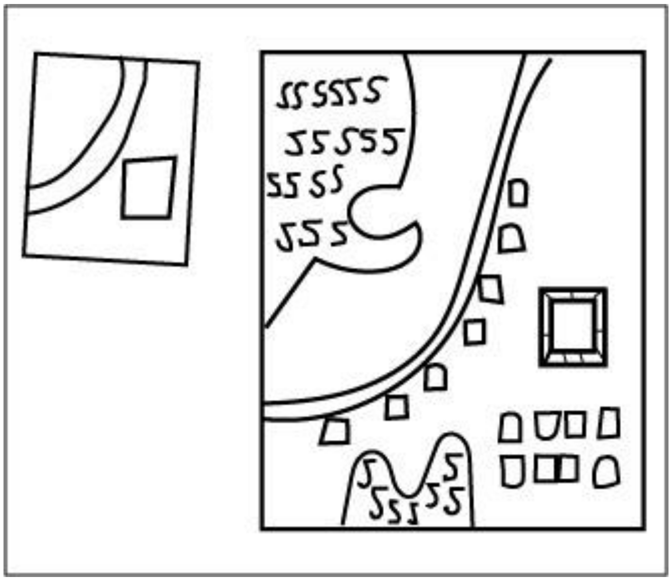


Dar es salaam
(Small scale map)

Dar es alaam
(large scale map)

3. **Amount of details.**

This controls scale size indirectly. Maps constructed to show varied levels of details differ in scale size. A map that planned to show few details is designed to be of small size and thus, subjected to small scale as makes smaller representation. Conversely; a map planes to show numerous details is designed to be of large size and thus subjected to large scale as makes larger representation.



**METHODS OF SHOWING SCALE ON MAPS.**

On a map, scale can be represented by one or more of the following useful methods.

- Statement scale.
- Representative fraction scale (RF Scale)
- Linear scale

**(a)Statement scale.**

This shows the relationship of distance between the map and the actual ground represented by being stated in words. E.g. one centimeter on a map represents one kilometer on the ground; 1 cm represents 1 km; or 1 cm to 1km.

Statement scale is also known as verbal scale.

**Properties of statement scale.**

- The scale on the map is expressed by being stated in words.
- Map distance is given in smaller unit of like centimeter and inch; while, the ground distance given in larger units of meter, feet, kilometers and miles, But it has to be noted that, cm

corresponds to meters and kilometers to give metric statement scale, while inch goes corresponds to feet and miles to give imperial statement scale.

· The amount of map distance in the scale is always 1.

**(b)Representative fraction scale.**

It is a form of scale expression in which the relationship of distance is given in ratio or fraction. It is established with special emphasize of showing the relationship of distance in similar unit. E.g. 1:50,000

Or $\frac{1}{50,000}$

**Properties of RF Scale.**

· The scale is expressed in ratio fraction with numerator and denominator.
· The numerator stands stands for map distance; while the denominator stands for ground distance.
· The numerator and denominator treated in similar smaller units.
· The amount of numerator is 1. For instance; scale should not be expressed as 2:50,000; instead it should be 1:25,000.
· It is neutral to metric and imperial scales.

**(c)Linear scale.**

Linear scale is alternatively known as graph plain bar, divided and open scale. It is a form of scale expression in which the line on the map shows the relation ship of distance between the map and ground represented.

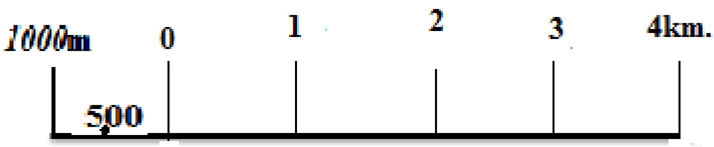
**Categories of linear scales.**

Linear scales are not all the same. They are extremely varied in appearance and nature of the measurement units used. Thus, linear scales are categorized in basis of the appearance and measurement units used.

According to the form of appearance; linear scales are categorized into two and include:

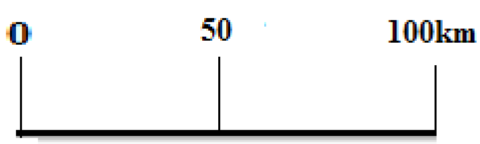
- **Long linear scale.**

It is a linear scale system commonly used to obtain direct accurate ground measurements especially of distance from the topographical map. It is very common on large scaled maps.




- **Short linear scale.**

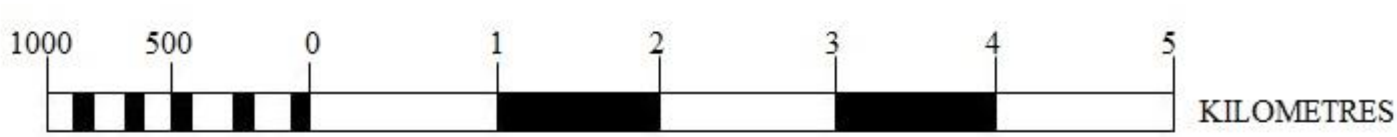
It is a linear scale system which gives a general idea on the relationship of distance between the map and actual ground represented.




**According to the nature of the measurement units used, linear scales categorized into three types. These include the following:-**

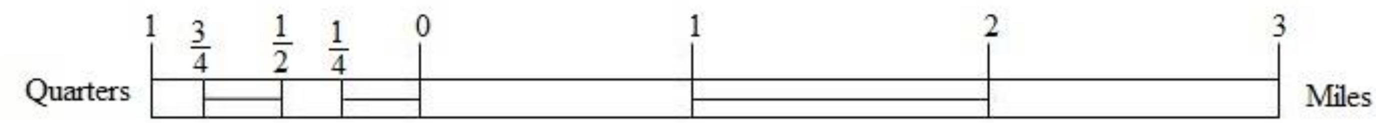
**Metric linear scale.**

It is linear scale system which uses metric units to express the relationship of distance between the map and actual ground represented.



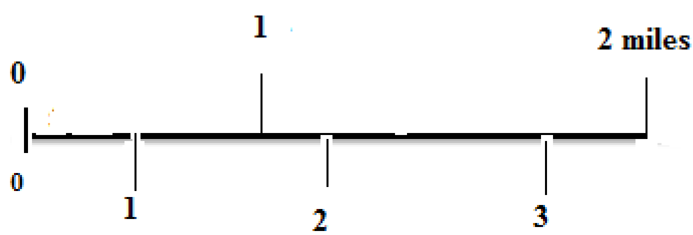
**Imperial linear scale.**

It is linear scale system which uses imperial units to show the relationship of distance between the map and actual ground represented.



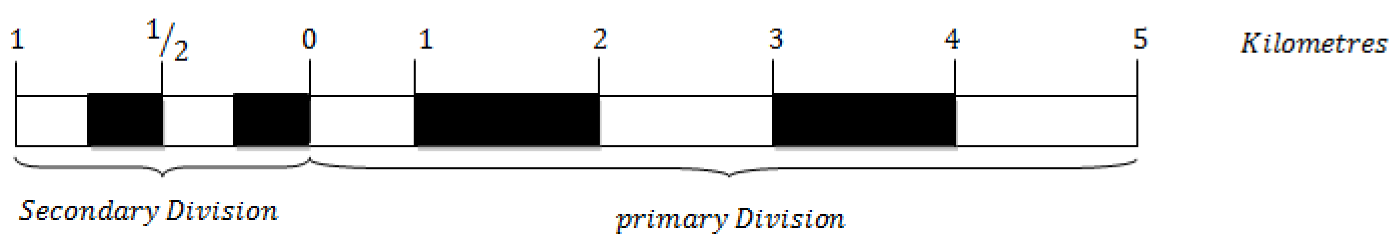

**Double linear scale.**

It is linear scale system with both metric and imperial units. Commonly on top metric or imperial units. Commonly on top metric or imperial measurements may appear, and at below the measurements in imperial or metric units may appear.




**Properties of linear scale**

- The relationship of distance between the map and ground expressed a long a line.
- The line scale is divided into equal parts, and each part shows the ground distance in regular interval.
- Most of the linear scales have two major portions of primary and secondary sections.



- The primary section is larger and placed at the right hand side of the line scale . This shows larger ground distances commonly known as primaries, and given in larger units of kilometers along the metric scale, and miles along the imperial linear scale.
- The secondary section is smaller and placed at left of the line scale. This section is divided into fractions to show smaller ground distances known as secondary's. These given in smaller units of merits along the metric scale, and feet along the imperial linear scale.

Note:-

Along the imperial linear scale, the larger measurements of miles indicated a long the top of the line scale; while the smaller measurements indicated along the bottom of the line scale.

**DRAWING OF THE LINEAR SCALE.**

The drawing of a linear scale should involves the following fundamental steps.

(i) take into consideration on the relationship of distance between the map and the actual ground represented. Assume the scale is 1 cm represents 0.5 km.

(ii) Determination (consideration) of the unit length for the linear scale drawing. It is principle for the unit length amount should measure ground distance of the whole number.

E.g.

As 1cm = 0.5 km.

X = 1km?

$$\frac{1\text{cm} \times 1\text{ km}}{0.5\text{ km}} = \frac{1\text{cm}}{0.5}$$

Hence; 2cm measure 1 km along line

(iii) Draw the line to have length that evenly divided by the amount of unit length. The length. The length of the line determined by the space of the map and sometimes by the recommended ground distance to be measured along the line scale.

(iv) Dived the line scale into major portions of priary and secondary sections. Allocate 0 to separate the two sections.

(v) Sub divided the primary section into equal larger segments with respects to the amount of unit length determined.

(vi) Subdivide the secondary section into 10 smaller fractions. The length of each smaller fraction is determined by taking the amount of unit length divided by the number of smaller fractions required.

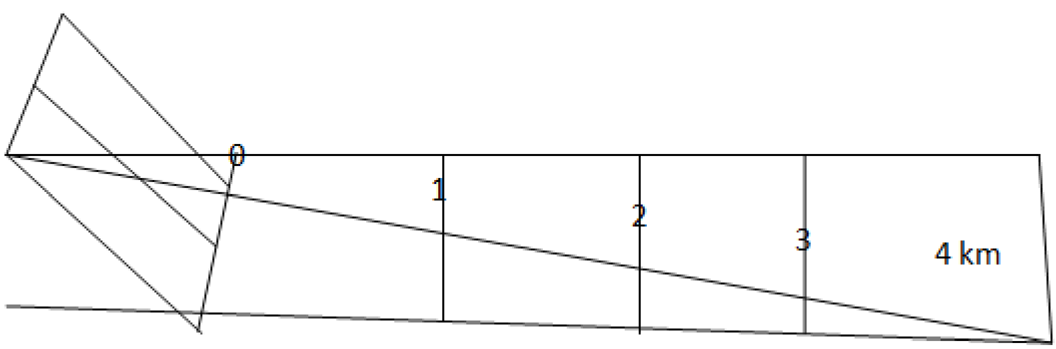
$\frac{2cm}{10} = 0.2cm$

Hence; each smaller fraction = 0.2 cm (2mm).

(vii) The segments along the primary section and the smaller fractions along the secondary section should be proved if are accurate. It is by drawing the line of the 200 – 400 from 0 or from the left of the line towards the end of primary section. Similarly, measure the same angle from last point of primary section. Divide the angle lines into similar segments to those of base line and join the points of the three lines.

To the secondary section, draw the line of 900 downwards and upwards at last parts and they should be divided into 10 smaller units.

(viii) Finish by indicating the numbers and the used RF scale or statement scale.




**SCALE CONVERSION.**

Scale conversion is a cartographic process of changing map scale from one form of expression into another. The cases may include the following:-

- Statement scale into scale
- RF scale into statement scale
- Linear scale into statement scale or RF scale

**Statement scale into RF scale:-**

Examples:

(i) 1 cm to 0.5 km.

The RF scale from the given statement scale above is determined as follows:-

· Recall 1 km = 100,000 cm

· Then

If 1 km = 100,000

0.5 km = ?

$\frac{0.5km \times 100,000cm}{1km} = 50,000$

**Thus,the RF scale = 1:50,000**

(ii) 1cm to 0.75km.

The RF scale from the given statement scale above is determined as follows.

Recall 1km = 100,000cm

Then

if 1km = 100,000

0.75km = ?

$\frac{0.75km \times 100,000cm}{1} = 75,000$

**Thus,the RF scale is 1:75,000**

**RF scale into statement scale**

**Examples**

**(i)** 1:25,000

The statement scale from above RF scale is determined as follows

Recall 1km =100,000cm

Then;

if 1km = 100,000cm

? = 25,000cm

$$\frac{1km \times 25,000}{100,000cm} = \frac{25,000}{100,000} = \frac{1}{4}$$

Thus;the scale is stated as 1cm represent 0.25km

**(ii)**1:250,000

The statement scale from the above RF scale is determined as follows.

Recall 1km =100,000cm

Then;

if 1km = 100,000cm

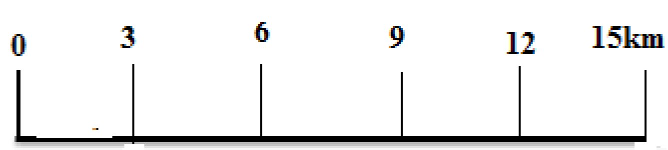
? = 25,000cm

$$\frac{1km \times 250,000cm}{100,000cm} = 2.5km$$

Thus; the scale is stated as stated as 1 cm represents 2.5km

**Linear scale into statement and RF scale**

Linear scale can be converted into statement scale or RF scale or RF scale by considering the unit leghth used to construct it. The unit leght is realized by measuring the length of a segment with a ruler.




According to the given linear scale above; the used unit length is; 2cm measure 3km.

Then;

As 2cms = 3km

1 cm = ?

$$\frac{1cm \times 3km}{2cm} = \frac{3km}{2} = 1.5 km$$

Thus; the scale is state as; 1cm represents 1.5km.From the statement scale; The RF scale becomes; 1:150,000

## IMPORTANCE OF SCALE.

Scale is useful in two varied way of map reading and interpretation;and making.

### In map reading and interpretation.

- Enables the map user to understand the relationship of distance between the map and the actual ground represented.
- It is useful in understanding the relative size of the area mapped by considering the used scale size. For instance; if the used scale size is assessed large, it implies the used scale size is assessed small, larger area represented'
- It is very useful in making area size, distance and gradient determination of the geographical features which appear on a map and on the actual area.
- It is useful to judge the amount of the details of an area represented by taking into consideration of the scale size used. For instance; if the used scale is assessed large, it implies, the map makes larger representation of the small area and it is possible for many details about the area to have been included on the map.

**In map making.**

- Determines the size of the map to be constructed
- Controls the amount of details to appear on the map relatively to the size used
- It is very useful in the cartographic process of map reduction and enlargement
- Controls the size of the convention symbols, sign and abbreviations
- It is useful in making map projection
- Controls or determines the size of the ground to be mapped

**EXERCISE**

Q. A racing motorist travels at a speed of 120km/hr covered a ground distance measured on the map by 6cms. If traveled for 15 minutes. Determine the RF and statement scales (NECTA 1984).

Q. A racing cyclist covers a distance of 45 km between town A and b in 30 minutes. If the distance measures 3 cm on the map.

(i) Calculate the speed of the cyclist

(ii) For how long will cover 120km

(iii) Draw a linear scale to read 120 km (NECTA 2002)

Q (a) (i) Define a scale of a map
(ii) How important is a scale of a map to map user?
(b) (i) Given 1:50,000 state the scale into centimeters to a kilometers
(ii) Given – 1cm on a map represents 4 kilometers on the ground. Express this scale as representative fraction (RF Scale) (NECTA 1996)

Q. (i) Why are scale necessary in map making?
(ii) Construct a metric linear scale for 1:30,000 to measure 1.6 km (NECTA 1983)

Q. By comparing a 1;25,000 and 1;50,000 map scales, show the usefulness of scales in map reading and interpretation (NECTA 1995)

Q. (i) convert the scale of the map to a unit lenghth of one kilometer of the linear scale.
(ii) Construct the linear scale by using the RF Scale of 1:30,000 and indicate a distance of 3.6 km (EZEB 2006)

Q. A bus driver traveling along Arusha – Babati road covering a distance of 10 cms on a map in 30 minutes, if the speed of the bus was 50km/hr.
(i) Calculate the distance covered in km
(ii) Find its statements scale
(iii) Draw a liner scale using the above statement scale (NECTA 2000)

Q. Mention two uses of the representative fraction scale (NECTA 1988)

Q (a) Differentiate between large and small map scales
(b) outline the determinant factors for map scale size

(MOCK Q.)

Q. (a) Explain why scales are necessary in map making
(b) By using the unit length of 1 cm to measure 3 km; construct a linear scale to read a distance of 8.2 kilometers.
(MOCK Qn.)

Q. (a) Differentiate between small and large scale maps.
(b) Show the potential significance of scales in cartographic process. (MOCK Q.)

**6.2 DETERMINE DIRECTIONS AND AREA**

**DISTANCE AND SIZE AREA MEASUREMENTS**

Topographical maps can be potentially used to asses the measurements of the geographical features observed with reflection to the respective actual areas represented. It is therefore important to learn how the measurements of the geographical features of represented areas can be established from the topographical maps.

The popular ground measurements which can be established from the topographical maps are of distance and size of different land structure.

**DISTANCE DETERMINATION**

Distance is defined as the length of an elongated object or space between the two points on the earth's surface expressed in units of linear measurements like; meters, feet, kilometers and miles.

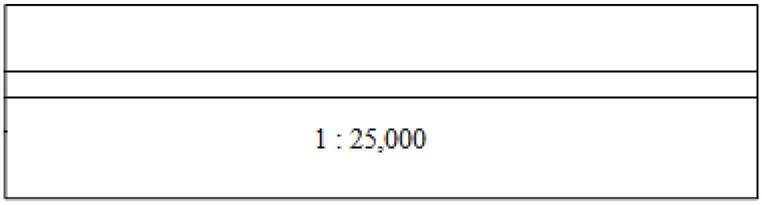
Distance measurements of any elongated object on the topographical map has to take into consideration of the following key issues.

- · Map scale; The ratio of distance between the map and the actual ground represented. This enables the change of convention distance (CD) into actual ground distance.
- · The appearance of the elongated object on the topographical map given whose distance is to be measured. This determines the technique to be applied to get the CD.

**Distance determination**

**For straight elongated objects.**

For straight elongated objects,one has to use a ruler more directly to get the conventional distance of the object on the map. i.e. a ruler has to be placed along the elongated object to be measured.




The distance of the road from above is determined as follows:-

· Map scale:- CD of the road = 8 cm

If 1cm represent 0.25 km

8cm represents ?

$$\frac{8\text{cm} \times 0.25\text{km}}{1\text{cm}} = 2\text{km}$$

Thus, the distance of the roads is about 2km.

**Distance measurements for the curved elongated objects**.

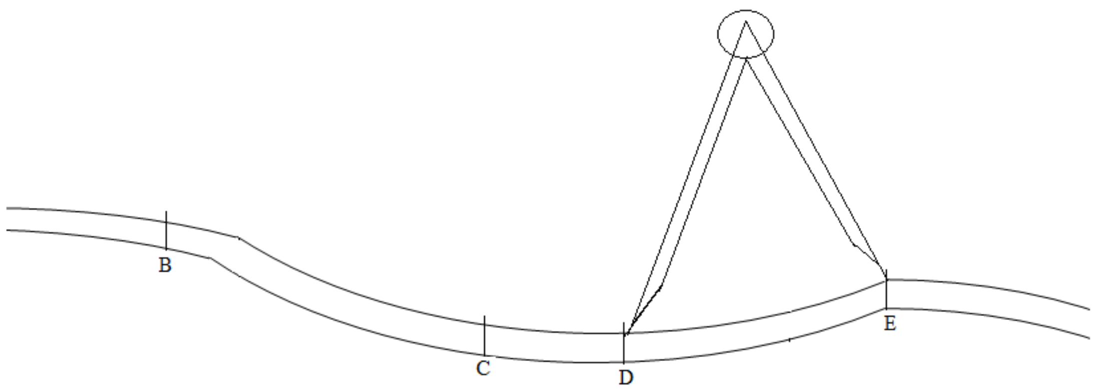
It becomes more difficult to obtain the conventional distance for the curved elongated object with the use of a ruler directly from the topographical map. Up on this challenge and others, one has to resort the use of the following enhancing tools to get the conventional distance of what required to be established. The enhancing tools include the following:-

- A pair of divider
- A piece of paper
- A piece of thread

**1. The use of a pair of divider**

A pair of divider up on its nature is commonly used to measure short straight courses between points a long the elongated object. To make this, one has to do the following.

- Identify the two recommended points of the elongated object on the topographical map given. The points can be identified by considering the given grid references, place names. Sometimes, both grid references and place names and can be considered.
- Divide the elongated object on the topographical map into convenient short straight sections.
- Open your divider and measure the straight divisions (courses) along the recommended elongated object.
- Add up all the measures to get total convectional distance of the elongated object.
- The obtained convectional distance should be converted into the actual ground distance with respect to map scale provided.



1 : 50, 000

The distance of the road above is obtained as follows:-

AB=1cm; BC = 1.5cm; CD = 0.5; DE = 2cm; EF = 2cm

· The total CD = 7 cm
· Map scale, 1 cm represents 0.5 km

Then;

If 1cm represent 0.5km
7 cm represent ?

$$\frac{7\text{cms x } 0.5\text{km}}{1 \text{ cm}} = 3.5 \text{ km}$$

Thus ; distance of the road is of about 3.5 km

**2. The use of a piece of paper**.

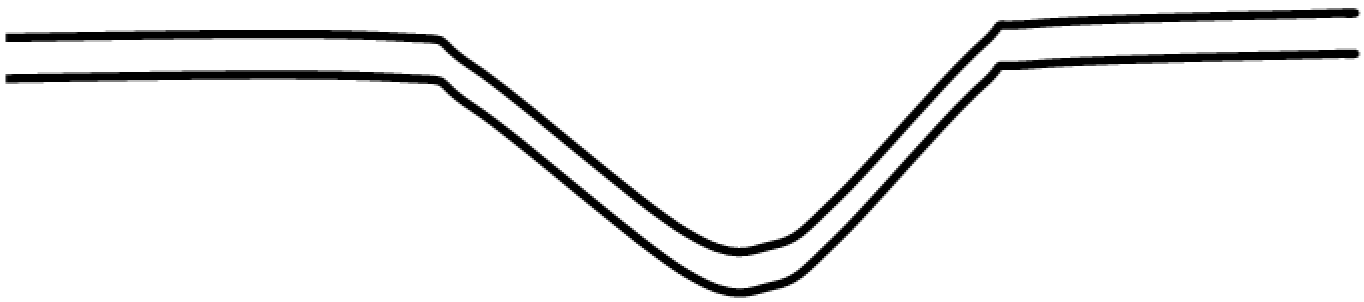
A piece of paper can be used to measure either a short or long distances.

**Procedure;**

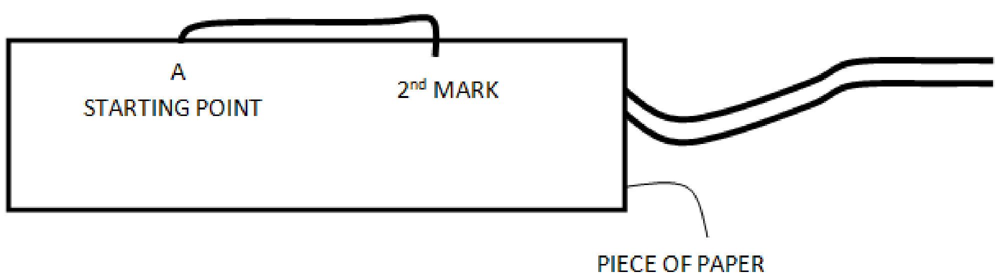
- Take a piece of paper and fold it.
- Put the piece of paper on the map and measure each small distance along the route.
- Take the piece of paper to the linear scale on the map to have ground distance

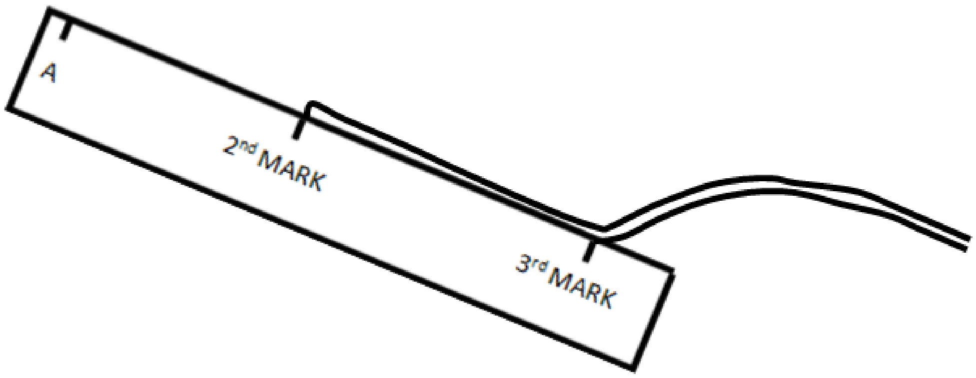
Example;

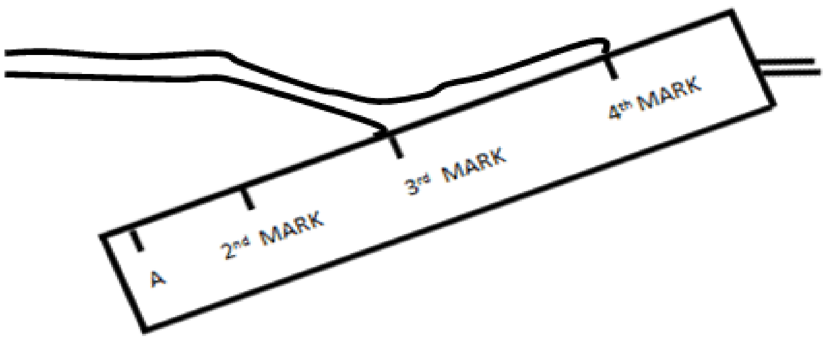
The distance of the road below can be determined as follows:-

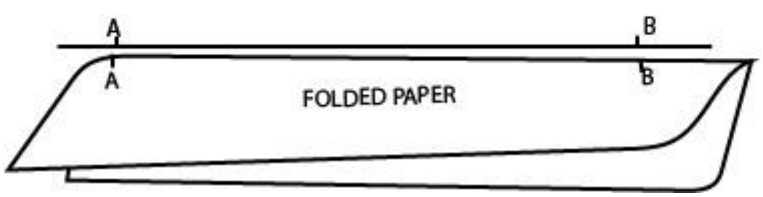


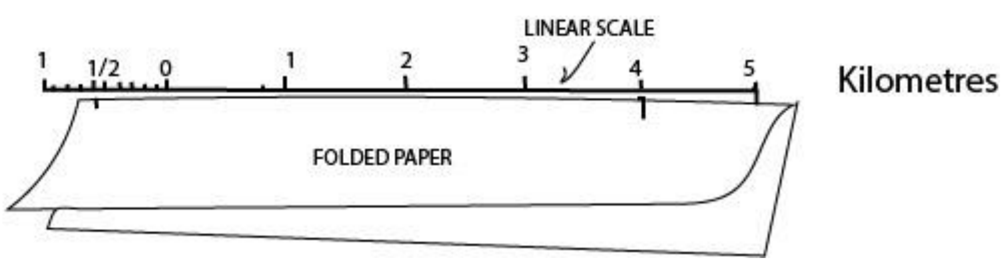
Distance determination with the use of a piece of paper is up on the following application:-




A
2nd MARK
3rd MARK


A
2nd MARK
3rd MARK
4th MARK


A
B
A
B
FOLDED PAPER


LINEAR SCALE
1
1/2
0
1
2
3
4
5
Kilometres
FOLDED PAPER

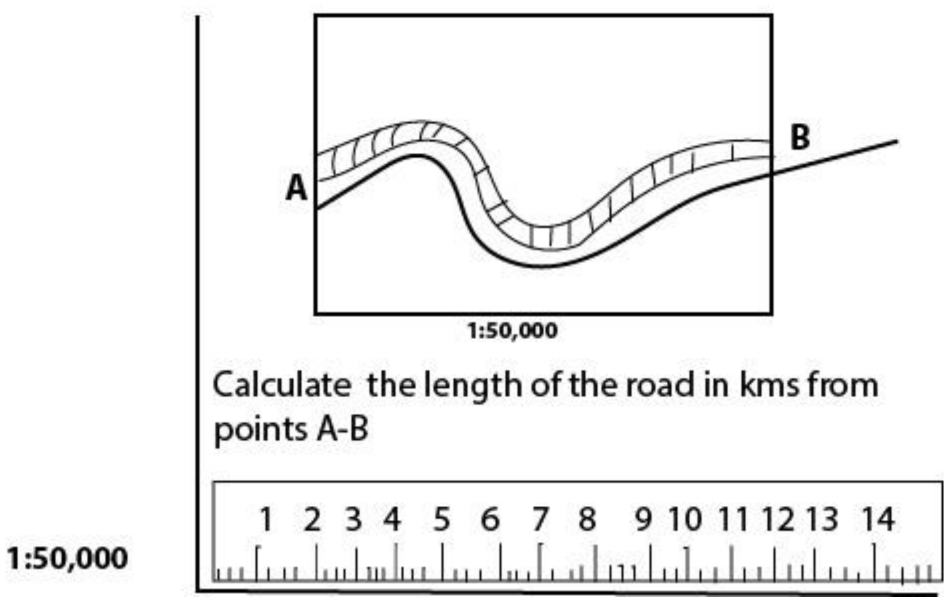
Thus; the distance of the road according to the application above is of about 4.5 km.

**3. The use of a thread.**

Procedure:-

- Identify the two recommended end points of the elongated object whose distance is to be measured on the map. The two ends can be identified by taking into consideration of grid references, place names or both.
- Take the thread and spread it along the elongated object from one end to another.
- Take the thread to a ruler to measure the conventional distance of the elongated object.
- Convert the conventional distance into ground distance with respect to map scale indicated on the map.

**Consider the following illustration**




The length of the road from A to B is determined as follows.

- Map scale; 1 cm represents 0.5 km
- CD of the road = 11 cm

THEN;

If 1 cm = 0.5 km

11 cm = ?

$\frac{11cm \times 0.5\ km}{I\ cm} = 5.5\ km$

Thus; the distance of the road is of about 5.5km

**AREA SIZE DETERMINATION.**

Area size refers to a bigness or extent of coverage of any part of the earth's surface expressed in square unit of measurements. For instance; the bigness of a water body, plantation, forestland, country and others of the same consideration.

Area size determination of any thing from the topographical map should take into consideration of the following two keys issues.

- Map scale; The ratio of distance between the map and the actual ground represented. This enables to change of conventional measurements obtained on the topographical map into actual ground measurements.
- The shape of the feature on the topographical map given whose area size is to be measured whether regular or irregular. This determines the method to be used to get the size.

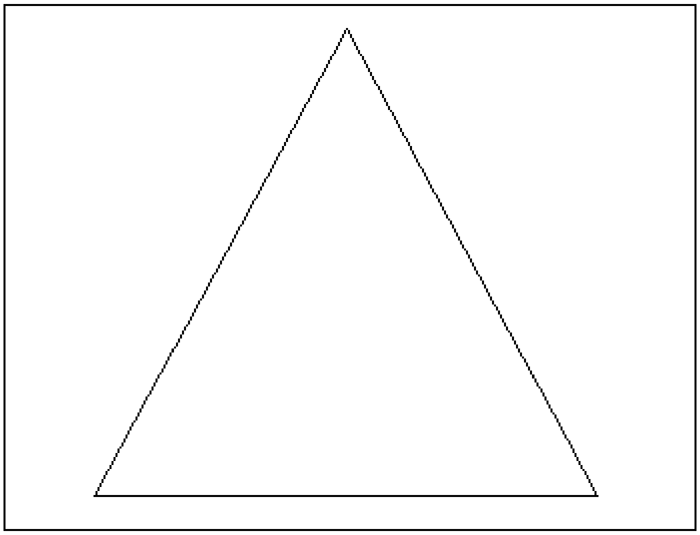
**Area size determination for regular features.**

Regular features are those whose appearance well defined. They include; triangle, rectangles, square, circle, trapeze, octogon and others of the same reflection. To calculate the size of these regular figures, some one has to apply a relevant mathematical application with respect to the shape of the features observed on the topographical map.

Consider the following:-

**(a) Triangle.**

Consider the following illustration.



1:50,000

The size of the area occupied by forest is calculated as follows:-

So long the forest land occupied the shape of a triangle, the relevant formula is as follows:-

**Area size = $^1/_2$ x base x height**

*Map scale; 1cm represents 0.5 km

*According to the measurements of the feature on the map.

- Base = 6 cms
- Heigh t = 14 cms

Then;

½ x (6 x 0.5 km) x (14 x 0.5 km)

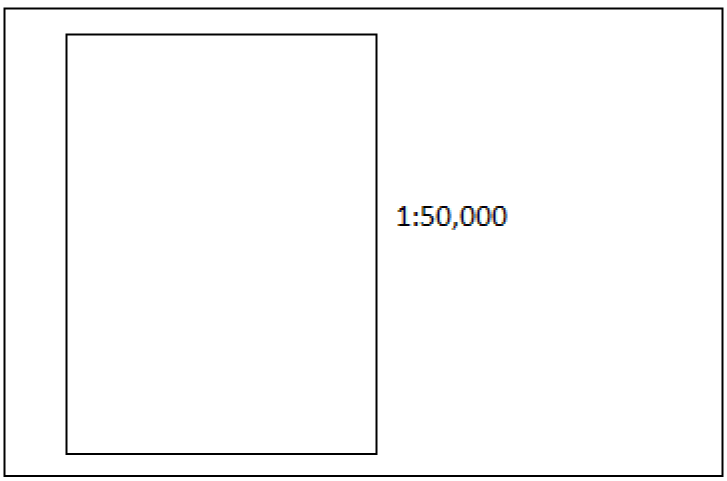
½ x 3km x 7km

$\frac{21}{2} = 10.5$

Thus; the area size of the forestland is of about 10.5 $km^2$

(b) **Rectangle;-**

Consider the following.




The size of the area occupied by forest from the given topographical map is determined by the following application.

So long, the forestland occupies the regular shape of a rectangle, the relevant formula is given as follows:-

| **Area size = width x length** |
|---|

*Map scale; 1cm represents 0.5 km.

*According to measurements of the figure on the map,

*According to measurements of the figure on the map

- Width = 4 cm
- Length = 8cm

4 cm x 8 cm

(4 x 0.5 km) x (8 x 0.5 km)

2 km x 4 km = 8km$^2$

**Thus; the area of the forestland is of about 8km$^2$**

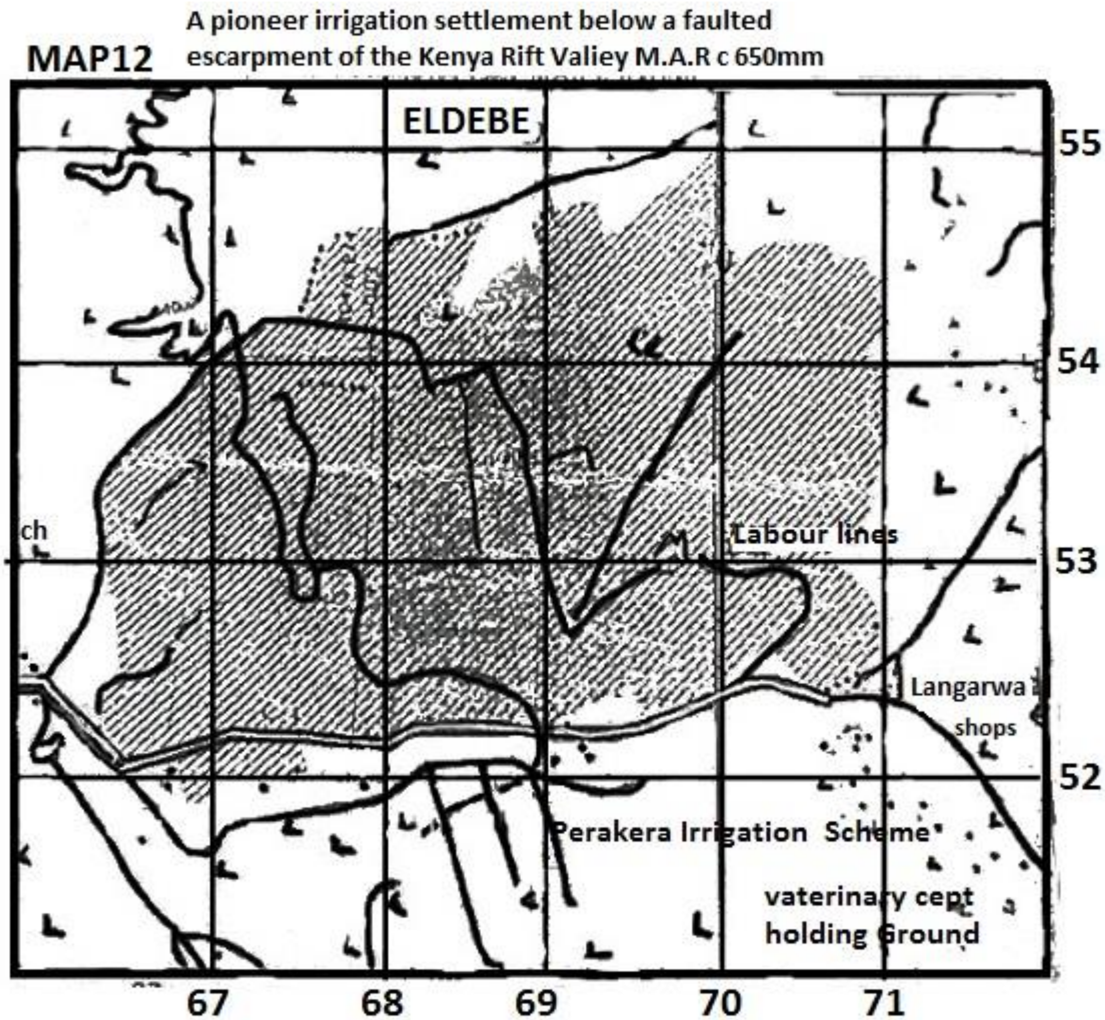
NOTE:
The two given above represent the other regular figures. It is therefore important for the students to be knowledgeable to relevant mathematical applications for calculating the size of the other regular figures up on observation on the topographical map.

**Area size measurement for the irregular figures**.
To determine size for the irregular features observed on the topographical maps, some onbe may resort the use of the following methods.

- Grid square method
- Stripping method
- Geometric method

**The grid square method.**

It is the most popular and widely used method of determining area for irregular figures observed on the topographical map with reflection to actual areas represented. It is mostly used, if the given map observed to have the vertical and horizontal grid lines on its face forming so **perfect square** as cross each other at right angles.




From above, the area size of the coffee plantation is calculated follows:-

* Map scale ……………… 1cm represents 0.5 km

*Method ………………… grid squares consideration

* Actual size of the ground by each grid square determination.

| **Area size = width x length** |
|---|

According to the grid squares on the given map;

- Width = 2cm
- Length = 2cm

2 cm

2 cm

Then;

· 2cm x 2cm

(2 x 0.5 km) x (2 x 0.5km)

1km x 1km = 1 $km^2$

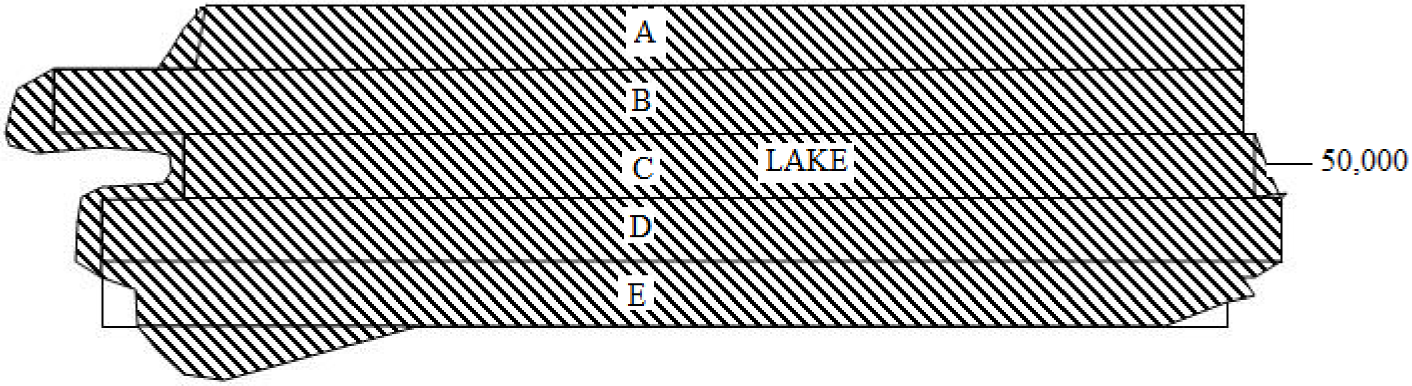
Hence; Grid sguare = 1 $km^2$
Complete squares = 3
3 x 1 km2 = 3 $km^2$

Incomplete squares = 11/2 = 5.5
* 5.5 x 1 $km^2$ = 8.5 $km^2$

Thus; the area size of the recommended feature is of about 8.5 $km^2$.

**Stripping method**
By this method, part of the topographical map with reflection to the ground represented under consideration is divided into a number of convenient strips. It has to be followed by finding out the area size of each strip and have to be all added to get the entire area size of the feature.

Consider the following illustration:-




The area size of the lake is obtained as follows:-

*Map scale 1cm represents 0.5

- **Strip A**: 8cm x 1cm

  (8 x 0.5 km) x (1 x 0.5 km)

  4km x 0.5 km = $2km^2$

- **Strip B**: 10 cm x 1 cm

  (10 x 0.5 km) x (1 x 0.5km)

  (10 x 0.5 km) x 0.5 km = 2.5 $km^2$

  5km x 0.5 km = 2.5 $km^2$

- **Strip C**: 8cm x 1cm

  (8x0.5 km) x (1 x 0.5 = 2 $km^2$) = 2 $km^2$

- **Strip D**: 9cm x 1cm

  (9x0.5 km) x 0.5km = $2.25km^2$

$4.5km \times 0.5km = 225km^2$

- **Strip E**; 8cm x 1cm

  (8 x 0.5 km) x (1 x 0.5 km)

  $4km \times 0.5km = 2km^2$

Then;

$2km^2 = 2.5km^2 + 2km^2 + 2km^2 + 2.25km^2 + 2\ km^2 = 10.75km^2$

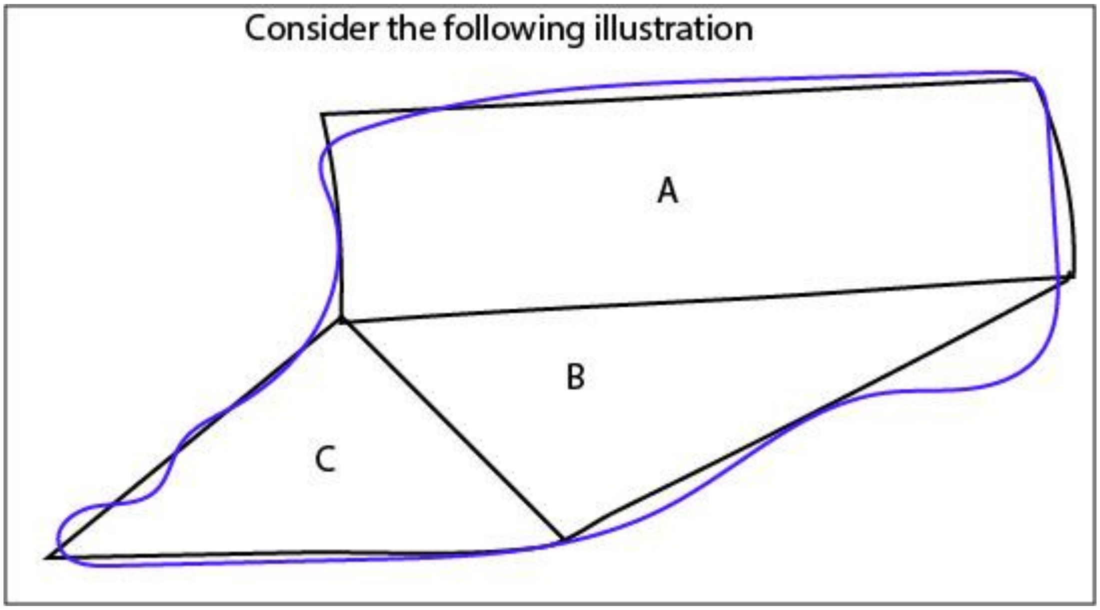
Thus; the area size is of about $10.75km^2$

Thus; the area size of about $10.75km^2$

**Geometric method.**

It is by dividing the boundary area of the feature into a convenient number of mathematical (geometric) figures of like rectangles, triangles or combination of these figures on\over the same. It should be followed by calculating the area size of the forced geometric figures with respect to the used scale. At last the distinctive size should be added to get the entire area size of the feature.

Consider the following illustration;-




*Map scale …………… 1 cm represents 0.5 km

**Rectangle A**

| Area size = width x length |
|---|

8cm x 18 cm

(8 x 0.5 km) x (18 x 0.5 km)

4 km x 9 km = 36 km$^2$

**Triangle B**

| Area size = ½ x base x height |
|---|

½ x 18cm x 10cm

½ x (18 x 0.5 km) x (10 x 0.5 km)

½ x 9km x 5km

½ x 45 km = 22 .5 km$^2$

**Triangle C:-**

Area size = ½ x base x height

½ x 16cm x 6cm

½ x (16 x 0.5km) x (6X0.5km)

½ x 8km x km

½ x 24km = 12km$^2$

Then; 36km2 + 22.5 km2 + 12km$^2$ = 70.5 km$^2$

Thus; the area size is of about 70.5km$^2$

**EXERCISE**

Qn. What is the length of the all weather road with loose surface from Grid 930352 to Grid 040339 in kilometers.

(NECTA 1999 ----- Extract map Babati………. Series Y 742)

Qn. Measure the lenghth of the major road from grd reference 886220 to grid reference 975192. Give your answer in kilometers. (NECTA 2004 ----- Extract nmap of Mwanza sheer no. 33/2)

Qn. Calculate the area covered by forest in square kilometers.

(Necta 2009 ----- extract map of MPWAPWA sheet no 163/4)

Qn. Calculate the area of kisangara estate in square kilometers

(EZEB ----- 2009……. Extract map of Kisangara sheet no 73/1)

Qn. Calculate the area covered by plantation agriculture in square kilometers (NECTA 1999 ---- Extract map Babati …… Series Y 742).

Qn. Find the actual distance of railway line from grid reference 860975 to 930039 in kilometers.

(NECTA 2006----- Extract map of Mpanda ----- sheer no 153/3)

Qn; Calculate the area of Weru sisal estate. (NECTA 1997 – Extract map of Moshi ----- series Y 742)

Qn. Measure the distance of the Moshi – mweka road all weather loose surface road (grid 154309 to 135400) (NECTA 1997 – Extract map of Moshi ----- series Y 742)

Qn. What is the total area covered by the lake in square km?

Qn. Calculate the area of lake balangida gidaghangaat and give your answer in square kilometers. (NECTA 1998 -----Extra map of hanang --- series Y 742)

Qn. Find the total area of the land of this Island found to the west of Easting 180 if the scale of the map to duced y half (DSM – Mock AN 2003----- Extract map Nansio Island sheet 22/1)

Qn. Calculate the area of seasonal swap, south of nothing 080 and west of easting 690. Give your answer is square km.. (JICA ---- 2009) – Extract map of utete)

**MAP REDUCTION AND ENLARGEMENT.**

The cartographic processes of minimizing and expanding the size of any map understood as map reduction and enlargement respectively.

**MAP REDUCTION**

As it has been pre described, map reduction is a cartographic process of minimizing the size of a map to provide smaller representation of the area.

To reduce the map the following as rules should be followed:-

- All sides of the map i.e. the length and width should be reduced with the same number of times.
- All drawings on the map should be reduced with the same number of times.
- The scale has to be changed to become a comparatively smaller in order for it with respect to map to give the same ground measurement as the old map does.
- The map has to be redrawn by using the reduction measurements.
- Insert the details on the reduced map according to new reduction measurements. The transfer of details should take into consideration of the grid pattens, and if possible for making more accuracy, the diagonal lines can be drawn the grid squares.

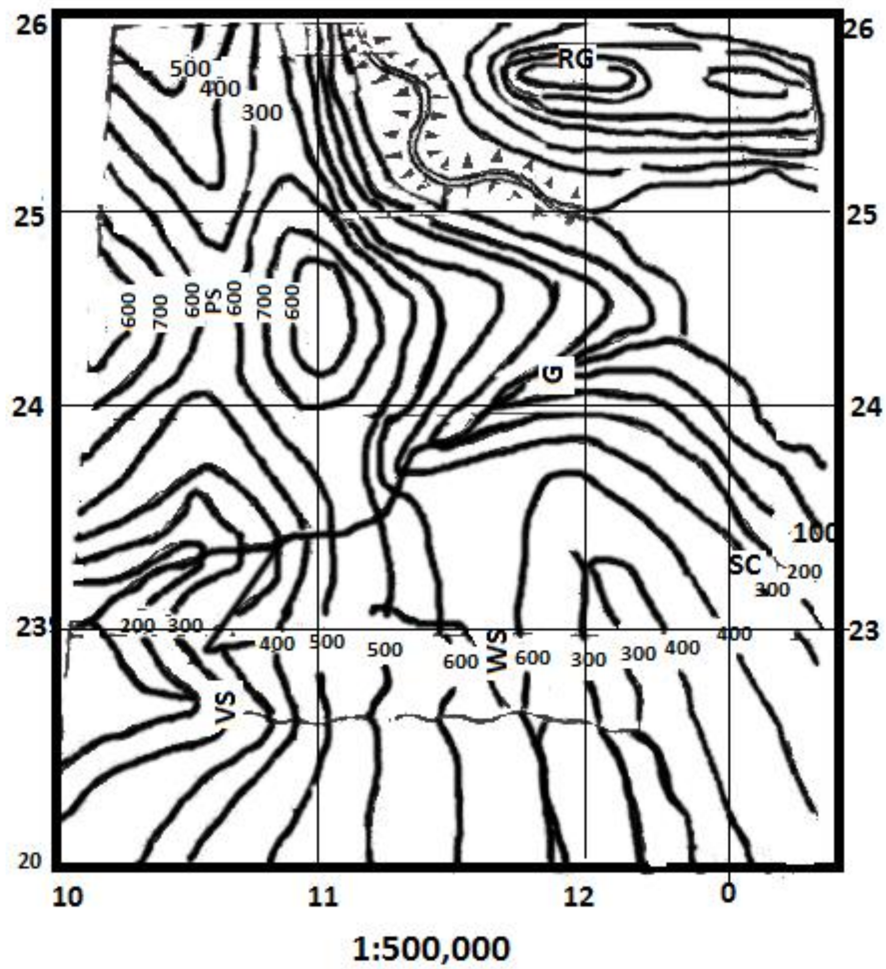
Note:

The conventional symbols, signs and abbreviations should be reasonably small in order for them to fit onto the size of reduced map.

**Impacts of map reduction**.

- The map size becomes smaller and thus gives smaller representation of the area mapped.
- The map would become less detailed as it more selective due to the limitation of the map's space.
- The cartographic symbols, signs and abbreviation appear smaller.
- The scale of the map becomes comparatively smaller.

**Consider the given map and reduce it by ½**




**Procedure.**

(i) Consideration of the given map by studying it clearly.

(ii) Determination of the amount of reduction reduction factor is by ½

(iii) reduction of the map length

- Length on the old map = 8cm

8 x 0.5 = 4cm

Hence;the new length = 4cm

(iv)reduction of the map width

- width on the old map = 8cm

8 x 0.5 = 4cm

Hence;the new length = 4cm

(v) Reduction of the grid squares

- Grid square on the old map = 2cm

2cm x 0.5 = 1 cm

Hence; the new grid square = 1 cm

(vi) Determination of the new scale

| **New scale = reduction factor x old scale** |
|---|

½ x 1/50,000 = 1/100,000

Hence; the new scale = 1: 100,000

Alternatively the new scale can be determined by the following application

$$\textbf{Map scale} = \frac{\textbf{Map distance}}{\textbf{Ground distance}}$$

* <u>3cm</u> = 1 cm to km

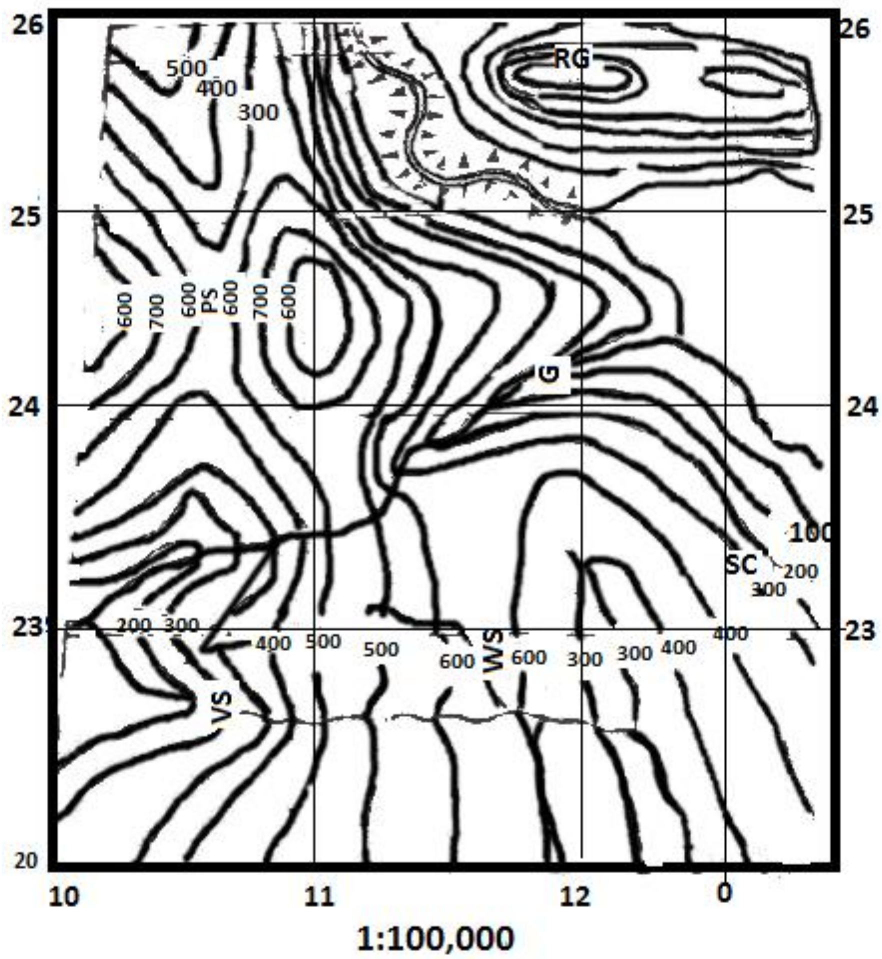
3 km

Or

<u>4 cm</u> = 1cm to 1 km

4km

Thus; the reduced map appears as follows:-




**MAP ENLARGEMENT**

It is a cartographic process of expanding the size of a map to provide larger representation of the mapped area.

To enlarge a map the following as rules should be followed:-

- All sides of the map, i.e. length and width should be enlarged with the same number of times.
- All drawings on the map should be enlarged with the same number of times.
- The scale has to be changed to become comparatively large in order for it with respect to the map to give the some ground measurements as the old map does.
- The map has to be redrawn by using the enlargement measurements.
- Insert the details. The transfer of details should take into consideration of the grid pattens, and if possible for making mre accuracy, the diagonal lines can be drawn across the grid squares.

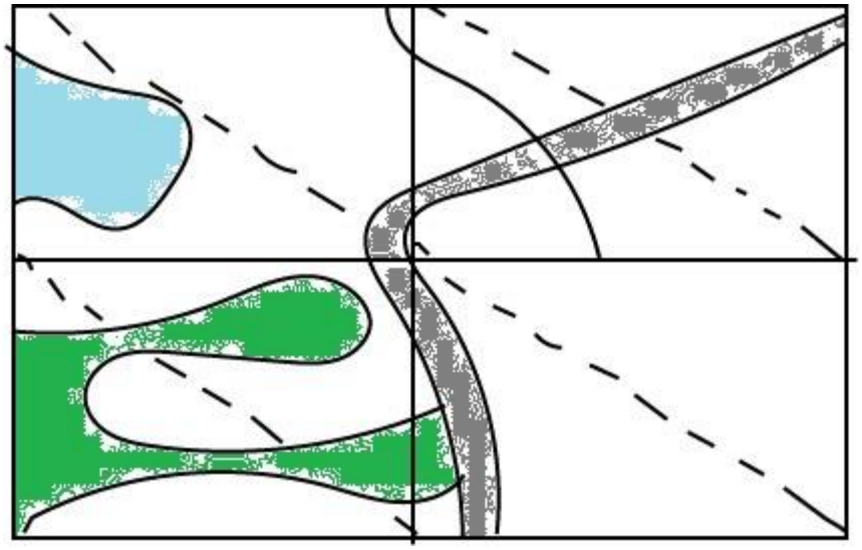
**Note**

The conventional symbols signs and abbreviations or initial should be reasonably large in order for them to fit onto the enlarged map.

**Impacts of enlargement**.

- The map size become larger and thus, gives larger representation of the mapped area.
- The map is likely to be more detailed as it is less selective due to the larger space of the map.
- The cartographic symbols, signs and abbreviations may appear larger in size.
- The scale becomes comparatively larger.

**Consider the given map below and it enlarge by 2.**



**1:50,000**

**Procedure**

(i) Consideration of the given map studying it Clearly.

(ii) determine of the amount of enlargement. Enlargement is by 2.

(iii) Enlargement of the map length.

- Length on the old map = 4cm

4cm x 2 = 8cm

Hence ; the new length = 8cm

(iv)Enlargement of the map width

- width on the old map = 4cm

4cm x 2 = 8cm
Hence;the new width = 8cm

(v) Enlargement of the grid square.

- Grid square on the old map = 2cm

2cm x 2 = 4cm

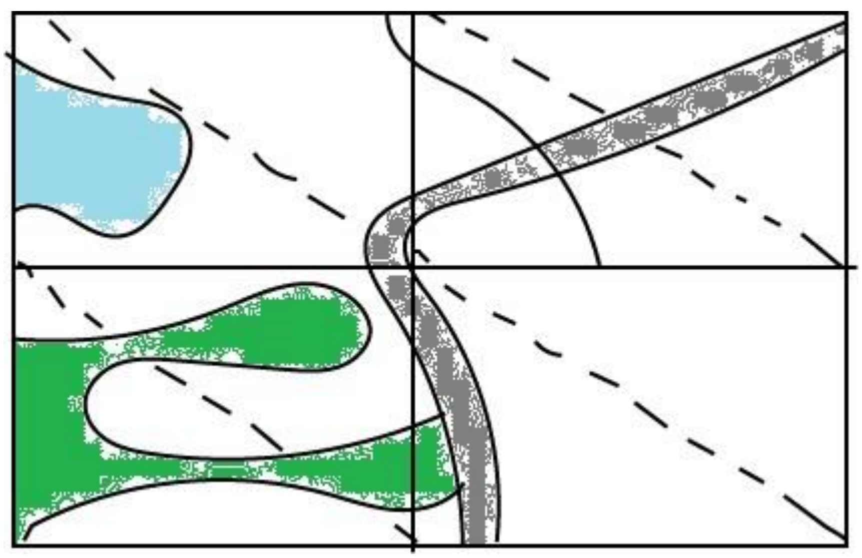
Hence, the grid square = 4cm

(vi) Determination of the new scale

| New scale = enlargement factor x old scale |
|---|

2 x 1/50,000 = 2/50,000 = 1/25,000

Hence; the new scale = 1:25,000



**1:25,000**

**Alternatively** the new scale can be determined by the following application.

**Map scale = <u>Map distance</u>**

**Ground distance**

$\frac{8cm}{2km}$ = 1cm to 0.25cm

Qn. (a) Outlining your steps redraw provided (1:50,000) to a scale of 1:100,000 and indicate the following features:-

The forest area, Songoro and chimumbu hills, lake Duluti, Nkoaranga hospital and all weather road bound surface.

(b) Examine the two maps and comment on the impact the change of the map scale has on the map area and its contents.

(DSM – MOCK, 2002:Extract map of TENGERU: (sheet No./ 55/4Ed)

Qn. (a) Calculate the approximate area in square kilometers of the contoured map if its scale changed to 1:100,000 (NECTA 2001, Extract map of Kondoa – sheet # 104/4)

Qn. Redraw the map north of northing 120 and west of easting 650 by the scale of 1:25,000 and on it indicate woodland and seasonal swamp.

JICA ===2009) Extract map of ulete)

Qn. Draw a map of district found at the western part of the map by using the scale of 1:100,000 and on its show the following.

(i) Boundary of the district

(ii) Mwanza – Shinyanga road

(iii) usagara – Fela station road

(iv) Railway line

(v) Ngeleka hill, jijawenda hill and kagela hill

(vi) Out crop rock around jijawenda hill.

(vii) Bridges along Fela – Mwanza road (NECTA 2010)

## 6.3 MAP ORIENTATION

### POSITION LOCATION ON TOPOGRAPHICAL MAPS

The position location of geographical features on topographical maps with reflection to actual areas represented can be established by employing one or more of the following methods:-

- Place naming
- The use of latitude and longitudes
- Grid reference
- Bearing and distance

**(a) Place naming**

By this, method names of places on the topographical maps and up on the earth's surface can be used to give the position location of a point, feature or another place e.g. the Yanga Sports club head office is at Jangwani.

If place naming method is used for giving position location of any geographical feature on he topographical map and up on the respective actual area represented on the earth's surf ace, should meets the following conditions:-

- The name of a place to be should be unambiguous i.e. some times more than one places may share the same name.

- The name to be located should be of of significance to a person.

**NB:** So long the place naming method is facing a problem of ambiguity, it can be dissolved supplementing it with another method of giving location like that of grid reference or direction. E.g. the school is at Ruvu, GR 432675.

**(b) The use of latitude and longitude:**

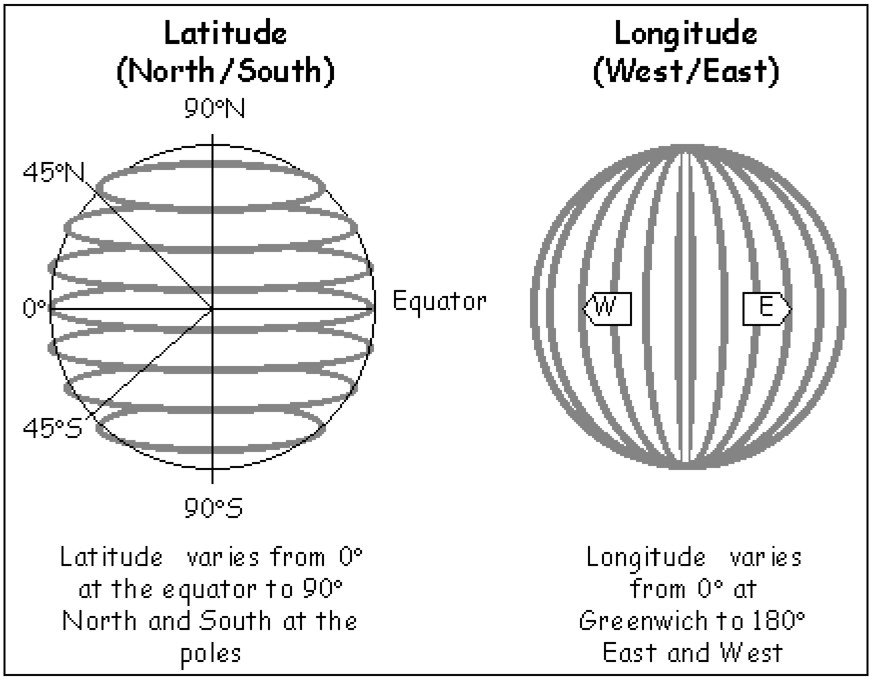
It is the most useful geographical method of giving position location on the map and up on the earth's surface. These measurements are always needed in actual making of the accurate maps. Nearly all maps indicate these along their edge though not all show these in more detail.

Both, latitudes and longitudes are really angular distance measured accurately from the centre of the earth and are expressed in degrees and further divided into smaller measurement units of minutes and seconds.

Latitude is an angular distance measured northward and southward of the line)

Longitudes are the angular distances eastwards and westward of the prime meridian.

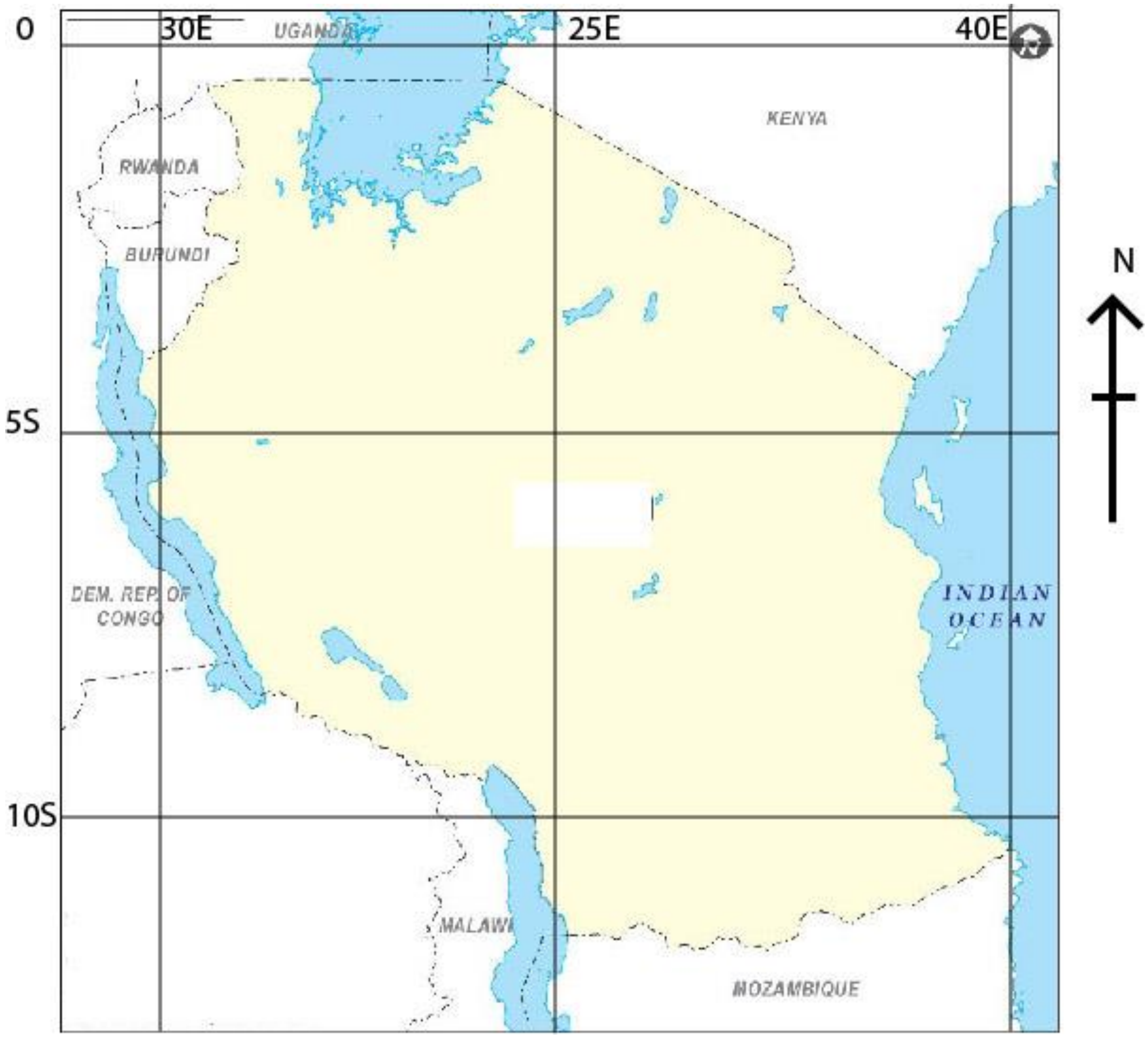
The latitudes and longitudes are commonly used to locate the position for the wider features on the small – scaled maps or atlas maps on which these established more detailed.




**Procedure of giving latitudes and longitudes.**

- Firstly establish the degrees of latitudes of a place where is located from one edge to another on the map
- Establish the degrees of longitudes of the place on the map from obne edge to another.

- Combine the degree reading of both latitudes and longitudes to give the proper position location of the place.



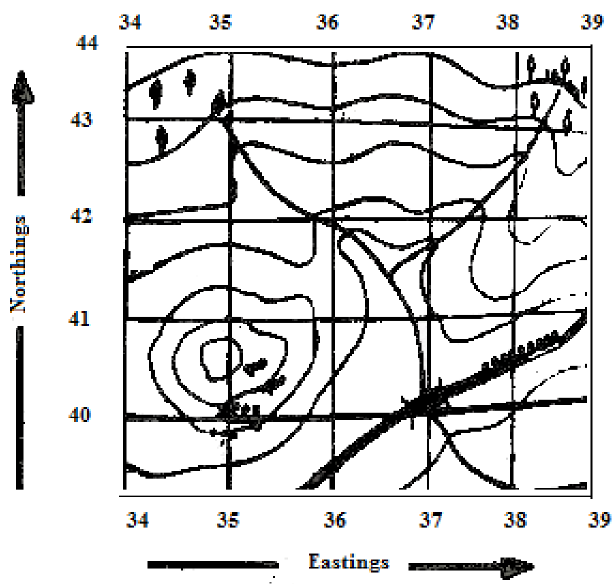

From above Tanzania located in Latitude and longitude position of $1^0$ 30’ sand $30^0$ to $40^0$ E.

**(c) Grid reference:-**

The use of latitudes and longitude becomes increasingly difficult for larger scaled maps. For this and others, map makers have devised a quicker and easier method known as **grid reference**.

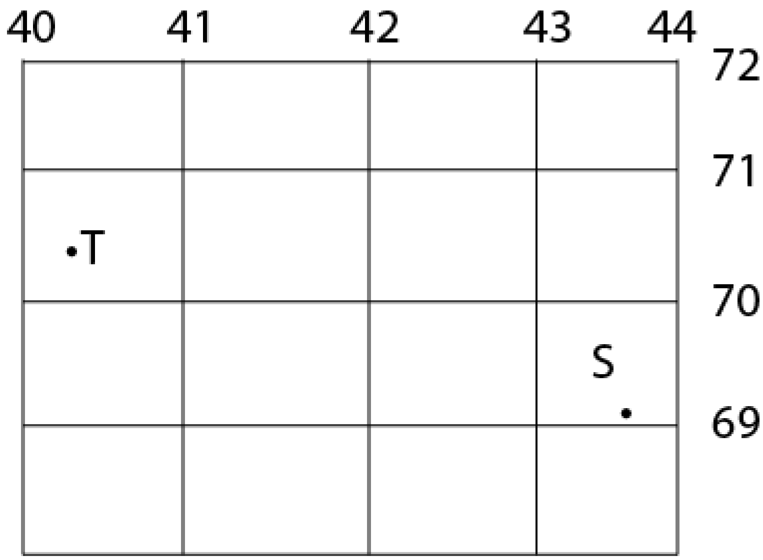
A grid is a network of the evenly spaced vertical and horizontal lines drawn on the map face. The lines drawn perpendicular to one another and cross at right anglesand form the so perfect squares.

All vertical lines are called easting, because of being numbered eastwards, while the horizontal lines are numbered northwards referred to northing.




The establishment or reading of the grid reference, it has to start by producing the numbers of easting, and then those of northing.

Grid reference can be given in four figure numbers, if the position to be located is at the exactly intersection of the vertical and horizontal grid lines. It should be in six figure numbers, if the position to be located is not at the intersection of the vertical and horizontal grid lines. However; it is always much better for the grid reference be in six figure numbers regardless of the cases.




- Point T is located at GR 403705
- Point S is located at GR 437692

**Note**

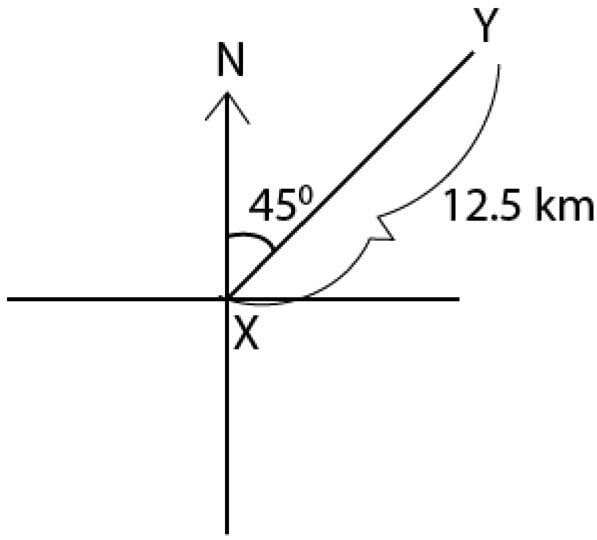
The grid lines belong to maps. It is thus, have no reality on the ground. They do not even relate as do latitudes and longitude.

**(d)Bearing and distance:**

The method is mostly used to **establish the location from another position** by giving the degree angle measure clockwise from north and the distance of an observation line between the two positions.

Bearing is the degree angle of an observation line connecting two points on the map with reflection to an area on the earth's surface measured clockwise from north direction.

Distance is the length of a space in between the two position points on the map with reflection to an actual area on the earth's surface represented.




From the above; x is located at bearing and distance of $45^0$ and 12.5 km respectively.

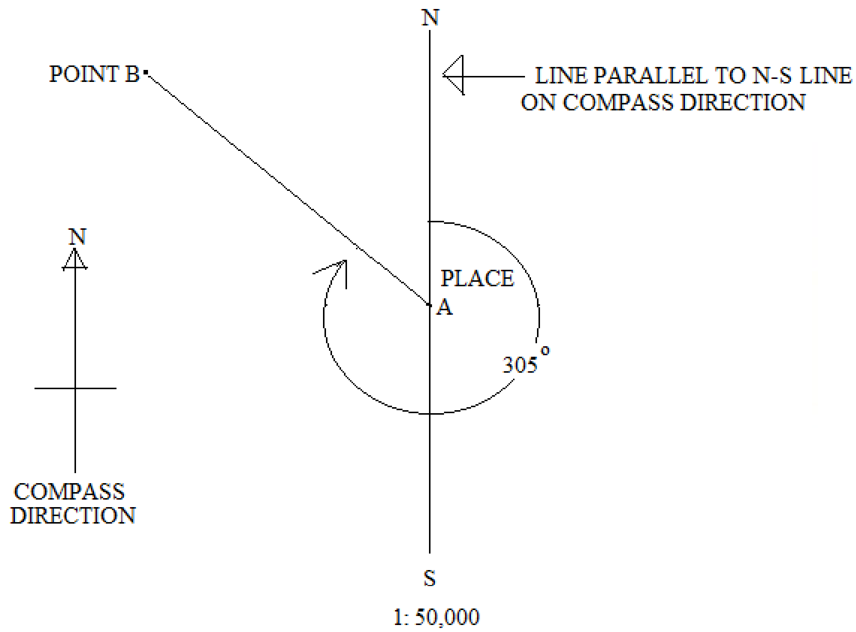
**Example:-**

Determine the location of point B from point A

<u>Bearing determination</u>

Procedure:

- Identify the two recommended points on the map by considering the grid reference or place names given. Some times both, grid reference and place names can be provided together.
- A straight line has to be drawn to join the two end points on the map. The line represents an observation sight between the two positions in the mapped area on the earth's surface represented.
- Establish the four cardinal points at the position of observer. The establishment of the cardinal points should take into consideration of the north direction indicated on the map. On some of the topographical maps, the north direction is given by means of a true north.
- Take the protector and measure the angle of an observation line that connects two position points clockwise from north direction.




The bearing of point B from point A is of about $305^0$

**Distance determination**

Procedure

- Take into consideration of the map scale
- Measure the conventional distance (CD) of the observation line that connects the two points on the map.
- Convert the CD into AD with respect to map scale
- From above the CD = 10cm

Scale; 1cm represents 0.5 km

Then;

10 x 0.5 km = 5km

Thus; point B is located at bearing and distance of about $305^0$ and 5km respectively from point A.

**Calculate the Bearing**

**Backwards bearing :-**

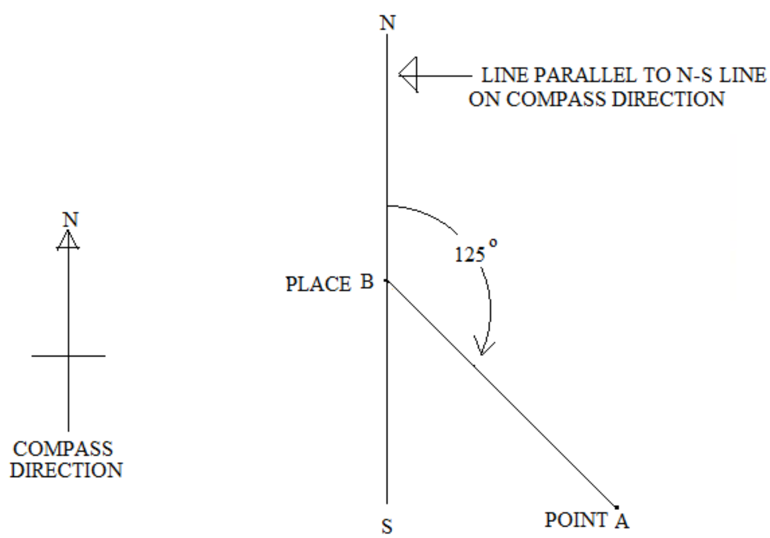
It is the reverse of the bearing of an object taken in front of the observer's position along the observation line is called **forward bearing**. While the bearing of an object measured clock- wise from north direction backwards to the former observer's position along the same sight line is called **backward bearing.** It is thus, backwards bearing s defined as the degree angle of the object measured backwards to the former observers position.

Backward bearing of an object is obtained by measuring the degree angle of an observation line clockwise from north direction backwards to former observer's position. This can be illustrated as follows:-

- Mark the four cardinal point at the observed object whose backward bearing to be established.
- Take a protector and measure the degree angle of an observation line clockwise from north direction

**Example**

The backwards bearing of point b from point A can be established as follows:-




Thus; the backward bearing of point b from point A is of about $125^0$

Note

If the forward bearing of the object has been established, the backwards bearing can be determined by mathematical procedure.

**$BB = FB \pm 180^0$**

$BB = FB + 180^0$ if the FB IS LESS THAN $180^0$

$BB = FB - 180^0$ if the FB IS GREATER THAN $180^0$

From the above case

The $FB = 305^0$

$305^0$ (FB) > $180^0$

THUS ; The $BB = 125^0$

**Significance of the backward bearing**

Backwards bearing is determined purposely to check the accuracy (correctness) of the forward bearing which has been taken in front of the observer's position to an object along the sight line. It is checked by observation the difference in degrees between the BB and FB.

Always the standard difference should be $180^0$ if the difference is less or greater than $180^0$ the reading has been subjected to an error and thus needs correction to make proper determination.

**Correction of errors**

Correction of errors is attempted with the use of the mean error but considering the varied cases.

Mean error is computed by making the following application:-

$$\text{Mean error} = \frac{\text{Amount of error in degree}}{2}$$

Amount of error = The different between BB & FB - $180^0$

The correction of errors with the use of mean error is done by making the following applications:-

When BB > FB

**FB + Mean error BB – Mean error**

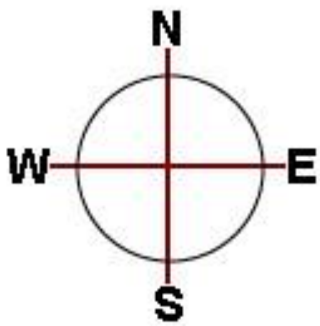
When BB < FB

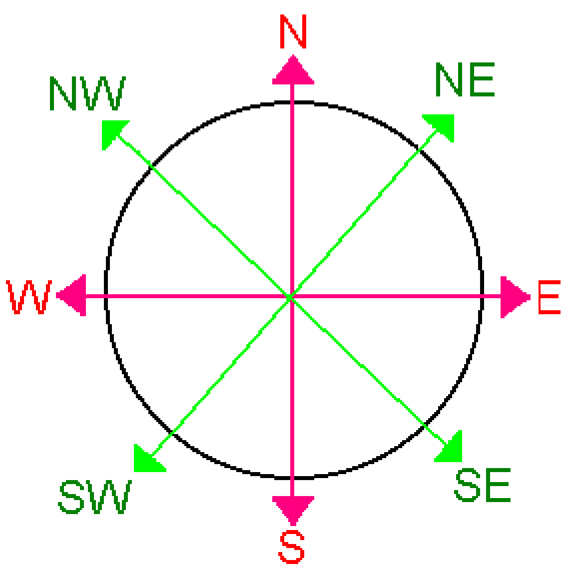
**FB – Mean error & bb + Mean error**

**DIRECTIONS**

Direction means the course or a line along which a person or thing moves or locks or which must be taken to reach a destination.

Direction on the map can e given in four, eight or sixteen cardinal points of compass and their corresponding angular bearings.


N
W
E
S


N
NW
NE
W
E
SW
SE
S


Note:-

One land direction measured with the use of magnetic compass. The magnetic compass has a needle which always points to the north.

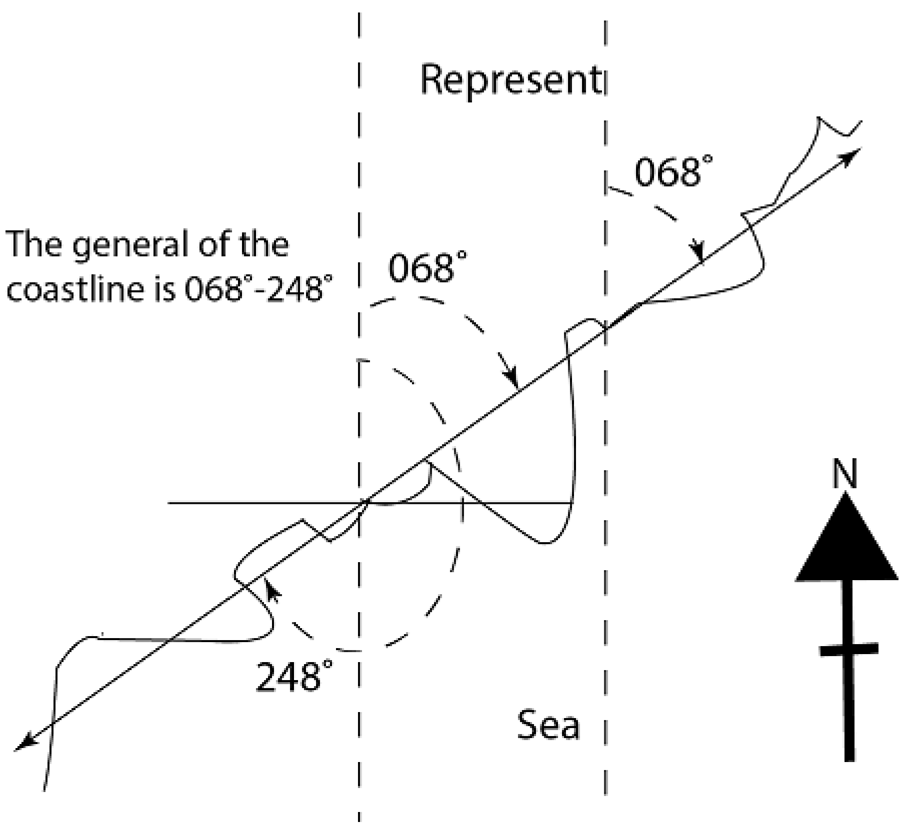
**ALIGNMENT OF ELONGATED OBJECT.**

Alignment is defined as a general direction and bearing of an elongated object on the map and up on the earth's surface measured from the central position along the straight line. Elongated object can be of like that of a road, railway, ridge, coastline, river and others of the same nature.

Alignment is best described by stating both, direction and bearing E.g. the road aligns from $45^0$ to $225^0$ (SW)

**Steps involved in giving the alignment**

- Identification of two end points on the topographical map given. The end points can be identified by taking into consideration of the grid reference or place names given.
- Drawing of the straight fine line using a ruler and pencil to join the two points.
- At the central point of the drawn line mark the four cardinal points.
- Take a protector and measure both degree angles in which the drawn straight line trends.




The alignment the coastline is from $068^0$ (ENE) to $248^0$ (WSW)

**EXERCISE**

Qn. Calculate the forward and backward bearing of Ryamugasire island grid 930340 from buhare home economics training centre grid 868324 (NECTA 2005 – Map extract of musoma sheet 12/2)

Qn. Calculate the forward and backward of Songea town at Grid reference 829169 (NECTA 2003 – Map extract of SONGEA sheet 299/1)

Qn. The compass bearing takes from a fishing boat to Samgoro hill and pump house Gr 045647 were $145^0$ and $122^0$ respectively.

Qn. By using grid reference write the position of the fishing boat.

Qn. Find the true bearing of the Samgoro from pump house (NECTA – 2002 the map of part of KENYA – NYAKWERE)

Qn. The compasses bearing of Lugongo and Kiamera hills were 1300 and 1490 respectively. These bearings were taken from a steamer on the lake.

Qn. Give the grid reference of the position of the steamer

(ii) Measure the distance in kilometers from the position of the steamer to Kaswanga pt :

(NECTA 1994-The map extract of Rusinga island)

Qn.An amateur surveyor recorded 87º as forward bearing from Goi Hill to Sangasanga hill, and 263 as his backward bearing.

(i) Correct the discrepancy of these readings.

(ii) State the importance backwards bearing.

(NECTA-2001, the map extract of KONDOA (sheet104/4.

Qn. Give the bearing of:

(i) The Masonic Lodge from Kibwesi

(ii) Tanzania packers factory from kiutu peak .

In each case, give the backward bearing.State the rule that enable you to check the correctness of your bearing (NECTA 1992 Extract, map of Arusha)

Qn. Determine the trend alignment of part from Raska zone grid reference 137417 to grid reference 148360 (NECTA – 2008 extract map of TANGA sheet 130/1)

Qn. Locate the position of Njoro school (NECTA 1997 – Extract map of Moshi Series y. 742)

Qn. (a) Find the trend of the major road from mwanza city to Musoma.

(b) Show the alignment of the railway line (NECTA 2004 – Extract map of Mwanza sheet # 33/2)

**KINDS OF NORTH INDICATED ON TOPOGRAPHICAL MAP.**

On most of the topographical maps, varied north are shown and these include rthe following:-

- Magnetic north (MN)
- True north (TN)

- Grid north (GN)

**Magnetic north**

Magnetic north is the one given by the line of half arrow head on the map representing the direction of magnetic pole (earth's magnetic field) from the mapped area.

Magnetic pole is position of natural attraction of global magnetism

The direction of magnetic pole is detected by a needle of magnetic compass in the mapped area by the time of map construction. The needle of the magnetic compass points towards the direction where the global natural point of magnetism is located from the area to be mapped.

The north line on most of the African maps is not uprightly vertical . It is slightly vertical towards west as the global natural point of magnetism is located in America.

The natural point of global magnetism is found off the coast of Boothia peninsular, the north of Canada nearly price of Wales and In South is in Victoria land Antarctica.

However; the direction of magnetic pole shown on the map by magnetic north, is irregular as the natural attraction of magnetism is in water and the rate of change per year is noted.

**True north**

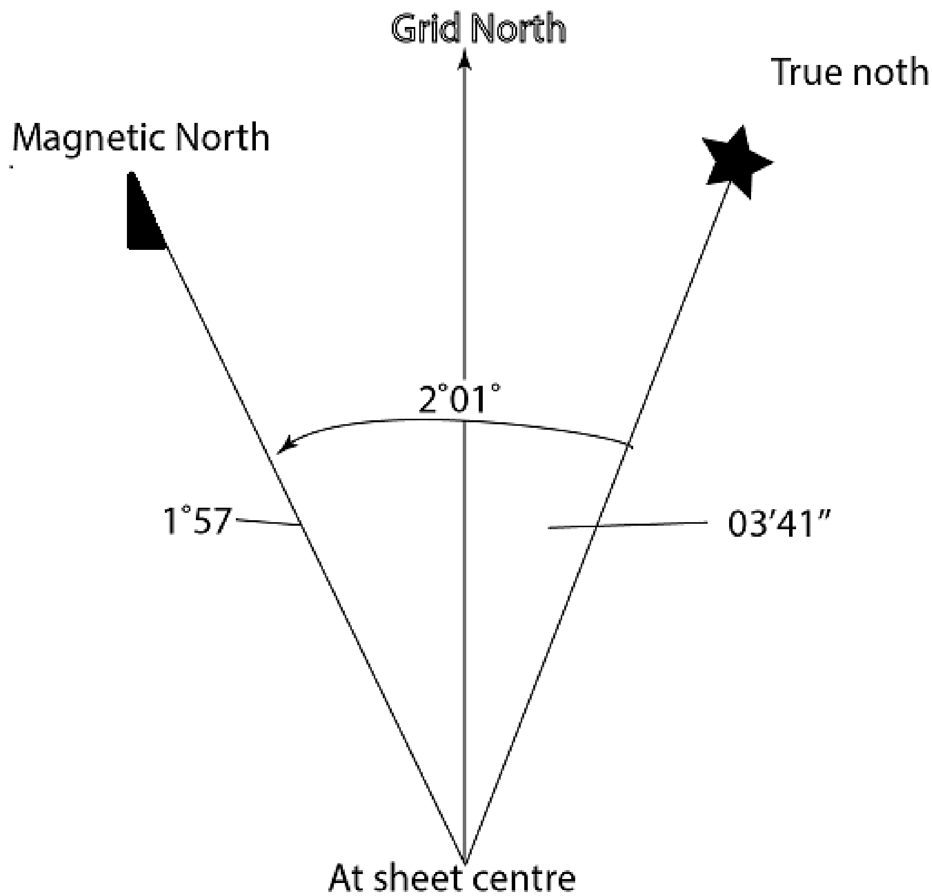
True north is the one given on the map as a star head line to represent the direction of global North pole ($90^0$ latitude) from the mapped area. It is parallel with the lines of longitudes.

The north pole is where all lines of longitudes meets. True north is the most useful north to geographic and it is mostly referred in the determination in position direction on the topographical map and up on the actual area represented.

The direction represented by true north does not change over the time because, the North pole is steadly constant in position.

**Grid north**

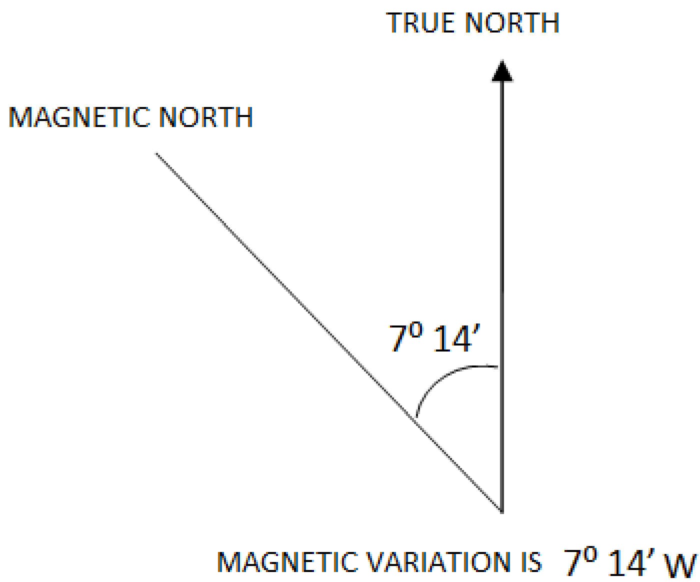
It is the unpointed north line given on the map, which follows the system of easting gridlines. This does not represent or show anything on the earth's surface and that is why given by the un pointed line.




**Magnetic variation:-**

Magnetic variation is an angular distance in a place from the direction magnetic pole to the direction of north pole. i.e. the measured angular distance from true north to magnetic north on the map with reflection to the actual area represented.

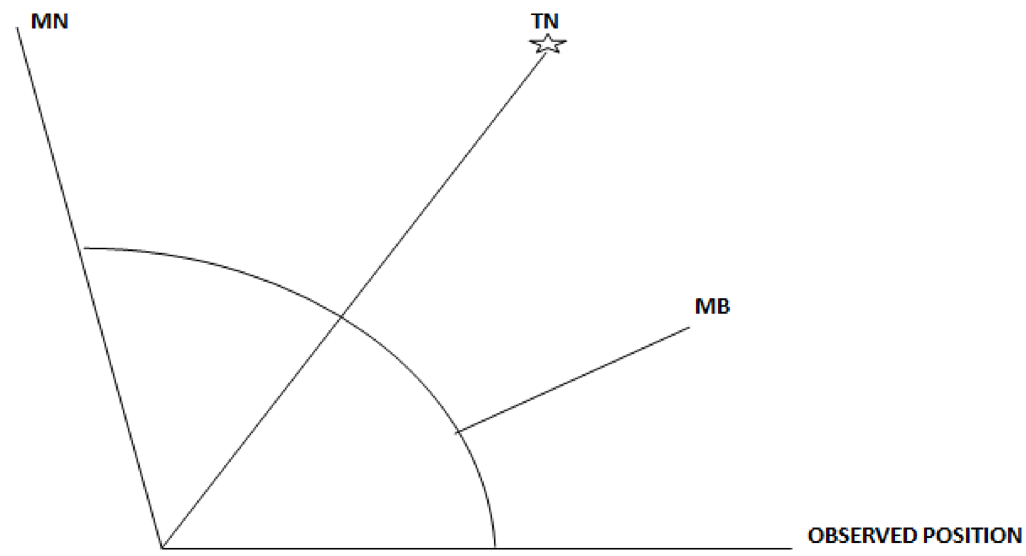
Always the direction of magnetic pole as represented by magnetic north on the map changes, but does not coincide with the direction of north pole (true north) This makes a considerable angular distance in between of the two direction does not remain the same at the time due to the irregulaties of the magnetic field on the earth's surface and thus, give to magnetic variation.




Magnetic variation is $7^0$ 14 W

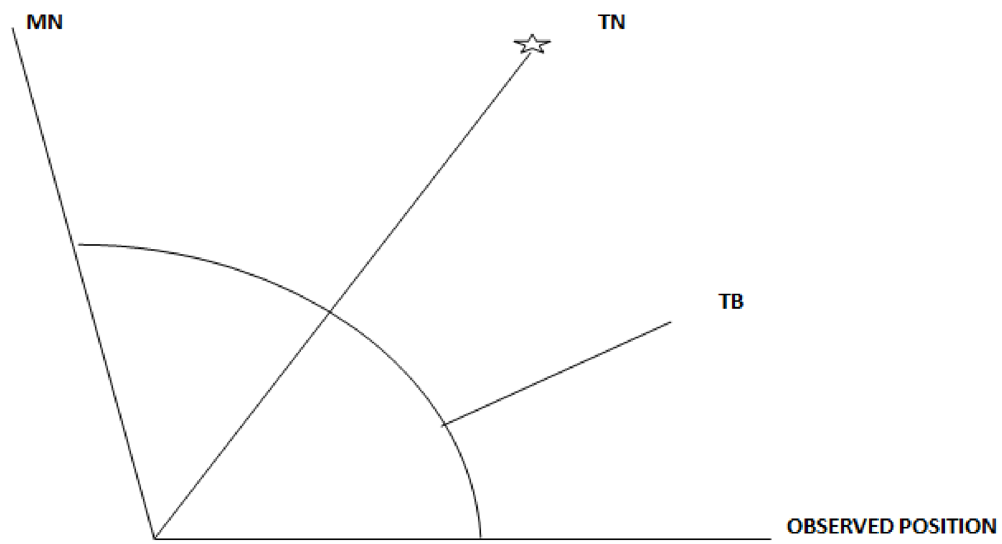
**Magnetic bearing:-**

It is a degree angle of an observation line of a place to another place measured clockwise from the direction of magnetic pole. This is not rigid as the direction of magnetic pole is irregular.




**True bearing:-**

It is a degree angle of an observation line of a place to another place measured clockwise from the direction of north pole. The angle on the map is measured clockwise from north pole towards the line of the observation. This is rigid as the direction of North pole from any place is steadily constant.




**Magnetic variation projection**:-

For some wishing to determine (project) magnetic variation of a place on the earth's surface with reference to the previous one,has to make the following fundamental steps.

(1) Data analysis as per the details (content) available.With respect to this, the following should be recognized.

- The previous recorded magnetic variation.
- The date when the last magnetic variation has been recorded.
- The current date whose magnetic variation to be projected.
- The rate of change per certain given defined period of time like, year, month etc

2. Determination of the time interval by subtracting the old date from the new date.

i.e.

Time interval = $T_2 - T_1$

3. Determination of the total change of magnetic variation by multiplying the rate of change with the determined time interval.

4. Get the new magnetic variation of the place by making addition or subtraction to the past magnetic variation. Addition is made if there is positive change: while, subtraction is made if there is negative change.

**Exercise**

Qn. Town Z had magnetic variation of $32^0$ 42 by march 1980, what was the new magnetic variation of the place by December 1990, if the rate of change is 10' per annum positively.

Qn. Town X in west Africa had MB and TB of $45^0$ 23'12'' and $25^0$ 34'57" respectively by January 1990. If the rate of change of the direction was 15' per annum negatively, calculate the following by July 2005.

(i)Magnetic variation

(ii) True bearing

(iii) Magnetic bearing

Qn. (a) Differentiate between magnetic bearing and True bearing.

(b) Town X had magnetic variation of about 340 21"by November 1982. What was the new magnetic variation of the same town by February 1993, if rate of decrease stood at 15' annually.

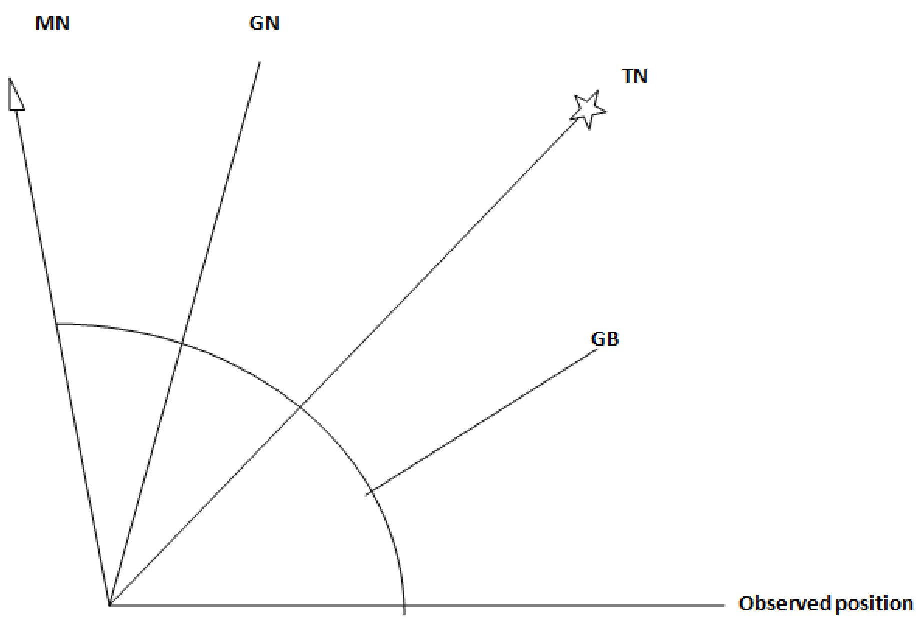
Qn. Differentiate between the magnetic north, True north and grid north (NECTA 1995)

Qn. (i) Define true bearing and magnetic bearing.

(ii) January 1945 the magnetic variation over town X.

**Grid bearing**

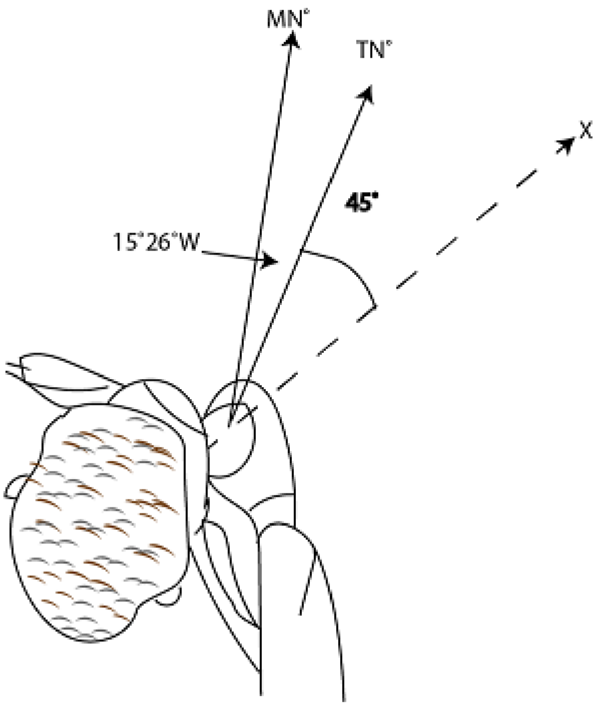
It is a degree angle of an observation line of a place to another place measured clockwise from the grid north.




**The conversation of magnetic bearing into true bearing**

To convert magnetic bearing into true bearing, some one has to take into consideration of the direction of magnetic pole relatively to the direction of north pole.

- If the direction of magnetic ole is to west of north pole direction on the map and up on the earth's surface, true bearing of the place is obtained by applying the following formula.




TB=MB - MV

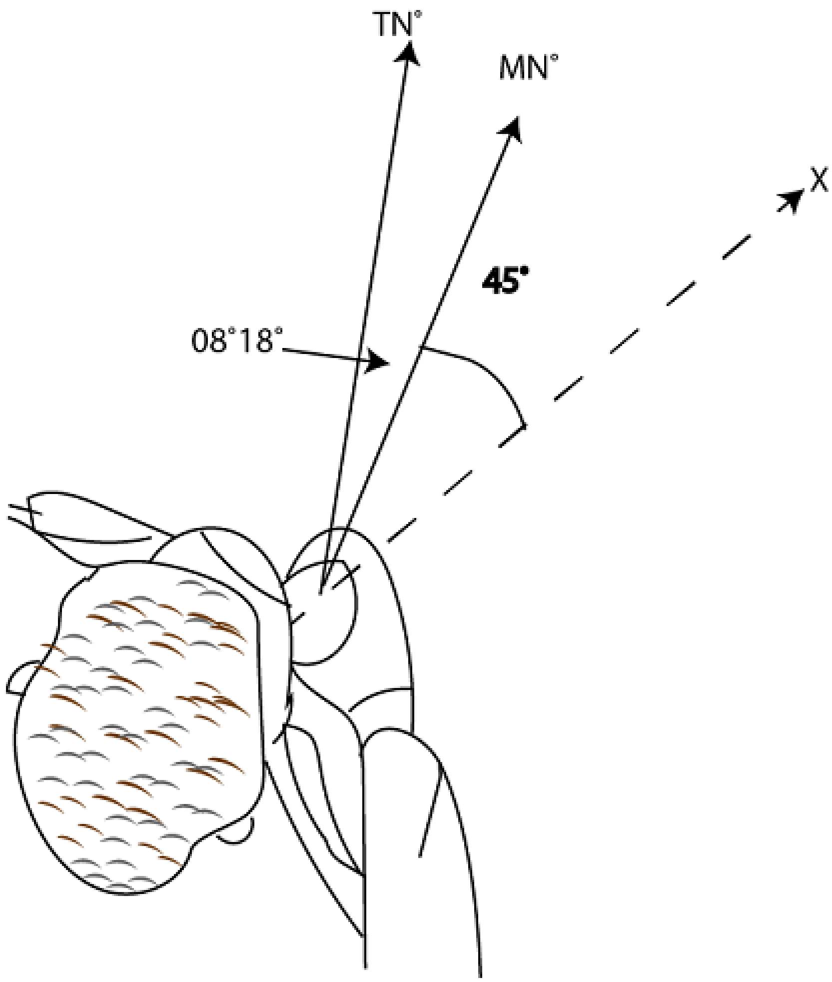
$45^0 – 15^0\ 26 = 29^0\ 34'$

Hence: the TB is of about 29º 34'

While:

MB = TB + MV & MV= MB - TB

- If the direction of magnetic pole to east of the north pole direction on the map and up on the area represented, the true bearing is obtained by applying the following application.




$45^0 + 08^0\,18' = 53^o18'$

Hence,The TB is of about $53^0 18'$

While:

MB = TB – MV & MV = TB – MB

**EXERCISE**

Qn. 9'56 If the annual decrease rate stood at 5'Find the magnetic variation of the same town in October 1966 (NECTA 1989)

Qn. (a) Define true bearing and magnetic bearing

(b) The true bearing and magnetic bearing aver town by January 1990 were $53^0$ 42 and 58'21" respectively, What can be the projected magnetic variation over the same time by july 2010 if the rate of change wood at 15'E

Qn. (MOCK)

(a) (i) Define true north, grid north and magnetic north

(ii) Town Y had MB and TB of about 27036' and 540 of 23" respectively by September 1982. Determine the MV. MB and TB of the same town as it was February 1993 if the rate of change stood 18'w.

## 6.4 UNDERSTANDING FEATURES ON MAPS

## RELIEF REPRESENTATION ON MAPS

Relief refers to the physical appearance of an area by contrasting landforms. Or Variation in shapes and forms of an area over the earth's surface.

The land forms which make the physical appearance of an area called relief features. These being landforms have defined shape and heights above the sea level.

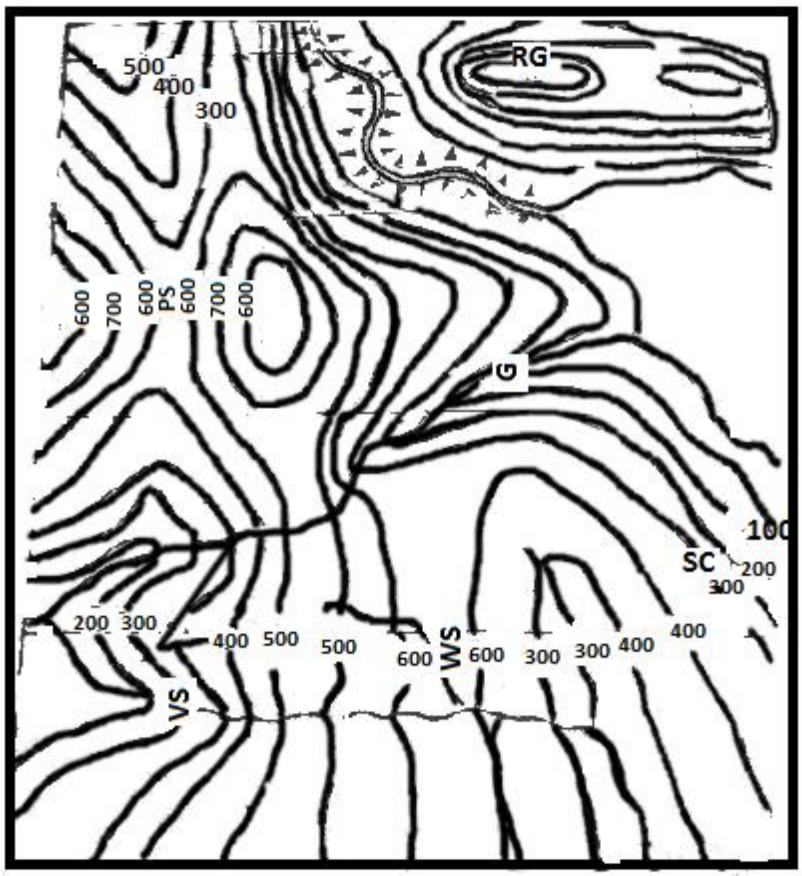
The cartographers use to show the relief features on the maps by employning certain methods which reflect their shape and heights in response to the physical appearance of the area.

The main methods employed for this purpose include the following:-

**1. Contouring method**.

The method involves the drawing of contours (isohypes) on the map face. Contour is an imaginary line drawn on the map face connecting all points of exactly equal height above the mean sea level. The first contour map was introduced in 1791.

Contours as used for relief representation on large scaled maps (topographical maps) reflect shape, size and height of landforms of areas represented.




**Properties of contours as used for relief representation.**

(a) Contours on the maps are numbered either in Meter or feet. The numbers represent the attitude values of relief features in the region mapped.
There are two numbering the contours

- The contour numbers are written on the higher Side of the contour line.
- The contour numbers are placed in the contour lines

(b) Contours are drawn in a specific interval on the map.

(c)Contours of different elevations do not cross each Other.

(d)When Contours lie closely to one another indicate steep slope, and if observed to lie far apart indicate a gentle slope. Based to this, contours of different heights may join to form a single contour line where contours are not observed over wider part, implies the landscape is widely flat.

(e)Usually contour lines tend to join around where there is the presence of a rounded landform like; a hill, plateau, escarpment and others.

(f)Contours form V shape pointing up or down stream to indicate the presence of a river valley or spur respectively.

**Merits of contour**s

• Contours are the most popular and widely used method for showing relief on topographical maps.

• Contours on a topographical map can be association with other methods of showing accurate heights of the relief features of an area represented. Provide the basis for hypsometric map construction.

• Contours on a topographical map can be associated with other methods of showing relief like; spot heights, trigonometrical point and benchmarks.

• Contours on a topographical map do not hide other details.

• Contours aid in making of some ground measurements from the topographical map.e.g/gradient determination

• Provide the basis for cross section drawing from the map. Setbacks of Contours

• Some times, contours fail to show certain highest heights due to the limitation of the vertical interval used. Such heights can be shown by means of spot or trigonometric point.

• Some of the landforms are not capable for being represented by means of contours e.g. coral reefs, levees and other of the same refletion .

• Contour are not suitable for showing relief on a small scaled map.

• It needs high skill to make interpretation on the relief features by reading the contours.

• It needs high skill to produce contours on map spot heights and form lines should be initially established ahead to contours.

• It becomes difficult to determine the exact altitudes of such parts which are not crossed by the contours.

The altitude of such parts given in estimation basis.

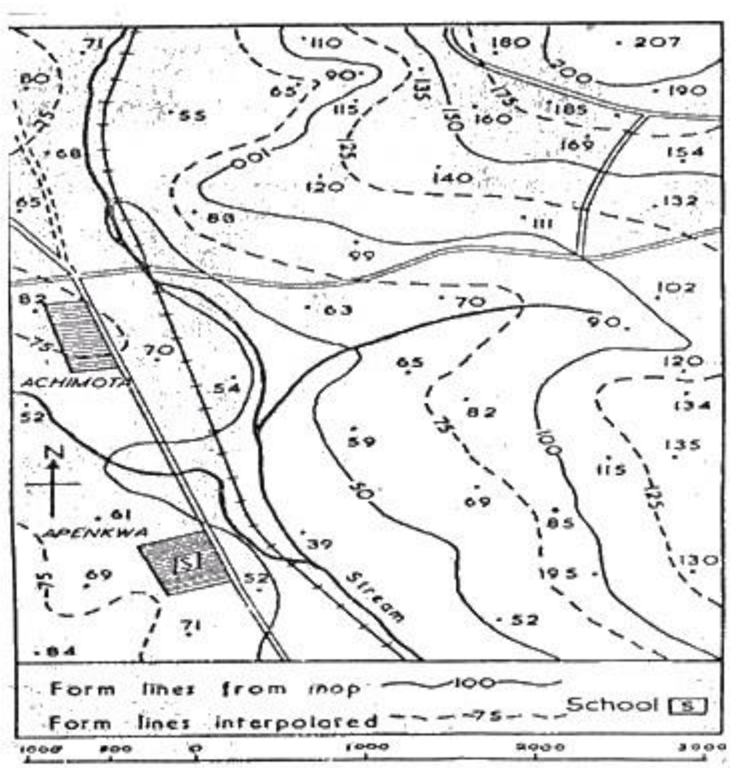
**Setbacks of contours**

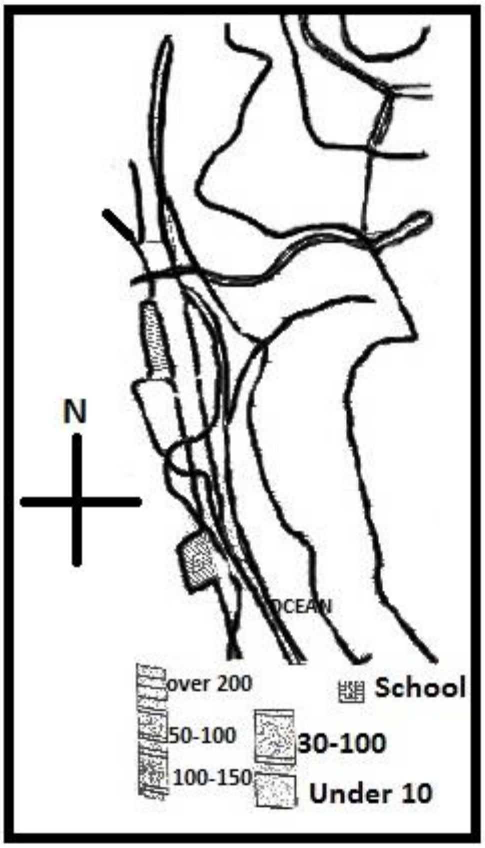
Some times contours fail to show certain highest heights due to the limitation of the vertical interval used.such heights can be shown by means of sport height or trigonometric point.

**2. Form lines**

A surveyor has some times to draw contours by eyes by estimating where the contours would run between two sport heights or by sketching them in approximately (interpolating). The lines drawn in this way are called forms line. Hence **forms lines** are defined as the dotted and unnumbered lines drawn on the map face joining points of approximately the same heights.

Form lines are not always plotted at fixed interval and these provide the basis for establishment of contours or layer units on the map.






**3. Layer tinting.**
(Layer colouring)

It is one among the most useful methods for showing relief on maps. It is by indicating distinctive colours on the map face, to contrast zones (Bands) of altitudes. The method is mostly used for Relief representation on small scale maps (atlas maps).i.e. on maps that represent very wider parts of the earth's surface.

A map that involves the system of colours to indicate relief is called **hypsometric map.** The method was firstly introduced in 1878.

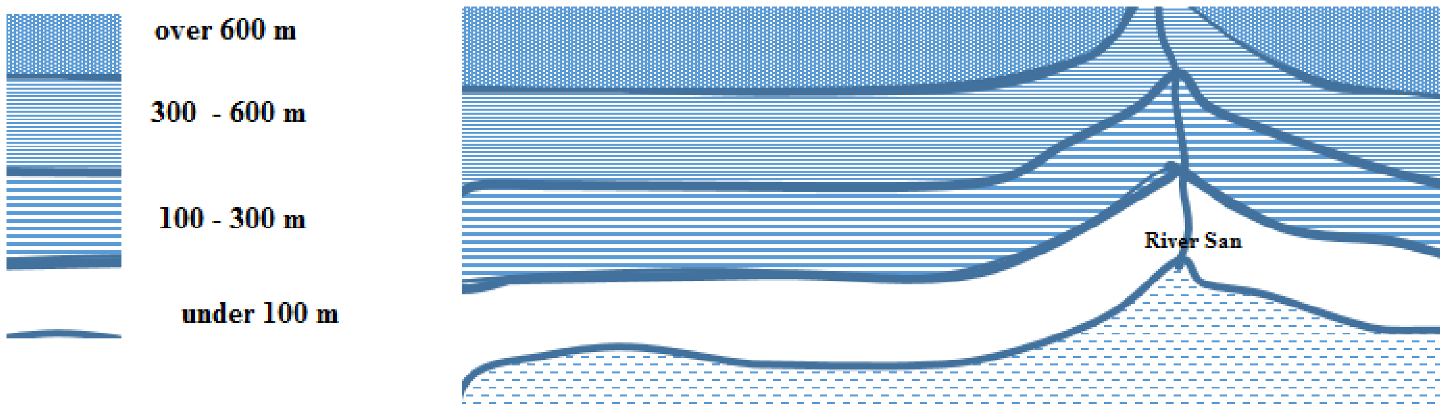
Any layer –tinted map should carry a key to interpret the different colour for varied bands of altitude. The common colours used for this purpose include the following:-

- **Blue**; represents water body. Light blue means Shallow water and dark blue means deep

- **Green**, indicates low land of either coastal plain or river valley. Pure green colourrepresents much low land with altitude from 0-200m; while; light green represent lowland of high altitude from 200-500m).

- Yellow, indicates high land. Whitish yellow represents high lands of low altitude from 500-1000m); while pure yellow is for higher land with height from 1,000-2000m).

- Brown; indicates highest mountain or area with permanent ice.(2000-4000m).
- Red or pink, indicates very high elevation with height above 4000m




## Merits of the layer tinting method.

- It makes a map look impressive and attractive to the users.
- It is useful method for showing relief on a small scale map.i.e on maps which represent wider areas.

- It is associated with the method of trigometric point. The trigonometric points provide specific exact highest altitude of particular part.

- They give quick information to map user so long the colours easily seen on the map.

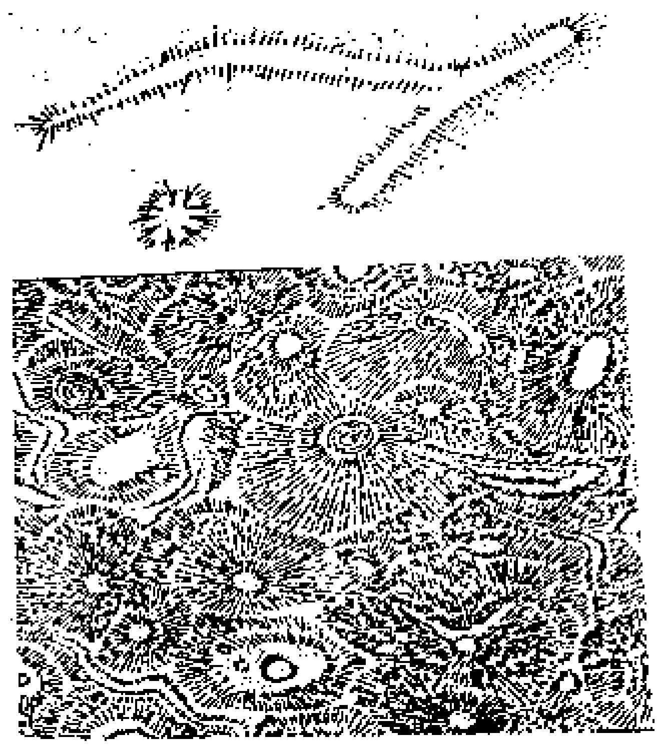
## Demerits of layer tinting method.

- It shows general altitude i.e. does not give the exact height of specific or particular point.

- It is more expensive to produce the layer colored map
- The method does not reflect the shape of relief features of an area on the map.
- Always colours carry certain people's mind. It is therefore, someone may have wrong interpretation. e.g the presence of green colour on the map may makes some one to reflect the presence of thick ever green forest.
- If colours have already been used for layer tinting on the map ,can be used for other purposes on the same map.
- It is not a complete method by itself. It relies on the presence of contours or form lines to provide the basis for colouring.

## 4. Hachuring

The method involves the use of hachure.
Huchure is a series of small lines drawn on a map face showing the direction and steepness of slope. The lines are drawn to follow the slope of the ground or direction of the slope on which water would run. It is old method of showing relief on maps and it was devised by L.C Muller in 1788. It was later improved by Austrian topographer Johann George Lehman in 1799.



## Merits of hachuring

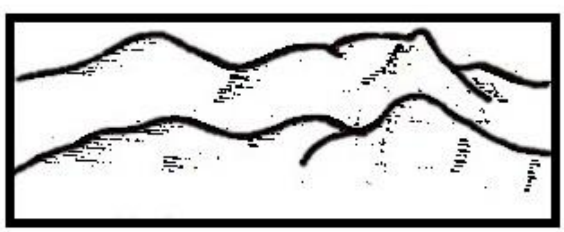
- Hachure easily seen on the map and thus give quick information about the features represented.
- Provide pictorial view of the relief features on a map.i.e they can successively communicate quit specific shapes of terrain.
- Show clearly the direction of slopes on the map. i.e. They provide a general sense of steepness.

**Demerits of hachuring.**

- Hide other details seen on the map and thus give quick information about the features represented.
- Hachure on the map is non numeric.i.e.are not associated with height numbers of relief features represented. Thus, the map users are not in position to detect the relief heights by studying hachure.
- Greet skill is needed to produce hachure on a map.
- The hachure may not be maintained on constant scale.
- The method is dying out. It is not much used for relief representation on the modern constructed maps.

**5. Hill shading.**

It is a method of showing relief in which some parts of the map are shaded to indicate the presence of hill, as they would appear if a light were shining on them. Usually, the slopes which face light are shaded lightly while those facing away are in shadow.



## Merits of hill shading

- It gives pictorial view to the map user about the hills of an area shown on the map .it thus becomes easier to understand.
- Make a map looks impressive and attractive to the users

## Demerits of Hill shading.

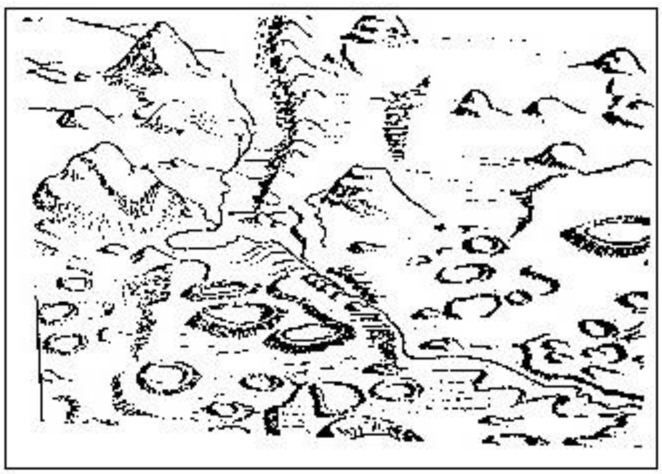
- Does not give heights of hill shown on the map.
- The shades indicated on the map might hide other details.
- It becomes difficult to determine the gradient of the hills represented so long, the hill shades not given with height numbers.

- May not easily maintain on constant scale of the map.

## 6. The use of physiographic diagrams.

The method involves the drawing of diagrams on a map face reflecting the physical slope of the relief features like hills and mountains as they have been observed in the area. This conventional representation of land forms on the map, gives an impression of viewing the landforms in three dimensions.

The physiographic diagrams are also known as pictorials.



**Merits of the physiographic diagrams**

- The physiographic diagrams if appear on the map, become impressive and attractive to the map users.
- The diagrams provide more pictorial view of the relief features representated as they more reflect the shape of the land forms represented. It is thus, becomes so much easier to understand.
- They are easily seen on the map and thus easy to read and provide quick information to the map users.

## Demerits of Physiographic diagram

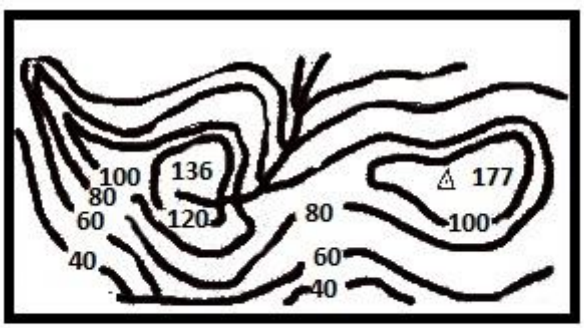
- Hide other details.i.e may not make other details for the represented area to appear on the map.
- Physiographic diagrams are non numeric as do not provide the heights of landforms represented thus, they do not make the map users to understand the altitudes of the represented relief features.

- Only limited landforms can be shown. i.e. not all landforms can be shown by this particular method.
- Not good method for the accurate maps as the physiographic diagrams cannot be maintained on the constant scale of the map.
- The method is no longer used for relief representation on the modern constructed maps.

**7. Trigonometric point.**

It is a very small triangle conventional sign with a dot at its centre and value number beside to it. This is non imaginary method for relief representation on the map as trigonometric points established up on the presence of height ground station. (Trigonometric station) on the ground. It is thus, trigonometric point is indicated on the map provided the represented area has trigonometric station.

The number given with the trigonometric point represents the highest altitude of the land scape




**Merits of the trigonometric point.**

- It is easy to indicate trigonometric point on the map by the cartographer
- It is non imaginary method for relief representation on the map.
- Enables the map users to recognize the highest relief height very easily.
- It shows the accurate relief height as it was measured more accurately in are above the sea level or from a recognized reference point of bench mark.
- Sometimes. it assists the contouring method in showing certain relief heights due to the limitation of the contours interval used.

**Demerits of the trigonometric point.**

- Not easily seen on the topographical map. It is as the topographical map shown the general geographical details of an area represented.
- Trigonometric point on a map does not give the shape of the relief feature represented.
- They are selective for showing only the highest heights of the relief features represented.

**8. Spot height**

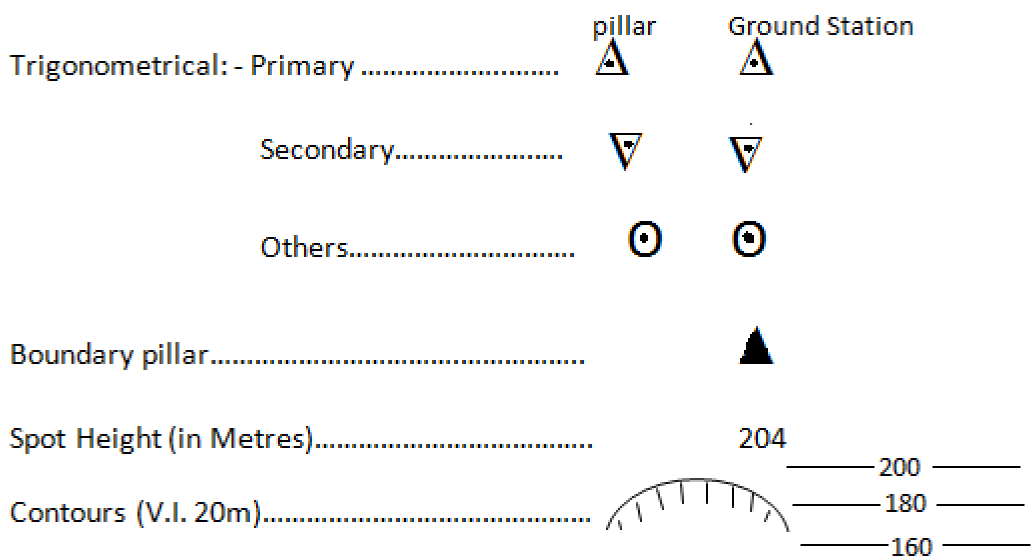
It is a conventional dot (point) together with the height number on a map face. It serves imaginary method for showing relief heights as have been measured above the mean sea level. The number shows the height of a relief feature shown on the map

**Merits of the Spot height.**

- It is easy to indicate spot height on the map by the cartographer.
- Enables the map users to recognize the relief height very easily.
- It shows the accurate relief height as it was measured more accurately in the area above the sea level or from recognized reference point of a bench mark.
- Sometimes; it assists the contouring method in showing certain heights due to the limitation of the contours interval.
- It shows the heights of hill summits as well as points along the interested structures

**Demerits of spot height.**

- Not easily seen on the topographical map. It is so as the topographical map shows the general geographical details of an area represented.
- Spot height on a map does not give the shape of the relief feature represented.
- • It is imaginary method for showing relief on a map.




**9. Bench mark**

It is a surveyor mark unit indicated on a wall, pillar, or building used as reference point in measuring altitudes.

Or

a point of reference used by a surveyor in measuring altitudes.

Bench marks indicated on maps following the presence of such marks in the are mapped.

Bench marks on maps appear by the **conventional letter of BM** together with height numbers measured on the ground.

**Categories of Bench marks.**

Bench marks indicated on the map and up on the landscape represented are extremely varied. Some have been established to provide permanent reference in measuring altitudes, while others provide short terms reference to measure altitudes by doing surveying. With respect to this, bench marks are categorized into two and include the following:-

**Temporary bench mark**

These established so closely to the site of surveyor to have continuous reference in surveying process. They use to appear by conventional letters of TBM. However; these on topographical maps do not commonly appear.

**Ordinance bench marks.**

These are the fixed bench marks indicated on the map with reflection to the actual area represented. They provide permanent reference in measuring altitudes of other interested point or areas.

**Merits of the bench mark.**

- It is easy to indicate it on the map by the cartographer.
- It is non imaginary method for relief representation on the map.
- It shows the accurate relief height as it was measured more accurate on the landscape above the sea level.

**Demerits of the bench mark.**

- Not easily seen on the topographical map. It is as the topographical map shows the general geographical details of an area represented.
- Bench mark on a map does not give the shape of the relief feature represented.

**Asses yourself!**

- Are you able to describe the different methods of showing relief on maps?
- Do you understand the application of the different methods as used for relief representation?
- Are able to narrate the merits and demerits of the methods as used to show relief on the map?

**EXERCISE**

Q. (i) why contours are considered to be the most useful ways of showing relief? (NETA 2007).
(ii) Explain the demerits of using hartures to represent relief on the map (NECTA - 2007).

Q. Outline and describe the different methods employed by the map maker to show the exact height of relief features on the map (NECTA 1997).

Q. (i) Describe the methods used to portray the relief features on the map.
(ii) Which other methods may have been used to depict the relief features on the map? (NECTA 2003, The map extract of Songea sheet 299/1).

Q. Describe any two demerits of hill shading as a method of representing relief on the map. (NECTA 2002).

## CARTOGRAPHIC SYMBOL AND SIGN

Topographical maps are drawn for geographical studies do not show the natural and artificial features as they appear in real life on the earth's surface. Some of the selected conventional signs and symbols used to serve this purpose, and these are collectively referred to **cartographic symbols and signs.**

Hence the cartographic symbols and signs are defined as the conventional signs and symbols inserted on a face of a topographical map representing the natural and artificial features of an area mapped. They act as language of map to provide geographical details of areas represented.

The cartographic symbols and signs are used to represent the natural and cultural features on the topographical maps, should have the following qualities.

- Should be correctly and clearly shown on the map.

- They should be easy to read.
- Easy to understand and interpret

**Note.**

Symbols are those used in maps which look like the natural and artificial features represented, while the signs are those which do not look like the natural and artificial features represented.

## CLASSIFICATION OF THE CARTOGRAPHIC SYMBOLS AND SIGNS

Cartographic symbols and signs are extremely varied and thus, classified into different types. They are classified according to their form of appearance on the map, and nature of data shown on the map. According to the form of appearance, cartographic symbols and signs classified into the following types:-

**Point cartographic sign:-**
These are the cartographic signs in form of dots inserted on the map face. They are employed to show **positional data** on the mp. i.e. show a specific point on the map and up on the earth's surface there a certain object or place occurs.

**Line cartographic symbols:-**
These are the conventional symbols, which take linear distinctive form of appearance on the map. They are employed to represent the elongated objects on the map with reflection to an area represented. Examples of the elongated objects represented by the line cartographic symbols are of; power transmission lines, roads, railway and administrative boundaries.

**Areal cartographic sign:-**
It is the conventional representation established on the map by which a continuous distinctive shade or tone employed to show a feature that covers wider part. Such features include; swaps, plantation, lakes and others.

Pictorial (descriptive) cartographic symbols:-

The conventional symbols given on the map to portray the shape of the features represented. e.g. the symbols for church, mosque, bridge and others of the same reflection.

**Geometric cartographic signs:-**
The conventional signs in form of geometric figures of like square, triangle, circle and other e.g. the trigonometrically point.

**Letter or number cartographic signs:-**
The conventional representing on a map in which one or more letter or numbers given. E.g. such for school, ch-for church, pwd – for public work department and others.
According to the nature of the features represented, cartographic symbols categorized as follow:-

**Relief cartographic symbols:-**

These are the symbols inserted on the map, representing the relief of an area. They include; contours, hachure, spot heights, trigonometric point and others.

(b) **Transportation cartographic symbols:-**

The conventional signs representing transportation systems of areas represented of like; roads, railways, air fields etc.

(c) **Vegetation cerographical symbols:-**

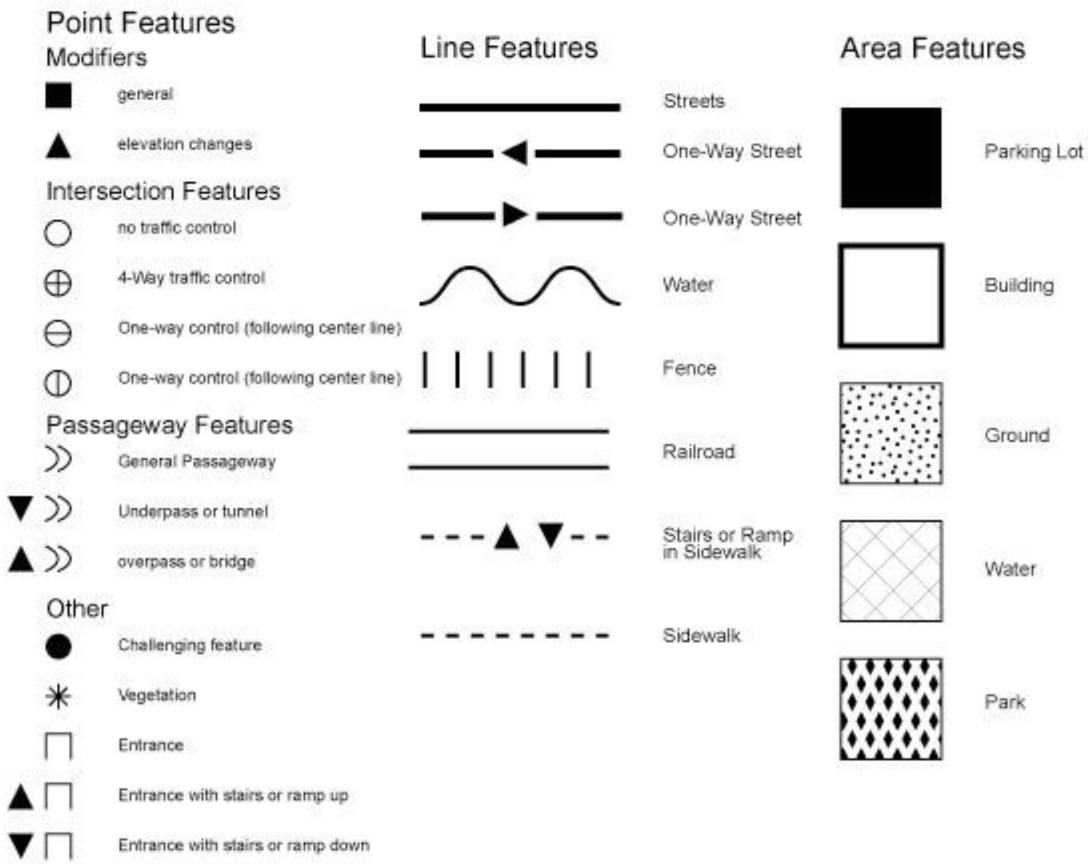
The symbols for natural and planted vegetation.

**(d) Settlements cartographic symbols:-**

The symbols, which represent both rural and urban settlements of an area on the map. They include round black dots for rural settlements and black rectangle blocks for urban settlements.

**(e) Water bodies (hydrograph) cartographic symbols.**

These given on the map to make representation of the water body systems.


Point Features
Modifiers
general
elevation changes
Intersection Features
no traffic control
4-Way traffic control
One-way control (following center line)
One-way control (following center line)
Passageway Features
General Passageway
Underpass or tunnel
overpass or bridge
Other
Challenging feature
Vegetation
Entrance
Entrance with stairs or ramp up
Entrance with stairs or ramp down
Line Features
Streets
One-Way Street
One-Way Street
Water
Fence
Railroad
Stairs or Ramp in Sidewalk
Sidewalk
Area Features
Parking Lot
Building
Ground
Water
Park

Boundaries: international---------------------

Provided or Regional---------------------

District---------------------

Municipality of Township---------

Sub-Districts---------MKWAJA

National park Game Reserve
or Natural Reserve--------------

Boundary pillar-------------------------------------- △

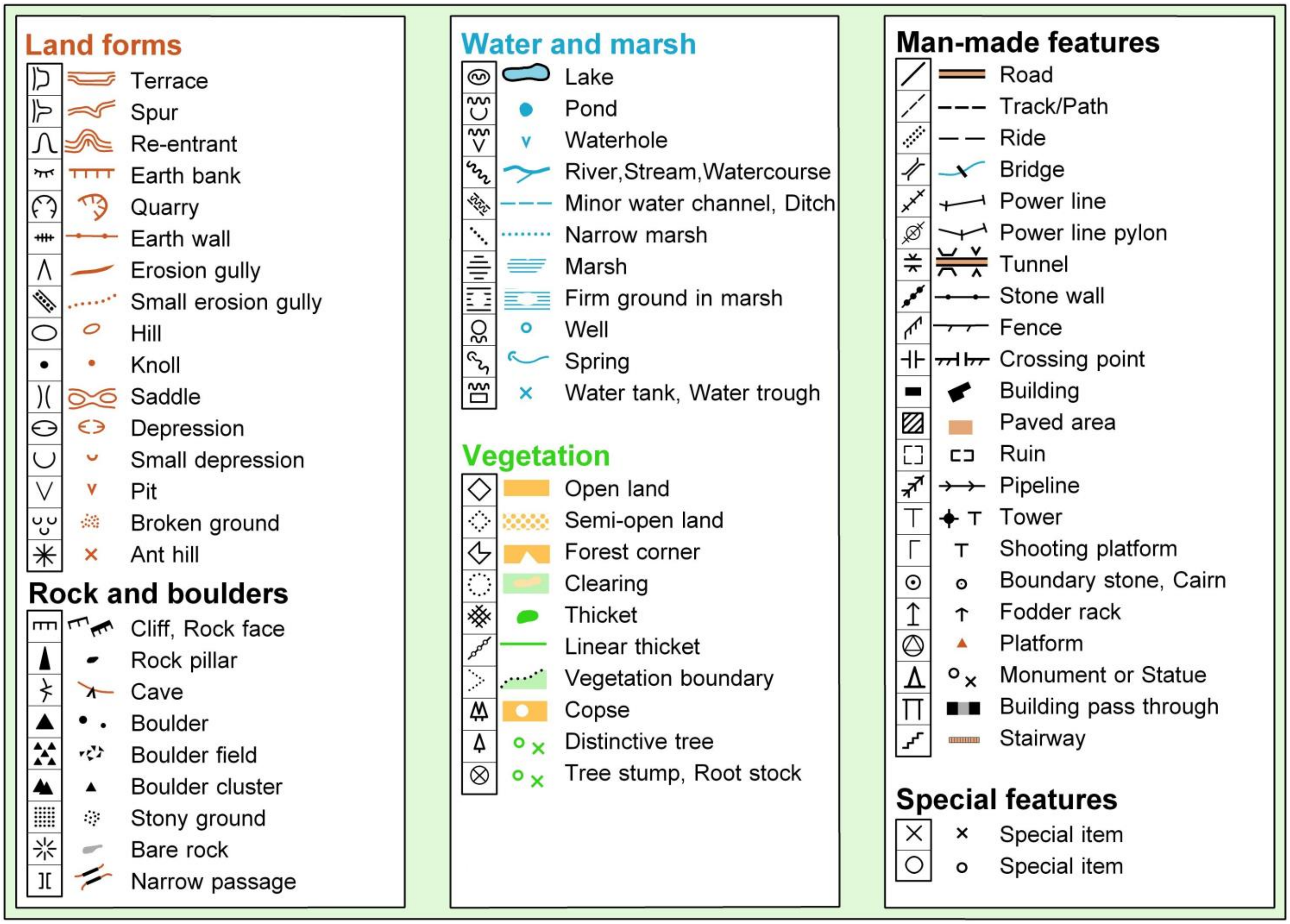
| | Ground pillar | Station |
|---|---|---|
| Trigonometrical station primary----------- | △ | △ |
| Secondary ---------------------- | ▽ | ▽ |
| Other------------------------------ | O | O |

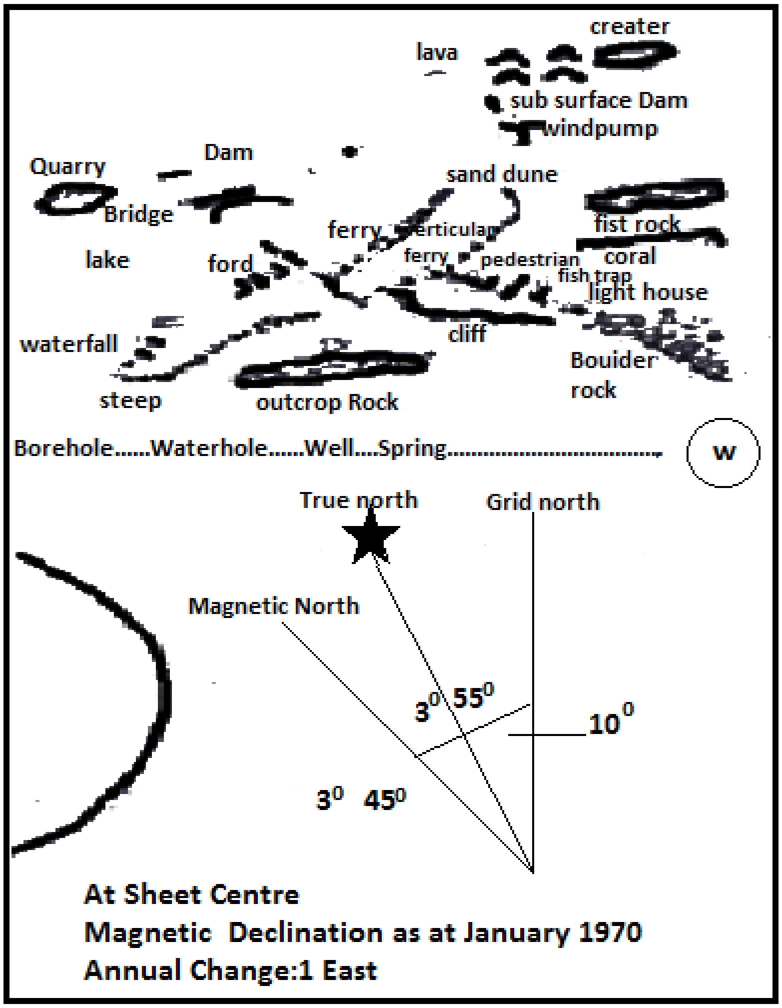
Height in Metres Ground level /69

Air photo Principal Point with sortie No +

AC- Area commissioner
CFR-Central Forest Reserve
Ch- Church
Ch-Ho- Court house
Dc- District Council
Disp-Dispensary

ABBREVIATION
Hosp- hospital
LA-Local Authority
Mkt- Market
Rc-Provincial or Regional commissioner
PO- Post Office
Pol-P ----Police post
Pol-S---Police station


Land forms
Terrace
Spur
Re-entrant
Earth bank
Quarry
Earth wall
Erosion gully
Small erosion gully
Hill
Knoll
Saddle
Depression
Small depression
Pit
Broken ground
Ant hill
Rock and boulders
Cliff, Rock face
Rock pillar
Cave
Boulder
Boulder field
Boulder cluster
Stony ground
Bare rock
Narrow passage
Water and marsh
Lake
Pond
Waterhole
River,Stream,Watercourse
Minor water channel, Ditch
Narrow marsh
Marsh
Firm ground in marsh
Well
Spring
Water tank, Water trough
Vegetation
Open land
Semi-open land
Forest corner
Clearing
Thicket
Linear thicket
Vegetation boundary
Copse
Distinctive tree
Tree stump, Root stock
Man-made features
Road
Track/Path
Ride
Bridge
Power line
Power line pylon
Tunnel
Stone wall
Fence
Crossing point
Building
Paved area
Ruin
Pipeline
Tower
Shooting platform
Boundary stone, Cairn
Fodder rack
Platform
Monument or Statue
Building pass through
Stairway
Special features
Special item
Special item




**<u>Asses yourself!</u>**

Are you able to define cartographic symbols and signs?

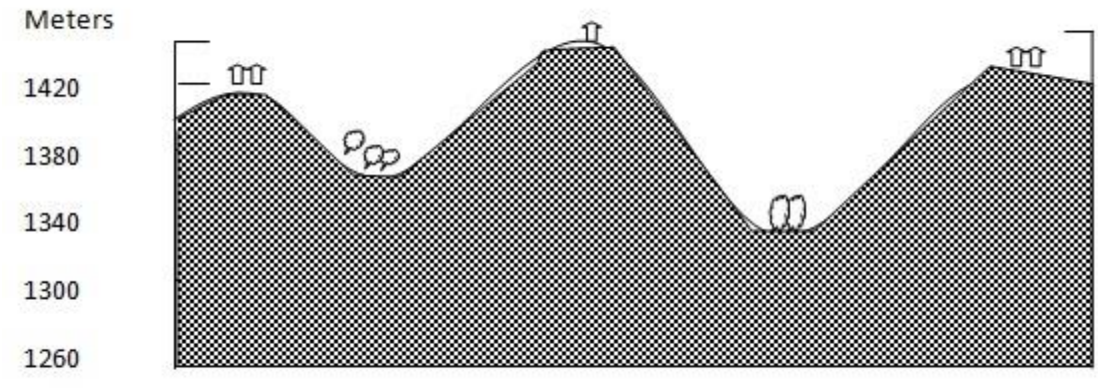
Do you understand the main qualities of cartographic symbols and sign?

Are you able to describe the different types of cartographic symbols and signs according to different elements of variation?

**CROSS SECTION, INTERVISIBILITY, HORIZONTAL EQUIVALENT AND GRADIENT.**

**CROSS SECTION**

Cross section is a transect diagram or topographical profile of an area drawn on a paper with details taken from the topographical map to show the structural appearance of the landscape in between of the two points. It is alternatively known as **relief section or topographical profile.**

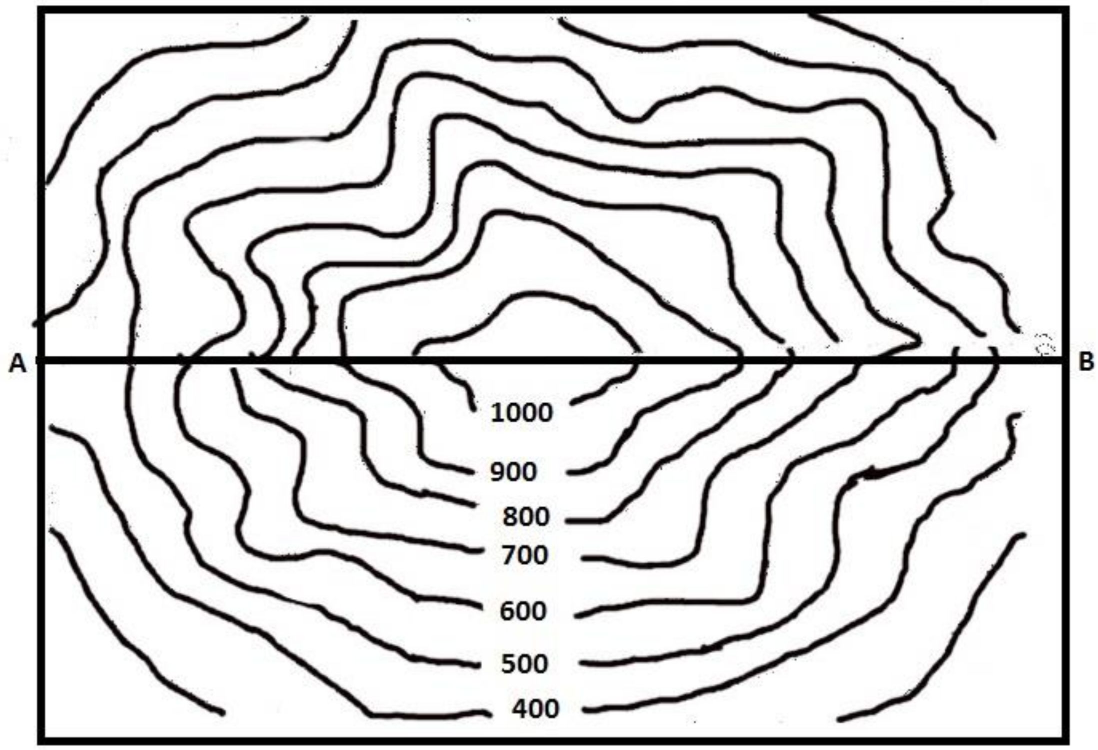



Cross section is of two types and include; the **simple (sketch) and annotated cross sections.**

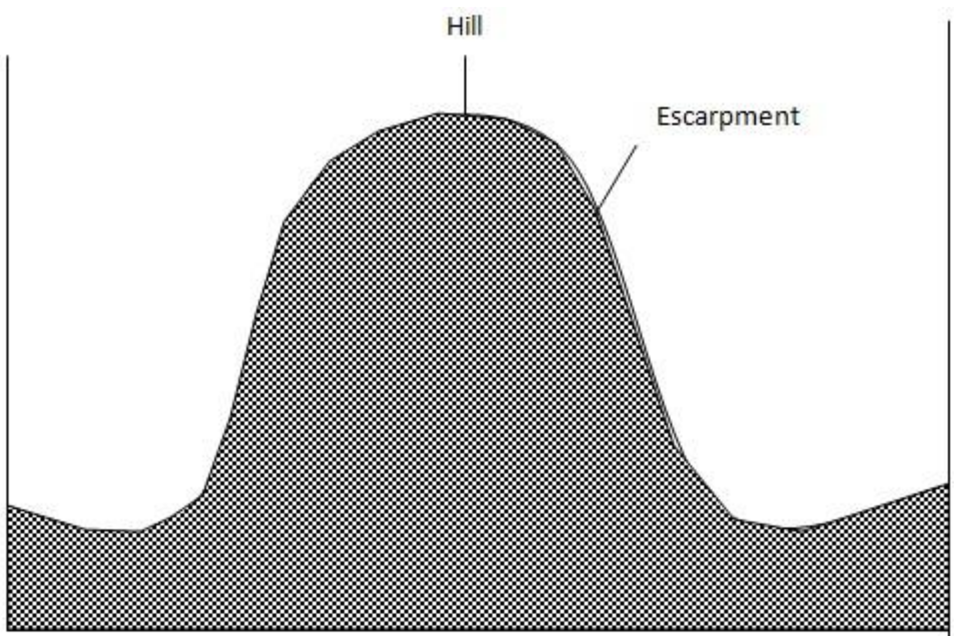
Simple-cross section is the one not drawn to scale and is made to show the general appearance of the landscape between the given points in terms of relief.

Simple cross section is drawn after estimation of the general rise and fall of the landscape. The estimation is done after the study of the contours on the given map. Beside to this,

altitudes along the vertical lines not given.

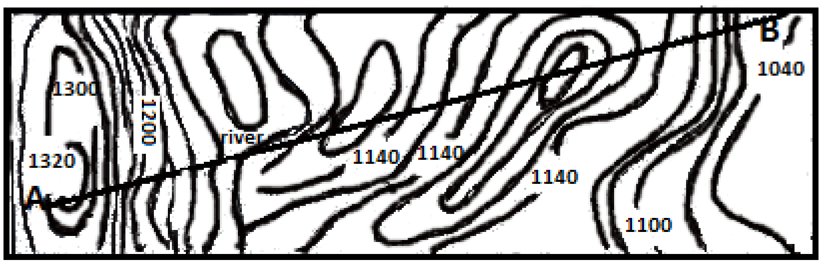


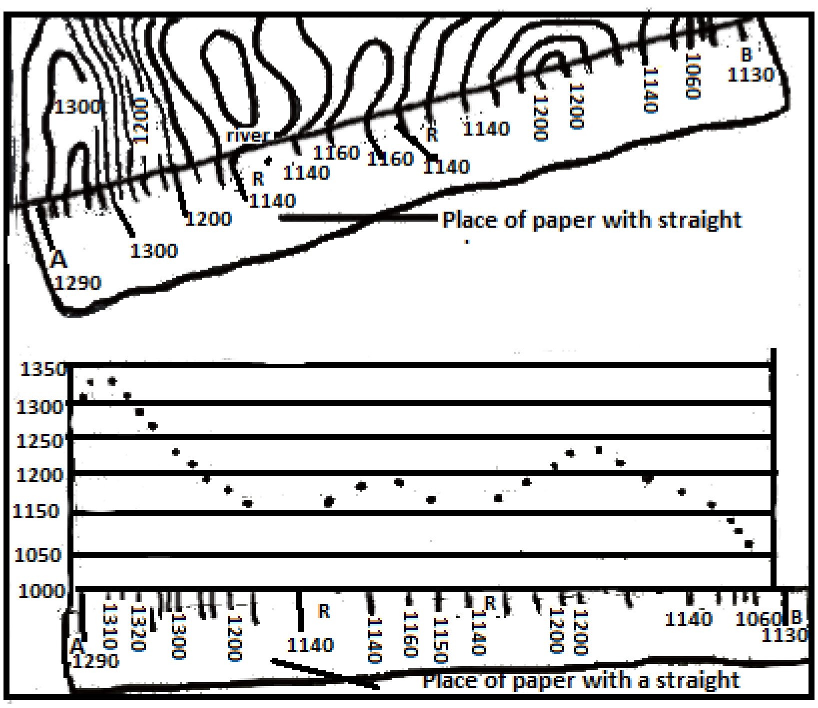

(i) An area to be sketched.

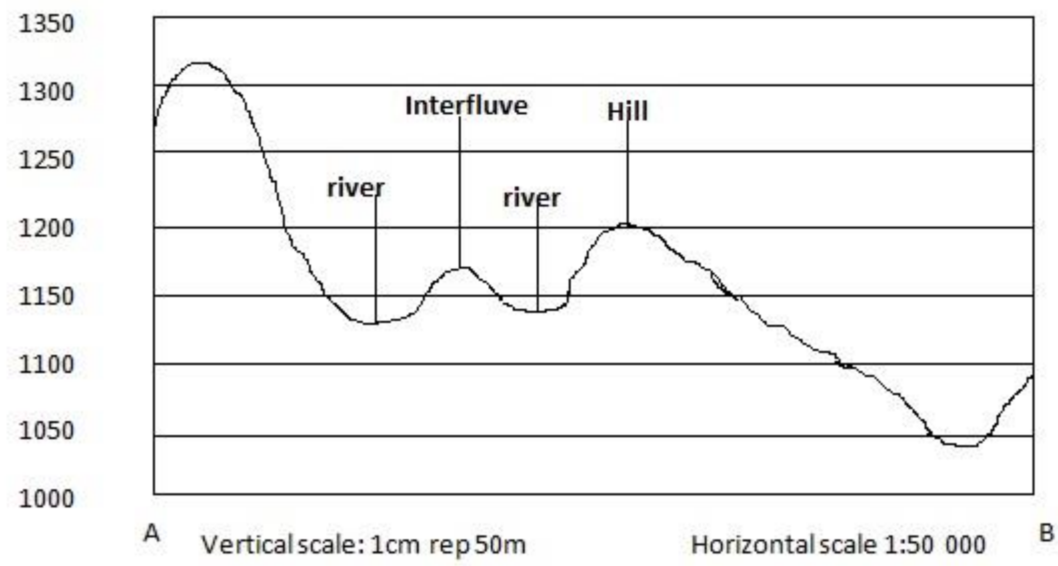


(ii) Simple cross section from A - B

The annotated cross section is the one drawn to scale and in which the position of important places and features indicated more accurately. It is also known as accurate cross section.






**The significance of a cross section.**

- Provides a clear pictorial view on the structural appearance of area in between the two places. With respect to this, a person may easily determine types of slope in the area and the appearance of the area whether undulating or un undulating.

- It is useful for indivisibility determination between two points in the area. This is made possible as a cross section shows physical appearance of an cross section shows physical appearance of area and if clearly observed, the judgment of indivisibility becomes easier.

- It shows clearly the altitudes of the different parts of the landscape in between of the two points in the area.

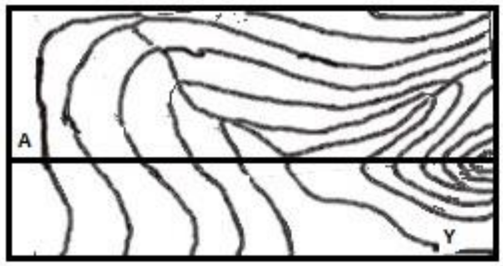
- Cross section aid in making of gradient determination of the sloped landscape by relating the VI to HE.

**CONSTRUCTION OF THE CROSS SECTION**

The construction of cross section should fundamentally follow the following significant steps.

1. Identify and mark the two end points to be sketched on the topographical map. The points can be identified by taking into consideration of the grid references or place names given.
   e.g. A and B.

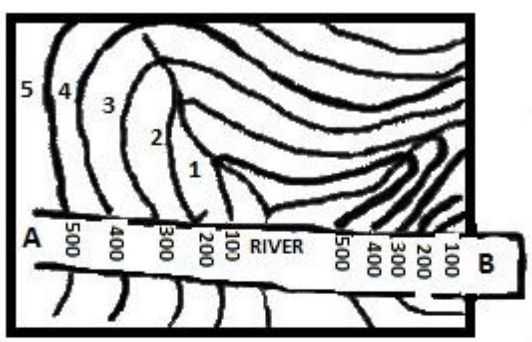
2. 2. Draw the straight line with the use of a ruler on the map to join the two identified points.




3. 3. Take a piece of paper with a straight edge, or fold it to get straight edge and place along the drawn straight line on the map. The piece of paper has to be slightly longer than the length of the line joining the two end points.

On the piece of paper mark the following important details.

- The two end points, which have been identified on the map.
- Where every contour line cuts the line.
- The contour heights.
- The important landscape feature of both, natural and cultural features.




4. Find the appropriate vertical and horizontal scales. The vertical scale is determined as follows:-

$$\text{Vertical scale} = \frac{\text{Highest altitude} - \text{lowest altitude}}{\text{Graph space}}$$

According to the traverse on given contoured map:

- Highest altitude = 600m
- Lowest altitude = 100m

$$\frac{600\text{m}-100\text{m}}{5\text{cm}} = 500\text{m}$$

*Thus; VS, 1cm represents 100m.*

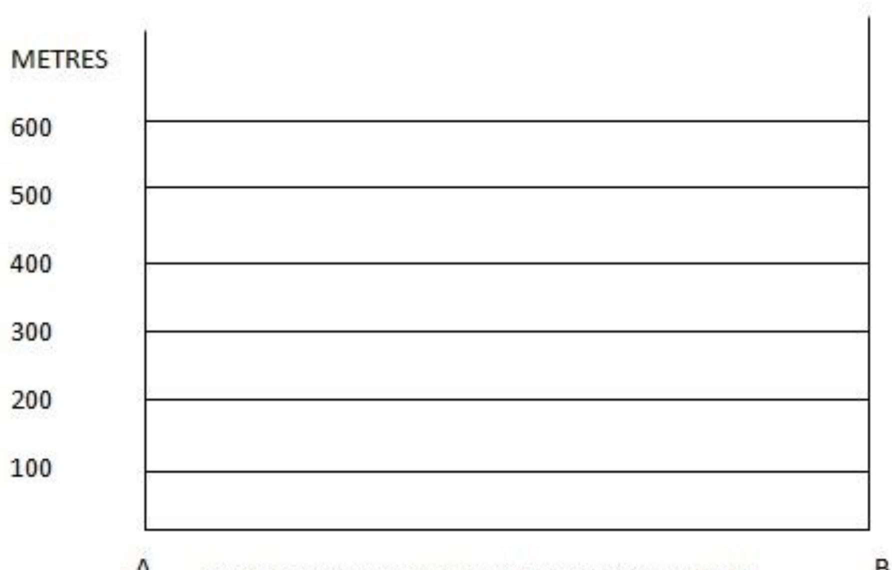
Vertical scale shows the relationship of height between the cross section and the actual landscape represented.

**Note.**

The graph space for the vertical distance of cross section lies up on a decision. Graph space should conditionally produce the vertical scale that can not results into vertical exaggeration that appears more than 10 or less than 5 as related to horizontal scale.

The horizontal scale remains to be the same to that used on the map. This provides the relationship of horizontal distance to actual ground represented.

5. **5. *Construct the framework*** for drawing the cross section. The framework should have both vertical and horizontal line distances. The horizontal line distance is determined by the length from one point to another on the map. The measurement of the vertical line has to correspond to the decided graph space.



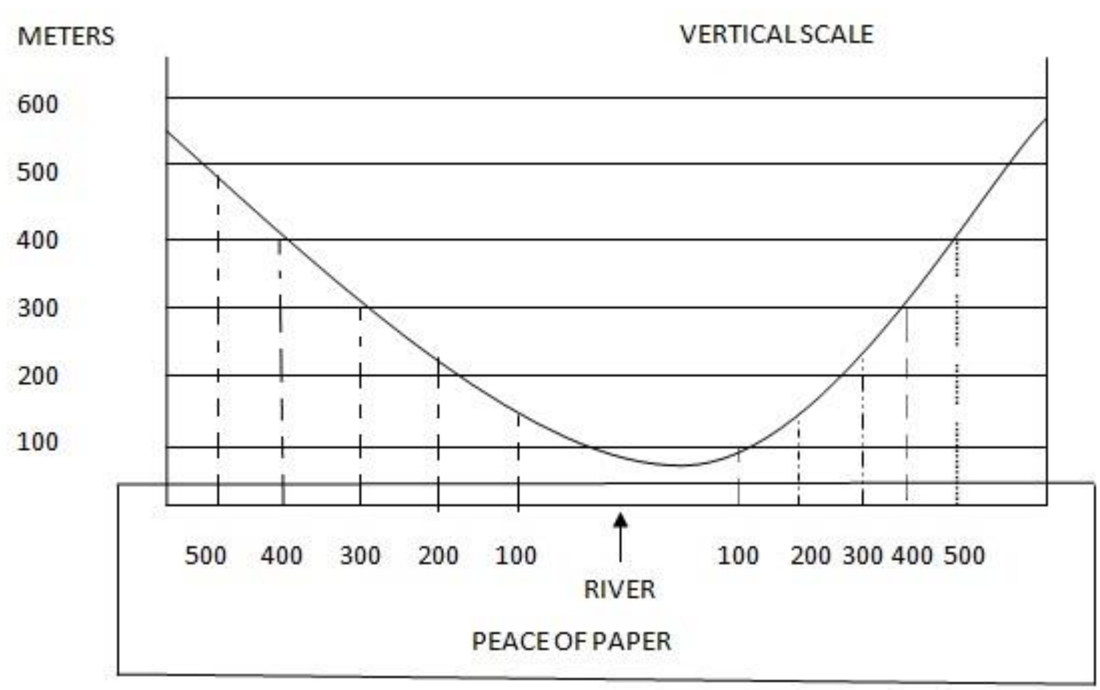

FRAMEWORK FOR DRAWING CROSS SECTION

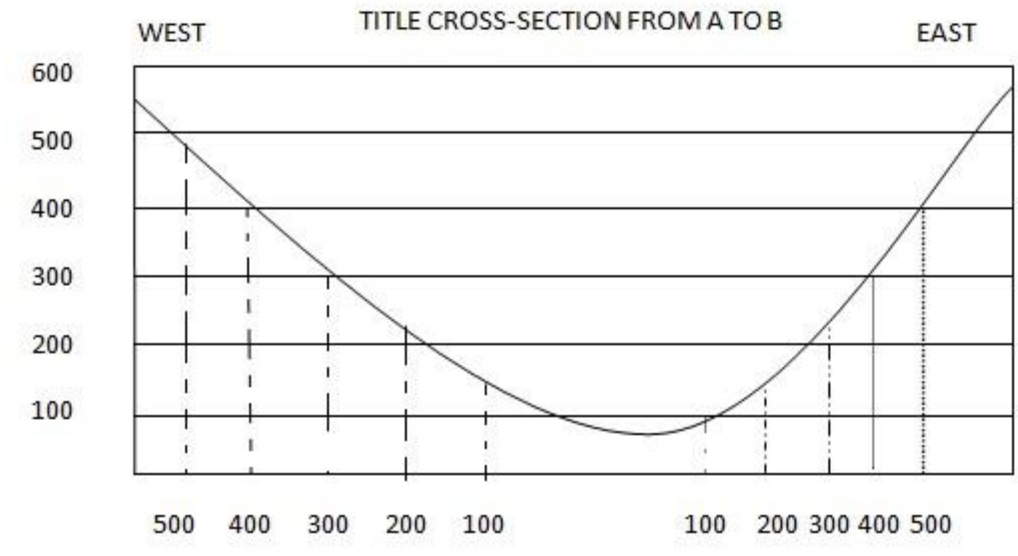
6.Take the piece of paper which has been marked with the map details for cross section, and place along the horizontal line distance of the framework. Relate the height numbers to those allocated along the vertical line distance.

7. 7. Connect the plotted points with pencil using the free hand to develop the structural appearance of the landscape.

8. 8. Finish the cross section by including the following:-

- **Heading;** To show what the cross section is for about.
- **Natural and cultural features;** These if clearly indicated show the clear outlay of what is represented by the cross section.
- **Vertical scale;** This shows the relationship of altitudes between the cross section and actual ground represented.
- **Horizontal scale;** This shows the relationship of horizontal distance between the cross section and landscape represented.
- **Vertical exaggeration;** It shows the relationship between vertical and horizontal scale of the cross section.
- **Key,** if necessary.
- **North direction.**
- **The source.**






Horizontal scale ; 1:50,000
Vertical scale; 1:10,000
VE = 5

**VERTICAL EXAGGERATION**

A cross section by its nature has both, vertical and horizontal scales. The vertical scale is nearly always subjective, while the horizontal scale is steadily constant. The vertical scale by being subjective, it can be magnified. The amount of magnification of the vertical scale over horizontal scale is known as **vertical exaggeration.** Vertical exaggeration is thus, defined as the amount of times by which the vertical scale is larger over horizontal scale.

**Or**

The relationship between the vertical scale to horizontal scale of cross section.

Vertical exaggeration is very important in cross section drawing as it determines the shape of the features represented on the cross section.

The standard vertical exaggeration of the cross section drawn from most of the topographical maps with scale of 1:50,000, is that which does not exceed 10 units and not less than 5 units. Vertical exaggeration is principally determined by applying either one of the following two principle formula:-

$$\text{Vertical exaggeration} = \frac{\text{Denominator of HS}}{\text{Denominator of VS}}$$

Or

$$\text{Vertical exaggeration} = \frac{\text{Vertical scale}}{\text{Holizontal scale}}$$

**Example:-**

If a cross section has the horizontal scale of 1:50,000 and vertical scale of 1:10,000, whose vertical exaggeration is determined as follows:-

$$\text{Vertical exaggeration} = \frac{\text{Vertical scale}}{\text{Holizontal scale}}$$

According to the cross section:-

- Horizontal scale = 1:50,000
- Vertical scale = 1:10,000

Then; 50,000

10,000

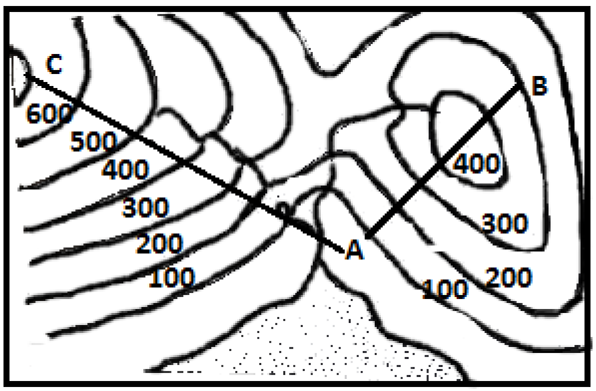
**Thus, the VE = 5. This implies the vertical scale is larger for 5 times to Horizontal scale.**

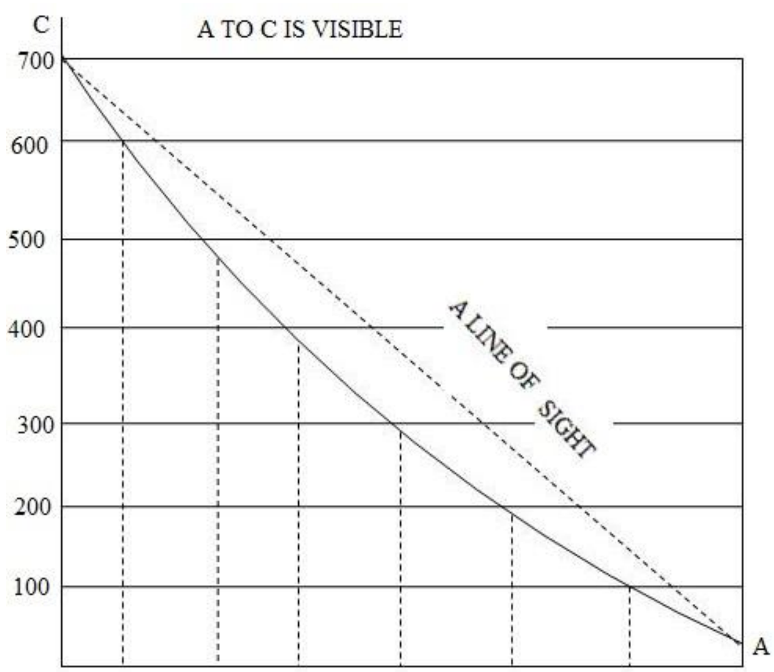
**INTERVISIBILITY**

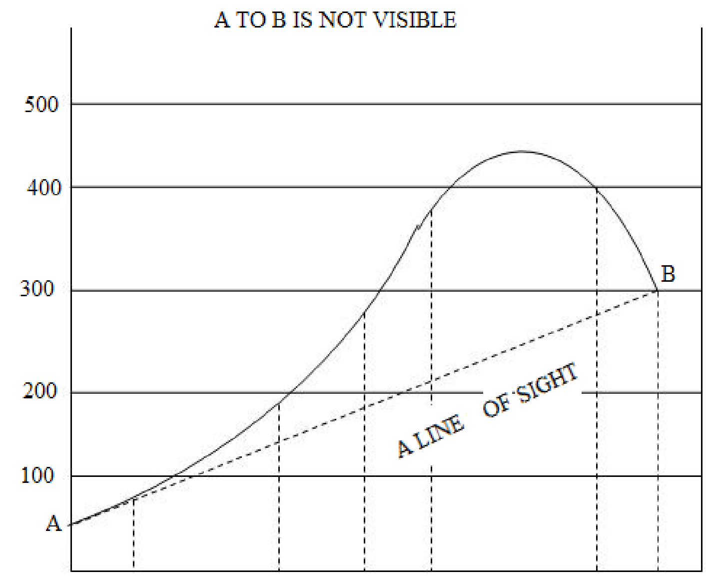
Indivisibility is the act of establishing whether the two positions in the area as observed on the map visible to one another or not.

A good way of realizing the indivisibility of two points on the map is **by drawing a cross section** from one point to another to view the structural appearance of landscape. On the cross section, draw a straight line called **sight line** to connect the two end points.

- If the straight line passes clearly between the two points, it implies the sighting from one point to another is not obstructed and hence, the two positions are intervisibility.
- If the land rises high above the sight line, implies that, the sighting from one point to another is obstructed thus, the two positions are **not intervisibility.**






### Factors affecting indivisibility.

Interivisibility between points on the map and up on areas on the earth's surface effected by the following factors.

- Relief; Natural features like mountain, hill and others in between of positions, affect intervisibility.
- Vegetation; presence of thick forest in between of positions also affects intervisibility.
- Buildings; the presence of tall buildings in between two positions also hinder intervisibility.

**HORIZONTAL EQUIVALENT (HE).**

Horizontal equivalent refers to a horizontal distance of the sloped landscape in relation to its vertical height.

Horizontal equivalent can be high, low or nil depending on the degree of a slope steepness.

Gentle slope; gives higher horizontal equivalent.
Steep slope; gives low horizontal equivalent.
Vertical slope; gives low horizontal equivalent
Horizontal equivalent is worked by converting the CD into AD with respect to map scale.

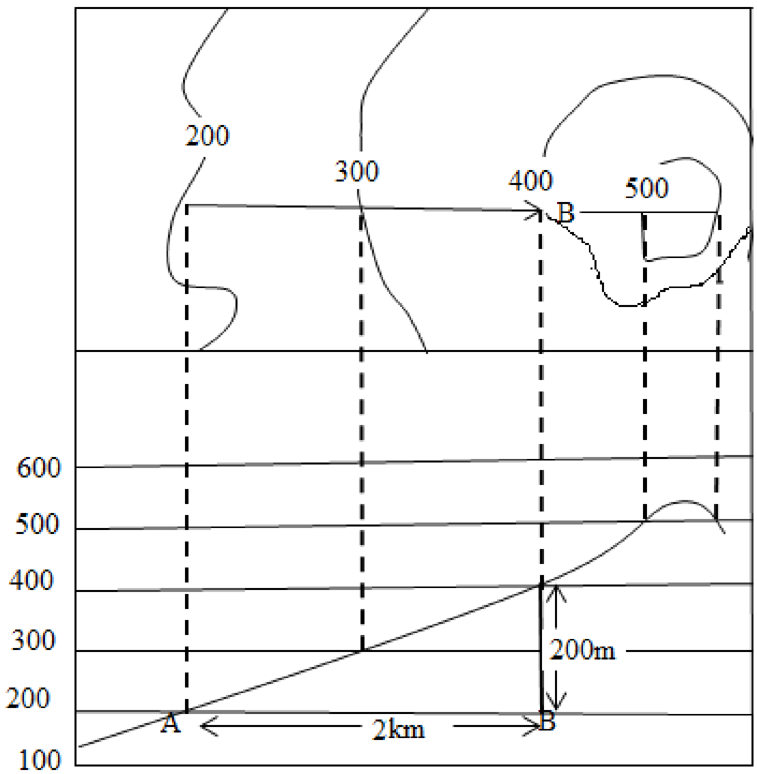
**Example:-**

Scale is 1cm=½km

CD = 10 cm

10 x½km =5 km Or 5000m.

Thus; the horizontal equivalent is 5,000m or 5km.




**GRADIENT**

Gradient is a degree of slope steepness; or the ratio between the vertical interval (increase) to horizontal equivalent; or the amount of rise or fall in meter or feet of the land in relation to horizontal distance.

Gradient is determined by the following principle formula:-

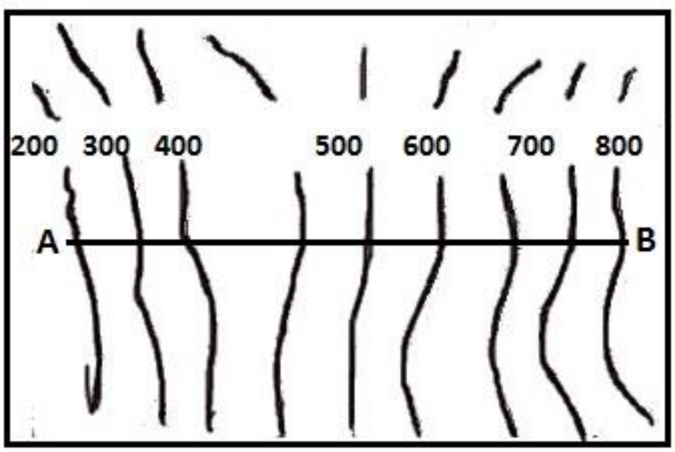
$$\text{Gradient} = \frac{VI}{HE}$$

Where by:

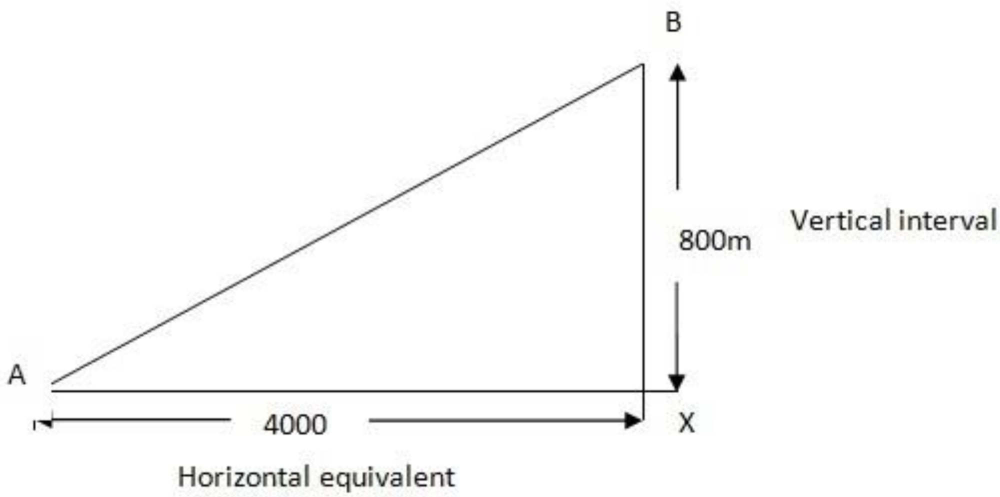
- VI=vertical interval; It is the difference in height meter or feet between the highest and lowest altitudes of the two recommended points.
- HE = Horizontal equivalent; It is the distance between the two given points as measured from the map.

**Procedure for gradient determination.**

- Identify the two points and name them like A and B.
- Join the points using a straight line to form line AB.
- Measure the ground distance between the two points.
- Calculate the actual distance using map scale given to get the horizontal equivalent (HE).
- Calculate the difference in height between the two points using the contours.
- Using the formula to have the gradient.




(a) Gradient of a slope from point A to B




Gradient = $\frac{VI}{HE}$

According to the given case on the map;

- Highest altitude = 1,000 m
- Lowest altitude = 200 m
- CD = 8 cm
- Scale; I cm represents 0.5km.

Then;

1,000m – 200m

(8 x 0.5km) x 1,000m

800 = 1

4,000 5

Thus; the gradient is 1 in 5. This implies there is a rise of 1 m high in every horizontal distance of 5m from A to B Or there is a fall of 1 m low in every horizontal distance of 5 m from B to A.

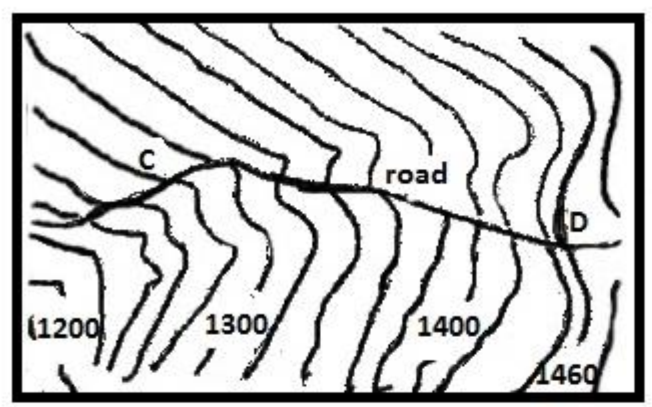
**Average Gradient.**

Average gradient is a degree of slope steepness for the elongated feature.The elongated feature can be of like a road, river, railway and others of the same nature.

**Procedure for average gradient determination.**

- Identify the two points of the elongated feature.
- Measure the length of the elongated feature on the map to get the CD.
- Convert the CD into AD b using map scale to get HE.
- Calculate the difference in height of the feature using the contours.
- Using the formula to have the gradient.

Example:-




The average gradient for the road is determined as follow:-

$$\text{Gradient} = \frac{VI}{HE}$$

According to the given case on the map;

- Highest altitude = 1,460m
- Lowest altitude = 1280m
- CD =12cm
- Scale; 1cm represents 0.5km.

Then;

1,460m – 1280m

(12 x 0.5km) x 1,000m

$\frac{1180}{6,000} = \frac{1}{5}$

Thus; the average gradient of the road is 1 in 5. This implies; the road experiences a fall or rise of I m low and high respectively in every horizontal distance of 5m in between of points C and D.

**Asses your self!**

- Are you able to define a cross section?
- Are you able to describe the kinds of cross section?
- Are you able to narrate the significance of drawing a cross section?
- Are you able to draw a cross section?
- Are able to narrate the factors affecting intervisibility?
- Are your able to suggest intervisibility by considering cross section and affecting factors?
- Are you to define horizontal equivalent and gradient?
- Are you able to calculate gradient and horizontal equivalent.

## EXERCISE

Qn. Calculate the gradient between Fotobiro hill and the point at grid reference

040640 (necta 2002 – Extract map of Nyakwere).

Qn. On the map drawn on scale of 2cms to 16 kms, there are two towns, A (altitude 800 meters and B altitude 1200 meters).

(i) calculate the gradient of the slope if the distance between the towns measures 4.2 cm the map.
(ii) Find the vertical exaggeration of the cross section if the vertical scale is 1:80,000. (NECTA 1997).

Qn. Draw a cross section from Mahenge peak and the western peak of Wibete

hill. (NECTA 1993; Extract map of Dodoma West sheet 162 /1).

Qn. The airfield and the top of the hill at Ilboru are 6.6kms apart. Calculate the

gradient between them (NECTA 1992; map extract part of TANZANIA – ARUSHA sheet 55/3).

Qn. Construct a neat annotated cross section from grid reference 630770 to 740770 (NECTA 1980 – the map extract part of TANZANIA – MONGOYO (Series Y742 sheet 295/1 Edition 1 TSD).

Qn. How would you determine the following on a topographical map?

Stream gradient.

Vertical exaggeration.

Horizontal equivalent (NECTA - 1983).

Qn. (i) Draw a cross section from Grid 360280 to 460330 and show area with plantation agriculture and the three major rivers.

(ii) calculate the vertical exaggeration.

(NECTA 1992 map extract part of TANZANIA – ARUSHA sheet 55/3).

Qn. Draw a cross section from point A to B , and calculate the vertical

exaggeration (NECTA 1989).

Qn. Determine the average gradient of river Kwamu kwme from grid 234626 to grid 196596. (NECTA – 2001, the map extract of KONDOa (sheet 104/4).

Qn. Calculate the gradient from Gr 000315 to Gr 020320. (NECTA – 1999, the map extract of BABATI (Y.742).

Qn. Calculate the vertical exaggeration for a topographical section across a map whose horizontal scale is one to one km and the subdivision of the vertical scale being one cm representing 50 m. (NECTA 1988).

## RELIEF FEATURES IDENTIFICATION ON TOPOGRAPHICAL MAPS

Topographical maps show numerous relief features of areas represented. The relief features are widely shown by means of contours. Usually contours on maps occupy patterns with respect to the shape of the landforms (relief features). The identification of landforms on the topographical map is by looking the patterns of the contours as well as their numbers. This can be aided by drawing a cross section.

Identification of the varied landforms on the topographical maps with respect to their shape is as follows

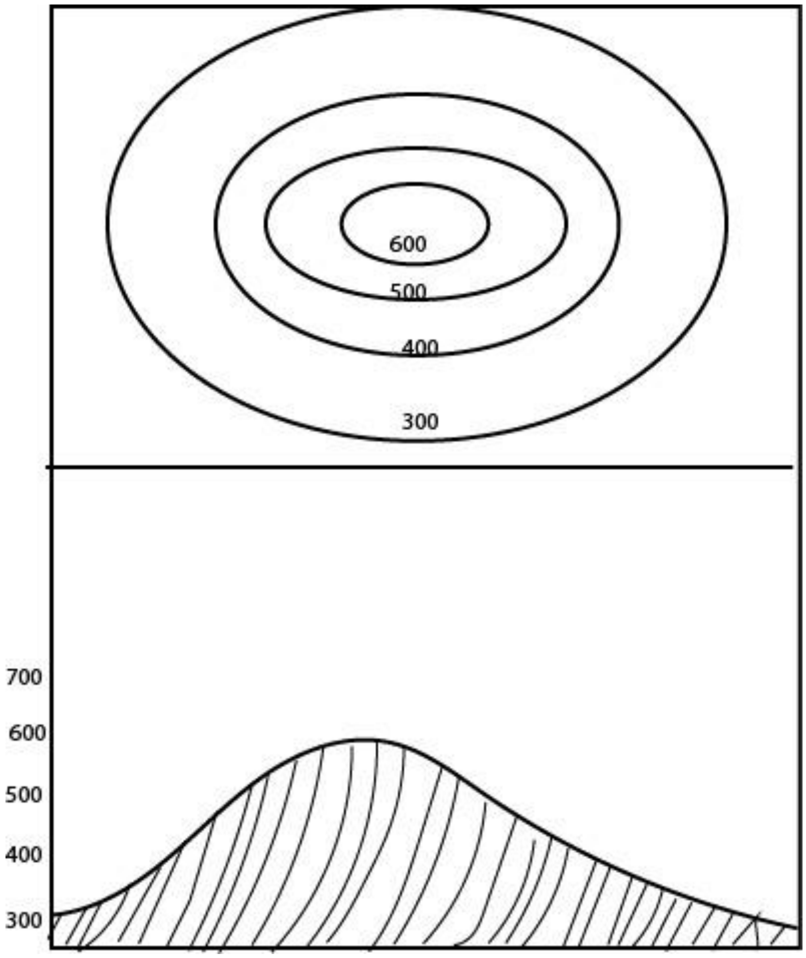
**1.Hill.**

Hill is a rounded up land not as high as mountain.

Or

As small rounded upland of low height above the surrounding area.

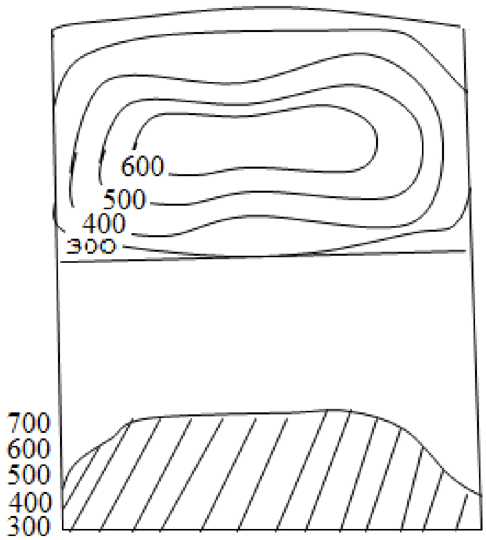
On the topographical map, hill is recognized by the presence of **roughly** circular contours close together and the last highest contour round small space on the map.




**2. Plateau.**

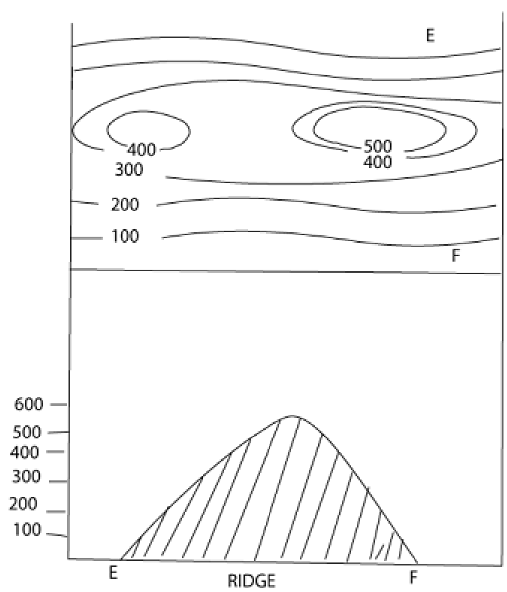
A plateau is an extensive upland with steep slopes and fairly gentle slope or flat on the top surface.

On the topographical map, plateau owning to its nature is recognized up on the presence of roughly circular contours close to one another but, the last highest contour rounds a large space on the map



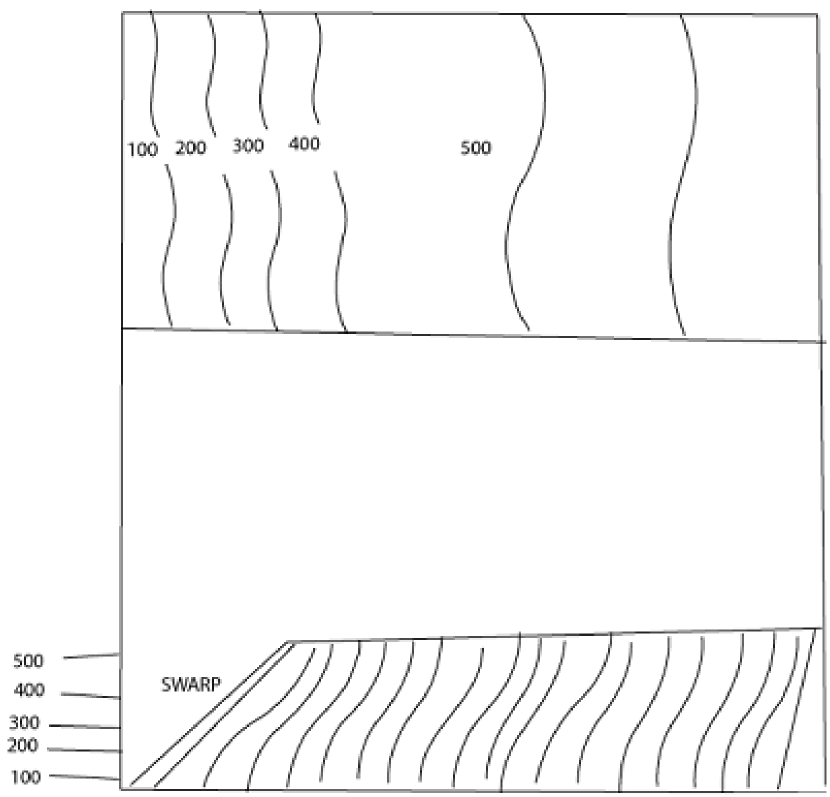

**3. Ridge.**

Ridge is a big, narrow and long with steep slopes. It is recognized if there is the presence circular elongated contours close to one another.



**4. An escarpment.**

It is an upland that has gentle slope on one side and steep slope on the other side. On the topographical map, escarpment is recognized if there is the presence of roughly circular contours observed be very close to one another at one part and far part at the other side.




**5. Slope.**

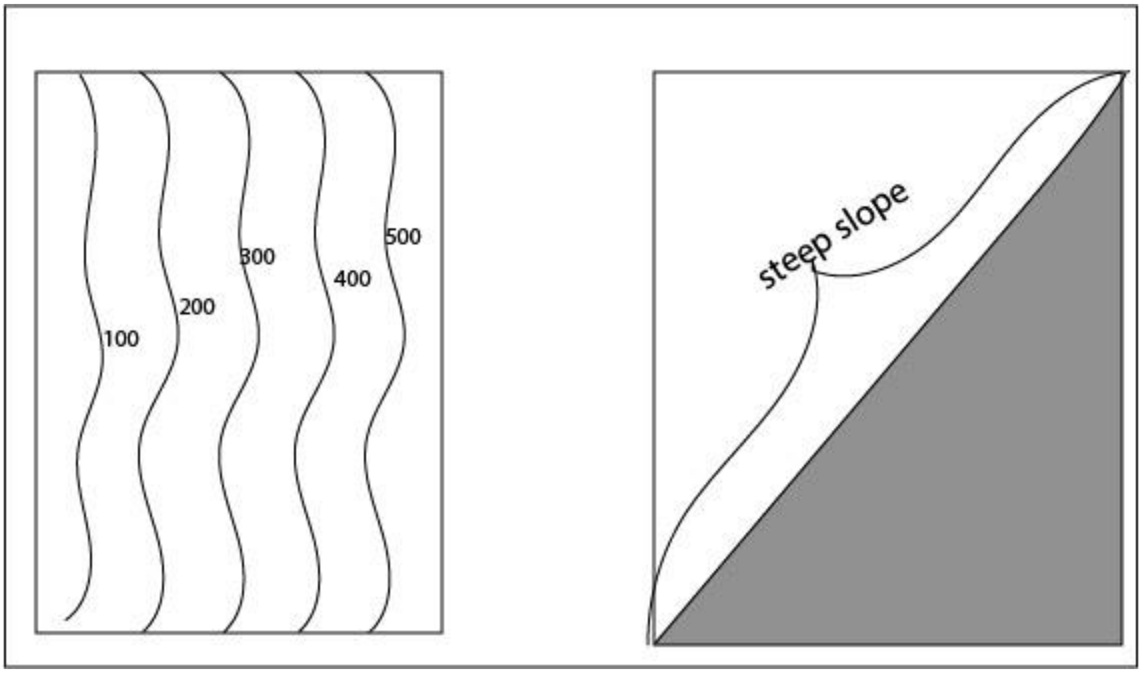
Slope is a slanting piece of landscape. Or the ground that progressively falls or rises from one area to another.

There are five types of slopes and include:-

- Steep slope.
- Gentle slope.
- Concave slope.
- Convex slope.
- Vertical slope.

**(a) Steep slope.**

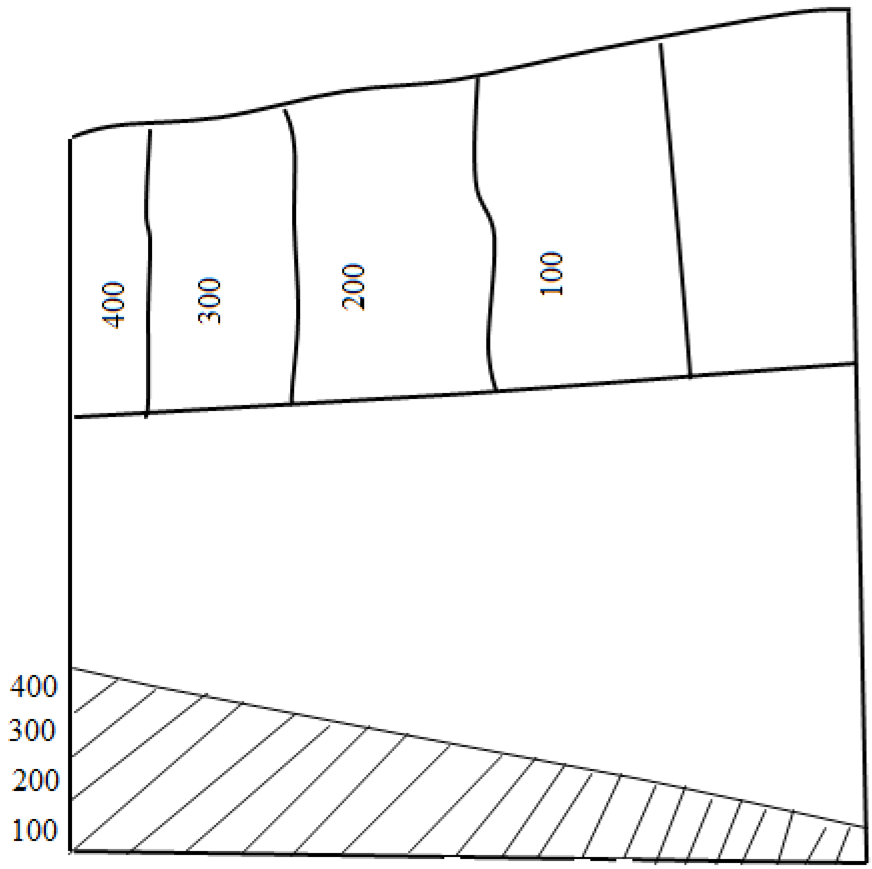
Steep slope is the one that has high degree of steepness evenly from the top to the bottom. Steep slope is recognized if on a topographical map, contours lie evenly spaced much close to one another from the top to the bottom.




**(b) Gentle slope / regular slope**

Gentle slope refers to a kind of slope that has low degree of steepness more evenly from the top to the bottom.

On the topographical map, gentle slope is recognized if contours indicating the presence of slating land, observed to lie far apart evenly spaced from the top to the bottom.

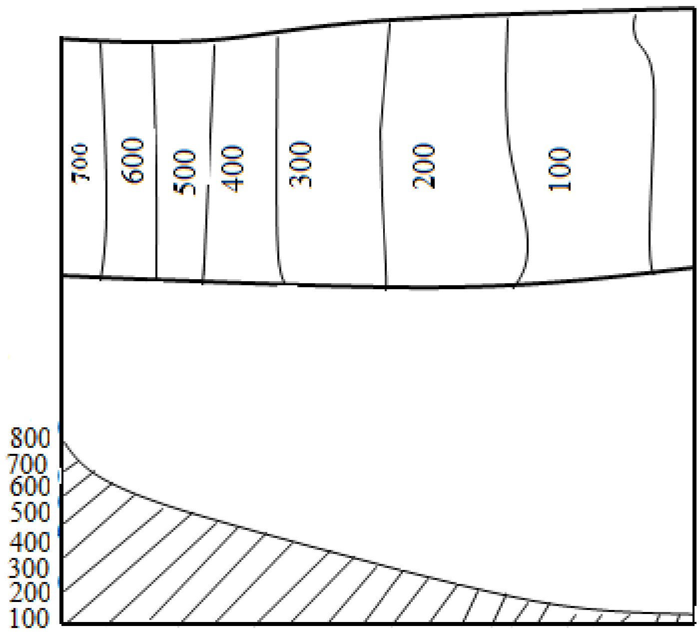



**(c) Concave slope.**

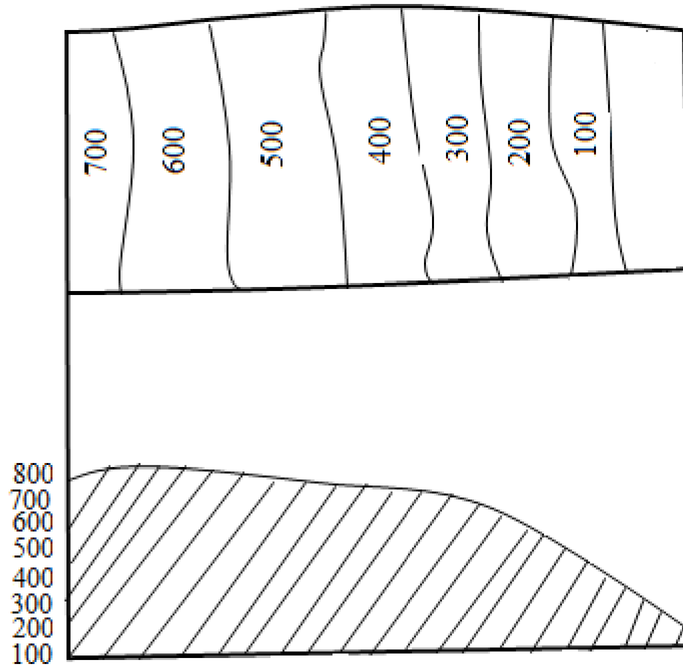
It is a slanting land, which is steep at the top and gentle at bottom. Or a slope that appears to have high degree of steepness at the top and low degree of steep at bottom. Concave slope is recognized if the contours indicating slanting land, observed to be closely spaced at the top part and wider apart at the bottom.

**(d) Convex slope.**

It is the slanting land which has low degree of steepness at the top and high degree of steepness at the bottom. The contours of convex slope are close to one another at the bottom and wider apart at the top.



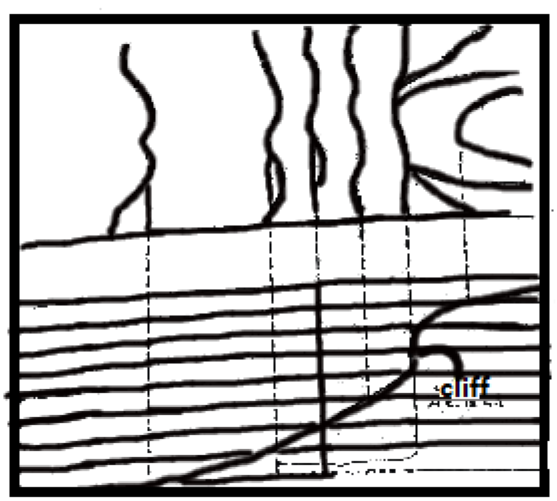

(i) Concave Slope




(ii) Convex Slope

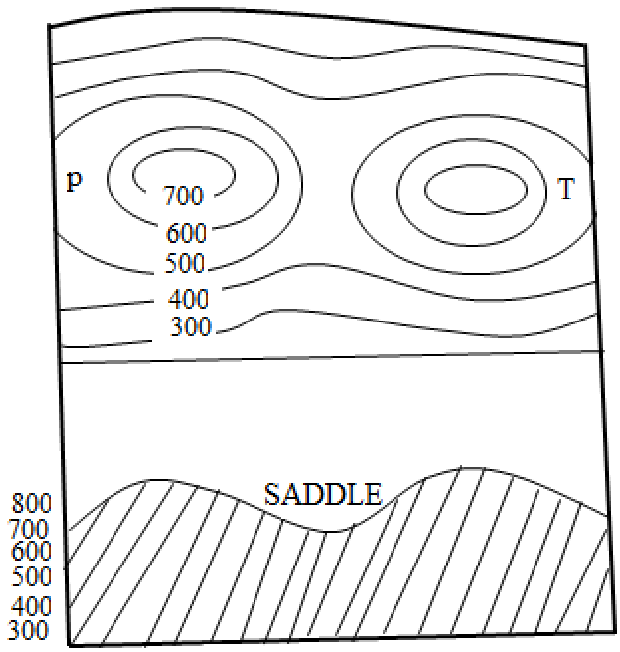
**(e) Vertical slope.**

It is the slope that has right angle steepness of about 90°. It is recognized if contours of different elevation join and form a single contour line.



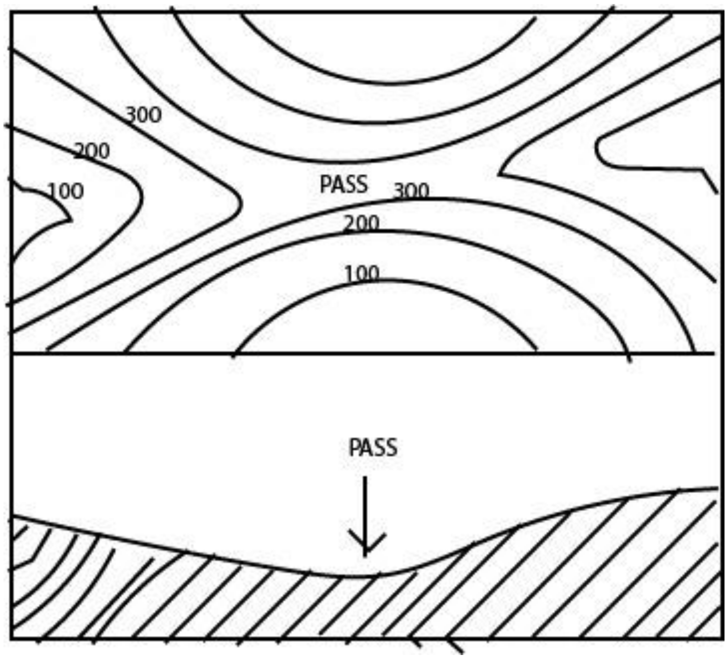

**6. Saddle or Col.**

A saddle or col is a low lying land in mountain range, which connects two mountain peaks or hill. The contours of a saddle or col that enclose two mountain peaks or hills, run roughly parallel and are far apart at the low lying land.



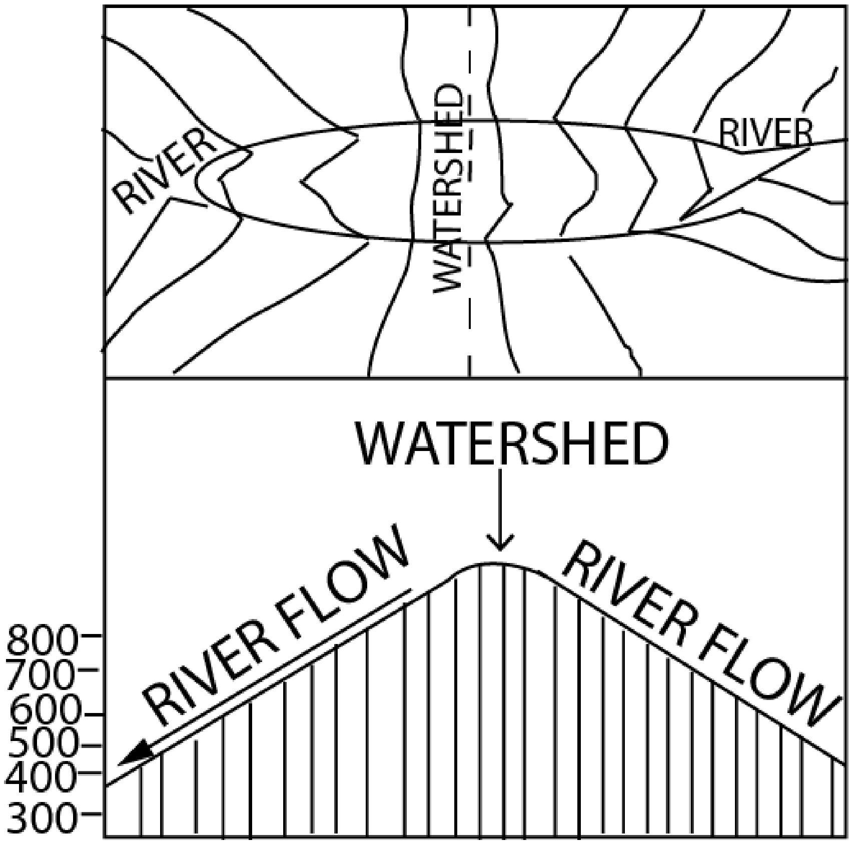

**7. Pass.**

Pass is a gap through a mountain allowing a through passage to different directions. Pass on the map is recognized, if contours of mountain peaks roughly converge towards a low-lying area.




**8. Watershed.**

Watershed is a line dividing the headwaters of two or more streams flowing to different directions. On the contoured map, watershed is recognized provided the highest contours run parallel to each other and streams of water appear to diverge to different directions.




**9.rRr River valley:-**

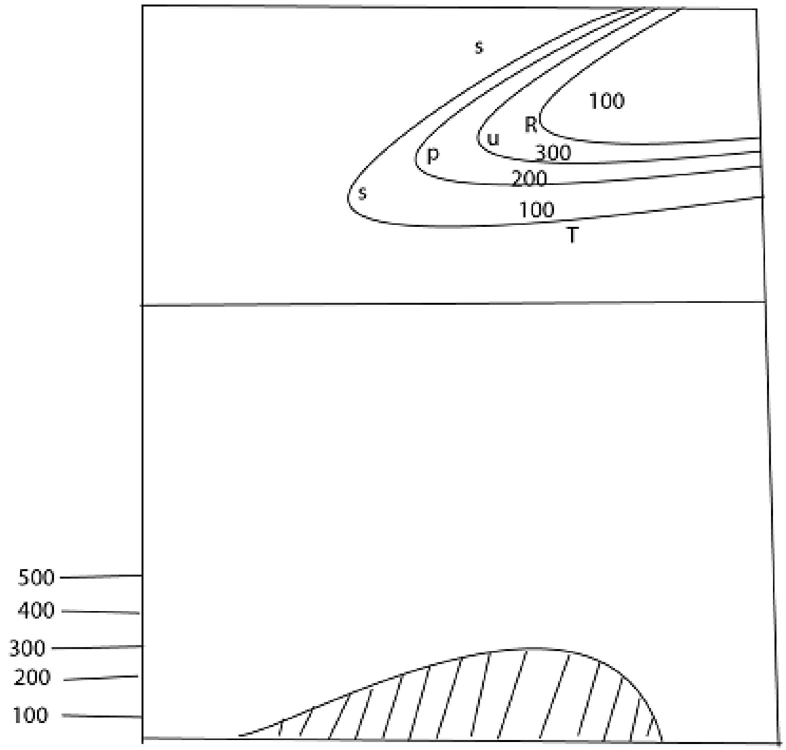
River valley is a long narrow and deep depression through which a river

flow. On the topographical map river valley, is recognized if the contours form V shape and the river crosses each contour.

figure here

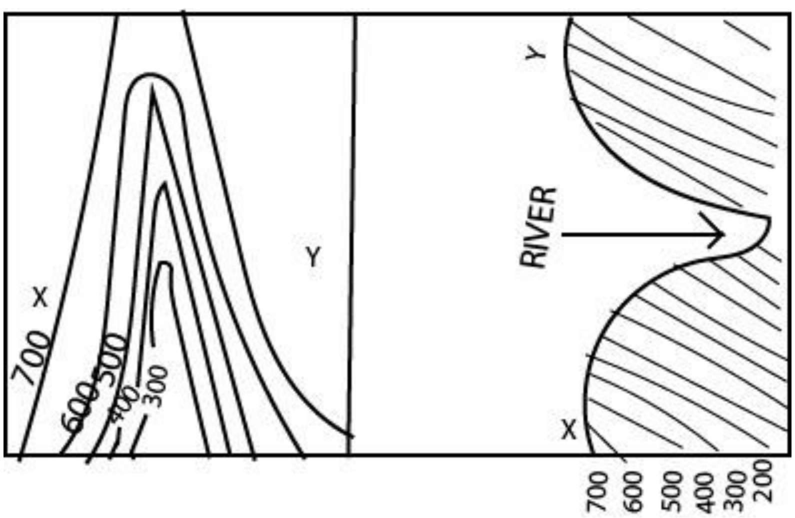
**10. Spur:-**

Spur is a projection of land or broad tongue of land from the side of a hill or mountain towards the valley. Spur is recognized if the contours form a V shape pointing down low lying area.



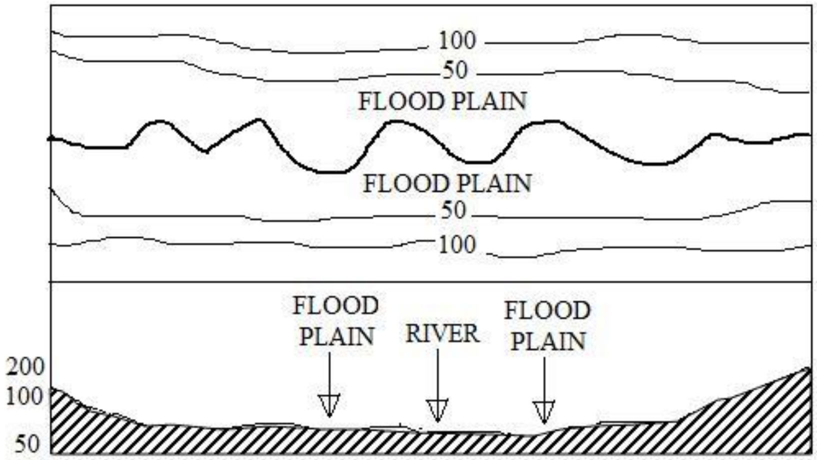

**11. Gorge.**

Gorge is a deep, narrow, steeply sided river valley. The contours of a gorge are close together forming a narrow V shape pointing sharply up-stream and the river crosses each contour.



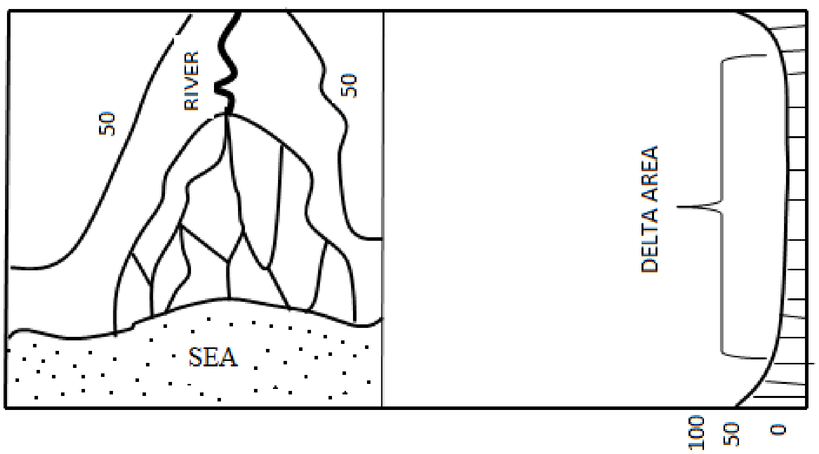

**12. Flood plain**

A flood plain is a flat low lying area lies immediately after river channel built up by deposition of alluvium. Flood plain on the map is recognized if the contours run roughly parallel to the main river and the lowest contours are spaced enough in a way that, it marks a general width of the flood plain.



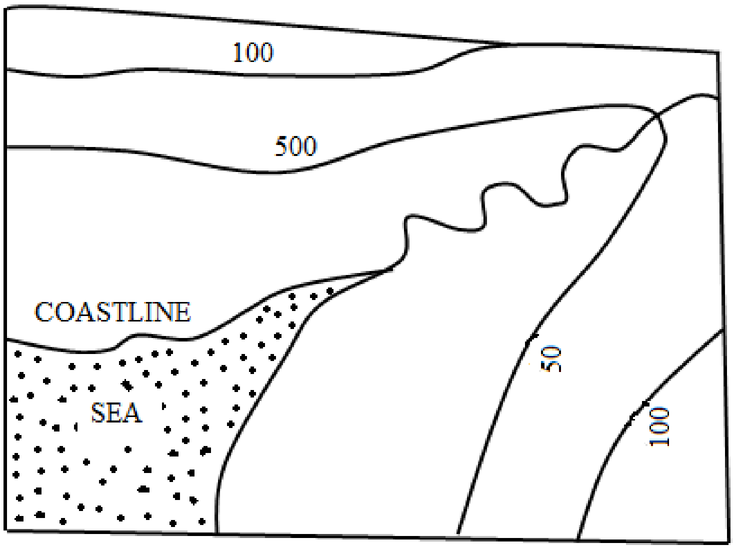

**13. Delta:-**

A delta is a flat low lying area of alluvial deposits at the mouth of the river crossed by many distributaries. On the topographical map, delta is recognized if the lowest contours follow roughly the area with tributaries.




## 14. Estuaries:-

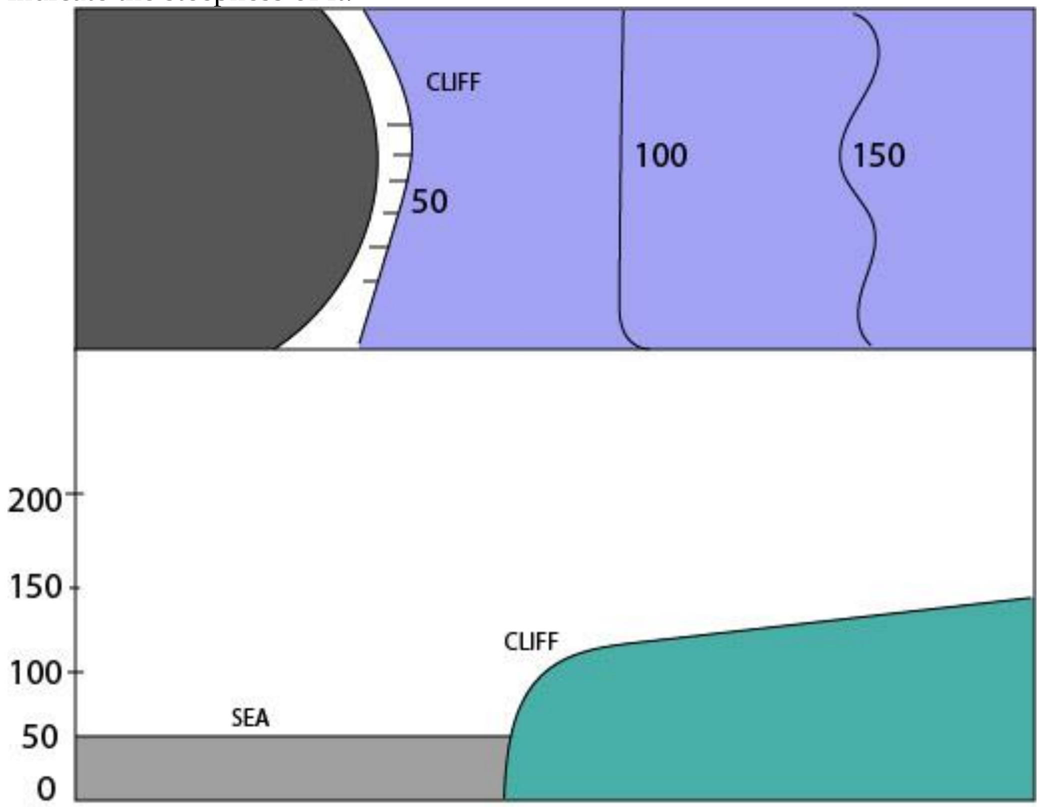
An estuary is a single broad river mount where a river enters a lake or sea. The contours of an estuary are widely spaced forming the wide V shape that point up stream.



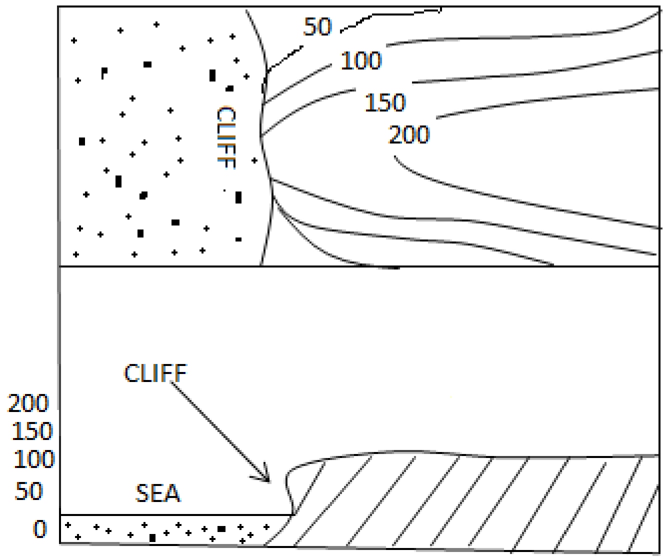

**15. Cliffs.**

A cliff is a high rock face along a coast, river or lake. On the topographical map, cliff may be indicated in two ways.

(a) A cliff may be shaded by short lines drawn at right angles to the coast, river or lake to indicate the steepness of it.

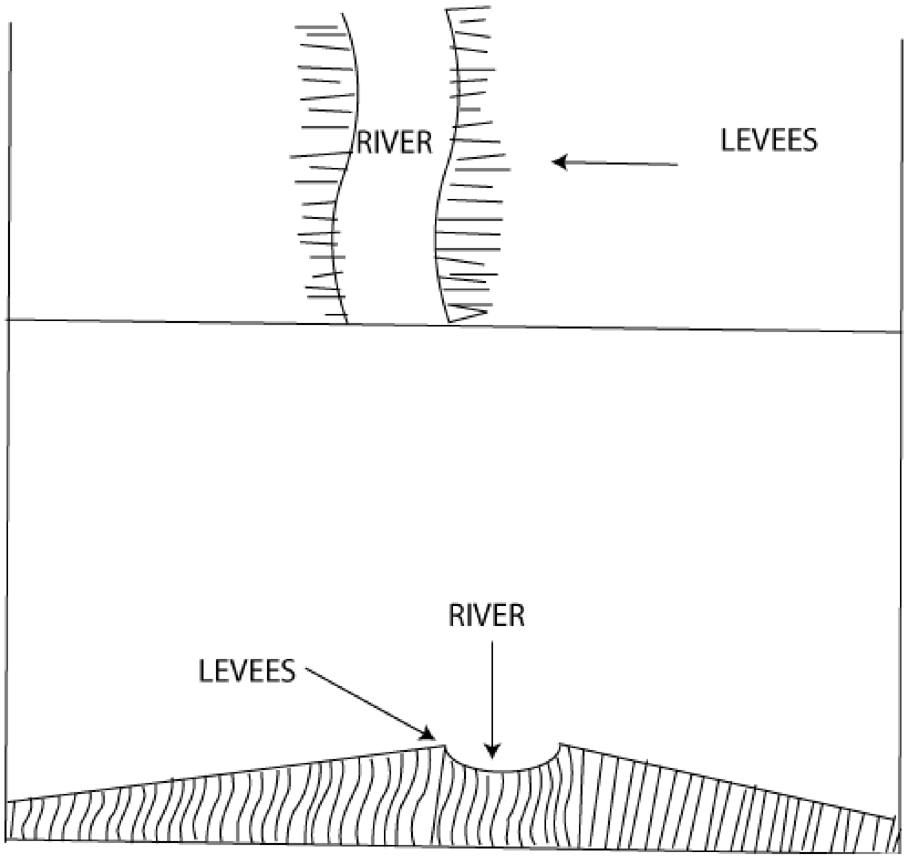


(b) Cliff on the topographical map may also be observed by the presence of contours of different elevations, join and form a single contour line parallel to the sea, lake or river.



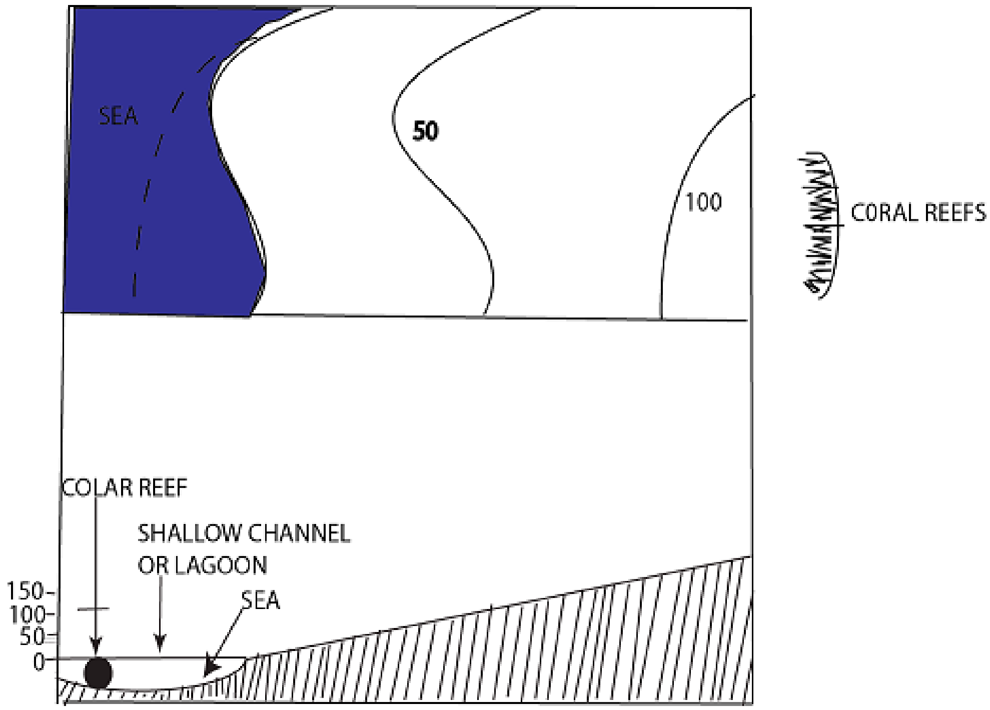

**16. Levees:-**

Levees are the natural embankments built up by a stream along the edges of its channel. On a topographical map, the embankments are shown by pecked lines at right angle to the course of the river.




### 17. Coral fringed coastline.

Coral fringed coastline is formed by a coral platform which lies close to the shore. On a topographical map, the coral fringed coastline is marked clearly by shading or by using symbols to show the area with coral fringing reef in the sea.




**Asses your self!**

- Do you understand the nature of landforms commonly shown on topographical maps?
- Are you able to identify different landforms the topographical map by considering the pattern of contours.

## EXERCISE:-

Qn. (i) Describe the land forms shown on the map.

(ii) Mention two factors which have influenced the direction of tributary into tributary R

(iii) Identify the feature at Y. (NECTA - 1988).

Qn. Describe the major landforms depicted on the map. Use the specific examples from the area (NECTA 204, the map extract of Mwanza sheet 33/2).

Qn. What type of landforms are depicted on the map? (NECTA 2008).

Qn. What features are found at grid reference,

(i) 960200? (ii)01139?

(NECTA -1993, map extract part of Tanzania-Dodoma west Sheet 162/1).

Qn. Identify the features found in the following grid readings

(I) 690110 (ii) 579145 (iii) 674063 (iv) 553123
(NECTA 2012-Uyole extract map sheet 245/3).

**MAP INTERPRETATION**

Map interpretation is the art of examining the given topographical map to realize the reliable geographical details of an area represented. Geographical details may include; climate, economic activities, relief, mode of transport etc.

Map interpretation is done by looking the conventional symbols and signs on the map and realize what they stand for. Map interpretation has to entails two basic processes of map reading and map analysis.

- Map reading; It is an art of examining the given topographical map to recognize the features that directed on the map.
- Map analysis; It is the art of relating the features that appear on the map to other geographical facts which are required to be described, explained or suggested.

In the process of map reading; carefully read and note; the map conventional signs and symbols, key the date of compilation, title, north direction, latitude and longitudes, and other important marginal details. However the perfect skill for interpretation of the topographical maps requires constant practices and wider geographical knowledge.

With map interpretation; some one is able to describe and explain the following geographical details:-

- Climate.
- Human activities.
- Vegetation.
- Drainage.
- Geological nature.
- Relief.
- Geomorphologic processes.
- Communication.
- Population distribution and settlements.

**1. CLIMATE**

Climate is the average (overall) weather conditions experienced in an area especially large area for a long period of time or through out. It is thus; realization and description of climate of an area from the topographic maps is by taking into consideration of the facts much related to climate which commonly shown on the map. They considerably include the following:-

**(i) Latitude:-**
Climate conditions vary considerably from one latitude region to another. It is thus; if the latitude region in which the mapped area is found observed, map user may realize the more likely climatic conditions of the area with regards to the wider geographical knowledge the person has.

The latitude region is recognized by taking into consideration of the degree numbers indicated along the map edge from bottom to the top or from south to north. Such degree numbers are of latitude values. Therefore; once you are given a topographical map to establish the climate of the respective area, try to observe the latitudes of the mapped are to understand in which geographical position over earth's surface the mapped area represented is located.

For instance:-

If the mapped area understudy is located from or in between 0° – 5° north and south of the equator, it implies that, the area is located in the equatorial belt.If other considerations remain constant, the area is suggested to experience equatorial climatic pattern with the following conditions:-

- High rainfall through out the year with two maxima peaks i.e. there is no prolonged dry season.
- High temperature throughout the year with small annual range.

If the map along its edge shows any latitudes in between of 6° – 20° North and south of the equator. It implies the area represented on the map located in tropical region. If other considerations remain constant, the area is judged to experience tropical climatic type with conditions of:

- -Moderately high rainfall which varies annually i.e. there is the presence of both wet and dry seasons in a year.
- -Temperature is high with great annual range.

However; if the altitude is below 500m; the area can be suggested to have coastal tropical climate with long rain season; but if altitude is above 500m, the area can be established to have **continental (interior) tropical climate.**

**Note.**

It is important for the map users to be aware with the climatic conditions experienced in varied natural regions.

**(ii). Altitude.**

Altitude means the height of an area from the mean sea level. Altitude has a considerable impact on climate as temperature and rainfall regime is influenced by altitudes. It is therefore, the consideration of altitude of an area from the map, may help to suggest the likely climatic conditions. With respect to this, once you are given a topographical map to suggest climate, consider the altitude of the area by reading the number of contours, spot height, bench mark and trigonometric points to realize whether the area represented on the map is of lowland or high land.

- If the altitude is higher mostly above 2000m implies the area represented is of much highland and likely to experience highland climatic pattern featured by high rains of orographical type which may vary with aspect and low annual temperature as greatly lowered by higher altitude.
- If the contours and other means show low height numbers, give an impression that, the area is of lowland and likely to experience high temperature.

**(iii) Water bodies (drainage).**

Drainages are very good guides to climate particularly on the relative amount of rainfall. It is so as the sources of water bodies in any are on the earth's surface is mostly by the amount of rain fall received.

- Presence of the salt lakes, seasonal streams, boreholes, seasonal swamps and widely spaced streams suggest that, the rains in the area are seasonal with long period of dry conditions.
- Presence of abundant permanent streams and permanent swamps, suggests heavy rainfall received in the area.
- Presence of the sea, suggests maritime (coastal) climate.
- Presence of lake particularly that of Victoria reflects lake equatorial type of climate.

**(iv) Natural vegetation and crops**

Natural vegetation and crops shown on the map have reflection to certain climatic conditions and thus; are also good guide to climate.

Natural vegetation

- Presence of thick forests on a map and up on the respective area indicates high annual rains.
- Woodland vegetation reflects moderate high annual rains.

- Scrubs, scattered trees and thickets vegetation reflect seasonal rains.

Crops.

Crops are raised depending on the climatic conditions that favour their growth. Hence; the consideration of crops cultivated, helps to deduce temperature and rainfall conditions of an area observed on the map.

- Presence of coffee and tea on the map and up on the area represented, suggests cool wet climate.
- Presence of cotton, sisal and cashew nuts suggests moderately high seasonal rainfall and high temperature.

NOTE.

Always the suggestion of climate of an area from the topographical map, students should not rely on a single guiding fact. Consideration should be centered on more than one guiding facts. It is so in a basis that, climate is influenced by a number of varied factors. It is thus; one considered factor, may not give the absolute reality about the climate of an area.

In East Africa from which most of the topographical maps for examination purpose extracted, the following types of climate experienced.

**Tropical climate.**

This is experienced over most of Tanzania exception in dry region of the central Tanzania. The climate is characterized as follows.

- High temperature with great annual range and in high plateau temperatures bit lower as result of high altitude.
- The amount of rainfall is moderately high and occurs in one season.

**Sub tropical climate:-**

It is the type of climate experienced in high land areas with in the equatorial belt. It is very common in Kilimanjaro, Kenya highlands, Kigezi, Ngara and Karagwe. The sub tropical climate is characterized as follows:-

**Desert and semi desert climates:-**

This type of climate is experienced in areas of central Tanzania, Northern Kenya and North eastern Kenya; and north eastern Uganda. Desert and semi desert climate is characterized as follow;-

- Temperatures are high around 27°C with very high annual range.
- Annual rainfall is generally low with long dry season.

**Coastal Tropical climate.**

This type of climate experienced along the coast of East Africa and its islands. The climate is very common in Dar es Salaam, Mombasa, Tanga and others coastal areas.

The costal tropical climate is characterized as follows:-

- Long heavy rain season.
- Temperature is high with great annual range.

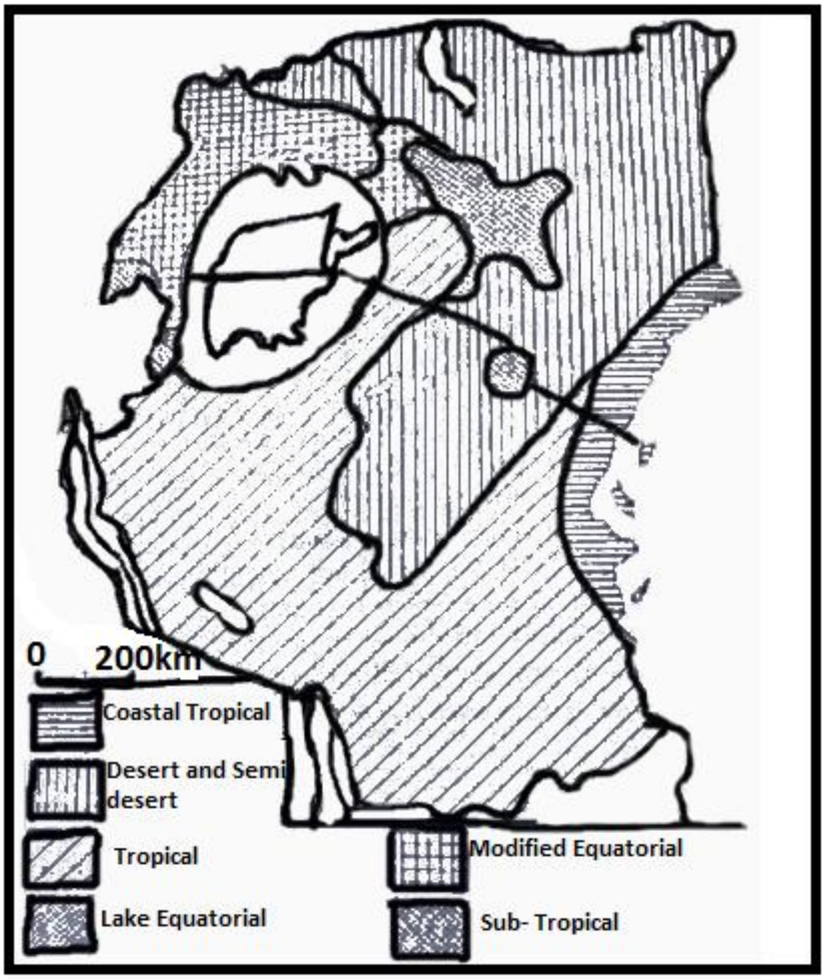
**Lake equatorial climate.**

This is experienced around lake Victoria, in Tanzania, Kenya and Uganda. The climate is characterized by the following conditions:-

- Moderately high temperatures.
- Moderately high rain rainfall.

Important climate description hints.

- Produce a statement in connection to what is to be described about climate.
- Give the type of climate and its conditions.
- Establish the evidences to reinforce your description (suggestion).




**For instance:**

Qn. Describe the climate of the area.

**ANSWER**

Climate of the area being the overall weather conditions as observed from the given extract map is described as follows:-

The area is realized to experience equatorial climate featured by high temperatures with small annual range and high rainfall through out the year.

The realization of climate is supported (reinforced) by the following evidences as observed from the map.

The area is of latitude of 2° indicated along the map edge. Also it is of low altitude. Commonly low latitude sustain high temperature being a feature of the recognized climatic pattern.
Cultivation of cocoa reflects high rains which is also a feature of equatorial climate.

## EXERCISE

Qn. With precise pieces of evidence propose the climate of the area shown on the map. (NECTA 2004, map extract of Mwanza sheet 33/2).

Qn. Suggest the possible climate of the area. (NECTA 1993, the extract of part of Tanzania (sheet 162/1).

Qn. Giving evidence from the map, suggest the climate of the area. (NECTA 1987, the extracts series Y 742 sheet 55/3 or ARUSHA).

Qn. Using evidence from the map, suggest the possible climate of the area (NECTA 1989).

Qn. Describe and account for the climate of the area (NECTA 1985, the extract part of Tanzania provide (sheet 55/3 series Y 742).

Qn. Comment on the possible climate of the area. (NECTA 2007, Extract map of West Hai).

Qn. Given topographical map of an area what indicators can be considered in deducing the climate of the area (NECTA 1983).

Qn. Describe how the relief and vegetation can help the map reader to depict climate on topographical maps. (NECTA 1997).

**2. VEGETATION**

Vegetation refers to a total assemblage of plant cover in an area. Topographical maps show vegetation with reflection to actual areas represented. It is thus; topographical maps may guide map users to realize the vegetation of an area represented.

The forms of vegetation present in East African areas of which commonly shown on topographical maps include the following:-

- Forests:- The vegetation of more close trees; or The vegetation largely dominated by dense growth of tall trees with closed leaf cover or canopy. These develop in regions with high annual rains.

- **Woodland:-** The type of vegetation of less closely big trees. These grown in areas with moderately high annual rains.

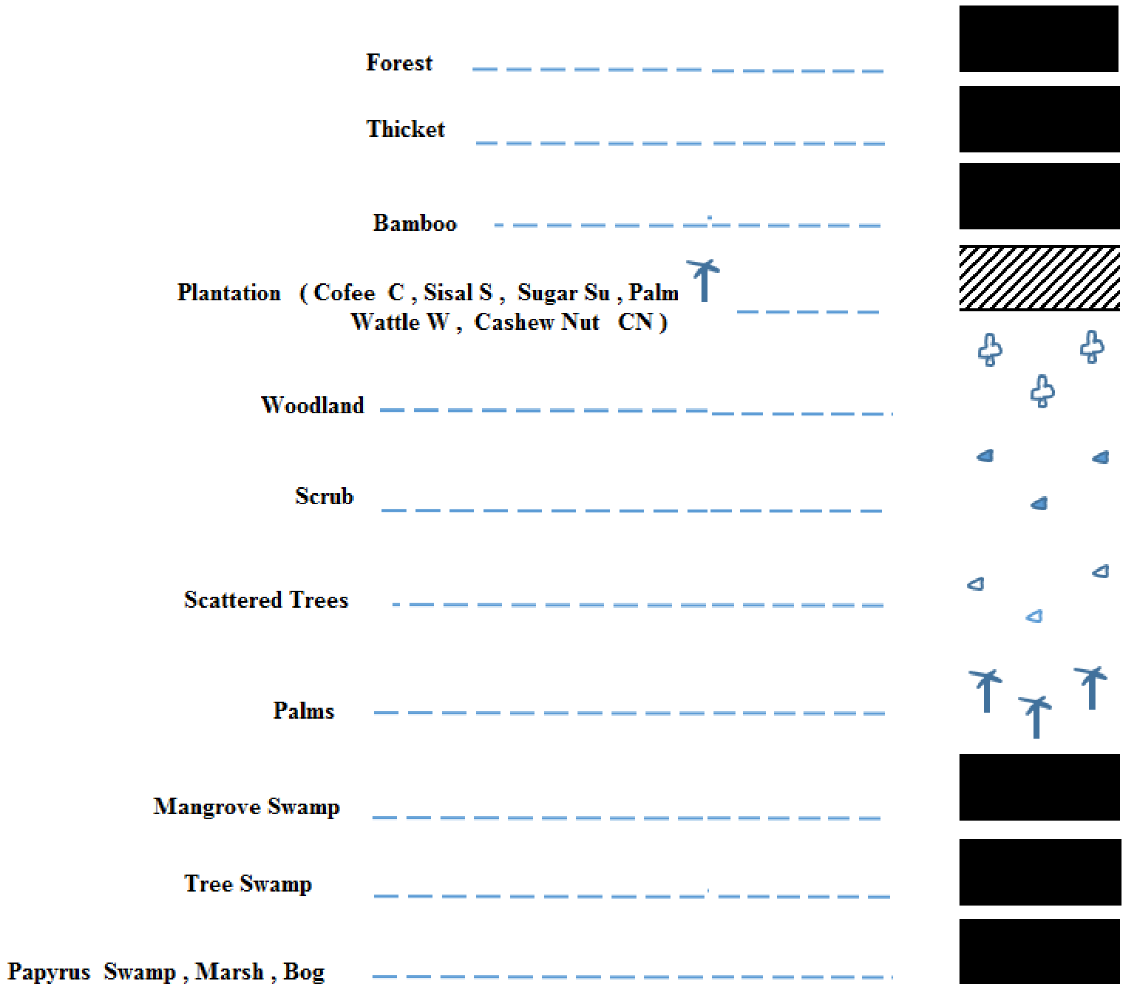
- **Thicket :-** This type of vegetation is of dense shrubs (closely shrubs) and some scattered big trees. Such vegetation nature commonly found in regions with moderately high seasonal rains.

- **Scrubs:-** The vegetation of less closely shrubs with widely scattered trees. Such vegetation commonly found in areas of annual seasonal rains with long dry season.

- **Scattered trees:-** These are the vegetation of widely spaced trees. These also commonly found in areas of seasonal rainfall.

- **Planted vegetation:-** Theseare more particularly of the cultivated plants (crops) like sisal, tea, coffee, cashew nuts and others.

The appearance of the distinctive vegetation forms on the topographical map is as follows:-




Vegetation on most of the topographical maps and up on the actual areas represented extremely varied in nature and distribution because of the following factors.

**Climatic conditions**

- High annual rains develop forest vegetation featured by the dense growth of trees.
- Moderately high annual rains develop woodland vegetation featured by the less closely trees.
- Moderately high seasonal rains develop thicket featured by the growth of closely shrubs.
- Seasonal rainfall makes occurrence of scrubs and scattered trees.

**Relief.**

It is considerably the physical appearance of an area. This influences vegetation relatively to soils and drainage as follows:-

- Where the landscape is steep as on a map contours observed to lie much closely to one another, drainage is good, but soils can be shallow. This may give to poor coverage of plants.
- Where the landscape is almost level as on the map contours observed to lie much more far apart, deep soils develop, but the area subjected to poor drainage. This also may make poor plants growth e.g. areas of seasonal swamps.
- Where the landscape is gentle sloped as on the map contours observed to lie far apart, may have deep well drained soil. This may make good coverage of plants.

**Soil:-**

Soil has ideal influence to plants growth in the following ways:-

- Fertile soil by being deep well drained makes good growth of plants. Such soil sustained where the topography is gentle sloped; and on the map can be realized if contours lie less closely to one another.
- Poor soil by being shallow, water logged makes poor growth of plants.

**Human activities:-**

- Areas under human utilization like; scattered cultivation and settlements, plants have been removed and thus; subjected to have poor coverage of plants.
- It is unlike to areas that not subjected to human utilization, can be observed to have good coverage of plants if other factors are also favorable.

***Important vegetation description hits***.

To describe vegetation, carefully study the map key to recognize the conventional symbols representing vegetation and relate to map face. After this the following hints can be given.

- Identify the types of vegetation shown on the map like, forest, woodland, scrub e.t.c.
- Give the distribution of each identified type of vegetation.

- Describe the extent of coverage of each identified type of vegetation.

**EXERCISE**

Qn. Explain the factors that have influenced the distribution of vegetation of

the mapped are (NECTA, 2006. The map extract of Mpanda 153/30).

**3. DRAINAGE**

Drainage is the removal of surface water from an area by the system of both natural and man made water bodies like of rivers, lakes, swamps, ditches, canals and other related systems. The common drainage systems of areas which normally observed on the topographical maps include the following:-

**1. Swamps:-**

A swamp is a body of shallow stagnant water that normally occupies an area of flat low lying land. Swamps normally found where the ground forms a shallow depression or is extensively flat. Swamps make drainage by receiving water drained into them by the streams of water flow in wet season.

Swamps are of different types and are shown using different symbols. The swamps are explained in the key of topographical map.

The different types of swamps include the following:-

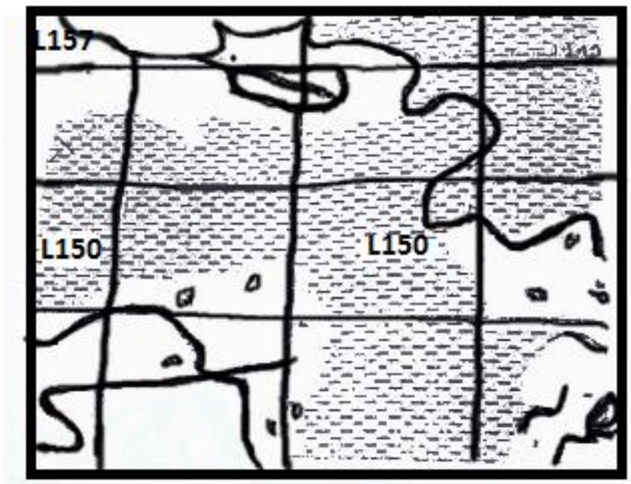
- **Mangrove swamp:-** These on the topographical maps can only be found along the parts of the sea shore. This is because mangroves only grow in salty sea water.

- **Tree swamps:-** These are the water waterlogged areas which have trees and other smaller plants growing in them.

- The papyrus swamps:- These are dominated by papyrus plants.

- **Marshes:-** These are dominated by grasses like plants.

- **A bog:-** It is water logged spongy ground with a surface layer of decayed vegetation.




2. **Sea:-**
   It is a large extensive body of salty water. This makes drainage by receiving water discharged into it by rivers. The sea is usually shaded in stipples (very small dots).

3. **Lakes:-**
   These are bodies of water that occupy a basin, depression or hollow on the earth's surface. They make drainage by receiving water drained into them by rivers and form an important inland drainage system areas.

4. **Reservoirs:-**
   These are the human made lakes which formed when people build dams across streams or rivers.

5. **Ponds:-**
   A pot is a small area of stagnant water which is commonly found along the stream courses. Most of the ponds are shown on the map using a dark blue tint.

6. **Waterholes:-**

A water hole is a shallow broad pit constructed by people. It is meant to trap rain water for animals to drink. It is shown on the map using the initials WH and a small circle which precedes the initials. i.e. oWH.

## 7. Ditches:

These are the trenches constructed in water logged areas for the purpose of draining water from the land. On topographical maps are shown by straight blue lines and the word ditch commonly written along side the line.

## 8. Rivers:-

A river is a mass flow of water in a natural channel from the area of upland towards the area of lowland where is likely to discharge its water.

A river can be permanent or seasonal. Permanent river can be topographical maps shown by irregular blue lines, and if the river is considerably big, the line appears thickened. While; the seasonal rivers are shown by the broken blue irregular lines. It has to bear in our mind that, some places have rivers which disappear as water percolates into the ground. Rivers of this nature on the map shown by continues irregular lines which end abruptly.

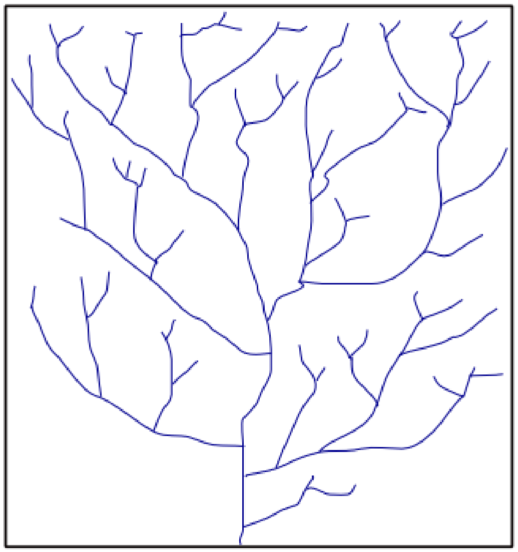
Drainage system of rivers occupy patterns depending on how tributaries converge to the main river and the general appearance of both consequent and subsequent streams. Drainage pattern is thus; defined as a layout made by the rivers on the landscape or is the shape produced by the arrangement of tributaries and main-river in a catchment area.

The patterns of rivers is the result of certain determinant factors which include the following.

- Slope of the land.
- The nature of the underlying rocks.
- The general relief pattern of an area.

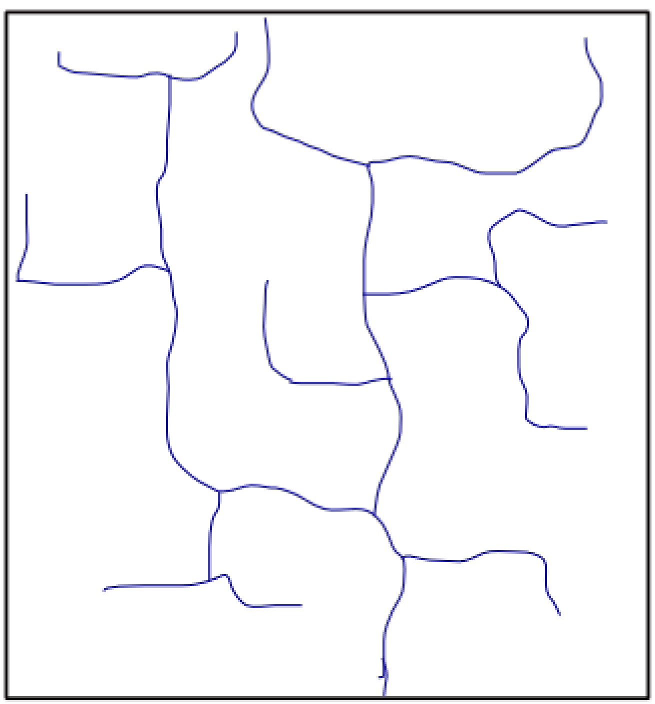
The common river patterns of areas appearing on topographical maps include the following:-

(i) **Dendritic pattern:-** It a drainage pattern in a shape of a tree trunk like structure with tributaries converged to the main river at acute angle resembling the shape of a tree like a feature. It develops on landscape of uniform rock hardness and structure and on gentle slope landscapes. It is very common in areas of igneous rocks.

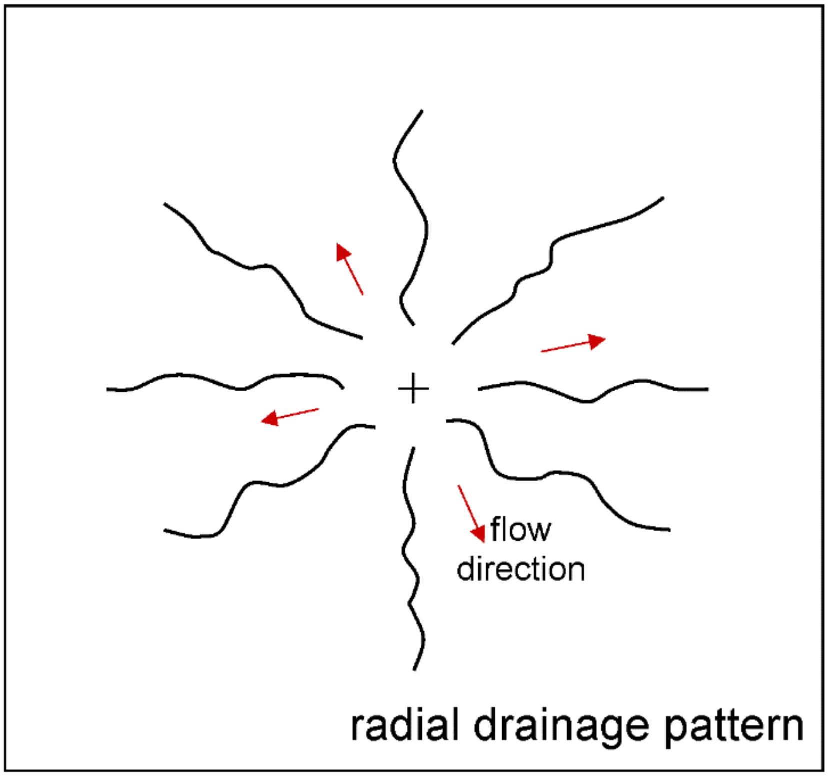


**2. Trellis or rectangular drainage pattern**.

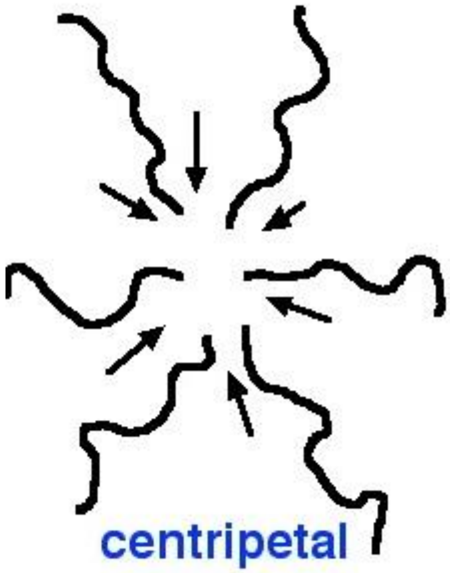
It is a pattern which occupies a shape of a lattice with tributaries converging to the main river at almost right angle. It develops on a catchment's area whose landscape has variation in rock hardness and structure. It may also occurs in areas of faulted landscape.



(ii) **Radial pattern**:- It is a drainage pattern whose tributaries diverge outwards down from the summit of rounded highland to different directions forming a shape of spokes round a wheel like structure. It is common to areas of roughly circular hills of igneous rock.




(iv) **Centripetal pattern:-** It is the one whose tributaries flow from different directions converging at a center of down warped landscape, where there is a swamp or lake. It is largely controlled by the shape of the landscape




.**River course (stage) identification**

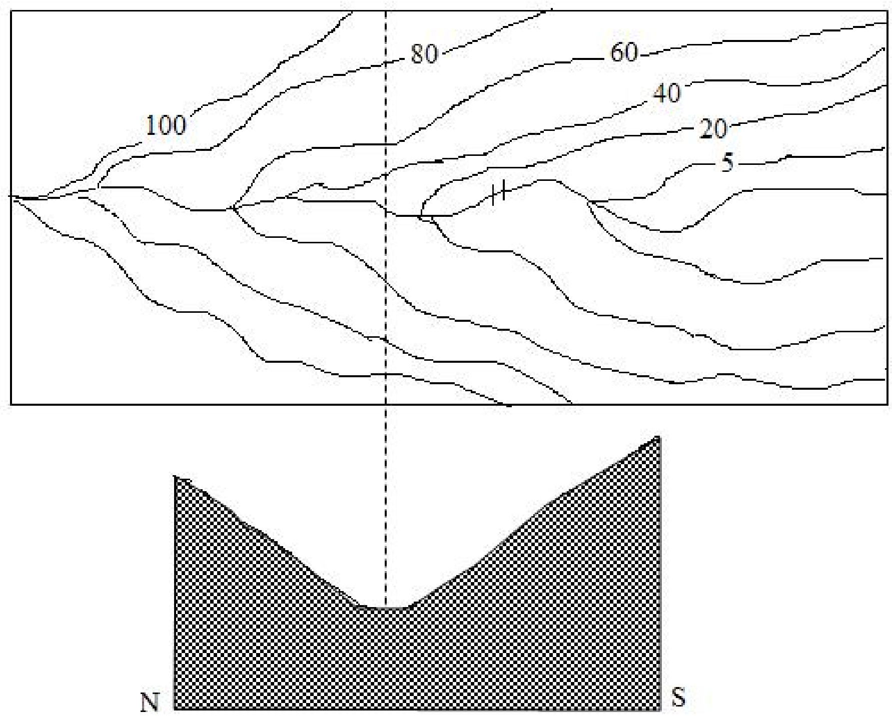
It has also to be noted that, a river has its course if development marked with three stages of life cycle. The stage of a river on a topographical map can be identified as follows:-

### (i) Youthful stage.

It can be easily identified by the presence of the following;

- The narrow V – shape contours like arrow heads pointing up to highest ground.
- Very close contours along the river course, which represent steep valley sides.
- Lack of meanders.
- Absence of a flood plan.

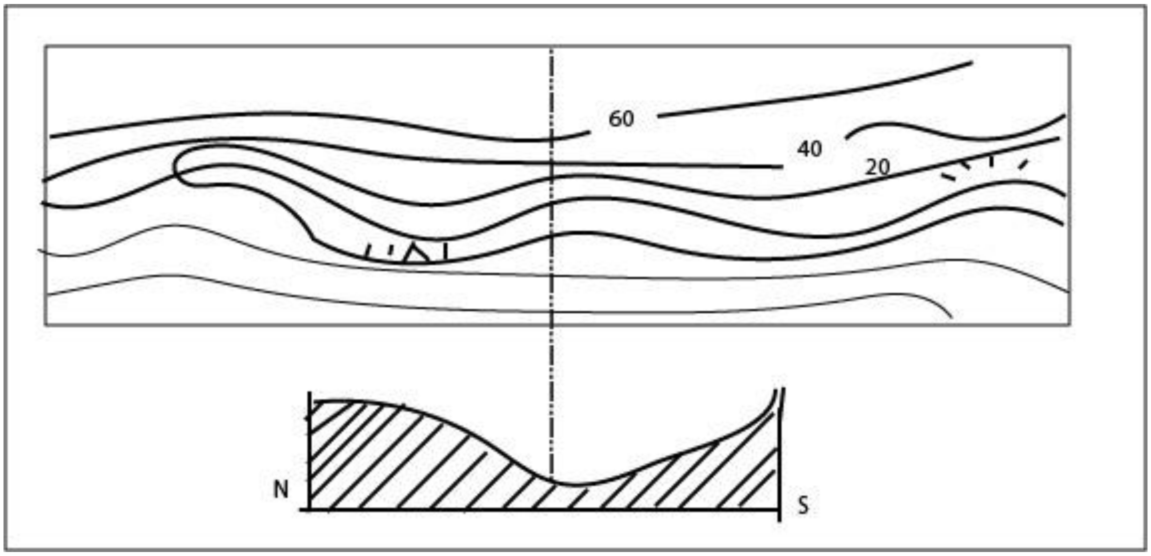
- Very few tributaries.




(ii) **Mature stage:-**

It is recognized by the following facts on the map.

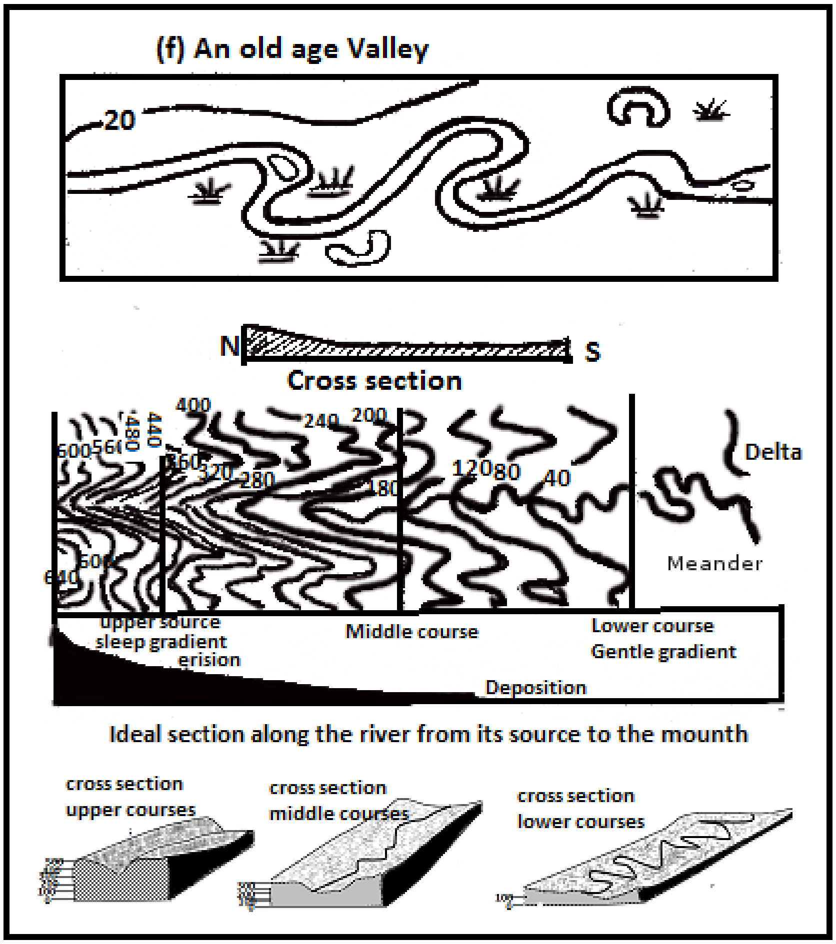
- Contours have a U – pattern crossing the river at wide interval which represent more gentle gradient.
- The landscape is fairly flat with a narrow flood plan on either side of the river.
- Presence of many tributaries.
- Low degree of meanders.

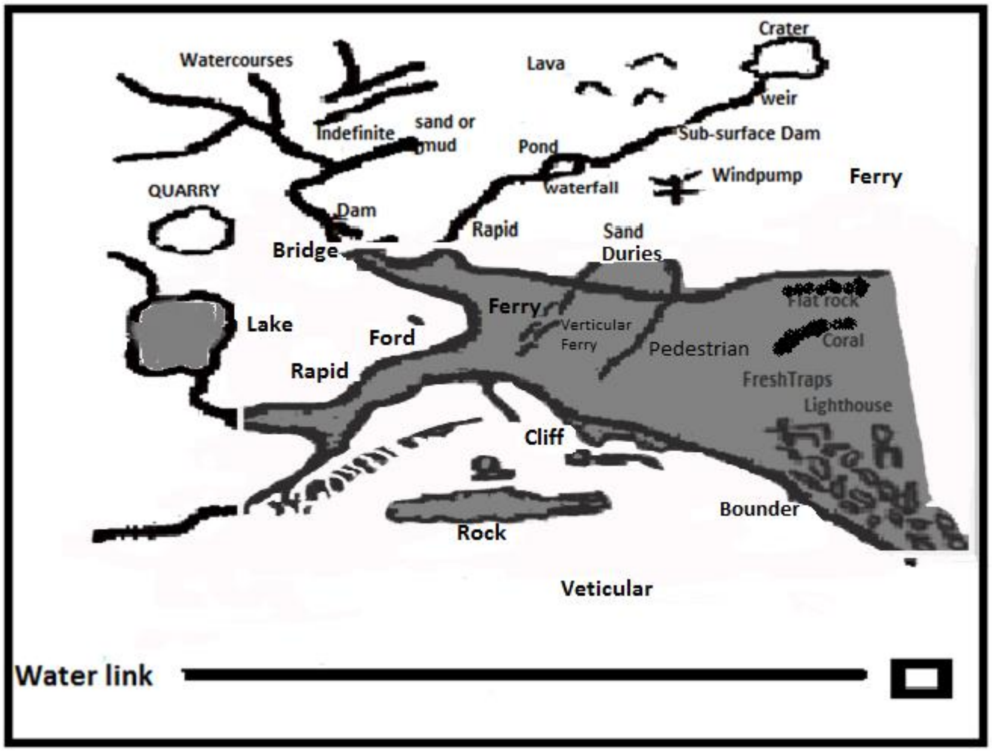



**(iii) Old stage.**

It is observed by the following facts.

- The presence of a very gentle gradient of the river course.
- Contours are very far apart cross the river.
- More pronounced meanders.
- The presence of a river broad flood plain.


(f) An old age Valley
20
N
S
Cross section
400
240
200
600
560
480
440
360
320
280
180
120
80
40
Delta
Meander
640
upper source
sleep gradient
erision
Middle course
Lower course
Gentle gradient
Deposition
Ideal section along the river from its source to the mounth
cross section
upper courses
cross section
middle courses
cross section
lower courses




**Factors influencing drainage systems.**

Drainage systems observed on topographical maps with reflection to actual areas represented are the result of the following determinant factors:-

## (a) Climate.

Occurrence of rainfall, supply water to surface which then development to water body systems of rivers, swamps and others as follows:-

- Heavy and continues rains, make areas to have permanent rivers and permanent swamps.
- Seasonal rains make areas to have seasonal rivers and seasonal swamps.

## (b) The nature of underlying rocks:-

- Impermeable underlying rocks influence the occurrence of swamps. This moreover makes rivers to flow steadily regular as water is in difficult to percolate into the ground.

- Permeable rocks make rivers to flow irregularly as may end abruptly.
- Rocks of uniform hardness influence rivers to develop either dendritic, radial and parallel patterns if other factors remain constant.

**(c) Relief / topography.**

- Sloped topography develop rivers as water make flow from the areas of upland towards the areas of low land.
- The extensive flat low lying topography influences the occurrence of swamps as bodies of shallow stagnant water occupying flat low lying areas.
- Depressed topography encourages the occurrence of lakes. Moreover, may influence the occurrence of centripetal pattern.
- The conical shaped uplands encourage the occurrence of radial drainage pattern.

**Important drainage description hints.**

When describing drainage of an area from the given topographical map, the following if possible as important hints should be given.

- Given the statement in connection to what you need to describe about the drainage of the area from the map.
- Identify the main features of drainage in the area as observed from the map. These may include; swamps, rivers, lakes, etc.
- Give the location of each feature on the map with reflection to the actual area represented.
- Give the characteristics of the identified drainage features like coverage, patterns, direction, seasonality, etc.

**For instance:**

Qn. Describe the drainage of the area.

**ANSWER**

Drainage refers to the removal of the surface water from an area by the layout of water bodies.

Therefore, the drainage of the area as observed from the given topographical map is described as follows. The area is drainage systems of river, swamps, and lake.

- Rivers; these are the flow of water in definite channels. They largely drain the area particularly the northern part where the landscape is comparatively higher and most of the rivers start to flow towards the southern part where the landscape is comparatively low. The rivers observed to occupy dendritic pattern. Some of the pronounced rivers include of Malela, Kitungwe, Kitogota, Lusingo, Kuga, Mbingu and others which might be present in the area.

- Swamps; These are the bodies of stagnant water which are observed to occupy flat low lying lands and in are all seasonal. These observed in the southern part of the area where the landscape with observation to contours is almost level. Swamps in the area make drainage by receiving surface water drained into from rivers.

- Lakes; These also make considerable drainage in the area. These observed in south east part where the landscape depressed. The most remarkable lake is that of Mnyamani and make drainage by receiving water discharged into it by rivers.

**EXERCISE**

Qn. Explain how the drainage pattern of the area is related is related to relief

(NECTA, 1993 …..THE MAP EXTRACT PART OF Tanzania – Dodoma west

(sheet 162/1).

Qn. Comment on the drainage pattern of the area. (NECTA 1995 – the map extract of part of Tanzania – KILWA KIVINJE (sheet 256/2).

Qn. Explain the main factors which have influenced the drainage system of the area. (NECTA 2000, the extract Madukani series Y742).

Qn. Describe the drainage pattern of the area. (NECTA 1987 the map extract

part of Tanzania provided (sheet 55/3 series Y72.)

Qn. Comment on the drainage in the area. (NECTA, 1985 the map extract part of Tanzania provided (sheet 55 series Y742).

Qn. Explain the relationship between relief and drainage of West Hai. (NECTA 2007, the map of WET HI, (sheet 56/1).

Qn. Explain how drainage pattern of the area is related to relief (NECTA 1991, the map extract of part of TANZANIA Fig.1).

## 4.ROCKS NATURE

Rocks are the aggregate or mixture of materials in solid form contented with minerals. Rocks are extremely varied and popularly include; igneous, sedimentary and metamorphic rocks.

The rocks of an area in exception of the out crop rocks and coral reefs are not directly shown on topographical maps. Rock nature can be identified by taking into consideration of the geographical facts related to geology which commonly shown on maps. These include the following:-

### (a) Landforms:-

Land forms are good guide to rock nature identification of an area from a topographical map.

- The presence of volcanic landforms on the map.

- Like crater, caldera, conical hills and mountains and others, reveals the igneous rocks of both intrusive and extrusive.

- The presence of coral reef reveals the organically formed sedimentary rocks.
- The presence of depression, sand dunes, and beaches reveals existence of less resistant rocks of which easily worn out into residuals to form such landforms by accumulation.

### (b) Drainage features:-

Drainage features in areas strongly related to the nature of geology. It is thus; consideration of the drainage features may helps to realize the existing geological nature:-

- The presence of dendritic, parallel and radial drainage patterns reveals the presence of hard rocks. Commonly such river patters develop on landscape of uniform hard rocks.
- The presence of swamps and lake reveals the existence of impermeable underlying rocks which limit the percolation of water into the ground.

### (c) Vegetation:-

Certain vegetation much related to geological nature of areas. Therefore; the consideration of vegetation may help to suggest the nature of rock of an area.

- The presence of thick forest; and crops of coffee and tea suggest the existence of igneous rocks. It is so as such plants found where the soil is fertile. In consideration, most of fertile soils are derived from volcanic igneous rocks.

- The presence of poor vegetation suggests the existence of sedimentary rocks as such rocks have low ability to retain water for plants.

**Note:-**

Metamorphic rocks have poor indicators (evidence). Probably, the presence of poor vegetation may reveal the existence of such rocks.

**5. RELIEF**

Relief refers to the physical appearance (surface form) of an area by landforms of contrasting shape and size.

The realization and description of relief of any area from a topographical map is by observing the patterns of contours and their respective heights. The arrangement (pattern) of contours reflects the surface form physical appearance), while the numbers reflect the altitudes.

In common, the relief of the area can be of either highland or low land. The area is recognized to be of high land if is of high altitude above 500m from the mean sea level. Lowland is recognized if the area has low altitude of below 500m from the mean sea level.

## RELIEF PATTERNS OF AREAS.

The common relief patterns recognized from the topographical maps and up on the areas represented include the following.

### (a) Mountain landscape:-

Mountain landscape is a surface form that rises more steeply or abruptly to summits above the surrounding area over wider area. On a topographical map mountain landscape is recognized, if contours lie so much closely to one another over a considerable wider part. Moreover; the map by contours shows many hills or summits, dissection of rivers (streams), the presence of passes, saddle, water shed and escarpments.

### (b) Plateau landscape:-

It is an extensive highland area, generally, level or gentle sloped at summit. On a topographical map is recognized if the landscape is assessed be of high altitude and wider part is almost level or gentle sloped. Thus; the contours observed to show higher height numbers and lie far apart to reveal a general level, and might be dissected by rivers.

### (c) Hilly landscape:-

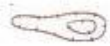
It is an area predominated by numerous isolated hills. On a topographical map is recognized if the contours or roughly round close to one another appear numerous and isolated.

### (d) Coastal plain:-

It is an extensive area of low altitude lies immediately after the sea. The lowland Coastal plain is recognized if contours on the map are widely spaced and the elevation rarely exceed above 300m. Beside to this, the mapped area is observed to lie immediately after the sea.

### (e) River basin:-

The lowland of a river valley is recognized if the mapped area is observed to lie parallel to the big river and the contours show low height numbers.

| Description | 1:50,000 |
|---|---|
| Indications in uncontoured areas |  |
| Depression contour |  |
| Cliff or steep scarp |  |
| Steep slopes |  |
| Crater |  |
| Quary |  |
| Sand dunes |  |

***Important relief description hints.***

Generally, in making description about the relief of the mapped area, the following hints should be followed.

- The map has to be divided into relief regions. This is done by observing contrasting contour arrangements.
- Give the position location of each relief region as shown on the topographical map.
- Give the general description of each relief region by giving out the prominent landforms and altitudes of each region.

**EXERCISE**

Qn. Describe the relief of the mapped area. (NECTA 2002, the map of part of

KENYA – NYAKWERE).

Qn. Describe the relief of the area shown. (NECTA 1996, the map extract Y742

55/3 or ARUSHA (reproduced from the same series).

Qn. What type of landscape does the map depict?

(NECTA 1995, map extract of part of Tanzania – KILWA KIVINJE (sheet

256/2).

Qn. With specific evidences on the map, suggest the landscape patterns that

predominate in the area.

(NECTA 2003, the map extract of SONGEA sheet 299/1).

## 6. GEOMORPHOLOGIC PROCESSES.

Geomorphologic processes refer to the natural activities (physical processes) which mould an area by resulting into the occurrence of landforms. Geomorphologic processes moulded the area from the topographical map, realized and suggested by taking into consideration of the following.

### (a) Land forms.

- The presence of volcanic land forms such as craters, caldera and volcanic hills and mountain reflects vulcanicity.
- Presence of block Mountains reflects crustal uplift by earth's movement.
- The presence of escarpment reflects both faulting and denudation.
- Presence of sand dunes, delta, beach, flood plains and levees reflects deposition.

### (b) Drainage.

- Presence of rivers and lakes suggests erosion and deposition provided the formed related features observed on the map.
- Presence of oceans reflects marine erosion and deposition provided the related features such as cliff and beach respectively observed on the map.
-

## 7. **COMMUNICATION.**

Communication in most of areas is enhanced by the means of transport and telephone networks. Hence on topographical maps communication is recognized up on the presence of the means of transport, telephone lines and telephone towers.

**FORMS OF TRANSPORT**

The topographical maps may show one or more forms of transport with reflection to areas represented. These include the following.

1. **Land transport;-**

This form of transport is by road, tracks, railway lines and foot path.

(a) **Roads**:- These are of the varied nature and include the following:-

- All weather road bound surface. They are tarmac roads and normally used throughout the year including during the rainy season.
- All weather road loose surface; they are murram surface road and also used throughout the year.
- Dry weather road; These are also murram surface roads, but

**(b) Footpath:-**

These are the ways through which people move from one area to another on foot.

**(c) Rail transport;**

It is reflected by the presence of railways; and these may appear on the

topographical map provided the represented area is served by this particular means of transport, or the railway line pass through the area.

Railway lines as observed from the topographical maps with reflection to areas represented, are of two categories and include the following.

- Main railway lines; These on the topographical maps represented by the black shading which alternate with white ones.
- Light railway lines: These are normally present with in plantation and mining areas. These are represented by the thin black lines which may be pecked.

All weather roads: Bound surface

All weather roads: Loose surface

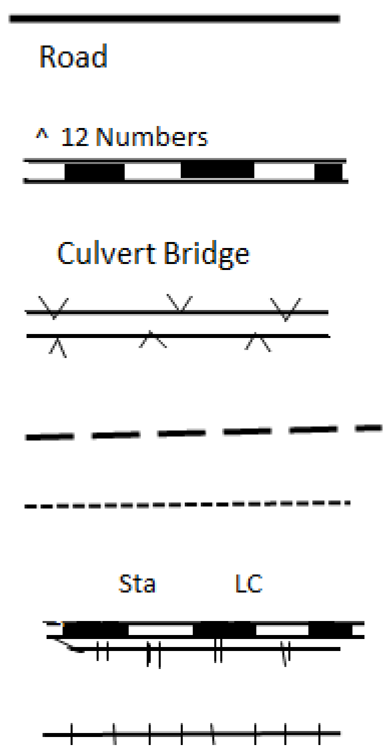
Dry weather roads

Main tracks (Motorable)

Other tracks and footpaths

Railway, Station, Siding, Level Cross

Railways, Light




**2. Air transport**

Air transport about areas can be realized if the following observed on the topographical maps

(a) Air port. This is a large area on the ground which is used by commercial airlines to land or to take off. It has facilities for passengers, goods and offices including of immigration.

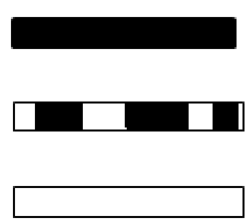
(b) Aerodrome. This is small airport that is mainly used by private air craft.

(c) Airfield. This is area of open and level ground where aircraft may land or take off. These normally have offices for air craft operations. However; the offices are not as large those of air ports. Airfield runway can be bound , murram or grass

Airfield Runway:- Bound…………………

Murram……………...

Grass………………...



**3. Water transport:-**

Water transport on the topographical map with reflection to the area represented is revealed by the presence of ports, big lake, sea and ferry across the river, lake or part of the sea; wharf, berth, jetty and pier.

- Wharf is a wooden or stone structure that is constructed at the water front onto which boats or ships are tied when they are being loaded or off loaded.
- A berth is the space on the side of the wharf which is set aside for a ship to anchor.
- A jetty is a structure that is built out into the water for breaking the waves. This keeps the water calm on the side of the land. It may have also serve as a landing place.
- A pier is a structure which is made of wood, iron or stone. It is built out into the lake or sea for walking on and for ships to stop and load or unload. Pier is bigger than jet and may have restaurant on it.

## FACTORS INFLUENCING TRANSPOTATION.

It has to be noted that; types, layout and quality of the means of transport as observed on maps with reflection to the actual areas represented influenced by the following factors.

**1.Relief.**

Relief being the physical appearance of an area influences both; layout and types of transport as follow.

- Roads and railways avoid to pass through areas of steep slope and are more liable to pass through areas of gentle slope. Thus; the layout of the overland transportation is observed in areas of gentle slope as such areas are less expensive for construction and also less hazardous.
- However, roads have more advantage than railway in this respect as motor vehicles can travel more easily uphill than trains.

**2. Drainage.**

Roads and railways avoid to pass through areas with many rivers and very flat areas liable to floods. It is hazardous more expensive to establish means of transport through areas of this nature.

**3. Economic activities.**

Means of transport are made to pass through the areas where economic activities are carried out to facilitate the carriage of the economic goods.

**4. Settlements**

- The layout of roads and railways is observed in areas where human settlements exist to facilitate the movement of people as well as their goods.

- In urban areas; air transport observed and other means transport of high quality. It is unlike to rural areas.

***Important transportation description hints.***

To interpret communication, some one has to study carefully the map key to detect the convention signs representing means of transport and relate them to a map face and the following hints can be given.

- Give the statement in connection to what you are going to describe about the area from the map.

- Identify the main means of transport in the area as observed from the map. These may include; land transport, air transport and water transport.

- Give the characteristics of the identified means of transport like; layout, quality and others.

**EXERCISE**

*Qn. With reference to the relief and settlement pattern of the area, account for the type, lay out and quality of over land transportation. (NECTA 2006, the map extract of Mpanda sheet 153/3)*

*Qn. Describe the nature of transport as seen on the map (NECTA, 1997 – the map extract of MOSHI series Y742).*

*Qn. Explain the communication of the area and show they are influenced by physical features. Comment on how the communication might be developed to meet future needs. (NECTA 1980, the map of TANZANIA – MINGOYO Serial Y742 sheet 295/1 Edition 1 TSD 1967).*

*Qn. Relate settlement distribution and communication lines to relief and drainage. (NECTA 1985, the map extract part of Tanzania provided (sheet 55/3 series Y742).*

*Qn. Comment on the transportation system of the area 56/1.*

**8. SETTLEMENTS.**

Settlement is a layout of dwellings in the habitable area where people live and conduct their social and economic activities by interaction with the prevailing environment.

A good number of topographical maps show settlements so long they represent areas in which people dwell.

Settlements on the topographical maps are given by means of selected conventional symbols.

There are two type of settlements which commonly shown on the topographical maps and these include; rural and urban settlements.

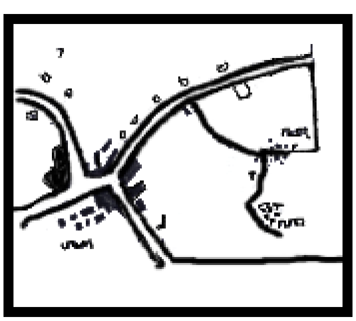
**Urban settlement.**

Urban settlement is commonly found in areas of the following nature.

- District administrative centers.
- Regional administrative centers.
- Capital city of a country.
- Areas with transportation system junction.

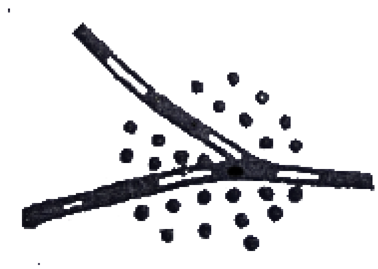
A good number or people approximated to over 80% in urban areas engage in non-agricultural activities mostly trade.

On the most topographical maps; urban settlements realized by the presence of the sign indicating the built up area.




**Rural settlement**

Rural settlement is in areas where the majority of people approximately to over 80% engage in agriculture shown by means of the black round dots. Thus; on topographical maps rural settlements realized by the presence of the black round dots.



**SETTLEMENTS PATTEERNS**

The signs showing settlements on topographical maps are observed to have **varied arrangement**. With respect to this, settlements on topographical maps and up on the areas represented recognized be in **varied patterns**. The most common patterns include the following.

**Dispersed pattern.**

It is alternatively called scattered settlement pattern. The houses are widely spaced one to another. It is very common in areas of the following nature:-

- Scattered cultivation.
- In areas where the individuals farms are large enough and population is too sparse.
- Pastoral societies.
- Newly established settlement area where the houses are few and thus may lie far apart.
- Evenly distributed of water sources. This makes settlement put in any suitable place.

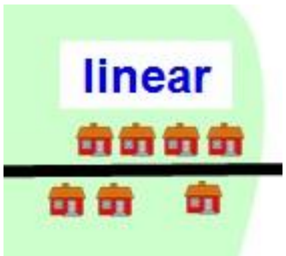

**Nucleated settlement patterns:-**

Houses and other related forms are compacted to one another. On the topographical maps, it is identified where the round black dots lie clustered or where black block lie in a specific area. This pattern is common in areas of the following nature.

- Urban areas where people more concentrated.
- Planned villages.
- Where there is a single supply of a certain economic resource and every is one is on need of it.
- The presence of economic factors like, industrial plants, mineral exploitation, plantation, and rich agricultural land.
- Presence of the social amenities like; health and education.
- Limited supply of water sources and this make people to stay very closely to it.
- Limited spacing for building due to natural and artificial restrictions. This makes people concentrate in available small space as a result settlement becomes clustered. e.g. Relief barrier which makes people to concentrate in a small area of more less hazardous areas.

**Linear settlement pattern**

It this pattern, the dwellings are concentrated along an elongated object of economic significance like; a road, a river, a railway line and others.




To realize and describe settlement, map user should be in position to observe the type of map symbols or sign that represent settlements.

On most of topographical maps as it has already been given; round black dots represent rural settlement; where as rectangular or square signs represent built up area like that of a town or a single building like market.

The way in which symbols and settlements are distributed on the map and up the area represented, is due to the many factors. Some have encouraged settlements and others discouraged.

**Factors encouraging settlements.**

- A reliable source of water supply. E.g. the presence of permanent rivers, lakes, dams, ponds, wells, or bore holes on the map. These are mainly used for domestic purposes as well as irrigation.
- Good soils for agriculture. This favours the cultivation of crops.
- Pleasant climatic conditions, which can be favouring kinds of crops cultivated and natural vegetation.
- Gentle slopes. People mostly prefer to establish settlements in less hazardous areas. Hence settlements are likely to be observed where the contours are reasonably wide apart, but not so wide apart. Gentle slopes provide a suitable gradient for the construction of means of communication and homes. More importantly soil erosion and mass wasting are less common.

- Transport and communication. Transport routes and especially roads, attract large settlements along side them. These largely ease the movement of people as well as their goods to else where of interests.

- Social amenities. Settlements tend to increase where amenities such as health and education exist. With respect to this, on maps there is high concentration of dots where the amenities exist.

**Factors deterring settlement.**

- Marshy or swampy areas. Usually symbols for seasonal or permanent swamps will be printed on such areas. More importantly the contours are very wide indicating flat lands liable to floods.

- Steep slopes. Steep slope give difficulties for road and railway construction. Erosion may be common and growing of crops is also difficult steep slopes on maps recognized if contours lie so closely to one another.

- Reserved area. These are the areas where a settlement is prohibited by law. These are known as government lands and reserved for national parks, games reserve or for future government plans. On the maps indicated in words.

- Unpleasant climatic condition. e.g. prolonged drought. This gives difficulties to cultivation of crops and water supply for domestic use and other purposes.

- Lack or shortage of water supply.

- Lack of the social amenities, transport and others.

**FORMS OF POPULATION DISTRIBUTION.**

Because of the factors, population distribution as observed on maps and up on the area represented is not even and makes varied forms related to is including the following.

**Densely distributed settlements.**

An area is described as being densely settle, where there is a high

concentration of settlements. On the topographical map, dense settlement are indicated by high concentration of dots or blocks of black squares. It is therefore where the concentration of dots appears very high, the population is described being very dense.

**Moderately distributed settlements.**

An area is described as being moderately settled, where the number of dots is moderate in quantity. i.e. Note very many and not very few.

**Sparsely distributed settlement.**

An area is sparsely settled where a few dots are spread over large area. It is therefore, where the dots are very few; the distribution of the settlement is described as being very sparse.

Important settlements description hints.

- Give the statement in connection to what are you need to describe from the map about settlements.
- Indentify the main types of settlements in the area as observed from the map whether rural, urban or both.
- In each type give the distribution, patterns and if possible the influencing factors.

**For instance:**

*Qn. Describe the settlement of the area*

**ANSWER:**

Settlement of the area as observed from the given extract map is described as follow.

The area has both urban and rural settlements.

The urban settlement observed on the eastern part of the mapped area where the area is heavily built up and form nucleated pattern. The location of this is assessed to have been influenced by the gentle topographical reasonable, lay our of transportation systems and the presence of so many social amenities like health.

Rural settlements make mostly case in the area. These observed almost every where in the mapped in exception of the eastern side.

However, rural settlement observed to occupy two patterns of nucleated and scattered. Nucleated is much observed in the northern and southern parts due to availability of social amenities and the presence of gentle topography.

Sparse settlement pattern observed in the central part due to the presence of scattered cultivation.

**EXRICISE**

Qn. Using the map extract given write short notes on:-

Settlements. (NECTA 2005 – the map extract of Musoma sheet 12/2).

Qn. Give account on population distribution of the area (NECTA, 2006 – the

map extract of Mpanda sheet 153/3).

Qn. Explain how the sites of some towns and villages and water south of 10 05

South are related to relief and water supply. (NECTA 1980, the map extra

part of TANZANIA MINGOYO.(Series Y742 sheet 295/1 Edition 1 – TSD

1967).

**9. HUMAN ACTIVITIES**

Human activities are of two categories and include:

- Social activities.
- Economic activities.

**Social activities**

Social activities include the ones conducted to meet social motivation like; education, medical care, security, entrainment and others. etc. The identification of these activities from the topographical map is as follows.

- **Education;** Identified by the presence of schools, collages, education centre etc.

- **Worship;** It is identified by the presence of church, mosque, mission schools and others which reveal the same.
- **Health care;** Identified by the presence of hospitals and dispensaries.
- **Entertainment;** It is identified by the presence of clubs, res house, hotels, motels and others which also the same.
- **Security;** It is identified by the presence of police station or police post, military camps, prisons and others of related.

## Economic activities.

Economic activities are the ones conducted by people for purpose of earning livelihood. These are for income earning to improve economic growth of an individual or society as a whole. Economic activities include; trade, tourism, mining, manufacturing industry Pastoralism, crop cultivation/agriculture and others.

Topographical maps have much that involves the development and exploitation of woods from green resources of forest. On the topographical maps,economic activivties can be identified by the presence of the following.

### 1. Lumbering

Lumbering is an economic activity that involves the development and exploitation of woods from green resources of forest. On the topographical maps, lumbering can be identified by the presence of the following:-

- Saw mills; these are for processing of woods.
- Forests, the natural resources from which wood exploited.
- Minor roads ending into the forestland, these established purposely to transport logs to saw mills.

### 2. Crop forming.

It involves the development and cultivation of crops. It is the one of the basic and most widely spread human activities in Tanzania, East Africa and else where in the world.

Crop forming in the area with reference to the topographical map provided. Can be identified by the presence of the following:-

- The directly shown large scale farms (Plantation), on the map e.g. sisal estates, cashew nuts plantation etc.
- Rural settlement in a basis that, over 80% of people dwelling in rural areas engage more directly in agriculture.
- If the area is assessed to experience suitable climate conditions for crops cultivation e.g. reliable rainfall.
- Presence of water bodies like, rivers, dams which can support irrigation agriculture.
- Presence of crops processing industries like; ginneries, decorticators and hulluries.

**3. Livestock keeping.**

Livestock keeping is among the human activities which based on domestication of animals of like; cattle, goats, sheep etc. on a topographical map, livestock keeping can be identified by the presence of the following:-

- Grassland with scattered settlement as people in grassland areas engage in animal keeping as their reliable source of earning livelihood.
- Presence of ranches and diary farms.
- Veterinary centers. These are the stations in which treatment and vaccination given to the domesticated animals. They are commonly established in areas where live stock keeping is conducted.
- Dams and bore holes. These have been constructed in many areas for domesticated animals.
- If the area is assessed to experience aridity condition and there is the presence of scattered settlement. In consideration on arid areas crop farming is of difficult and thus, people earn lively hood mostly by engaging in animals keeping.
- Cattle markets. These commonly established in areas where animal keeping is conducted.

**4. Mining and quarrying**

Mining involves the development and exploitation of minerals from the ground and other sources. The activities from the topographical map can be suggested by observation of the following.

- The presence of the conventional signs indicating mineral works. Usually signs for minerals works are interpreted in the map key.
- Sometimes, the presence of lakes in valley may guide you suggest the activity due to the fact that, such lakes are exploited for salts and soda.
- Presence of quarries.

**5. Fishing.**

Fishing activity involves the development and exploitation of fish from the water body systems of rivers, lakes and ocean.

From the topographic maps, finishing is suggested by the presence of the following.

From the topographical maps, fishing is suggested by the presence of the following.

- Small settlements along the coasts of sea, lake and large rivers. It is so as lakes, rivers and seas provide good basis for fisheries. Beside this, people living along the water courses are fishermen oriented.

- Presence of fish ponds, fishing cooperatives societies, fishing colleges, fishing villages etc.

**6. Manufacturing industries.**

These are the activities which involve the turning of organic, inorganic, refined raw materials by chemical and mechanical means into new products. On topographical maps manufacturing industries can be observed by the presence of the following.

- Factory special symbols which indicated on the map interpreted in the map key.

- Presence of township characterized by having high concentration of transport networks of road railways. It is so as manufacturing industries follow urban centers to have accessibility to markets, transports, and labour supply.

- Presence of industrial area as directly shown on the map.

**7. Trade.**

Trade is an exchange of goods and services. Trade can be identified by the presence of the following:-

- Township as the majority in towns engage in non agricultural activities including trade.
- Transport network of roads and railway together with settlement. These normally facilitate the movement of people for trade purposes, and also facilitate the exchange of goods and services.
- Presence of other economic activities.

**8. Tourism.**

Tourism is suggested by the presence of the following.

- Historical sites like museums indicated by some signs on the map.
- Attractive landform such as craters, mountain, beaches etc.
- Hotels, motels and rest house, recreation centes.
- Presence of national parks, game reserve and forest reserve.

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# PHOTOGRAPHS INTERPRETATION

**INTRODUCTION TO PHOTOGRAPHS.**

Photographs are the true image pictures showing truly appearance of the earth's surface objectives on the flat bodies of special pieces of paper taken with the use of a camera and chemically printed.

Or

Are the pictorial representations of the remote sensed data recorded on film in a camera then chemically printed on special pieces of paper.

With respect to the definition given, photography is produced as the image of the object captured and recorded with a camera on a light sensitive film. The film by then is developed in a **developer machine** to remove darkness in it to develop brightness of object's image. The image in the film by then printed on a special paper using chemicals to develop clear true image pictures. The camera recording the images of objectives can be mounted on **the ground** or **aerial platform**.

A person who takes photography with the use of a camera is called **photographer**; and the art of producing these pictures is known as **photography.**

Photographers have potential significance in geographical studies in a number of ways. For in stance; they are used to asses the geographical facts of respective areas. Alternatively used to make storage (recording) of the geographical details of pieces. It has to bear in mind that, land details change with time,But a photography once produced remains unchanged. Some of the geographical details that can be assessed from photographs include; relief, land use, drainage features, settlement and vegetation.

**TYPES OF PHOTOGRAPH ON GEOGRAPHICAL PHENOMENAL.**

Photographs are not all the same as images of objects on them observed to have varied appearance. The varied appearance of image objects are determined by the orientation of the camera axis (**Photographic views**). Thus; photographs are classified according to the appearance of the images on them relatively to the orientation of the photographic views. Also; photographs are classified by considering the nature of platform from which the camera and photographic view has been mounted and set. By regarding the two categorizing factors, the numerous photographs are broadly classified into the following types. · Horizontal/ground photographs.

- Vertical aerial photographs.
- Oblique photographs.
- Satellite photographs.

**GROUND (HORIZONTAL) PHOTOGRAPHS**

These are the photographic prints of which whose images have been captured and recorded on film as photographic views horizontally set with camera mounted on the platform of the ground I e the photographic view by camera towards the object is from the surface level of ground the camera is placed fixed on a tripled stand very close to the ground comparatively Ground photographs are also known as **terrestrial photographs.**

The horizontal photographic view may target a particular object or the general scenery of the area it is thus; the horizontal photographs may show major object or the general scenery of the area basing on this; horizontal photographs sub divided into two

- Close up ground photographs
- General view ground photographs

### Close up ground photographs.

These photographs are produced as the photographic view focuses on a major item such as a tree a person an animal a house and others of the same reflection The particular item obscures most of the other details behind it and thus the picture shows a **died ground** These photographs are alternatively known as particular view photograph

### General view ground photographs.

These are taken by the photographic views with mounted camera focusing the general scenery of areas commonly; the photographic view are not intercepted by an obstacle as a result all objects at an area recorded on the film and printed to appear on the photo by getting progressively smaller from the fore ground to back ground hence; the photograph give the general view of the scenery this photograph shows horizons.

Horizon means part of the photograph where the land and sky apparently meet.

Close up ground photograph

General view ground photograph

**Characteristics of ground photograph.**

· On the ground photographs particularly objects get progressively smaller from the fore section to back section and horizons likely to be seen.

· The ground close up photographs do not show horizons.

· They cover smaller areas of ground.

· They do not make uniformity coverage of the ground represented.

· Scale changes by getting progressively smaller from the fore ground to back ground due to the non uniformity coverage of the ground.

· They show front views of the object's image.

· Ground photographs are taken from surface level.

**Strengths of the horizontal photographs.**

· The objects on the photograph are clearly seen.

· It is easy to interpret as the image of objects is clearly observed on the photograph.

· They are less expensive to be produced compared to other types of photograph.

· Comparatively; horizontal photographs are the most familiar pictures to people compared to other forms of photographs.

· Ground photographs can be used as an aid to field sketching.

· They give more easily instant data of areas.

**Setbacks of the horizontal photographs.**

· Cover smaller area size of the ground. It is thus; enables people to make analysis of geographical features of small areas.

· Subjected to scale distortion as image of objects as well as ground coverage get progressively smaller from the fore ground to back ground this makes difficult to asses the used scale.

· They are not potential for assessing the measurement of the geographical features like; area size and distance due to scale distortion.

· Not all objects are seen on the photograph as some are hidden by others

· They are not potential for map making due to scale distortion and coverage of smaller areas .

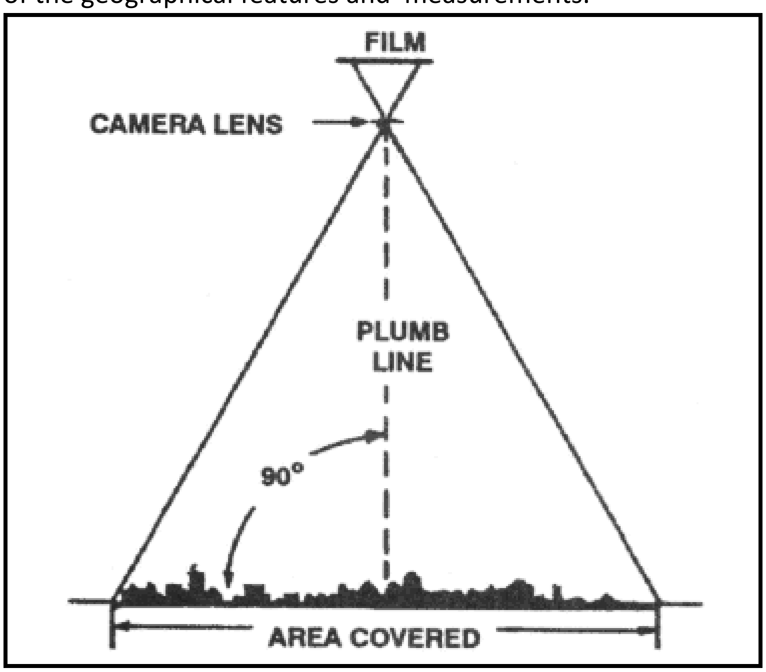
Note

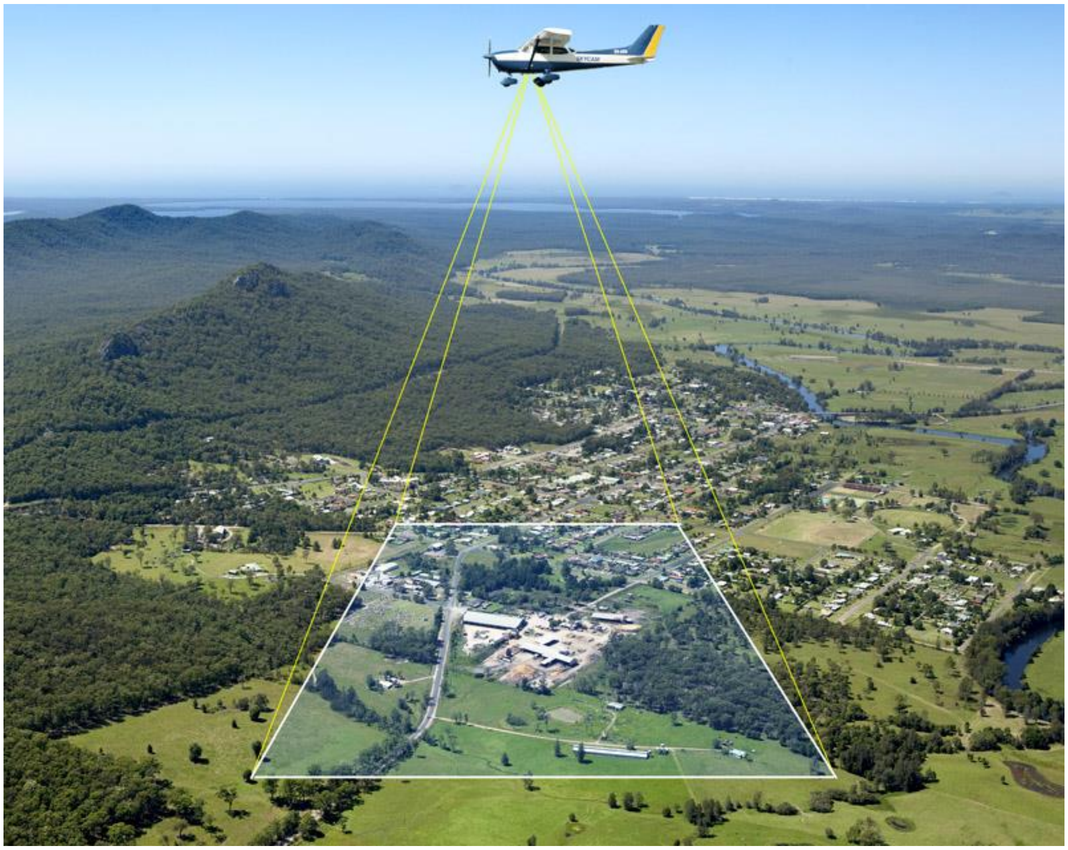
Horizontal photographs are produced purposely to have an aid for making geographical analysis and description of the smaller areas

## VERTICAL PHOTOGRAPHS

These are photographic prints whose images of objects have been captured and recorded on film as photographic views vertically set with camera mounted on the platform of the aircraft. i.e. the earth's surface is viewed vertically from the air craft with the camera axis at almost right angle of 90 though the angle can be displaced to either 87 or 93 due to the movement of the aircraft

According to the history the first vertical aerial photograph was taken from a balloon by a French man in 1855 and were much improved in Germany However; the importance of these photographs for map making became during the first and second world wars when maps were needed for military purposes. Vertical aerial photographs have less scale distortion and mostly used for map making and assessments of the geographical features and measurements.





**Characteristics of the vertical aerial photographs.**

- They display the top view of the objects as photographic view vertically directed towards the landscape.
- The image of objects on photographs appear less distorted in size.
- They are taken with camera axis vertically directed.
- They make considerably uniform coverage of ground.
- They are less subjected to scale distortion.
- The change of scale by getting progressively smaller is from the centre to outwards
- Advantages of the vertical aerial photographs
- They have less scale distortion following the uniformity coverage of the landscape on the photo
- It is possible to judge the photo scale as there is uniformity coverage of the landscape on the photo and images are less distorted in size. Scale is assessed by relating the corresponding measurements between the photograph and ground or by relating the focal length of the used camera and flying height of air craft above the ground
- Cover larger area of the ground. It is thus; people make geographical analysis of the wider geographical areas
- They are mostly used in map making because of covering wider areas and less scale distortion
- It is possible to make photogrammetric i. e. They are used to asses measurements of the geographical features as whose scale almost is less distorted
- Vertical aerial photographs can be viewed stereoscopically. i. e. images can be viewed in three dimensions with the use of a stereoscope
- They provide instant data particularly those which can not be given by the horizontal photographs e. g. the volume of moving objects at a time such as cars ships etc
- They can provide details of the impenetrable or remote areas which can not be visited by ground surveyors or photographed horizontally. e. g. swampy land dense tropical forest, desert interiors ice caps and others of the same consideration

- **Disadvantages of vertical aerial photographs**.
- Objects are not clearly seen as very huge area covered and only the top view of objects are displayed
- It is some how difficult to make photo interpretation as objects are not clearly seen
- They show only the top views of the land objects taken
- The taking of the vertical photographs is affected by the adverse weather E. g. cloud cover during the rainy season
- The taking of the vertical photographs is still an expensive process
- Minor detail is often lost in vertical aerial photographs and need to be supplanted by ground survey
- Because of being non selective; vertical photographs are wasteful as show masses of details some of which may not be needed in the analysis and description

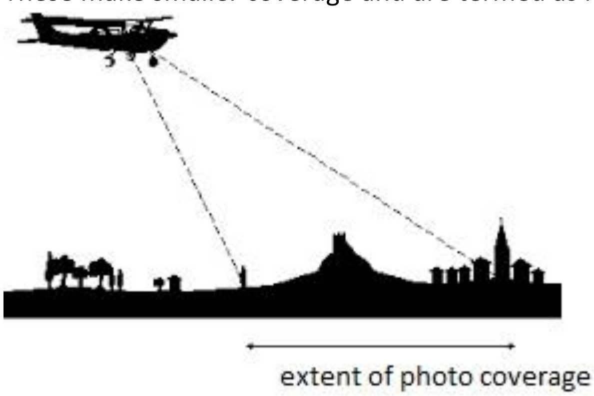
**OBLIQUE PHOTOGRAPHS**

These are the photographic prints of which images have been captured and recorded on film as photographic views tilted with mounted camera from either aircraft or elevated ground. Tilting of the aircraft can be from low oblique photographs which only show the surface. Tilting of the photo graphic view from high height produces the high oblique photographs which commonly show both horizons and surface. By regarding from where the tilted photographic view set; **oblique photographs** are divided into two and include;-

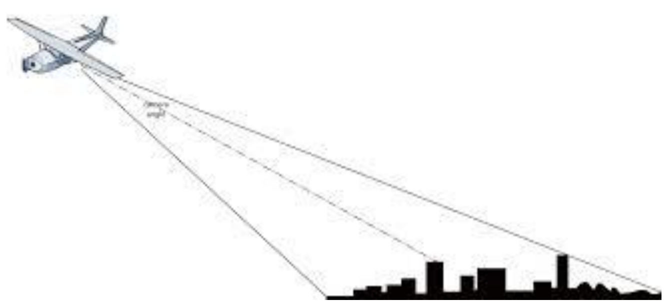
- Ground oblique photographs/low oblique
- Aerial oblique photographs/ high oblique

**Ground oblique photographs**

These are the photographic prints whose images have been captured and recorded on film as photographic views tilted with mounted camera from elevated ground e.g. from a hill looking down. These make smaller coverage and are termed as low oblique aerial photographs.




**Aerial oblique photographs.**They are the photographic prints of which whose images have been captured and recorded on film as photographic views tilted with mounted camera from aircraft



**Characteristics of oblique photographs**.

· Images of objects on the photograph get progressively smaller form the fore ground to back wards.

· Subjected to scale distortion as there is no uniformity coverage of the ground on the photograph.

· The change of scale by getting progressively smaller is from the fore section to back section.

· Show both side and top views of the objects.

· Images on the photo are highly displaced as they occupy apparently linear position

**Advantages of the oblique photographs**

· Objects on the photograph are relatively large in size. Hence they are clearly seen.

· It is easy to interpret the photograph as images of objects in them are clearly viewed.

· They show both side and top parts of the objects.

**Disadvantage of oblique photographs**.

· They suffer from the problem of image displacement i.e. the objects on the photo are observed to occupy the linear position.

· They are subjected to scale distortion as objects get progressively smaller from the fore ground to backwards. Hence it is difficult to judge the used photo scale.

· They are not used for map making due to scale distortion.

· They are not potential for assessing the measurements of the geographical features.

**Differences between the oblique and vertical photographs.**

· Vertical aerial photographs cover larger area size of the ground, while; oblique aerial photographs cover smaller area size of ground.

· Vertical photographs show only the top view of the objects; while oblique photographs show both side and top views of objects taken.

· Oblique aerial photographs show both the surface and horizons while the vertical aerial photographs show only the surface.

· Oblique aerial photographs show displaced images; while the vertical photographs do not show displace images.

· Oblique photographs are much subjected to scale distortion; while the vertical aerial photograph is less subjected to scale distortion.

· The change of scale by getting progressively smaller is from the centre outwards on vertical aerial photographs while on the oblique aerial photographs are from the fore section to back section.

· Vertical aerial photographs display much smaller images of the objects; the oblique photographs display relatively large sized images of the objects.

· Vertical aerial photo is used in map making while the oblique aerial photo is not used in map making.

**SATELLITE PHOTOGRAPHS**

These are the photographic prints whose images recorded (taken) electronically with the use of a scanner as a sensor placed in a satellite.

Or

photographs of earth and other planets made by means of artificial satellites in which multi spectral scanners installed (equipped)

The scanning view is directed towards the land space from the satellite operating in a very high altitude.

Satellite operates at vertical distance of 900km above the mean sea level.

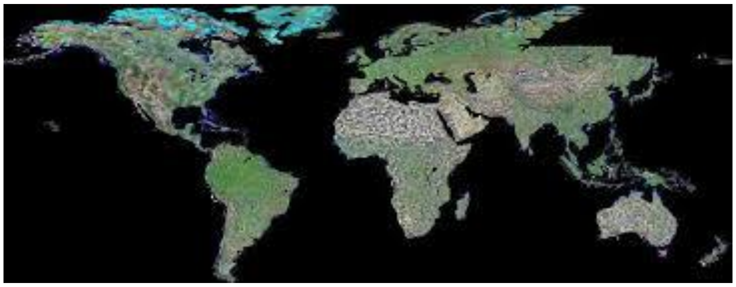
The satellites are equipped with sensitive receptors called multi spectral scanners which reflect details from the earth's surface. The data recorded by multispectral scanners are relayed (sent) electronically to ground stations where with other electronic machines the imaginary data processed to develop photographs which give much details up on meteorological condition, geology, soil, pollution, forests, and crops.

The satellite imagery have daily used for weather for forecasting, provide information for mapping, land use and plotting the landscape details and other uses.

**Types of satellite imagery.**

Satellite imagery are recognized by considering types of data they display.

(a) Land sat satellite imagery: - these provide details about **earth's resources.**



(b) Meteosat satellite imagery: - these provide meteorological data for daily weather forecasting.

**Uses of satellite imagery.**

· They are used to forecast the weather conditions likely to occur in some days to come.

· They are used to monitor forest fires, ice flows and ocean currents.

· They are used for resources assessments. i.e. satellite photographs are used to reveal the resources which present in different parts of the earth's surface.

· They are used for mapping purposes. The boundaries of countries, continents and other features which appear on maps mostly traced from the satellite imagery.

· They are used for environmental management.

· Satellite imagery facilitates scientific studies. For instance; satellite imagery used to detect sea surface temperatures.

· They are used for military purposes. Satellite imagery provide secure communication for the military.

**Disadvantage of satellite imagery.**

· They are most expensive to be produced as it can be compared to all other forms of photographs.

· They are difficult to be processed.

· They require high skill to be interpreted because of their colour composites.

## IMAGE DISPLACEMENTS, SCALE DISTORTION AND PARTS OF THE PHOTOGRAPHS.

### IMAGE DISPLACEMENTS.

### (PARALLAX)

On some photographs, the images of objects do not appear uprightly vertical as are in real life. They are observed to appear displaced by occupying apparently linear position. This in the study of photographs is knows as **image displacement**. It is thus; image displacement is defined as the photographic setting of objects on the photo to occupy apparently linear position.
The scientific term used to describe and explain image displacement is known as parallax. Hence; parallax is defined as the apparent shift in position of an object on the photo with respect to reference point. By reference point refers to the position of an object on the photo.

**Causes of image displacements**.

(a) The change of viewing position

If a photograph is taken by the tilted photographic view, the images of objects on the photo are made to have both top and side views and thus; appear displaced. With respect to this; oblique photographs are the ones which have highest degree of image displacement compared to horizontal and vertical photographs.

(b) Height of the viewed objects.

This makes variation in the degree of displacement of objects on a photograph. The higher objects are more displaced that the smaller objects on the photo. For instance; the high buildings on oblique photographs appear more displaced compared to the smaller buildings.

(c) Position of the object on the photo.

Usually objects at **a nadir (principle point)** are less displaced compared to those that are away from the Nadir (principle point) this is observed on vertical photographs, the objects on the fore ground have low degree of displacement compared to those on the back ground. But this factor is mostly considered to objects of the same height.

**Note**

Image displacement is one among the sources for image displacement on photographs.

**SCALE DISTORTION.**

On photograph scale is changed by getting progressively smaller from one section to other sections. This in the study of photographs is referred as photo scale distortion. It is thus; photo scale distortion defined as the variation in relation ship (ration) of distance between the photograph and ground by getting progressively smaller from the principle point outwards on vertical photographs or from the fore ground to backwards on horizontal and oblique photographs. However; the degree of photo scale distortion is much higher on oblique and horizontal photographs than on vertical photographs.

**CAUSES OF SCALE DISTORTION.**

Scale distortion is made by the following causal factors.

(i) Non **uniformity coverage of the ground**.

The section on photograph that covers small area is subjected to large scale, while that covers wider area is subjected to small scale.

(ii) **Distortion in size of the objects**.

Objects that appear apparently smaller make small scale compared to those which appear apparently larger.

(iii) **Image displacement.**

More displaced objects make small scale compared to objects which are less displaced.

## 7.2 PARTS OF PHOTOGRAPHS.

Photographs are used to make description and analysis of the geographical features observed with reflection to be actual areas represented. The features described should give their position location on the photographs. The location position of the features is by pointing out parts of the photographs where the features are found. It is thus important to understand the major parts of photographs in such a way that the features can be described and analyzed clearly.

Parts of photographs are recognized by dividing the photographs horizontally and vertically into three dimensions

Horizontal division makes a photograph to have three equal parts of; fore ground, middle, ground and back ground.

| Back ground |
| --- |

| |
|---|
| Middle ground |
| Fore ground |

Vertical divisions makes a photograph to have three equal parts of; left, centre and right.

| | | |
|---|---|---|
| Left | Centre | Right |

If both horizontal and vertical divisions combined, a photograph is made to have nine equal parts. The main parts include the following:-

(a) **Fore ground:**

This develops; left fore ground, centre fore ground, and right fore ground.

(b) **Middle ground:-**

This develops; left back ground, centre ground and right ground.

(c) **Back ground:-**

It develops; left back ground , centre back ground and right ground.

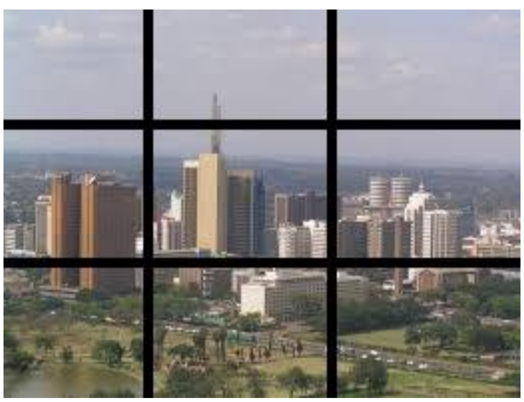
| | | |
|---|---|---|
| Left back ground | Centre back ground | Right back ground |
| Left middle ground | Centre middle ground | Right middle ground |
| Left foreground | Left back ground | Right fore ground |

**Note:**

The nine parts of the photographs as already pre described have the following vital significance.

- They are used for position location of the features on the photograph in the course of making description.

- They are considered for diagrams drawing from the photograph. i.e. they are used to place features on the diagram at right positions.



**VERTICAL PHOTOGRAPHS SCALES.**

Photograph is much smaller in size, while objects represented are much large in size. It is thus; photographs being much smaller subjected to have considerable relation of distances to the much large objects represented. This is what referred to photo scale. It is thus; **photo scale** is defined as the relation ship of distance between the photograph and their respective object represented.

The scale of a photograph is not much up on the decision of the photographer. It is thus; once a photograph produced, its scale should be assessed to allow further assessment of the geographical features. In this aspect; it is possible to asses's scales for photo graphs which make uniformity coverage of ground. Hence it is difficult to assess specific scale for horizontal and oblique photographs whose specific scales can be assessed.

Photo scale extremely varied in size and the most common types are **large and small photo scales** depending on the size of the ground covered. Coverage of smaller area make large scale, while coverage of wider area make small scale.

The scale of the vertical photograph relatively to the size of the ground covered is the function of the following determinant factors:-

- Focal length of the camera used.
- Flying height of the air craft above the ground.

**PHOTO SCALE EXPRESSION**.

The assessed scale can be expressed in one of the following techniques.

I. In fraction $\frac{1}{50,000}$

II. **In ration form**. 1:50,000

III. **In unit equivalent**. e.g. 1cm on the photo = 0.5 km on the ground.

IV. **In statement**; e.g. 1cm on the photo represents 0.5 km on the ground.

**PHOTO SCALE DETERMINATION.**

Scales of the vertical aerial photographs are determined by two methods and they include the following:-

1. By relating the corresponding distances between the photograph and ground. The distances should be measured and the application is as follows:-

$$\text{Photo scale} = \frac{\text{Photo distance}}{\text{Ground distance}}$$

Ground distances obtained in the one of the following two ways:-

- By making actual measurement at the photographed area.
- The use of scaled topographical map representing the same photographed area.

**Example:-**

**Ground distance from area A to B is represented by 5cms on the photo. The same ground distance is represented by 10 cm on a topographical map drawn on the scale of 1:50,000. Determine the photo scale.**

**Solution.**

The photo scale is determined as follow:-

$$\text{Photo scale} = \frac{\text{Photo distance}}{\text{Ground distance}}$$

According to the given data:-

- Photo distance = 5 cm
- Map scale = 1:50,000
- CD on the map = 10 cm.

$$\frac{5cm}{10 \times 0.5} \quad \frac{5cm}{5km} \quad \frac{5}{500{,}000} = \frac{1}{100{,}000}$$

**Thus; the photo scale; 1:100,000**

**2**. By relating the focal length and flying height above the ground. The technique (method) is applied as follows

$$\text{Photo scale} = \frac{f}{Hg}$$

.

**While:-**

- F = focal length of the used camera.
- Hg = flying height of the air craft above the ground.

**Note:-**

Flying height of the air craft above the ground does not on the photography. What directly appears on the photograph is the flying height of the air craft above the sea level. It is thus; the flying height above the ground is obtained by subtracting the ground height from the flying height of air craft above the sea level.

$$\boxed{Hg = H - g}$$

**Where by:-**

- Hg = The height of the aircraft above the ground.
- H = Height of the air craft above the sea level.
- g = Ground height above the sea level.

**Example:-**

Determine the scale of the vertical aerial photograph taken with the camera of 6” if the flying height are 7,000m and ground height 4,000m respectively.

**Solution:-**

Scale for vertical aerial photography up on the given data is determined as follows:-

$$\boxed{\text{Photo scale} = \frac{f}{Hg}}$$

While; Hg = H – g

According to the given data:-

f = 6’

H = 7,000m

g = 4,000m

$$\frac{6''}{7{,}000m - 4{,}000m}$$

$$\frac{15\ cm}{3{,}00m}$$

$$\frac{15}{300000}$$

$$\frac{1}{20{,}000}$$

**Thus; the photo scale; 1: 20,000**

**Note:-**

1. The focal length of the used camera is determined as follow.

$$\boxed{\text{Focal length = photo scale x Hg}}$$

2. The height of the air craft above the ground is determined by the following application.

$$Hg = \frac{focal\ lengt}{photo\ scale}$$

3. The height of the aircraft above the sea level is determined as follow.

$$\boxed{H = Hg + G}$$

**Where by:-**

- H = Height of the air craft above the sea level
- Hg = Height of the air craft above the ground.
- G = Ground height above the sea level.

**Exercise.**

An air craft flying at the same level over the terrain ground took two photos over the coastal plain that was at the sea level and mountain peak respectively, using the camera of the same focal length. The first photo scale was 1; 37,000 taken at 4500m a.s.l. and the second photo scale was 1:20,000

(a) Calculate the camera focal length.

(b) Determine the altitude of the mountain peak.

Calculate the height of an area shot by a camera whose focal length is 132mm mounted on an air craft which is flying at 10500m above the sea level. The suggested scale is 1:25000.

A vertical photograph with suggested scale of 1:20,000 has been taken by photographic view set from air craft at altitude of 5000m. The used focal length was 6" (15cm).

(a) Determine the imperial altitude of the photographed area.

(b) What metric scale the photograph may have if the photographic view set at altitude of 400m.

Calculate the flying height of an aircraft for the vertical aerial photograph at the scale of 1:20,000 whose mean ground level is 500m above the mean sea level with the focal length of

i. 210mm

ii. 152mm

**PHOTOGRAPHS OVERLAPING, PHOTOGRAMMERTRY,**

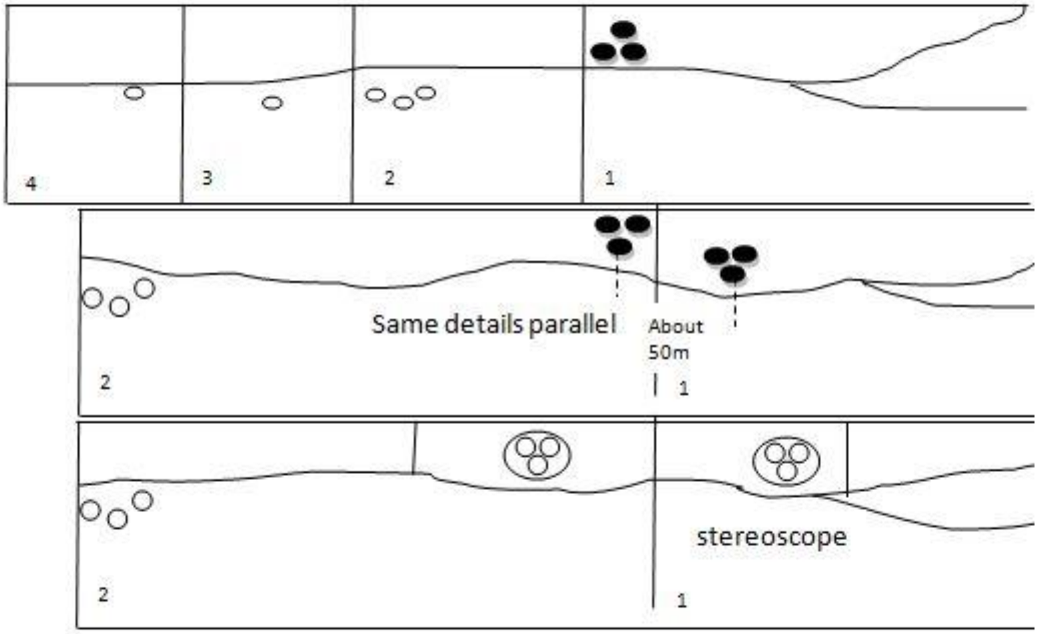
**MAP MAKING AND DIAGRAMS SKETCHING.**

**1. PHOTOGRAPHS OVER LAPPING.**

It becomes difficult for a single photographic view as a respective photograph to cover the very huge part of land space at once. Following this difficult several successive photographic views as well as photographs can be produced to make the whole huge part covered. Then the different successive photographs taken along the same or different photos to appear on the same photo. This photographic technique is referred to photo over lapping or photo mosaic. Thus; photo overlapping is the photographic technique of two or more successive photos combined and appear as one photo.

Or

Is the technique of making the ground that party appears on the different successive photos appear on a similar photographic by combining the different successive photographs.

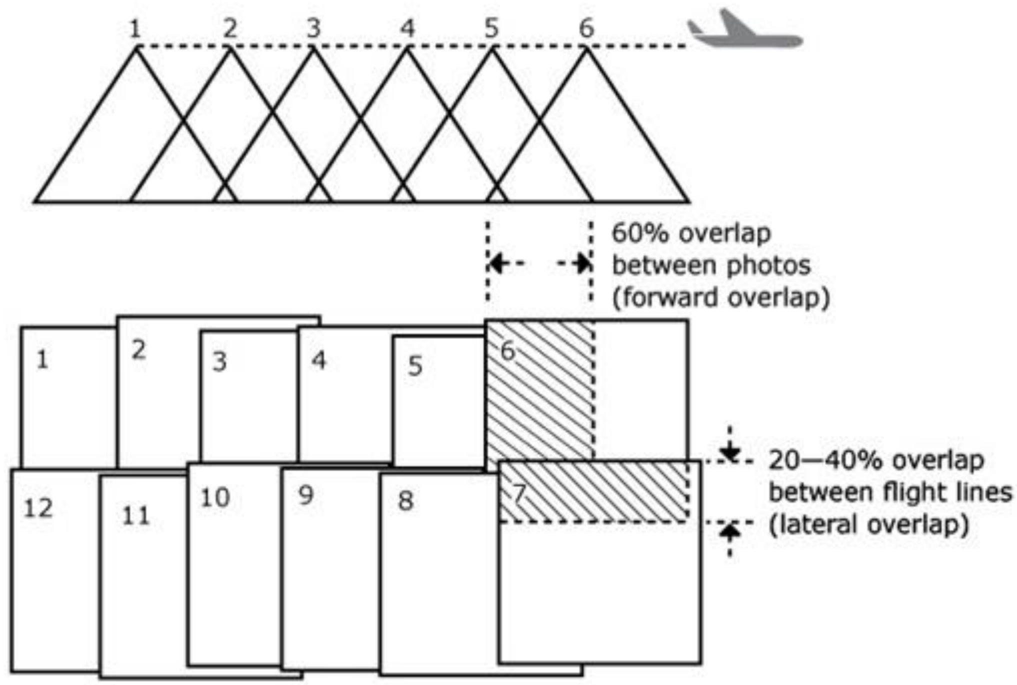



There are two types of the photo over lapping namely:

- Forward photo overlapping.
- Side photo overlapping.

**1. Forward photo overlapping.**

Forwards photo overlapping is made by combining two or more successive photos taken along the same flying height line.




2. **Side photo overlapping.**

Side photo overlapping is made by combining the top and bottom parts of two different successive photographs taken along different flight lines.

3. **PHOTOGRAMMETRIC.**

Photographs are used to asses the geographical facts including the measurements of the geographical features measurements like area size and distance is known as

photogrammetric. How ever; photo gram metric does not stick only on measurements determination; it also involves the assessment of other geographical facts.

Photogrammetric is made possible only on vertical aerial photographs as whose scales less distorted.

**Distance measurement.**

Distance refers to a length of an elongated object or an interval between two parts on the earth's surface given in linear measurement units.

The distance of any features is determined as follow.

- Photo scale consideration.
- Measure the photo distance of the object. If the elongated objects is straight, a ruler can be used. But if the objects is not straight, a divider, a piece of paper or thread can be used.
- Convert the photo distance into actual distance by regarding the photo scale.

**Size determination.**

Area size means the extent f coverage or bigness of a feature on the earth's surface given in unit square.

The area of any feature is determined as follow:-

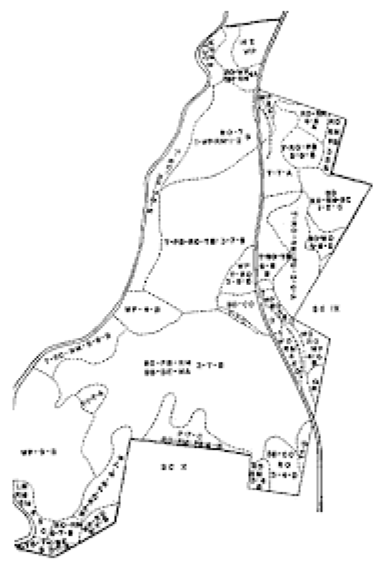
- Photo scale consideration.
- Examine the appearance of the feature on the photo.

If the figure is regular apply more directly the relevant mathematical formula with respect to the shape of the figure. Is considerably irregular, divide it into a convenient number of the mathematical figures, and then calculate the area size of each figure.

3 **SKETCHING OF MAP FROM THE VERTICAL AERIAL PHOTOGRAPH**.

Drawing of a map from the vertical photograph should follow the following procedure.

- Examine carefully the given photograph. If possible use the stereoscopy to get the more clear view of the objects.
- Take a trace paper and over lay the photograph.
- Separate the features of the photograph on the trace paper by producing the fine lines. This has to take into consideration the textures of the objects.
- Provide the distinctive shade on the trace paper to have clear distinction of the features on the map.
- Develop the map more clearly and associate it with important supportive details to make it well defined. The supportive details include; title key, north direction, scale and other important thinks.
- The map sketched is of the same size with photograph. It can be further develop by being enlarged or reduced.



Sketched from Arial photograph

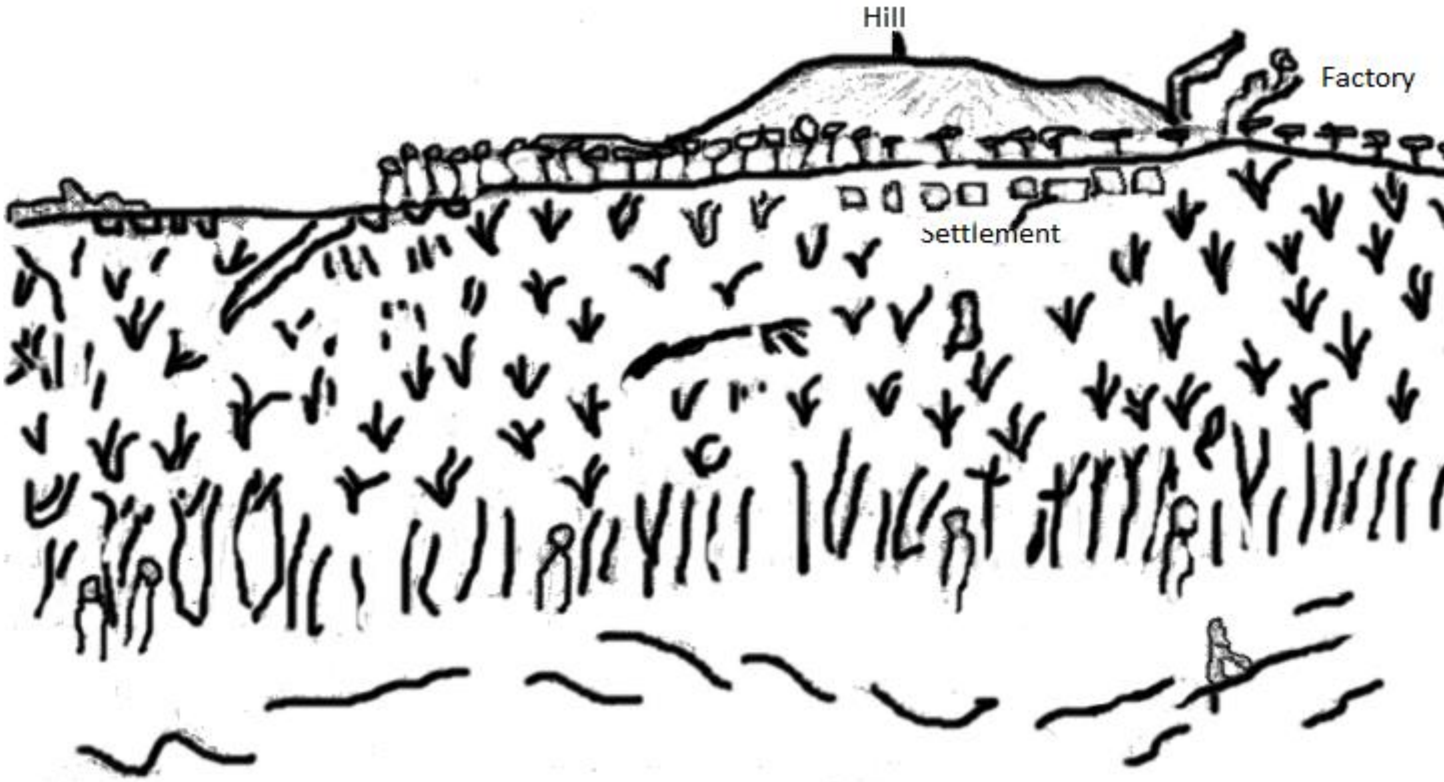
2. **SKETCHING OF DIAGRAMS**.

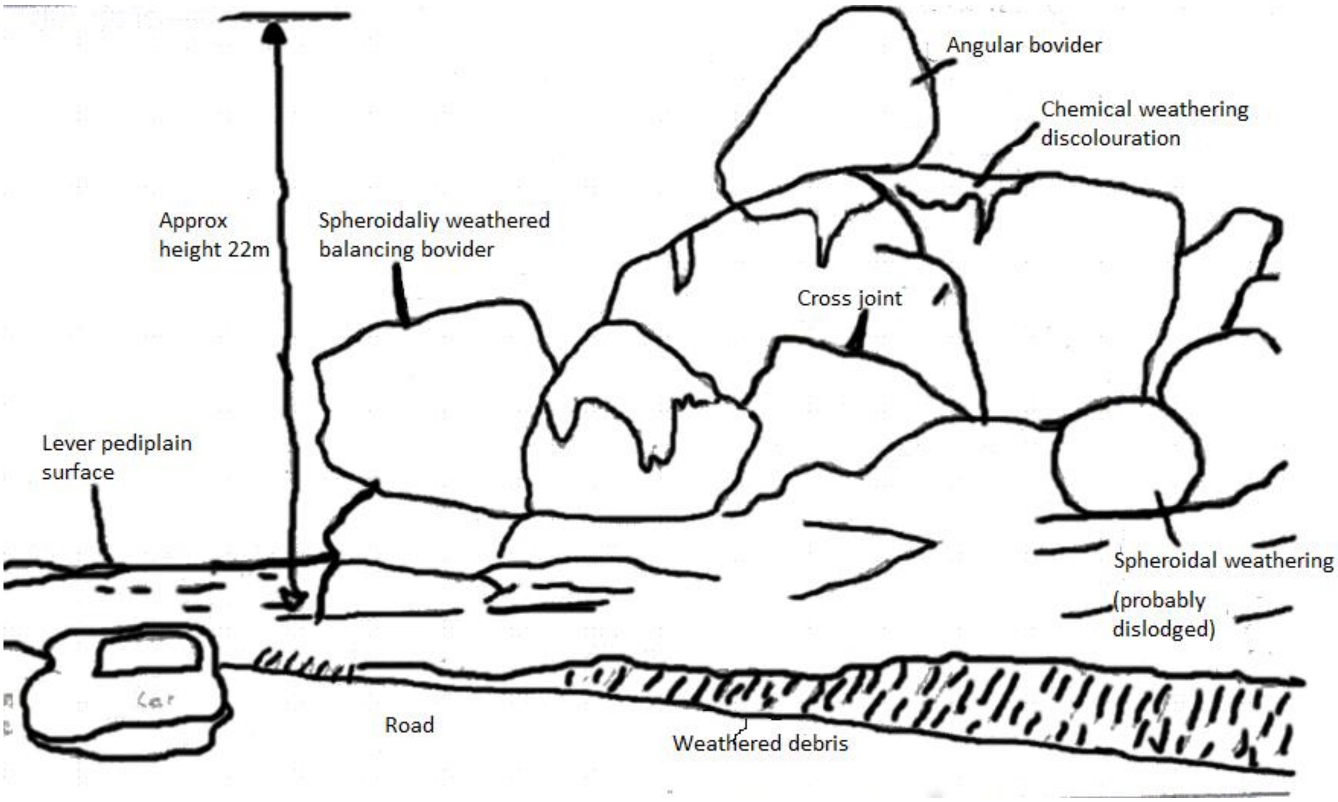
A map can be only sketched from the vertical photographs. From the horizontal and oblique photographs, diagrams can be sketched to provide visual impression of the features described from the photograph.

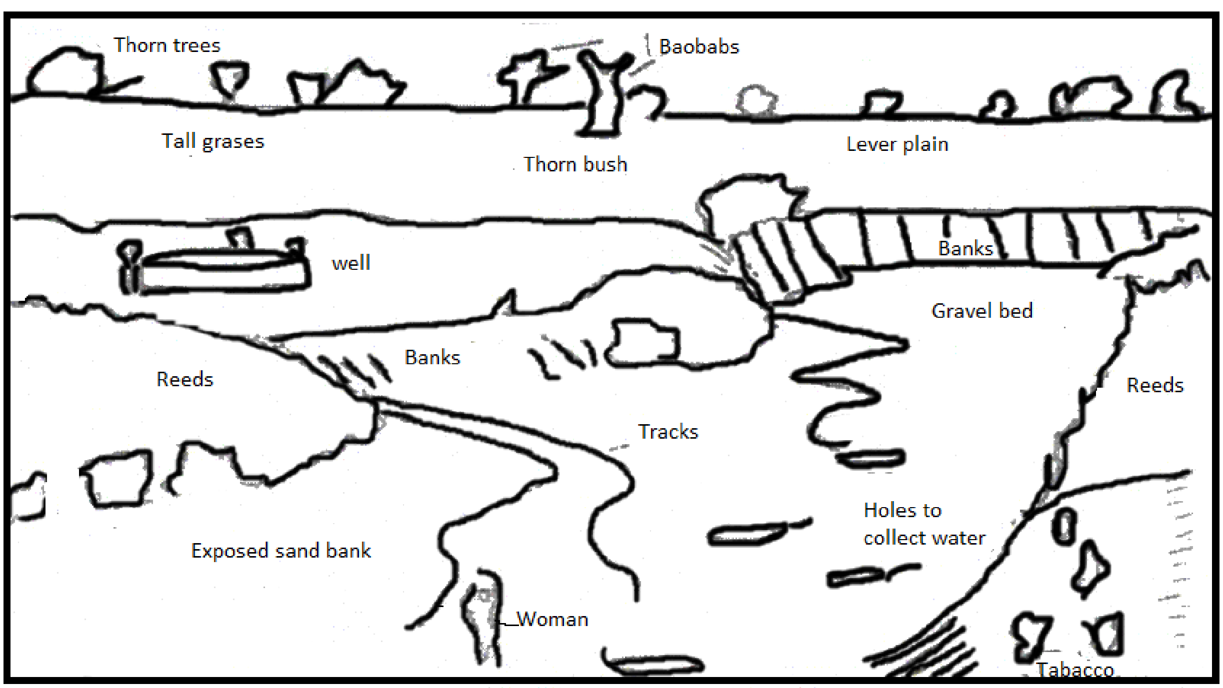
To draw diagram from photograph, the steps given below should be followed.

- Draw a frame work of either rectangle or square on piece of paper. The frame work should be proportional to the size of the photograph. Keep this paper aside.
- Subdivided the photograph from which a diagram to be drawn into three equal sections by faintly drawing horizontal lines a cross the photograph use pencil to develop foreground, middle ground and back ground.
- Transfer the details from the photograph into the frame work of the diagram.
- Start by inserting details in the back ground as it appears on the photograph.
- Fill the details in the middle ground and finally put in the important features in the foreground. The square drawn on the photograph guide in placing the various features in their rights positions.
- The sketch should be completed by drawing and labeling all the important features such as vegetation, land use, prominent buildings, transport and communication and then; give a suitable title of the sketch.

HARVESTING SUGAR CANE




Angular bovider
Chemical weathering discolouration
Approx height 22m
Spheroidaliy weathered balancing bovider
Cross joint
Lever pediplain surface
Spheroidal weathering
(probably dislodged)
Car
Road
Weathered debris


Thorn trees
Baobabs
Tall grases
Thorn bush
Lever plain
well
Banks
Gravel bed
Reeds
Banks
Reeds
Tracks
Holes to collect water
Exposed sand bank
Woman
Tabacco

**7.3 USES OF PHOTOGRAPHS**.

Photographs are produced purposely to meet certain objectives, and these are what considered as **the uses of photographs**. Some of the considerable uses of photographs include the following:-

(a) They are used for map making in a number of ways as follow.

- They make confirmation of the details to be surveyed in an area to be mapped.
- They can be used for preliminary mapping of areas
- They are used for rapid survey of the remote areas which can not be reached.

(b) Photography's **provide the basis for making geographical description and analysis**. It is thus; photographs make people to understand the geographical details of areas represented.

(c) They are used **for making resources assessment** more particularly of areas that can not be easily reached. For instance; assessment of plant species, wild animals and others.

(d) They are for **military purposes** and mostly used for doing **reconnaissance in war**.

(e) Photographs are used **for making measurements assessment** of the geographical features particularly for areas that are not easily reached. The assessment can be on distance, size and height.

(f) Photographs are used **for engineering works. i**.e. they give significant information that can be used to provide good basis in designing engineering structures.

(g) Photographs are used to **make storage of instant** data of like; graduation, weddings, meeting. Family celebrations and others.

(h) They are more applied for **field investigation.**

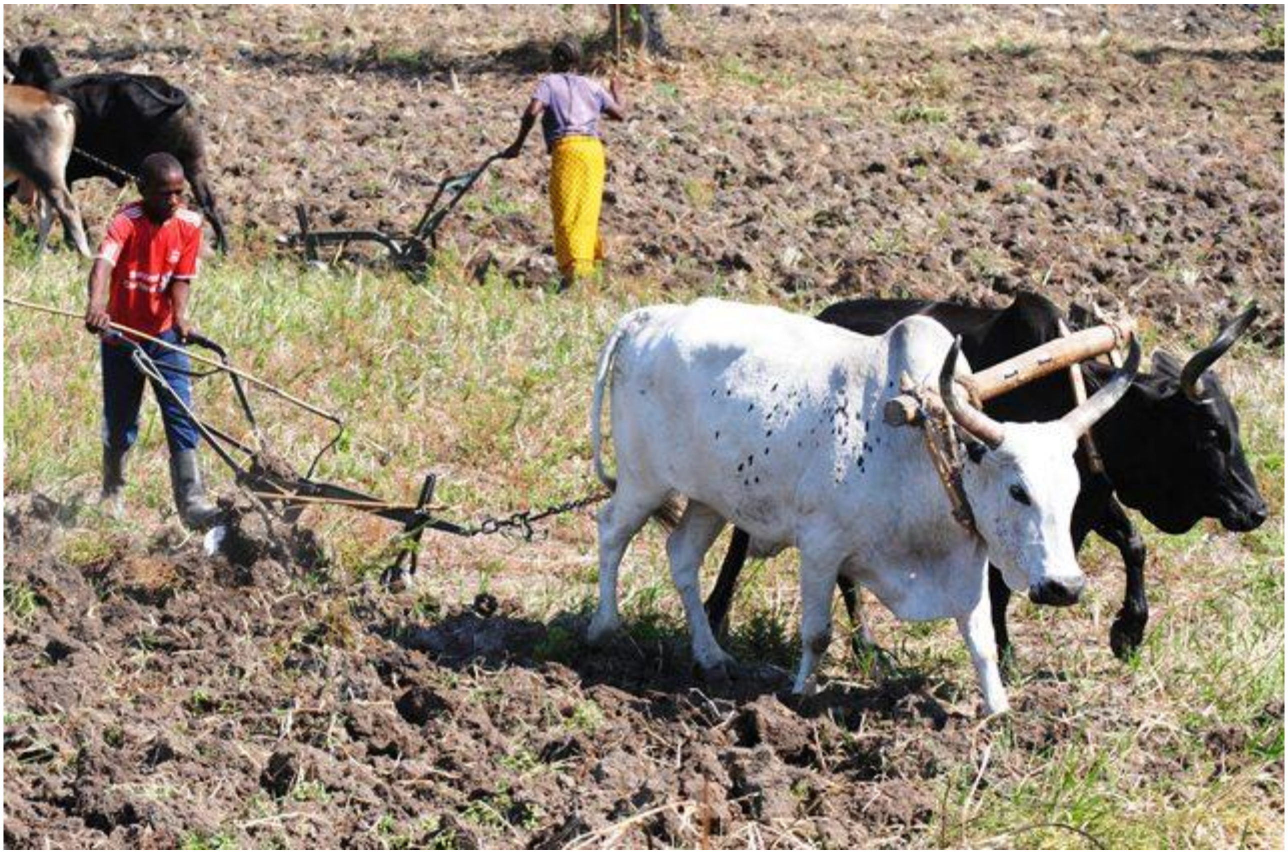
**Strengths of photographs in geographical studies.**

- Photographs **permit observation of the wider** area of interest at the same time.
- They are **not selective** as show everything that visible. i.e. they show all details of the particular area photographed as the camera does not select. Hence; photography provides a mass of details of an area captured.
- They display the **absolute appearance** of objects in true image as appear in real life.
- They provide the **basis for geographical description and analysis** of the photographed area.

- They provide **easily instant data** about an object for instance; the occurrence of floods, people, gathering, cars congestion etc.
- They give **quick information** of the required feature, as it can be compared to other sources. This is attained as a photograph takes a short period of time to be produced. For instance; photograph of an object can be produced within three minutes. Beside to this, they are less expensive to be produced
- Photographs particularly vertical aerial photos are used **for map making.**

## Limitations (setbacks) of photographs.

- Sometimes, photographs give **un required details** as the camera recording images on films are not selective. i.e. they provide **mass details some of which are not needed in the analysis.**
- They give **wrong impression on the size of objects**. A big object on a photograph may look apparently larger. Hence people, who are not familiar with the objects observed on the photograph, develop wrong idea into their mind about the size of the objects.
- Photographs are subjected to **a problem of scale distortion**. i.e. the ration of distance to ground is not uniform all over the photo, as it gets progress silvery smaller from the fore ground to back ground or from the centre to out wards. Hence; it is difficult to judge the used photo scale. How ever; the degree of photo scale distortion is much higher on horizontal and oblique photographs; and it is less enough on the vertical photographs.
- Not all objects of the landscape can be easily seen on the photograph because of being hidden by other objects.
- Photographs do not show clearly **the major directions** of the photographed area.
- It is far more difficult to **determine accurate measurement of the geographical features** from the photograph, as the scale is not constant. It is thus; the measurements of the objects from the photographs particularly the horizontal and oblique photographs given on the estimation basis.



**Similarities and differences between photographs and maps.**

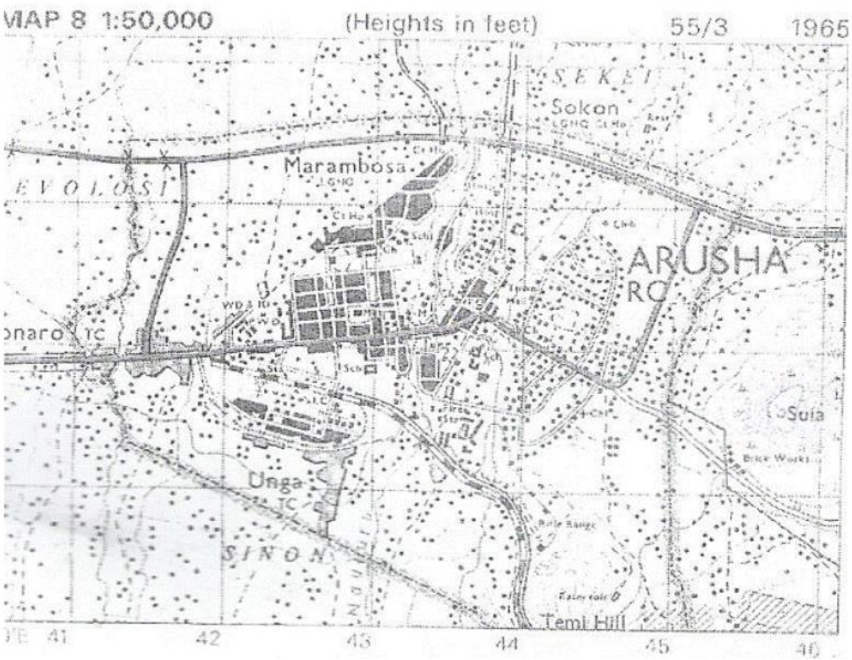
Geographical studies area partly enhanced by photographs and maps. i.e. both have similar role towards geographical studies and they are considered being reliable geographical tools. It is there fore important to understand how the two geographical tools appear **similar** and **contrast.**

**Similarities.**

- Both are subjected to **scale** as are much smaller in size compare to objects visually represented which are much large in size. i.e. they have considerable relationship of distance to the large objectives represented.
- Both give **land details in terms of natural and man made features** as they make representation of areas in which the features are present. Hence; provide good basis for making analysis and description of the geographical features.
- Both make visual representation of land details on **flat bodies** mostly the pieces of paper.
- Both show position location of the features. On maps are shown by methods of place naming, grid reference, bearing and latitudes and longitudes; while on the photograph are shown by pointing out the important parts of the photography where the objects found like; foreground, middle ground, back ground, left, right, fore right etc.
- Both show the features of landscape in **three dimensions**. i.e. The features on maps or photograph displayed with their height, length and width.

- Maps are selective as do not show all details of the represented area; while photographs are not selective as all details of the focused areas appear.
- Maps make uniformity coverage of the ground; while, photographs do not make uniformity cover age of the ground.
- In connection to the above point, **map scale is constant.** i.e. the ration of distance on the map to the ground is constant; while the scale of a photograph changes by getting progressively smaller from the principle point to outwards on vertical air photographs; or from the foreground to background on ground and oblique photographs.
- Photographs show objects of the earth's surface on true image as appear in real life; while maps shows earth's surface objects by means of conventional symbol and signs which normally described in the map key

- Photographs particularly the vertical aerial photographs, are used for map making while, maps are not used for photograph production.
- Photographs take short period of time and less expensive to have been produced as it can be compared to maps.
- Maps show north direction while photographs do not give.
- Map interpretation is comparatively difficult; while the interpretation of the photographs not difficult as features displayed on true image as appear in real life




### 7.4 TYPES OF INFORMATION FROM PHOTOGRAPHS.

Photograph interpretation is an art of examining a photograph to reflect the geographical facts of the respective photographed area. It is done by identifying and translating the features seen on the photograph to the real situation

Photo interpretation has to do with two important processes:

- Photo reading
- Photo analysis

Photo reading is the art of examining and identifying the images of as appear directly on the photo. While photo analysis is a process of translating the features seen directly on the photo to other geographical facts. However; interpretation techniques of the photographs differ depending on a type of a photograph the photo user has been given.

**Interpretation of ground and oblique photographs**

Interpretation of the ground and oblique photographs is comparatively easier as objects on such photographs clearly observed. However; perfect skill for interpreting these photographs requires constant practices and wider geographical knowledge.

Interpretation of these photographs should involve the two basic processes of photo reading and photo analysis. By photo reading; objects on the photo in all sections are recognized. This is done directly by naked eyes as the objects clearly observed on the photograph. In photo analysis, the recognized features are related to other geographical facts for description, explanation or suggestion. For instance; with the presence of sisal on the photograph, the interpreter may judge that the area receive moderate amount of rainfall as the crop requires such a condition of water supply.

## Interpretation of

## Vertical aerial photograph.

The perfect skill for interpretation of the vertical aerial photographs also requires constant practices and wider geographical knowledge. It involves the same basic processes to other forms of photographs of the following;-

Photo reading; which is relatively to the identification of the objects that observed on the photograph.

Photo analysis; it is about the translation of the features recognized on the photographs to other geographical facts which might not appear directly on the photo. Photo reading is dote by the use of naked eyes directly or with the use of the special device called stereoscopy. By the use of naked eyes, enable the photo user to observe only flat views of the objects on the photo. But with the use of **stereoscopy**, the objects on the photo are magnified and enable the user to view the features more clearly in three dimensions by getting, their height, depth and width.

However as the objects clearly observed by the naked eyes, the interpretation of the vertical aerial photographs is aided by considering some guiding techniques based on the characteristics of the features on the photo in terms of appearance. These are what also understood as elements of the vertical photographs and include the following:-

**Patterns.**

It is about layout (spatial arrangement) of observable objects on the photograph with reflection to the actual area. Consideration of patterns help to recognize features and translated to other geographical facts. For instance; the pattern of the rivers on the stand the nature of relief and rocks. E.g. radial pattern if observed gives an impression that the area has rocks of uniform hardness. Scattered settlements may make people to understand that, people engage in animal keeping or scattered cultivation.

**Shape:**

Shape refers to the general from, structure or outline of individual objects on photo and up on the area or the regularities of the objects on the photo and up on the photographed area. This is basically helps to recognize **natural** and **man made features**. Usually regular shape indicates man made features, while irregular shape indicates natural feature. For instance; if vegetation on the photograph observed regular, reflects that, the vegetation is of planted trees.

**Textures:**

Texture refers to the shade pattern or smoothness and coarseness of objects on the photograph. Some objects on the photo like that of vegetation display a shade pattern which can be course or light. It is thus; the consideration of the objects textures on the photograph in relation to other consideration helps to reveal the size and concentration of objects on the photo and up on the area. For instance if plants on the photograph observed to have course texture impress that the vegetation is of closely big trees.

**Colour:**

Colour refers to the relative brightness of objects on the photograph. Commonly objects on the photo display colours and the common colours are of either dark or light especially on the black and white print. The colours have reflection to certain objects. For instance the dark coloured objects on the photo may reflects a road dense forest etc; while lighter colour reflects railway, grassland etc. But to recognize specific object, it requires other considerations of the objects on their pattern, texture, shape etc. e.g. the dark coloured liner object reflects a road.

**Association:**

Association takes into account of the relationship between features in an area. It has to bear in mind that, some objects are always found in association with others. It is thus; the identification of features that one would expect to associate with other features may provide a clue about other objects. For example the presence of ox bow lake reflects the presence of a flood plain as such associated in a food plan.

**Site (location).**

If the location of a photographed area is recognized the person who likely to realize other facts which also present in the area. The location is revealed by considering the feature present on the photograph.

**Size.**

It is about apparent bigness of the features on the photograph. The consideration help to recognize size of photographed area and relative photo scale size. For instance; if objects appear bigger on the photo; make reflection that smaller area covered and the photograph has large scale. Conversely; if objects appear much smaller impress that; wider area covered the photograph subjected to small scale.

**Back ground information.**

If all attempts to identify objects have field, the user of photograph must then refer to maps and written descriptions of the area.

**TECHNIQUES (CONSIDERATIONS) SPECIFIC DETAILS INTERPRETATION.**

1. **1.** RELIEF

Relief refers to the physical appearance of an area by contrasting landforms. Relief features are many and varied in nature. The common relief features that can be easily identified on the photograph include the following:-

(a) Flat landscapes.
These types of relief are characterized by being extensive level or more gentle sloped. The flatland can be of lowlands or uplands. The flat land is known as plains and has altitude less that 500m above the

mean level. Flatlands of high altitudes above 500m are called plateaus. To recognize if the flat land is of plain or plateau, requires other considerations for instance; if the flat land is under coffee cultivation is recognize to be of plateau with consideration that the crop requires high altitude.

(b) Dulating landscapes.

These area the landscapes which appear or observed to rise steeply or more steeply or more steeply above the surrounding area. These are of two patterns including hilly and mountains landscapes.

· Hilly recognized if the dulating landscape covers much wider area on the photo.
· Mountains recognize if the dulating landscape covers much wider area on the photo.

To describe the relief of the photographed area, the following procedure should be followed

· Identity and name the relief features observed on the photograph.
· Locate the position of varied relief forms on the photograph. i.e. whether it is on the fore, middle and back ground.
· Give the general description of the relief.

## 2. 2. A TYPE OF PHOTOGRAPH.

The common types of photographs given for examination purpose are of the horizontal, oblique and vertical. To identify the type of photograph given, consideration should be paid to the characteristics of the photograph relatively to the appearance of the object's images.

### Ground photograph.

This can be identified with the observation of following.

· If the photograph shows the front view of the images of objects.
· Objects get progressively smaller from the foreground towards background. If horizons see it tells, the ground photograph is of general view; but if horizons not observed it tells the type of ground photo is of close up.
· If ground covered is assessed small.

**Oblique photograph.**

It can be identified with the observation of the following;

· If on the photograph; images displaced as they occupy apparently linear position.

· If on the photograph; images objects have both side and top views.

· If on the photograph; objects get progressively smaller from the fore ground to back wards.

· If the photo shows horizon; it is judged to be of the high oblique photo not observed, it can be judged as low oblique photograph.

### Vertical aerial photograph.

It can be identified with the observation of the following;

· If on the photograph; objects have the top views as the photographic views was vertically directed towards the landscape.

· If on the photograph; objects are not distorted in size following the uniformity coverage of ground on the photograph.

· If ground covered is assessed large.

## 3. 3. THE SITE (LOCATION) OF THE FEATURES.

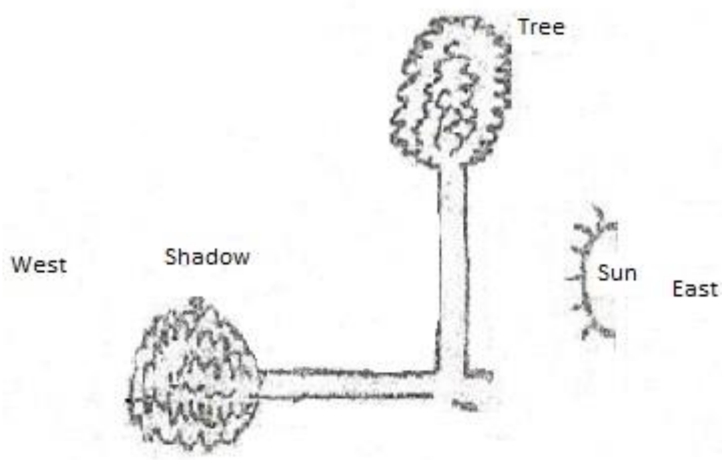
It is considerably to where the photograph might have been taken. In order to suggest where the photograph might have been taken; the user should have enough knowledge on the distribution of human activities; and manmade and physical features with in Tanzania, East Africa, Africa, and else where in the words. As for example; the type of a crop grown will give a clue where the photograph might have been taken. For instance, If the photograph shows sugar can plantation, it can be suggested that, the photograph might have taken in Mtibwa, Kilombero,Moshi and Kagera. It is so as the areas mentioned, are under cultivation of sugar cane in large scale.If the photograph shows water falls, it can be suggested that, the photograph was taken from; Kidatu, Kalambo, and Tana. It is so as the mentioned areas have the HEP stations using waterfalls to generate the power.

## 4. 4.TIME AT WHICH THE PHOTOGRAPH WAS TAKEN.

The time at which the photograph might have been taken is complex matter. This is because; no exactly time can be appointed out by the photograph. It remain to be a matter of generalization on whether the photograph was taken in the morning noon or evening. There are two suggestions for the time:

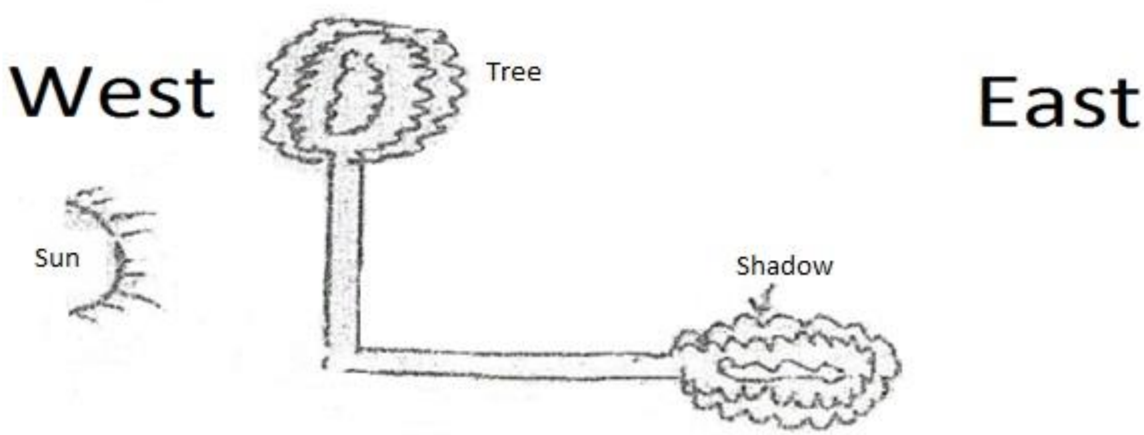
(a) Observation of the shadow of the objects.

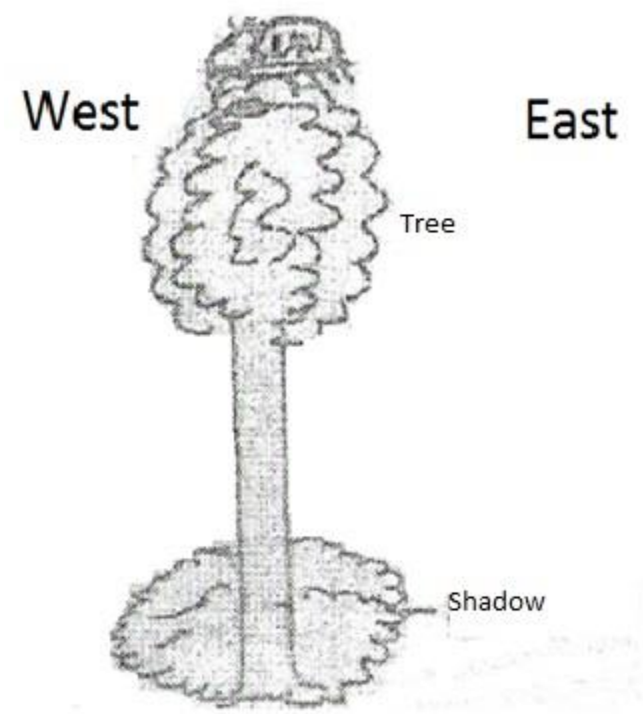
· In the morning; shadow casts long and lies western side. This is is because; the sun is in eastern side. Thus the diagram if it could be of photograph would impress that the photograph was taken during the morning.




If the photograph was taken during evening time, its shadow lies eastern side because the sun is in western side. The diagram below if could be of photograph, would impress that, the photo was taken in the evening time.

· If the photograph has been taken at afternoon, its shadow lies around object. This is because the sun is over head at that particular period of time.






(b)Observation of the human activities.

It is much to the observation of agricultural activities carried out on photograph. Human activities particularly of agriculture are carried out with respect to time consideration. It is thus; if on a photograph a certain human activity is observed, can be considered to reveal the time at which the photograph might have been taken.

(c)Brightness of the image features.

This has ideal reflection to the relative at which the photograph might have been taken.

- More bright images reflect the photograph to have been taken in the mid day time.
- Less bright images reflect the photograph to have been taken in the evening.
- Dark images reflect a photograph to have been taken during the night.

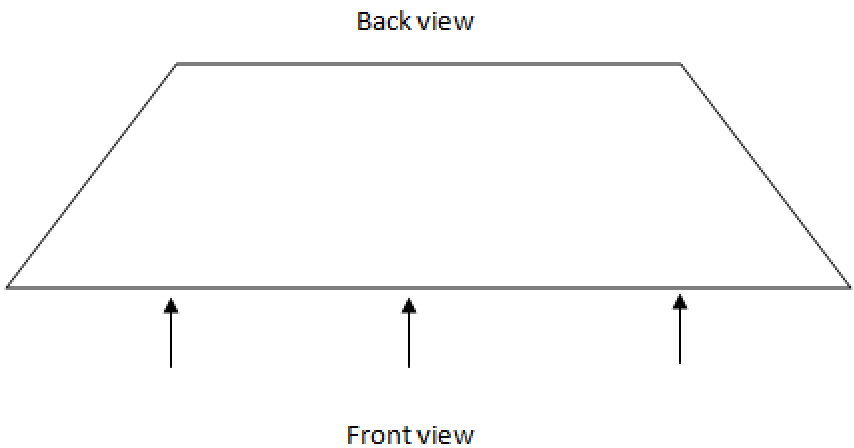
### 5. SEASON AT WHICH THE PHOTOGRAPH MIGHT HAVE BEEN TAKEN.

Seasons are of two dimensions including rainy and temperature seasons. Rainy seasons are two and include **wet and dry**. Temperature season are also two including **hot (summer) and cool (winter).** It is possible to judge the season in which the photographs was taken. The following considerations if observed of photographs may help to asses the season.

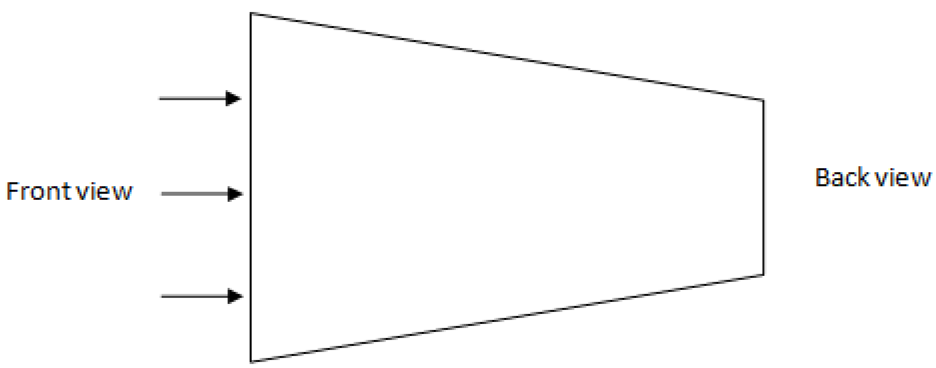
- Bright clear skies with dry vegetation could indicate dry period or season.
- Luxuriant vegetation, young crops in the fields flowering plants and rainy clouds in the sky could indicate a went season.
- Winter would be reflected by the presence of snow on the ground.
- The type of cloth worm by people can also indicate the prevailing temperature season whether summer or winter e .g. The warm of thick clothe reflects winter season.

### 6. 6. THE POSITION OF CAMERA MAN.

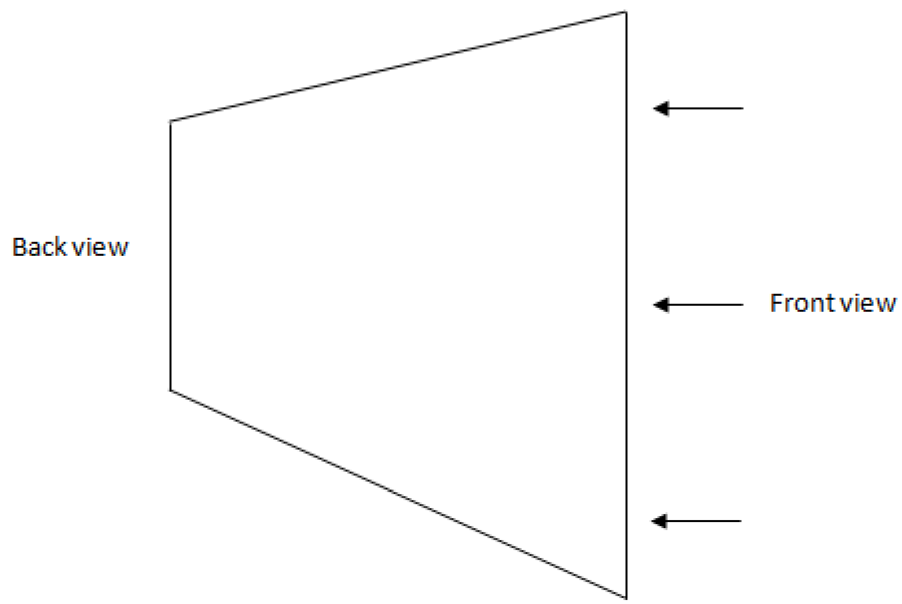
To asses the position of the camera man or position of the photographer do the following:-
Study the photograph and observe which part the images of objects in the photograph are larger and decrease towards far from the fore ground. The part which shows big objects is the place (direction) from which the photograph was taken.




The photograph was taken from front view of the photograph




The position of the camera was not from left hand side




*The photograph was taken from right hand side*

## 7. 7. SOIL

It is possible to recognize the nature of a soil found in an area by studying a respective photograph. Nature of soil recognized by taking into consideration the following if appear on the photograph.

**(a) Kind of crop growing in an area.**

Some crops growing on certain soils. It is there fore, the consideration of crops if observed on the photograph may help ideally to deduce the soil type. Some cases for may include the following:-

- Paddy; reflects impermeable heavy clay soil as the crop growing on such type of soil.
- Wheat; reflects light clay or heavy loam soil.
- Maize mostly reflects deep rich soil. However, maize grown on a very wide range of soil types.
- Tea and coffee reflect; volcanic deep fertile acidic soil which is also well drained.
- Cocoa suggests; deep well drained light clay or loam soils.
- Coconuts and cashew nuts reflect that the area has sandy soils.
- Horticultural crops reflect loam soils the crops grow well on such soil.

It is thus; the students as well as other photo users must have wide knowledge on soil requirements for varied crops apart from the ones given.

**(b) The topography of an area.**

The consideration helps to reveal the depth and drainage of the soil.

- If the photograph shows level land the soil is assessed being deep poorly drained.
- Sloppy topography reflects shallow well drained soils.

**(c) Natural vegetation.**

Consideration of vegetation helps to assess fertility and depth of the soil.

· The presence of the dense forests; reflects deep fertile well drained soils.
· Poor vegetation reflects poor soils.

## 8. 8. WEATHER AND CLIMATE.

Whether and climate do not appear in photographs more directly. In order to state the climate of a given area portrayed on the photograph, observation should be made into the following their conclusion:

**(a) Kinds of the crops observed on photograph.**

· Observation of coffee and tea reflects cool wet climate.
· Cocoa as mostly grown in equatorial environment, if observed on the photograph reflects hot wet climate.
· Sugar cane would 1mean the area has warm wet climate.
Sisal and cotton reflect dry season ( minimum rainfall)

It is thus; the students as well as other photo users must have wide knowledge on climate requirements for varied crops a part from the ones given.

**(b) Vegetation.**

Plant covers much related to climate and thus; if vegetation observed on the photograph may helps some one to suggest the likely climatic condition especially on the amount of rainfall.

· The observation of forests reflects heavy rainfall.

· Grasses baobab and short trees suggest low annual rain fall.


## 9. 9. DRAINAGE

Drainage is the processed by which water is removed from the land to a lake or to the sea by a system of water flow mostly of rivers. The systems which make the removal of water known as drainage feature. The common drainage features include; rivers, lakes, seas, swamps and others.Water features appear bright in photographs and are easily recognizable on all types of photographs. It is thus; photographs may helps to assess drainage features and their different related aspects as follow.

· The presence of a body of flowing water reflects a river.

· The presence of a body of stagnant water may reflect a lake or swamp. To reveal the drainage feature if is of a lake or swamp, requires the making of other considerations.

· The presence of water falls and rapids indicates that the river is flowing in a steep region (landscape).

· Meanders show that the river is in the middle stage or old stage. Beside to this associated with the presence of flood plain

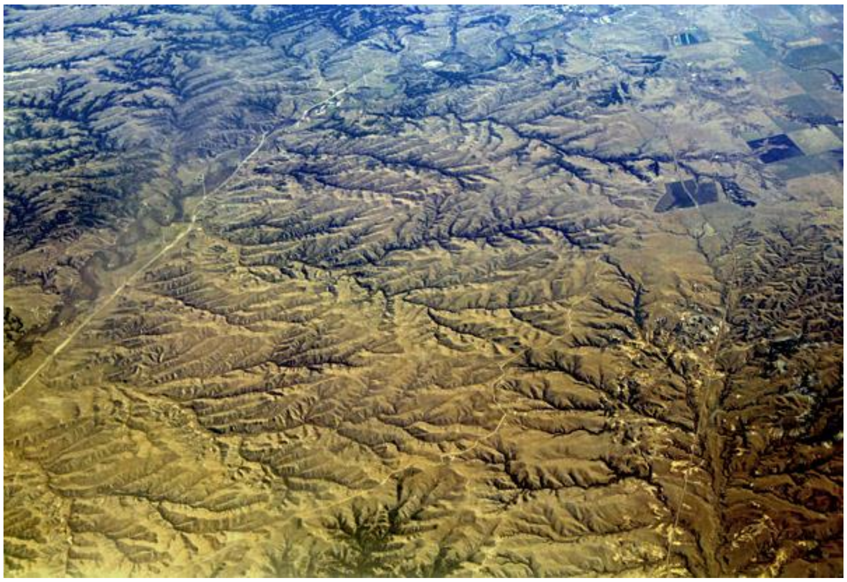
· The presence of many channels or distributaries before the rivers enter the ocean or lake indicates river delta.

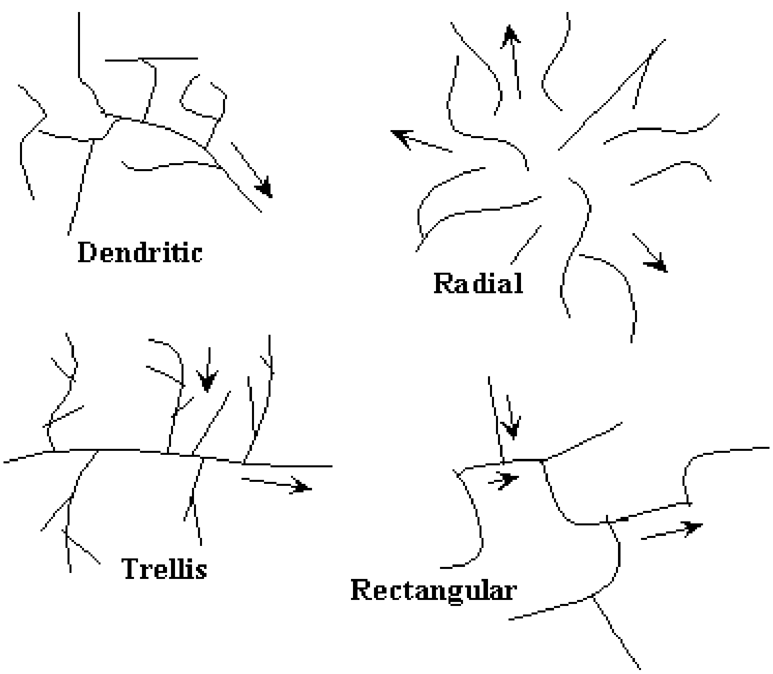
Drainage patterns of rivers are clearly observed on vertical aerial photographs and the following cases of related can be deduced.

· If streams and main rivers form roughly a shape of a tree like structure, dendritic pattern deduced from the photograph.

· If streams appear to join to the main river at right angles, trellis pattern is recognized.

· If streams appear to diverge to different directions from the conical shaped upland radial pattern is recognized.






**VEGETETION.**

These are the plant covers which develop under natural conditions in a particular climate, relief and soil.

However; due to human activities, most of areas have lost their natural (primary) vegetation. The vegetation we commonly see in photographs with reflection to actual areas are likely to be **secondary** or **derived**.

**The description of vegetation from photographs should take into account the following aspects.**

· Types of vegetation .e.g. forest, thickets, scrub, grass and marshes.

· Characteristics of plants observed on the photographs .i.e. describe the height and shape of the vegetation e. g. tall or short trees. In same cases a close study of the photograph can be reveal whether the leaves are broad, needle shaped or thorny.

· Try to identify some species of trees which are easily identifiable, e.g. the baobab or acacia trees.

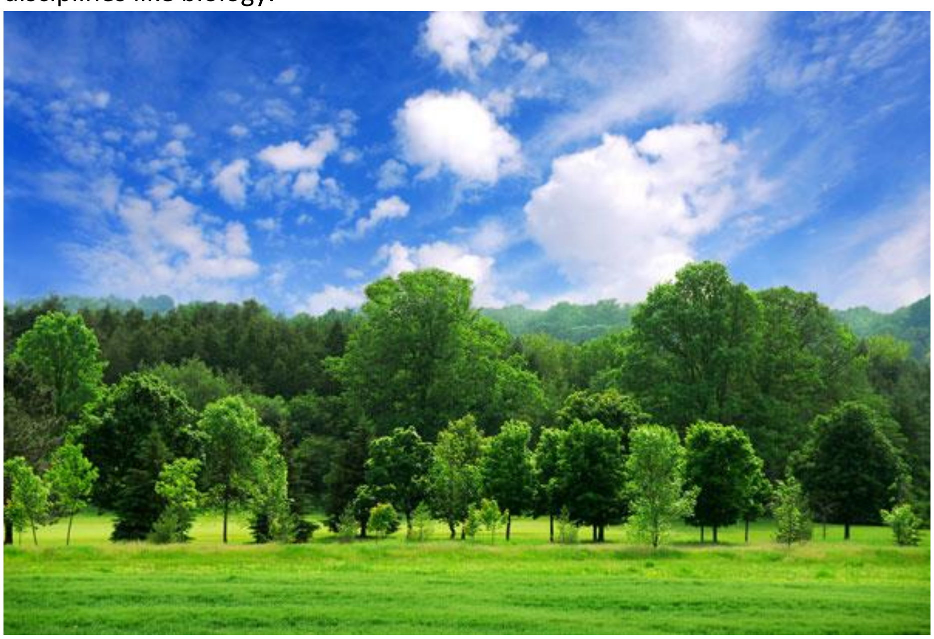
· Relate vegetation types to climatic region, e.g. tropical rainforests, tropical grassland and desert vegetation.

· Try to distinguish the planed vegetation from natural vegetation. Planed trees usually appear in patterns or in rows and the trees appear of the same species.

**Note.**

(a) All aspect given above are so much useful in making description about the vegetation. However; description depends on recommendation of the question.

(b) It is also important; the description of vegetation should consider the knowledge from other disciplines like biology.



**11. ECONOMIC ACTIVITIES**

These are means of earning lively hood by the people in the habitable areas. Some of the economic activities easily identified from the photograph by taking into reasonable consideration. The activities and their related suggestion aspects include the following

**(a) Farming.**

Farming includes crops cultivation and livestock rearing. These could further be subdivided into subsistence and commercial farming. The guidelines on how to identify types of farming from photographs include the following;-

**(i) Subsistence farming.**

Evidence to look to identify this type of farming include the following.

- The presence of temporary houses.
- The land is normally divided into small portions.
- Observation of mixed cropping.
- The use of simple farm implements such as machetes and hoes.
- Field may appear separated by hedges.

**(ii) Tradition livestock farming.**

- Cattle grazed on grassland.
- Large field divided into paddocks.
- Windmills for water supply.
- Presence of water tanks, ponds reservoirs in the dry areas.

**(iii) Plantation farming.**

This form of farming is recognized by observation of the following on a photograph.

- A single crop covering extensive stretches of land, e.g. sugar cane, tea, coffee, sisal, wheat etc.
- Presence of storage facilities in a formed area.
- Many labours in the fields e.g. many people picking tea or coffee.
- Nucleated settlements within the farm. These are usually for the workers.
- The presence of processing factories with in the farm.

· Presence of feeder routes within the farm.

**(b) Lumbering.**

Lumbering can be recognized by the observation of the following:

· People cutting trees with power saws on the photo.

· People loading timber into Lorries.

· Logs poled near a sawmill.

· Large forest clearing with tree stumps.

**(c) Industrial and mining activities.**

In photographs industrial and mining activities are donated by the presence of the following:

· Factory buildings with tall chimneys.

· Nucleated settlements for workers.

· Large open pits, large excavators, and Lorries carrying of loads of rocks (this show that open – cast mining is being carried out.

**12. SETTLEMENTS.**

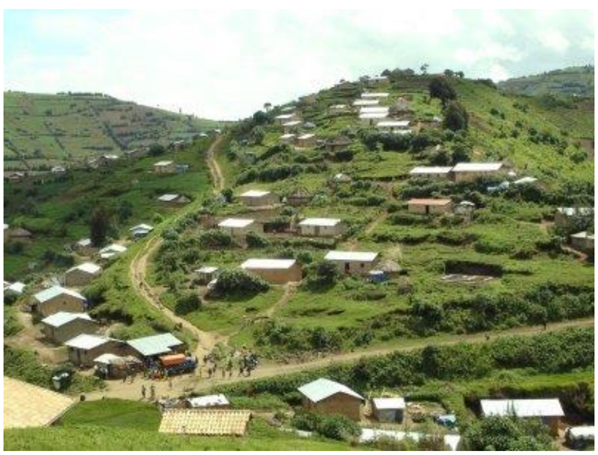
A settlement is a group of dwellings where people lived and interact with one other. Settlement sub divided into rural and urban dwellings.

Rural settlements recognized by the observation of the following;

· Simple architectural designs of semi-permanent houses.

· Evidence of farming or finishing activities.

· Uneven and unplanned distribution of dwellings.



**Urban settlements can be identified by:**

- Permanent buildings which are dominant.
- Regular street patterns.
- An industrial part of the town which has many large buildings
- High population densities.
- Heavy motor vehicles traffic.
- Port facilities such as docks, cranes, warehouses and containers.A well developed communication network.

**TRANSPORT AND COMMUNICATION**.

Various forms of transport are shown differently. The following are indicators of transport :

(a) Motor transport, shown by either motor vehicles or roads.

(b) Rain transport, indicated by railway line with or without trains.

(c) Air transport, indicated by the large flat tarmac piece of ground with buildings on one side, and control tower (air craft may be parked on the runway near the airport buildings.)

(d) Water transport, indicates by the presence of boats, ships and large water vessels.

(e) Facilitates such as telephone lines, satellite mast indicate the presence of communication services.

Water transport

Satellite dish

Railway transport

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# SURVEY

**SIMPLE SURVEY AND MAP MAKING**

**INTRODUCTION TO SURVEYING**

Surveying is an art or a science of measuring and recording distances, shape and heights in the field on the earth surface from which maps or plans can be developed.

Or is an art or a science of making measurements of natural and man made features on the earth surface made on the earth surface in the field areas help the features. The collected information from field areas about the natural and artificial features are finally represented in a form of a map or a pan of which drawn at a specified scale

**5.1 VARIABLES USED IN PROCESS OF SURVEY**

The conducted surveys are of wide range and thus fall into different types as reasonably classified. The wide range of survey classified according o the size of areas whose measurements determined and according to specific objectives.

By considering the size and nature of the surface areas that has been surveyed or would be surveyed, the art of survey is divided into two variables

- (i)Geodetic survey
- (ii)Plane survey

**Geodetic survey**

It a type of survey which covers such larger areas like the whole of the earth surface, a continent or a country and takes into account of the curvature of the surface area. Geodetic survey is mostly used to establish Saturn points (bench marks )

**Plane survey**

It is types of survey used for the smaller areas of which the surface is considered flat and the earth curvature is not taken into consideration. Areas surveyed are not more than 10km X 10km size

Survey according to the specific objective include the following significant types

-Topographical survey

- -Engineering survey
- -Geological (mining) survey
- -Hydrological survey
- -Photogrammetric survey

**Topographical survey**

It is a survey by which the topographical features of the earths surface such as road, revivers, mountains plateaus ocean building lakes, vegetation and others are measured and whose measurements used to develop maps or plans which show their relative positions both horizontally and vertical. Maps developed after the conduct of topographical survey are known a topographical maps

**Cadastral survey**

Cadastral survey is also known as boundary survey. It is a kind of survey conducted with an aim of preparing legal documents on boundaries of towns, cities, industries for owner ship purposes. i.e A sort of survey carried out to produce plans which shown properties boundaries. It is mostly conducted to develop administrative areas.

**Engineering survey**

It is also as built up survey. It is a kind of survey which provides details (special information) for construction purpose. The construction can be of buildings, reads, railways, bridges, water dam etc. They are commonly carried of during and after planning the construction of engineering projects.

**Geological (mining) survey**

It is a kind of survey conducted by the geologists with the aim of realizing the distribution of rocks and their content. Or all surveys for mining works on the earth or under ground.

**Hydrographical survey**

It is a sort of survey for water areas particularly seas and lake, They are carried out to determine the depth of water bodies at different points and nature of the bottom of the sea. These are commonly carried out for harbor construction, oil drilling and natural gas exploration as well as exploitation at sea area

**Note**

With all types of survey, topographical survey is of the major concern in our level. This is one of the major concerning in our level. This is conducted by different ways which include the following

- Chain survey
- Plane table survey
- Prismatic survey
- Leveling

**IMPORTANCE OF CONDUCTING SURVEY**

- (i)To determine altitude size and distance of different areas
- (ii)To establish position location of both natural and artificial features
- (iii)They are potential for maps construction. Details on heights bearing, distance and size of features for areas which appear on maps derived from survey works.
- (iv)To plan and control various kinds of engineer projects such as roads, railways, buildings canals and dams contraction
- (v)To develop data bank of land and natural resources which aid in developing and management of environment

**SURVEYING PROCESS**

The conduct of surveying particularly topographical survey in the field area, should involves the following three significant steps

- Reconnaissance survey
- Observation and measurement
- Presentation or plotting of the data

## 1. I Reconnaissance survey

The site whose details to be taken by conducting survey should be pre visited. This is commonly known as **reconnaissance survey** and it is defined as preliminary survey by which surveyor takes a general picture about the areas into his or her mind by working all over the site. During the pre visit; the surveyor should do the following beside walking all over the site

- • Making a sketch plan of the site in the field to be surveyed
- • Choose the surveying stations
- • Marking of the surveying stations by establishing station pegs.

**II Observation and measurement**

It is considerably to be the conducted to actual surveying. During this state, the surveyor determines the relative positions and size of the natural and artificial features on the lad surface. There are three forms of measurement required

(a) Liner measurement

(b) Angular measurement

(c) Heights measurement

Liner measurement involve the determination of distance between to one point and another on the surface on the earth. Measurements are done with the use of chain or tapes.

Angular measurements involve the taking of the bearings between stations or from one station to another. Angular measurements are commonly taken with the use of prismatic compass.

Heights (altitudes) are determined with the use of leveling staff and leveling instrument and this particularly determination is made in the conduct of leveling.

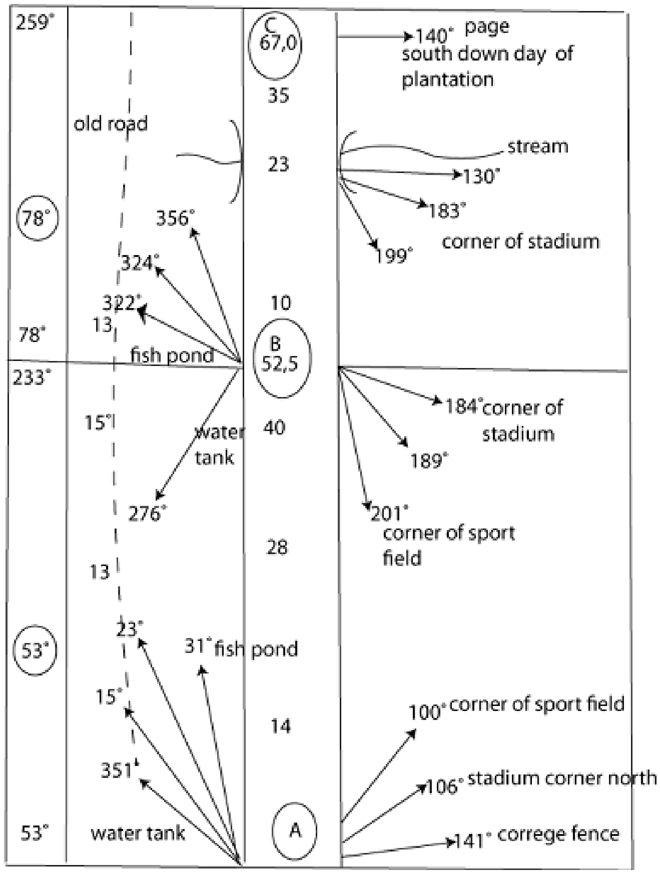
**III. Presentation (plotting)**

It is all about the presentation of the data collected from the field during surveying in the form which allows the information to be clearly interpreted and understood by others. It is done by entering the measurements taken at the field in the field notes. The process is known as **booking of field data**. Thus booking is the process where by the measurements which are done in a field areas entered in a field note book for recording

Commonly booking is done by surveyor and not by assistant for the sake of avoiding unnecessary errors.

In the process of booking all measurements entered must be in raw units from the bottom up wards. All the linear measurements should appear at the center of the column. Features at the right hand side must be recorded on the right hand side, while those in the left side must be recorded on the left hand side of the column. All offsets must be shown on the relevant side as they appear along the survey line. The forward and backwards bearings must be known and should be circled.

Booking can be by either single line or double line bookings




**5.2 CHAIN AND TAPE MEASURE SURVEY**

Chain and tape survey is a science of measuring series of straight lines on the ground with the use of a chain or tape measure. It is the simplest and commonest method of making linear or horizontal measurements on land particularly for the smaller distances.

**Significant uses of chain survey**

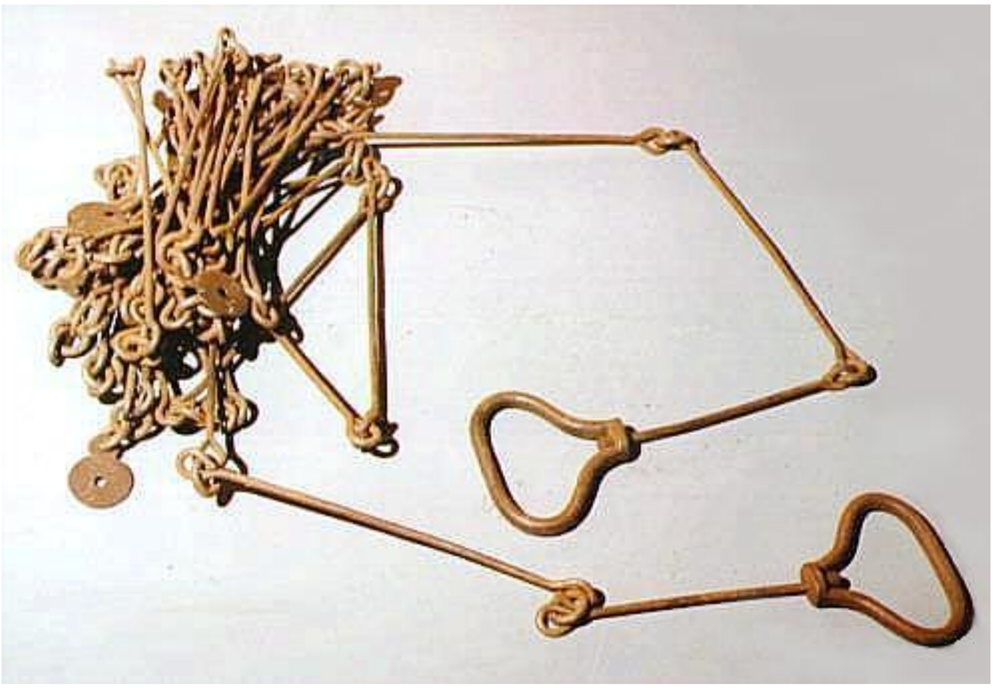
- • Chain survey is conducted to develop details which can be used for mapping areas.
- •Chain survey is conducted to develop details for construction purposes.
- •Chain survey is conducted to collect data to be added to the existing data.
- •Chain survey is conducted to supplement other topographical survey techniques like plane table survey and prismatic compass survey.

**Tools used in the conducting chain survey**

The main tools used into the conducting chain survey include the following:-

1. **i. The chain:-**

It is a tempered steel wire with length of about 20m or 30 m. It has links connected by small rings in such a way it can be easily folded and carried in the field. The length from ring centre to another is of about 200 mm. It is used to measure distance on the ground along the line of tracery.



2. **ii. Tapes**

(a) Those which made up of steel and available in varied length up to 100m

(b) Those make up of fiberglass and they are available in lengths of 10m, 15m, 20m, and 30m Tapes like chain, are also used for liner measurements particularly of short distances.


3. **iii. Cross staff**

They are made of metal or wood with eye slits at right angles. They are used to measure right angles of the off sets from the line of traverse.

4. **iv. Ranging rods /poles**

They are poles of woods or light metal 2m, 2.5 or 3m long. They are painted alternatively in red and white bans each 500 mm long so that they can be easily seen from a distance. They have pointed metal ends for driving into ground. They are used to mark points required to be seen in linear measurement

5. **v. Arrows**

These are steel skewers of about 0.4m long. They are used for marking points an ground when chaining a long (line) distance, They are potentially used when the chain has to be laid down several times and the positions of the end of chain are marked with the arrows.

**vi. pegs**

6. They are wooden station marks with 40mm square and 50 cm long. They are driven into the ground to mark positions permanently during survey.

7. **vii. Optical square**

It is optical instrument of camera like for setting out angles. It is commonly used for marking off sets at right angles from the line of traverse.

8. **viii. Prismatic compass**

It is a compass box with needle in the magnetic liquid to enable the needle to swing freely at the centre. There is a card which is graduated in the degrees to enable the reader or the viewer to read the given bearing or observed bearing

9. **ix. Field sheet/Note book**

They are writing sheets They are used for recording or booking all necessary field work information

**FIELD WORK OF A CHAIN SURVEY**

**(METHOD OF CHAIN SURVEYING)**

The conduct of chain survey in the field area

**1. Preliminary inspection of the field area**

The site whose details to be taken by conducting chain survey should be pre visited. This is commonly known as reconnaissance survey. During the pre visit, the surveyor work all over the site to obtain a picture in his or her mind of the whole area. More over, the surveyor should do the following beside walking all over the site.

- Making a sketch plan of the site in the field to be surveyed.
- Choose the surveying stations.
- Marking of the surveying stations with leader.

**2. Organization of chain survey team**

It should have three people including the leader, follower and booker

- The leader has a role of reading measurements taken in the field with the use of chain. He also pulls the chain forwards and insert the arrows at every point or station
- The booker has a work of recording data as given from eh leader

- The follower has a role of organizing the instruments during the field work. He also directs the leader where to insert the arrow and collect them.
- 

### 3. The main chain survey work has to start as follows

(a) The chain is thrown and extended from one position to another and disentangle knots

(b) Leader takes arrows and ranging road, and follower takes ranging rod

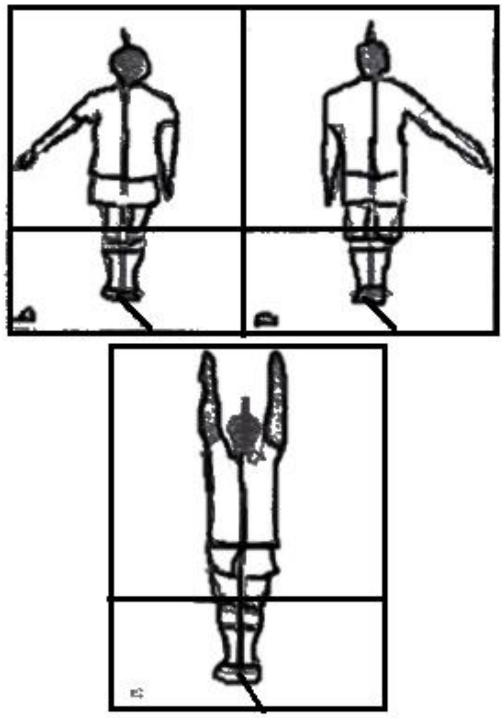
(c) Follower erects road at first base point places brass handle of the chain against rod. In this leader ex tends the chain follower by the follower

(d) Leader straightens the chain and inserts arrow at end of brass handle. Offsets, liner distances and the point can be taken

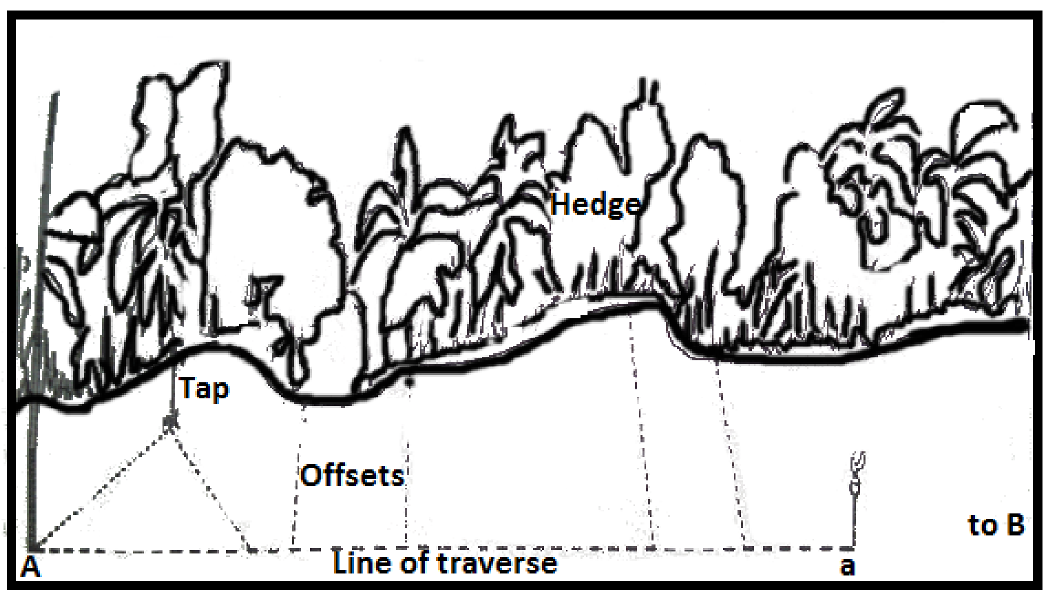
(e) The leader drags chain so that follower is on a leader is arrow. Then follower moves to the leader arrow and places pole behind arrow.

**Note:**

The process of dragging the chain, signing and aligning is repeated until the line is completed the same process is also repeated with another lines until the whole area is surveyed.



**correct signals as seen by surveyor leader.** (a) Move chain to left (b) Move chain to left (c) Chain correct

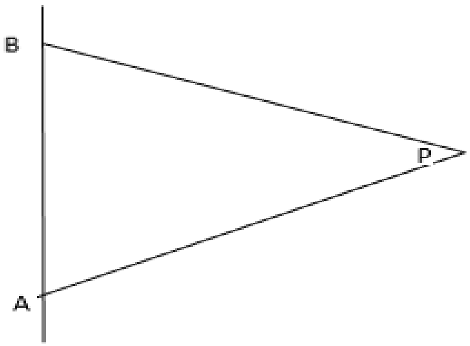



**Point fixation in chain survey.**

Fixation of points as chain survey conducted is by following methods.

1.**Trilaterization method.**

it is by two measured distances. Where the equal measure distances from the baseline meet, the point is fixed.

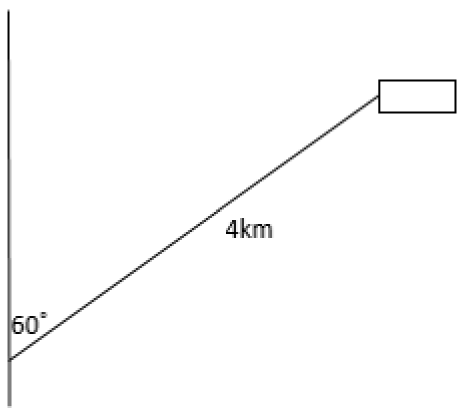



i.e The AP=BP

**2 Radiation method**

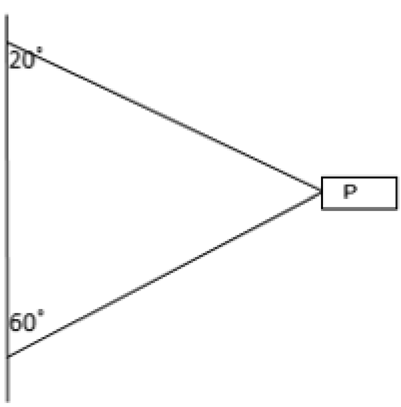
it is also known as bearing and distance method or polar method. it is by taking both bearing and distance of position point from the line traverse.

The method is illustrated as follows:



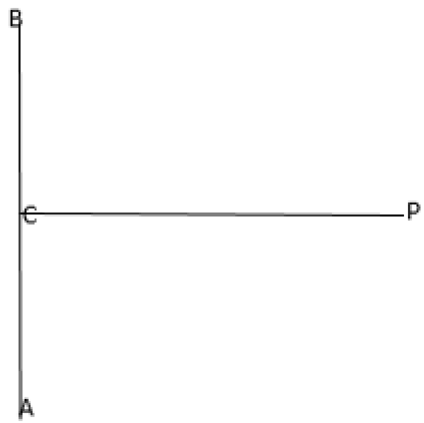

**3 intersection or triangulation method.**

The position of point is given by the intersection of two rays of bearing and distance.'




**4 Off set from baseline.**

It is by measuring right angle and distance of the off-set from the line of traverse.




**NOTE**

1 Chain survey can be accurately conducted if the following are adhered to:

- -The use of few lines as possible.
- -Avoid steep slopes and major obstacles.
- -Select one major line.
- -Keep chain lines short and measure them accurately.

2.Chain errors can be avoided by doing the following

- -It should be checked that all chain lines are included.
- - Read markers on chain carefully.
- -Call measurements to booker clearly and ask him to repeat.
- -Ensure correct position of arrows as they must touch edge of handle or measuring tape and perfectly upright.

**OBTACLES IN CHAIN SURVEY**

Those are the features (object) lying with in the area to be surveyed along the survey line which may hinder or prevent chaining or ranging.

**Types of obstruction**

There are three types of obstruction in chain survey

- (a) Those which do not allow crossing from side to side, river, a lake, pond preventing chaining.
- (b) Those which will prevent vision but not chaining e.g a hill
- (c) Those which prevent both chaining and vision e.g building.

**TECHNIQUES (WAYS) TO OVERCOME THE OBSTACLES**

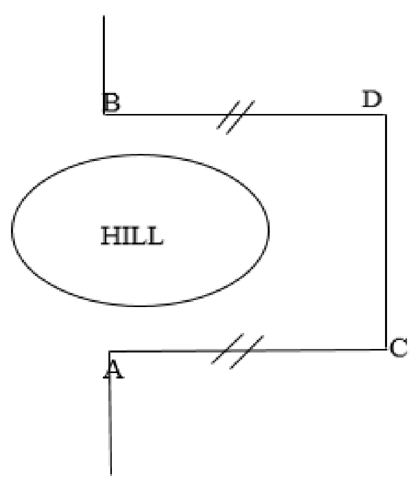
There are seven ways on how to overcome the obstacles. The methods depend on the nature of obstacles as follow

**1.** 1. **HILL**

Hill is a rounded upland it is a considerable obstacle if lies on the path of the chain line. The obstacle of hill can be avoided by the following consideration techniques.

(a **(a) Simple system of offsets**

This technique, a surveyor sets out equal perpendicular far long enough distances to clear the obstacle as follow




In the above application BD distance= AC distance This it obvious, as BD= AC the measured DC distance is equal to BA distance

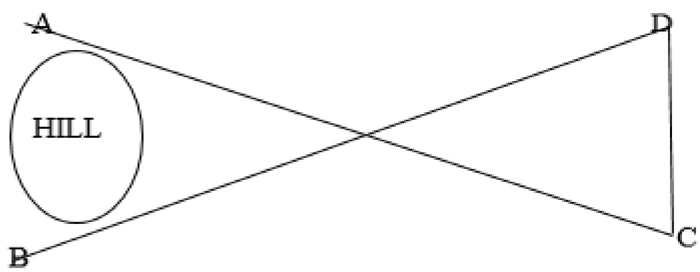
**(b)The method of similar triangle**

(b It is applied as follows

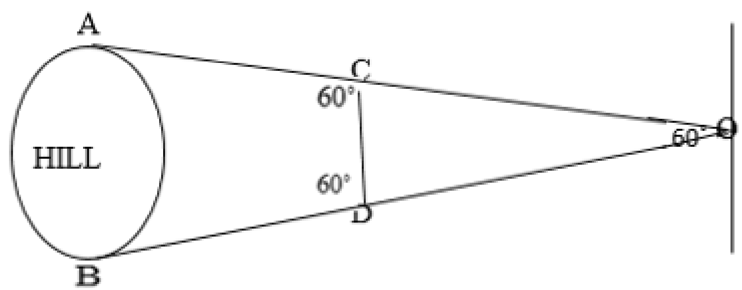
(c AOC = BOD

Them

As Aoc=Bod The measured DC distance is equal to AB distance



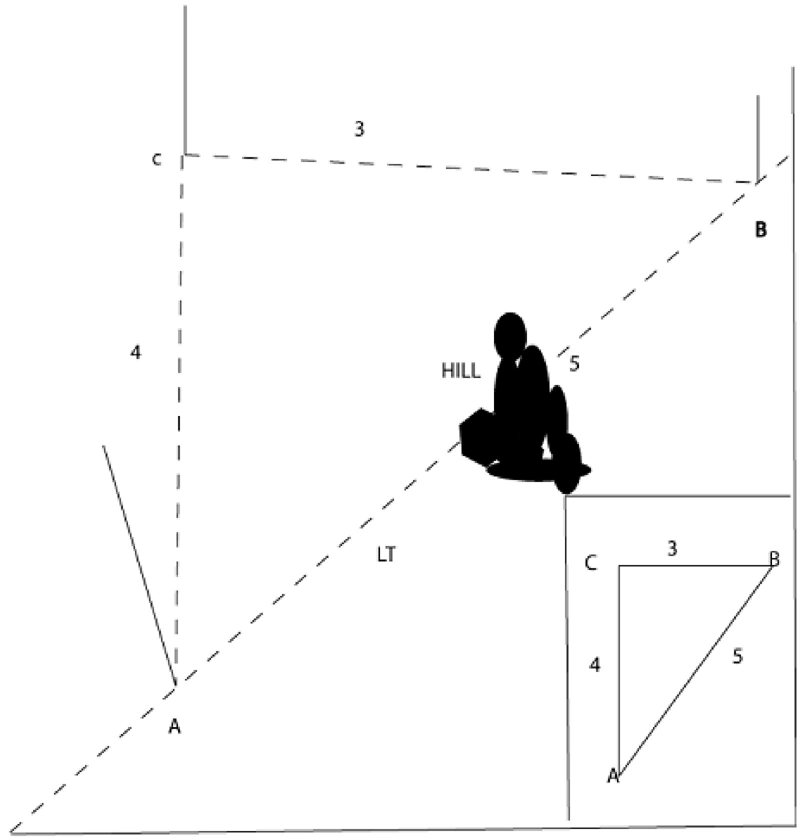

**(c)The method of equal triangle**




With the technique of equal triangle a applied above C is the mid point of AO and D is the mid point of BO it thus AB=2Xcd

**Trigonometric method**

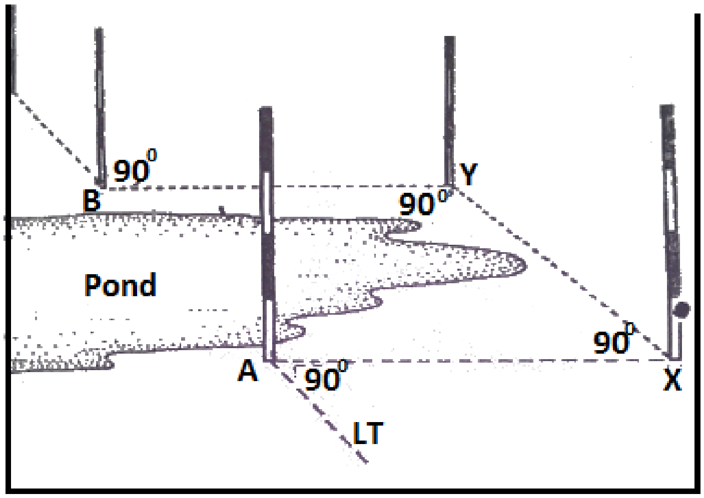
(d From point A measure the length of random line chosen to avoid the hill to C. Then chain a line at right angle from AB to C Calculate the length of AB by Pythagoras theorem




**2. POND**

The obstacle of pond can be avoided by the following application.

Measure the perpendicular the same length from AB (AX and BY) Measure the length of XY.
Then AB = AY




**3. RIVER**

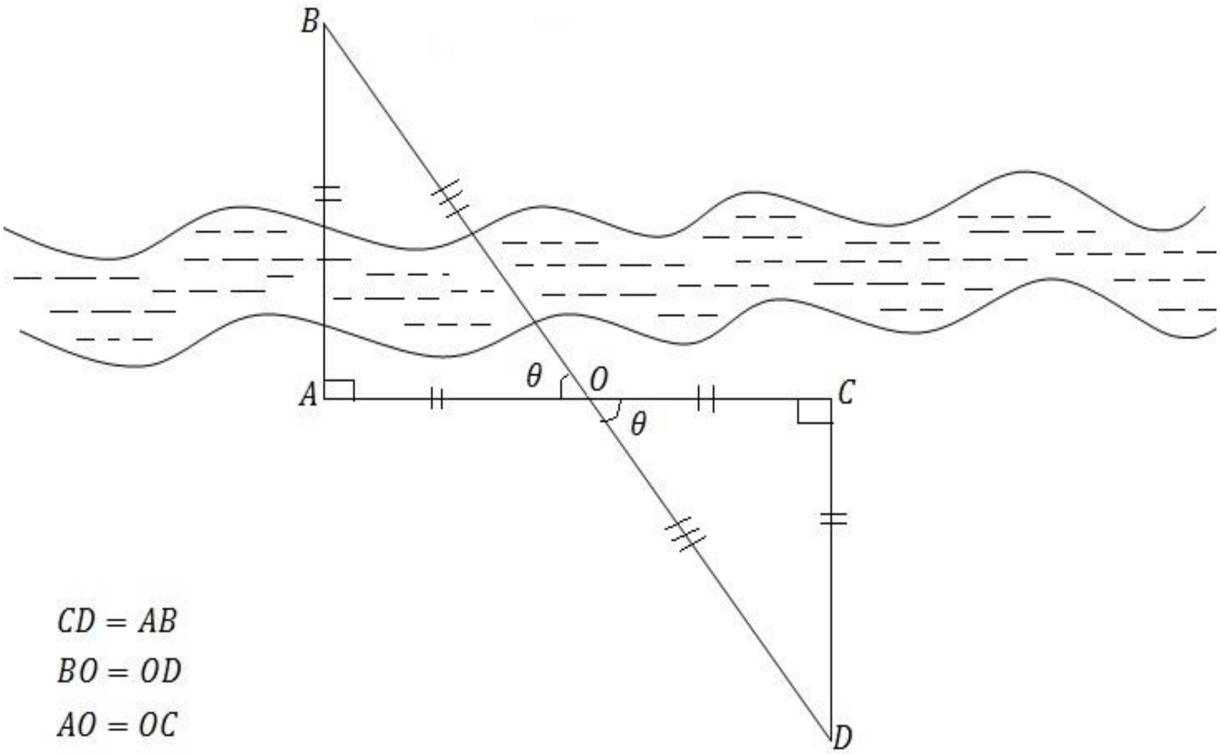
Make chain line from one side to the opposite side i.e from B to D

Set up ranging pole at A and develop chain line along the river to C and it should be assured that AO=Oc from C develop chain line of right angle to D

Then
AO = OC

BO=OD

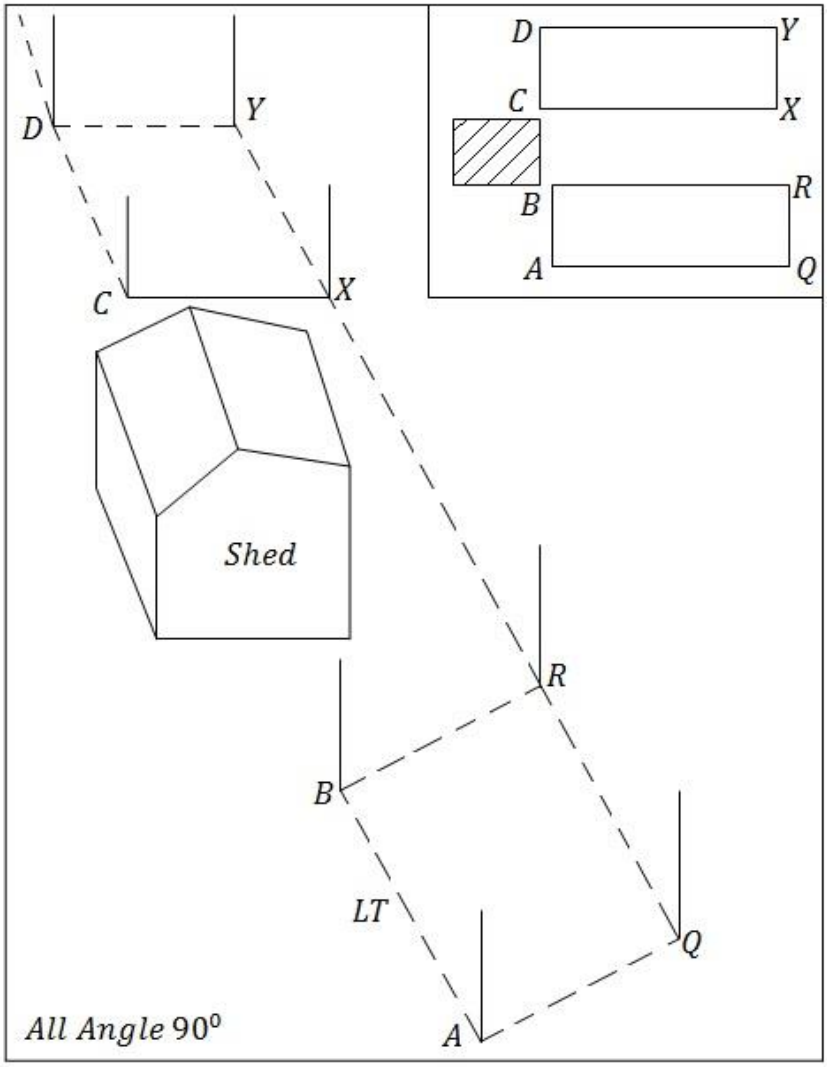
CD=AB




## 4. BUILDING

- Set up ranging pole at A and B along the line traverse
- Measure an equal distance along the line of traverse AQ and BR check corner of the rectangles so farmed are right angles

· Extend the line of traverse through C and D




**BOOKING AND PLOTTING CHAIN SURVEY**

**(A)BOOKING**

Booking is a process where by the measurements done in a field are entered in a field note book for recording. Or is the process of entering the measurements take on the ground into the field note book. This is normally done by surveyor and not by assistant so as to avoid unnecessary errors

In booking the details the following should be taken into consideration

· All linear measurement should appear at the centre of the column and it has to start from the botton upwards

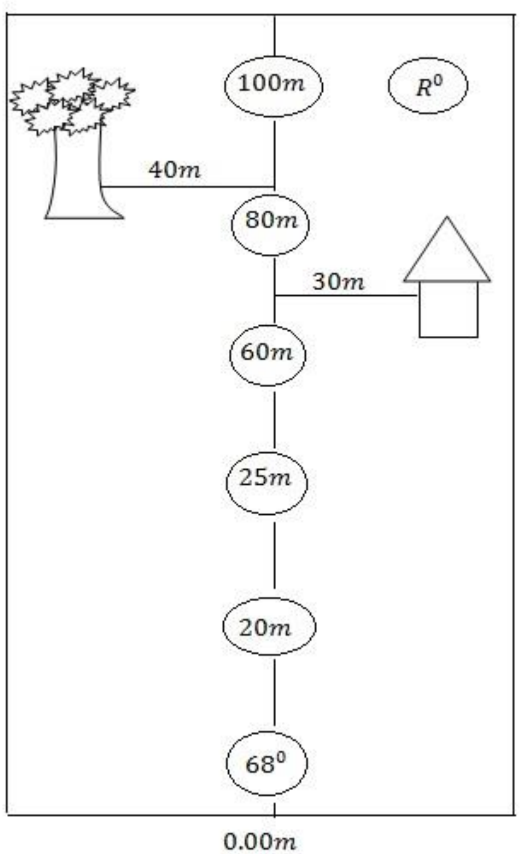
- Feature at the right hand side must be recorded on the right hand side while those at left hand side must be recorded on the left hand site of the column.
- All offsets and ties must be shown on the relevant side as appear along the survey line.
- The forward and back ward bearings must be known and they should be circled.

**Methods of booking**

There are two main methods of booking details in a field note book after they have been taken from the field by the conduct of chain survey

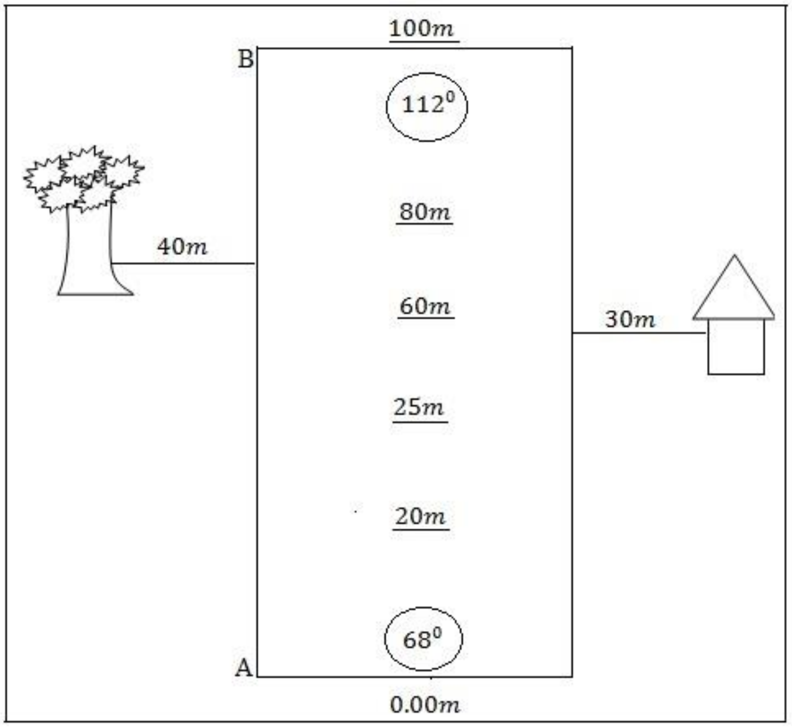
(i) Single line booking

By the single line booking the details on linear measurements are entered along the single line at the centre as illustrated below.




(ii) Double line booking

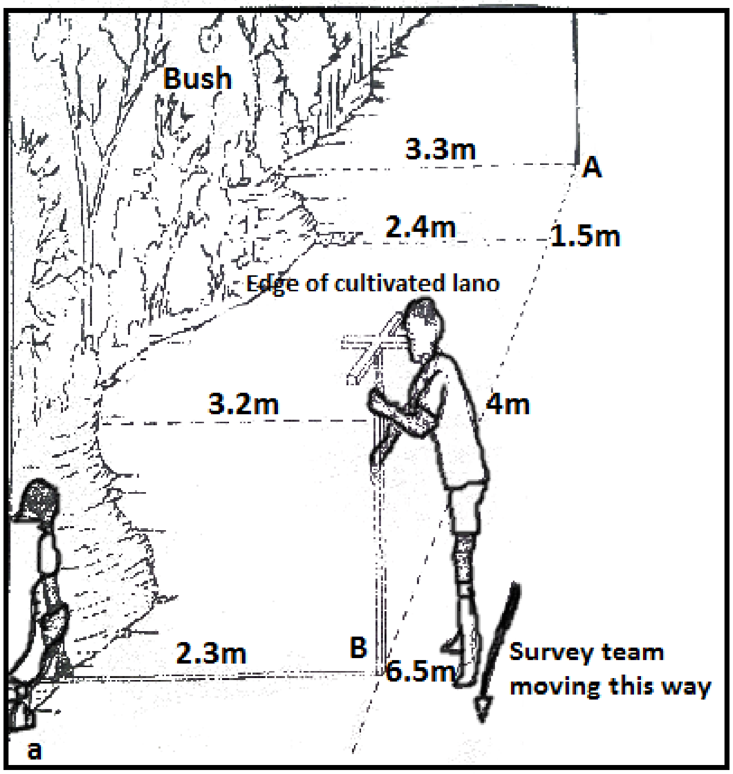
By the single line booking the details on linear measurements are entered inside along the double lines at the centre as illustrated below.

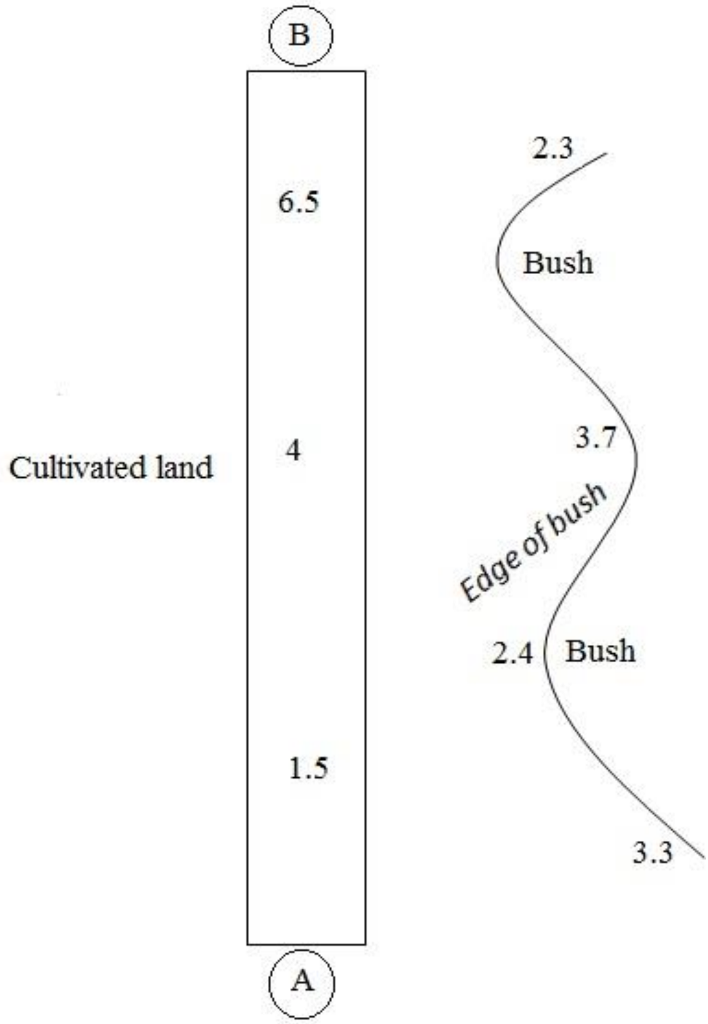



In book of the chain survey detail involves the following significant steps:

- - Plot your survey booking north so that the top, bottom, left and right respectively represent top bottom left and right respectively represent north, south west and east
- - Always keep you paper perfectly flat, do not remove from the drawing table
- - Measure every line to away features from the survey line on right and left hand sides
- -Mark out around with small circle and dot inside to represent station

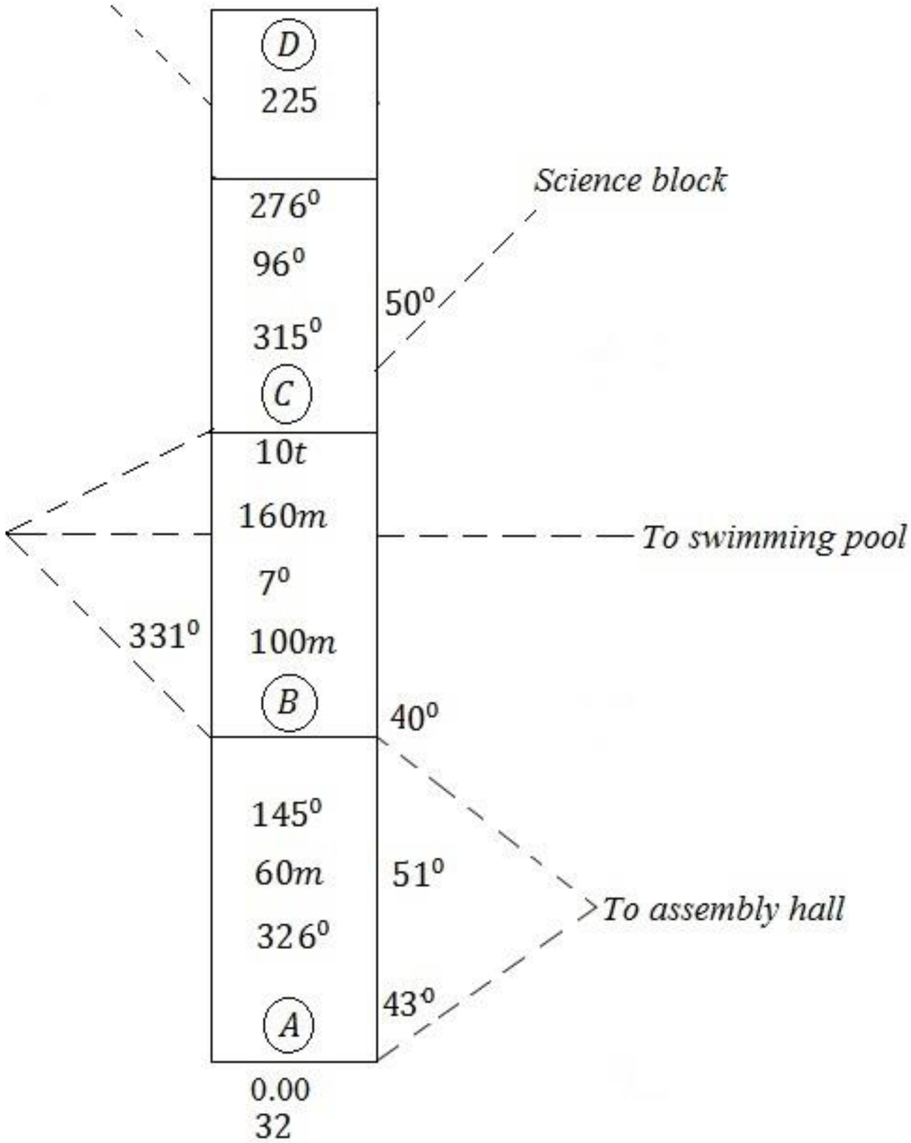
Example 1.


Bush
3.3m
A
2.4m
1.5m
Edge of cultivated lano
3.2m
4m
2.3m
B
6.5m
Survey team moving this way
a




According to the booking into field note book develops the following interpretation

- The claim survey covers two stations A to B
- The survey line has a total distance of 6.5 m
- At a distance of 1.5m observer seen the edge of the bush at off set distance of 2.4m
- At distance of 6.5 observer seen also the edge of the bush at a distance of 2.3




**The figure to the last immediate page shown as follows**

1. 1.The chain survey line covers four stations A to D with total distance of about 225m

2. 2. At point A (Station A) the survey line runs through the bearing of 326 to B

3. 3. At station A one observe assembly hall at bearing 43 of the right side of the survey line

4. 4. Along the survey line at a distance of 60m the surveyor observed assembly hall at 51 right side of the survey line

5. 5. At station B, 100m from A, surveyor observed pavilion at the bearing of 331 at left of the survey line.

6.The surveyor also observed an assembly hall at 40 to the right hand side of the surveyor line

6. 7. From point B the surveyor changed direction and surveys through direction 7

7. 8. At a distance o f160m away from B towards C the surveyor observed line) and also at right angle at the same distance point observed a swimming pool (right hand side of the survey line

8. 9. At point C 315 from B surveyor observed BB of 187º from C to B

9. 10. At station C the surveyor observed a science block at a bearing 50º left side of the surrey line to the left side of the survey line a bearing of 275º be observed assort pavilion.

11 11. From point C surveyor changed direction and took 96º

12 12.The last station D was at distance of 225m. He observed the BB of 27º to C. He observed science book (left side of survey line).

**(b) PLOTTING**

Plotting is a process of putting or transferring the information or details obtained in the field into a piece of paper to develop conventional visual appearance of the surveyed area. The plotting date mostly from what have been bake in the field at book.

In plotting the surveyor should have the following equipment.

- A Scale ruler
- A pair of compass
- Drawing paper
- Protector
- Square ruler
- Pencil and rubber
- T square
- Drawing table
- Drawing pins

**Plotting procedure**

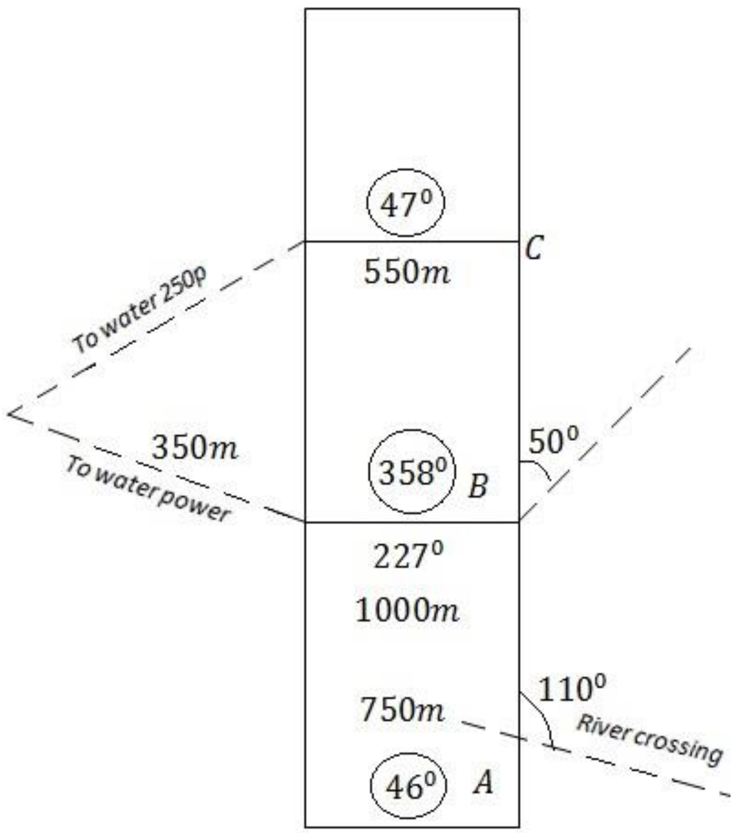
· 1. Choose suitable scale like that of 1cm to represent 10m

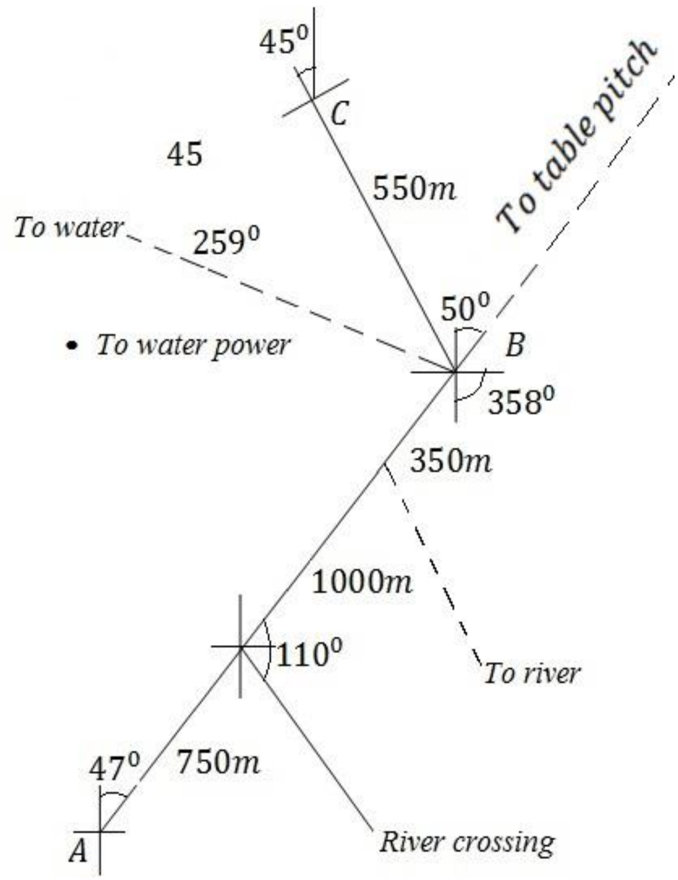
· 2. Select the starting point on the nature of data booked in the field note book

· 3. Establish the north direction

4. By considering the north direction the elected starting point as well as the booked data established the survey lines, off sets and ties, and respective features

**A FIELD NOTE BOOK**






**Errors in Chaining**

The operation of the chain survey may get subjected into errors. The errors result due to the following:

- -Incorrect ranging length of the chain
- -Chain not being too tight and not properly aligned
- \- Sag in the chain
- \- Expansion and contrition due to differential temperature conditions.
- -Incorrect booking made during data collection or actual surveying.
- -Arrows being not properly insured.
- \- Presence of sleeps on the way.

**Advantages and disadvantages of chain survey**

**Advantages**

- It is useful method for surveying small areas.
- It is useful method of taking linear measurement over smaller distances.
- Chain survey is much applied in other surveying techniques like prismatic compass survey.

**Disadvantage**

- Sometimes it becomes time consuming method as it is so much slow in the conduct of it
- It is heavy and tiresome to work.
- It is subjected to the problem of errors accumulation.
- It is required to the problem of errors accumulation.
- It requires more than two people to run survey effectively.
- It requires extra time for office work particularly in making of plotting of the data.

**5.3 PRISMATIC COMPASS SURVEY**

Prismatic compass survey is a branch of topographical survey in which directions of survey lines are determined with prismatic compass and the length of lines are measured with a tape or chain to develop a controlled network of connected positions (point) known as traverse. Or it is surveying technique with the use of prismatic compass entailing the fixing of object position in the field by measuring the angle of bearing between the line of magnetic north and the line of sight to the object. In practice the prismatic compass survey is generally used to run traverse. In surveying connected together to form an open or closed polygon.

**Significance of conducting prismatic compass survey**.

- -Prismatic compass is mostly used to have details for rapid mapping of areas in relation to details collected by other topographical surveying techniques.
- - It is used to take angular measurement of objects relatively to one another in terms of bearing.
- -Used to develop transverse of the survey lines by confectioning several stations.
- - It is used to locate position of objects in the field by either intersection or resection method.

- -Used for setting the magnetic north of the areas to be surveyed as well as to be mapped.

**Equipments used in the conduct of prismatic compass survey**

1. **1. Prismatic compass**

It is the circular compass box with a small magnetic needle swinging horizontally and circular card inside it. The circular card marked clockwise in degree number values. The magnetic needle shows the north direction and the degree number along the sightline is the bearing of an object from the position of observation. The prismatic compass is used to determine the bearing of an object


**2. Ranging pole**

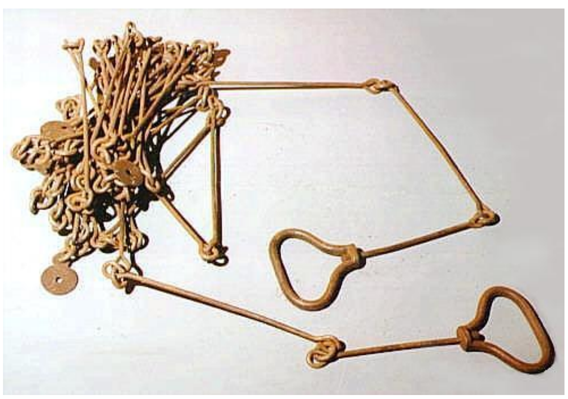
It is used for making stations of the survey lines whose distance are to be measured.

**3. Arrows**

They are used to mark the end of chain along the survey line.

**4. Tape measure or chain**

Either one of the two used to take linear measurements along the survey lines from are position to another.

**5.Field note book and pencil**

Used to record the details obtained in the conduct of prismatic compass.


**PROCEDURE IN PRISMATIC SURVEY**

1.Preliminary surveying should be firstly carried out. During the preliminary survey the following should be done

- -The main stations should be chosen and they are to be marked by ranging poles or any natural feature like a tree
- -The survey lines should be clearly laid out. In laying the survey lines should be as long as possible

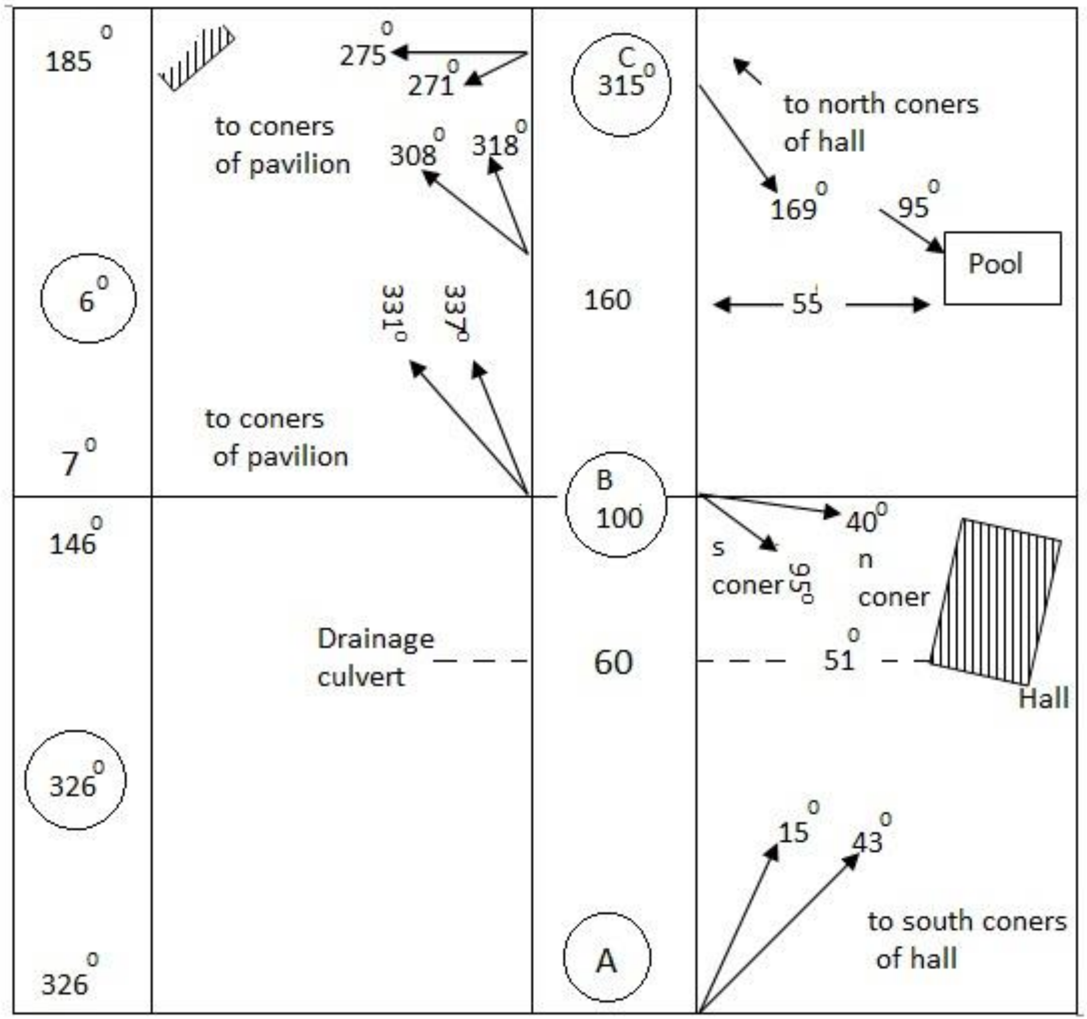
2.Mark the stations e.g A,B,C etc

3.Angular measurement are made to the next station e.g A to B,B, to CC to DD etc. In determination of the angular measurements the FB and the BB are taken and entered in the field note book.

4.Linear measurement are made using the chain or tape measure and also entered in the field note book.

5.Simultaneously, the offsets and ties to most important object are taken in the course of traversing.

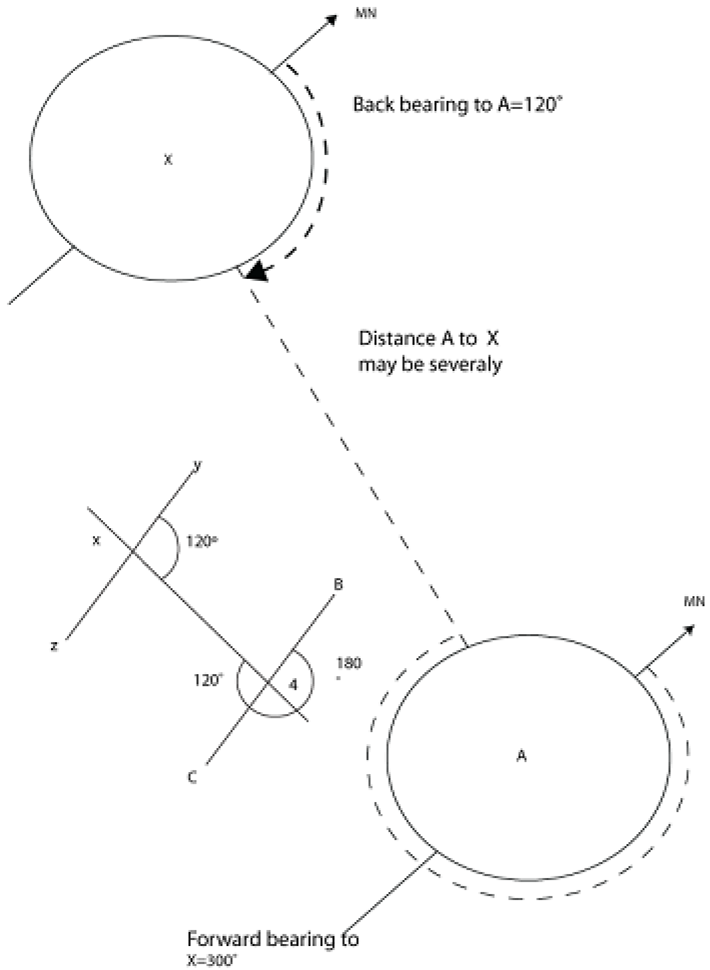
6.The booking of the date in the entry book may appear as following the next page.




**Reading of bearing in prismatic compass survey.**

Bearing means an angular distance along the sight line from one position to another position detected clockwise from magnetic north of the used prismatic compass.

A bearing of the observer to a distant object is called forward bearing. A bearing from the distance object to an observer is called backward bearing




Principle involved in taking the bearings

- The forward and backward bearings differ exactly by 180.
- If the forward bearing is greater then 180 substract 180 to get the backward bearing

| Bb=fb-180 |
|---|

- If the forward bearing is less than 180 add 180 to get the backward bearing

| BB=FB+180 |
|---|
| |

**Precaution of Using prismatic compass**

Before using the prismatic compass the following should be observe

- The prismatic compass should be checked if it is in good order or not in order to avoid errors inherited from such instrument
- Walk over the area of the survey checking whether there are materials made of iron and remove them when is possible.
- Check whether you have any instrument made of metal such as watch before using magnetic compass. Such materials make attraction during actual survey.
- In taking the bearings check the difference between FB and BB. The difference should be exactly 180

**Lack attractions in magnetic compass survey**

It is made by the presence o metals or any thing in the field area that may disturb the earth magnetic field at the point of observation and may affect the correct reading of the compass needle the magnetic needle of the magnetic compass is disturbed not to point exactly to the magnetic north, in stead it is elected seriously from its normal position. Example of elements which make attraction in clued keys watches rock material metallic properties in the ground, electric cables, spectacles ring telephone and others which make the same.

**Detection of local attraction**

Local attraction detected by observation the difference between FB and B

- If the difference is 180 there is no local attraction
- If the difference is greater or less than 180 there is local attraction between stations

**Correction of local attraction**

Local attraction are corrected with the use of means error of which computed as follows

$$\text{Mean error} = \frac{\text{Amount of error}}{2}$$

Amount of error = The obtained diff – stand diff

With the mean error correction is made under the following principle considerations.
- If BB>FB: Then; FB + Mean error & BB- mean error.
- If BB< FB: Then FB - Mean error & BB_ mean error.

| Line | Distance | FB | BB | Errors | Cor FB | Cor BB |
|---|---|---|---|---|---|---|
| AB | 300m | 50˚ | 232˚ | 2˚ | 51˚ | 231˚ |
| BC | 500m | 192˚ | 10˚ | 4˚ | 192˚ | 12˚ |
| CD | 400m | 87˚ | 263˚ | -2˚ | 85˚ | 265˚ |
| DE | 300m | 65˚ | 248˚ | 3˚ | 66.5˚ | 246.5˚ |
| EF | 600m | 90˚ | 270˚ | 0˚ | 90˚ | 270˚ |

**PLOTTING IN PRISMATIC COMPASS SURVEY**

Plotting in prismatic compass survey is a process of putting or transferring the information or details obtained into field onto a piece of paper to eyed area in a form of traverse.E

**Procedure**

1. 1.Choose suitable scale according to the size of paper you have.
2. 2.Choose suitable starting point.
3. Set the north direction (MN).
4. By using protector, measure the angle for direction and mark the distance according to the scale. In close traverse, the finishing point should coincide with starting point if the traverse do not coincide, adjust the traverse using graphical method

The process of establishing a traverse as a net work of connecting series of lines is known as traversing.

**COMPASS TRAVERSING**

As it has already been given in the introductory part, the position on the ground is established if its bearing and distance from another known point are measured. Te process of establishing the positions of successive points is known as traversing

A traverse is therefore defined as a plot of a series of survey lines connecting established points. There are two types of compass traverse including

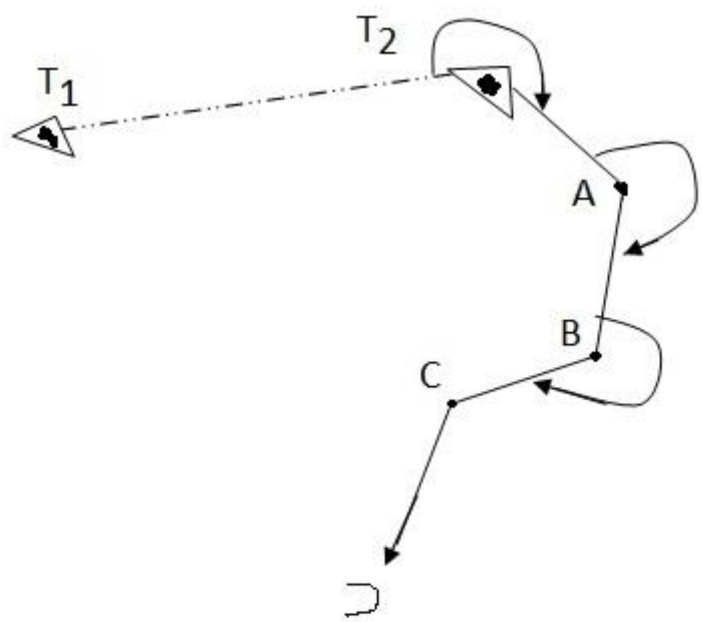
(a An open traverse

(b A closed traverse

The open traverse

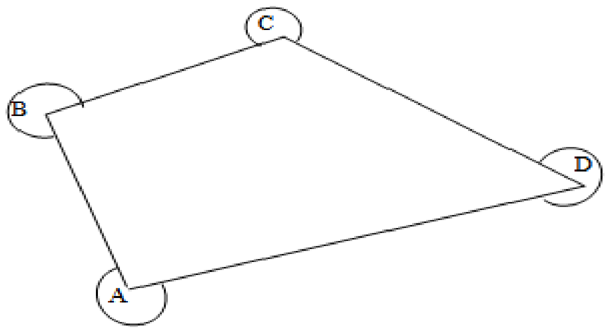
Closed traverse is also known as free traverse. It is the one of traverse of which proceeds from known point to another, the finishing point coincide with the starting point. The open traverse is established following the conduct of open traverse survey.

The open traverse survey from which the open traverse polygon established is conducted to have a good plan of route for road or railway construction or for pipe line establishment




Closed traverse is a series of linked traverse lines where the terminal point closes at the starting point. Or the one which proceeds from known point to another and the finishing point coincides with the starting point

Closed traverse is useful in making the boundaries of wood or lake. Civil engineers utilize this practice for preliminary surveys of proposed projects in a particular designed area.

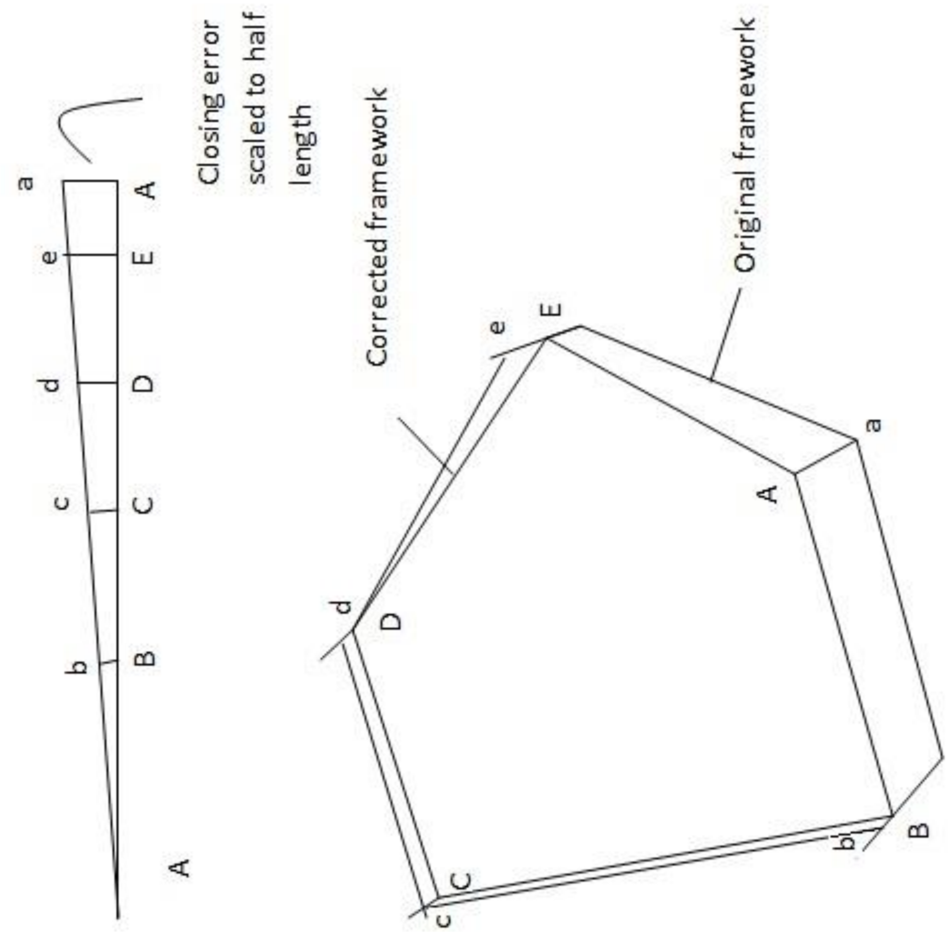



Adjustment of closing error

In plotting a scales closed traverse, the terminal point may not coincide with the starting point. If this is revealed, a closing error detected and it has to be corrected (adjusted).

Closing error is adjusted by the graphical method as follows:

- • Measure the distance of the disclosure (closing error) with our example the distance should be measured from a A
- • In all direction of the closing error, draw parallel lines at all station to the disclosure.
- • Find the total distance of the traverse
- • With suitable scale, draw a horizontal line representing the discourse A to AI
  • Mark the distances between each station on the horizontal line between each station
- • At station A draw a perpendicular line representing the closing error
- • Draw the hypotenuse line joining A and A
- • Join other perpendicular lines from each station on the horizontal line to the hypotenuse line
- • Measure each perpendicular line
- • Lastly use measures to adjust the disclosure.



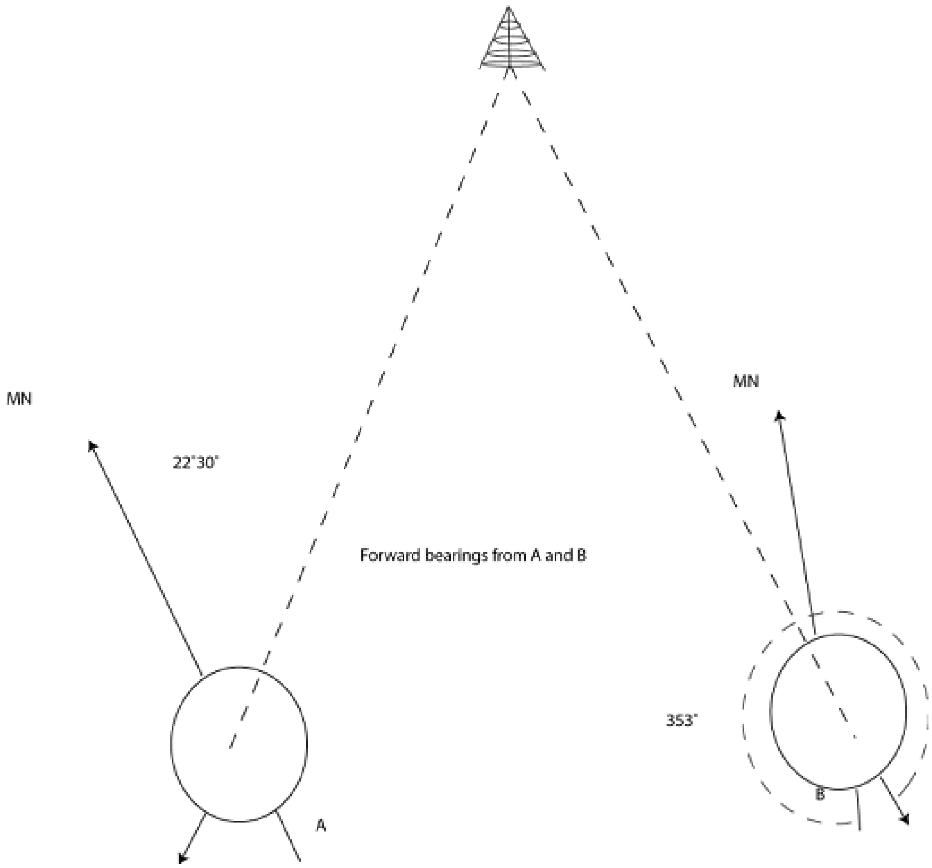

**Intersection and resection**

**In prismatic compass traverse**

These are the methods used in recognizing position of objects in areas on the earth surface by doing prismatic compass survey and also applied on maps.

**Intersection**

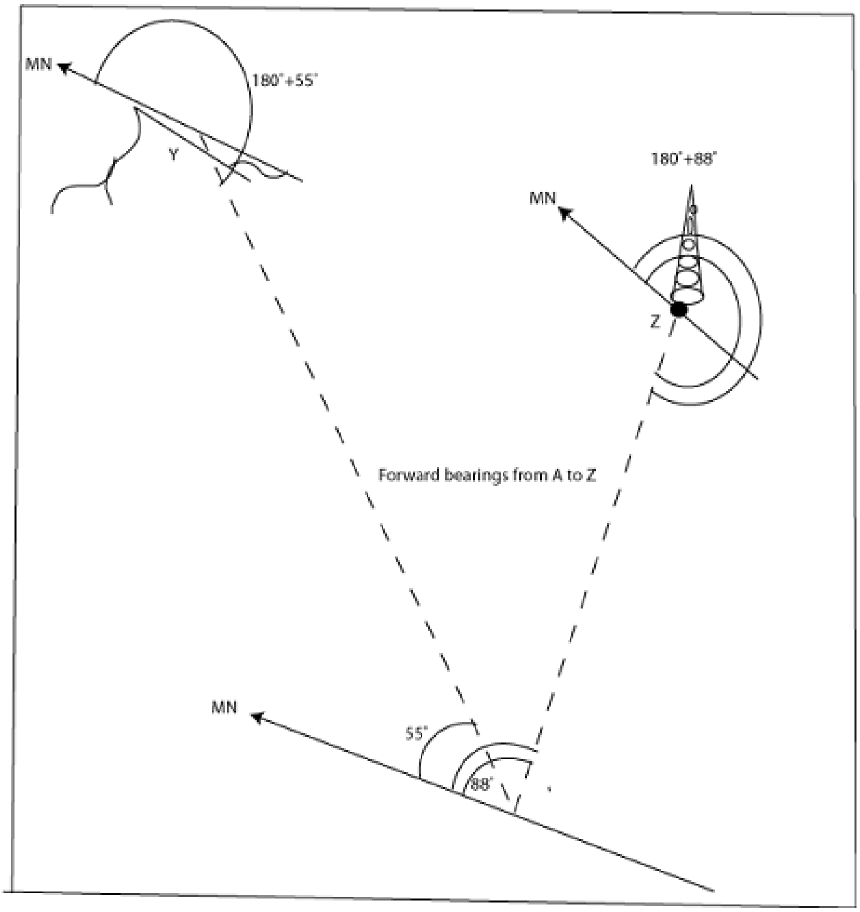
It is a method of identifying an object by taking bearings towards it from two or more fixed points radio tower is found at bearing of 22.30 and be recognized by taking the bearing from the two points of observation to it. The application is as follow.




**Resection**

It is a method of taking bearings to two objects in the field which can be located on the map. The reading are converted into backward bearing, then converted to true bearing and angle lines drawn from the points to meet at observers position. The methods is used to recognize the point of observer by taking bearings from the two observed object.

E.g The compass bearings of Y and Z as taken from A were 55 and 88 respectively. The point of observers recognized by resection method a follow




**Chaining errors in the prismatic compass survey**

Error is a state of being incorrect in the field during data collection

Errors are numerous and fall into the following groups

1. (1)Mistake
2. (2)Systemizing or cumulative errors
3. (3)Accidental or compensation errors

**Mistakes**

These result due to experience or due to carelessness on the part of the surveyor. The typical mistake in clued.

- • Misreading of the chain

- • Miscounting./loss errors
- • Reading from the wrong end of the chain
- • Wrong booking
- • Miscounting chain length.

**Systematic or cumulative errors**

The error arise from eh chain itself by being not accurate e.g the chain may not have 100 links

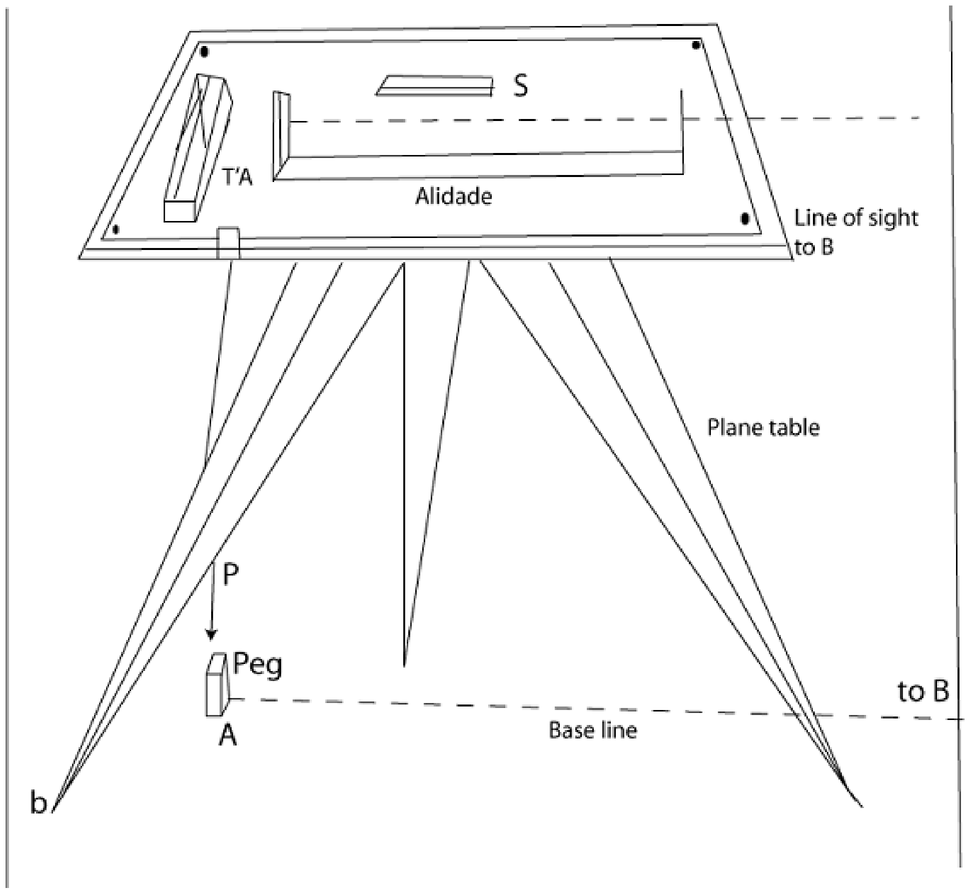
**Accidental or compensation errors**

The error arise from a chain itself by being not accurate e.g the chain may not have 100 links

**5.4 PLANE TABLE SURVEY**

Plane tale survey is a surveying technique used to fix the position of distant object by intersection radiation or resection by employing a drawing board (plane table) placed on tripod stand. It represents the most accurate and rapid way of fixing position of objects for map making.

In plane table survey, the table is covered with drawing paper on which the details are entered during the survey




**EQUIPMENT USED IN PALANE TABLE SURVEY**

1. **i.Plane table**

It is device used in surveying to provide solid and level surface on which field drawings, charts and maps established. It is of any size and the most suitable are those of 45 x45 cm, 45 x 60 cm nd 60x75cm Commonly, inside the table there is a socket which allots it to the mounted on a tripod stand when in use it is set over apoint of precise horizontal level then a drawing sheet is attached over its surface.

2. **ii.The tripod stand**

It is wooden or metallic stand with three sides which can be easily moved and adjusted. A tripod stand needs to have some privet to allow the table to be rotated in a horizontal plane and clamping pin and screw which hold the table steadily or firmly the table.

3. **iii.The alidade**

It is a device that allows one to sight a distant object and use the line of sight to perform a task. It is fundamentally used to sight and measure distant objects from the position of the table. With alidade the distance and direction angle of the object can be measured and established on the table by drawing over the paper sheet. Alidade is so used to cheek the table to the exactly level if it has water level

**4. iv.Trough compass**

It is also known as plane table compass. It is a rectangular wooden box with magnetic needle floating freely at the center. It is used to find the magnetic meridian in a field area to be plotted on the drawing paper sheet over the table.

5. **v.The plumb bob (plumbing fork)**

It is attached to the edge of the board and the metal weight directly over the ground station. It is used to fix the table exactly.

**6. vi.Sprit level or one level**

It is used for leveling the table if alidade has no water lever.

7. **vii.Chain or tape measure**

Used to measure ground of the sightlines to distant object if the alidade is not capable.

**8. viii.The cover**

A plastic cover is used to prevent the table during rain while surveying.

9. **ix.Good drawing paper**

The paper should be mounted on the table either by pins or clamps.

**1 x.A hard pencil**

It is for drawing in the field. Also a rubber should be organized for rubbing incase mistake entered.

**1 xi. An umbrella**

It is used to avoid hot sun or rainfall.

**METHODS OF PLANE TABEL SURVEY**

Fixing of data on a table sheet is done differently by the plane table surveyors depending on whtat is intended to be established about the position of the distant object. Considerably to this plane table survey appears to be of four methods including the following:

· -Radiation method

· -Intersection method

· -Traversing method

· -Resection method

**Radiation method**

By radiation method, it is a kind of plane table survey which is made up of rays radiating from the centre of the surveyed area. It is employed with an emphasize of establishing the position of distant objects from the centre at which the pane table is established.

In this method, the direction of objects (points) to be located are obtained by drawing radial lines along the sight line of alidade. The horizontal sightline then measured with tape or chain and scaled off by marking their position on the drawing.

**Procedure**

1. 1.Surveyor should walk around the survey area in which the objects lie and select a position for the plane table from all objects . ie Has to walk around then commanding position for plane table should be chosen.

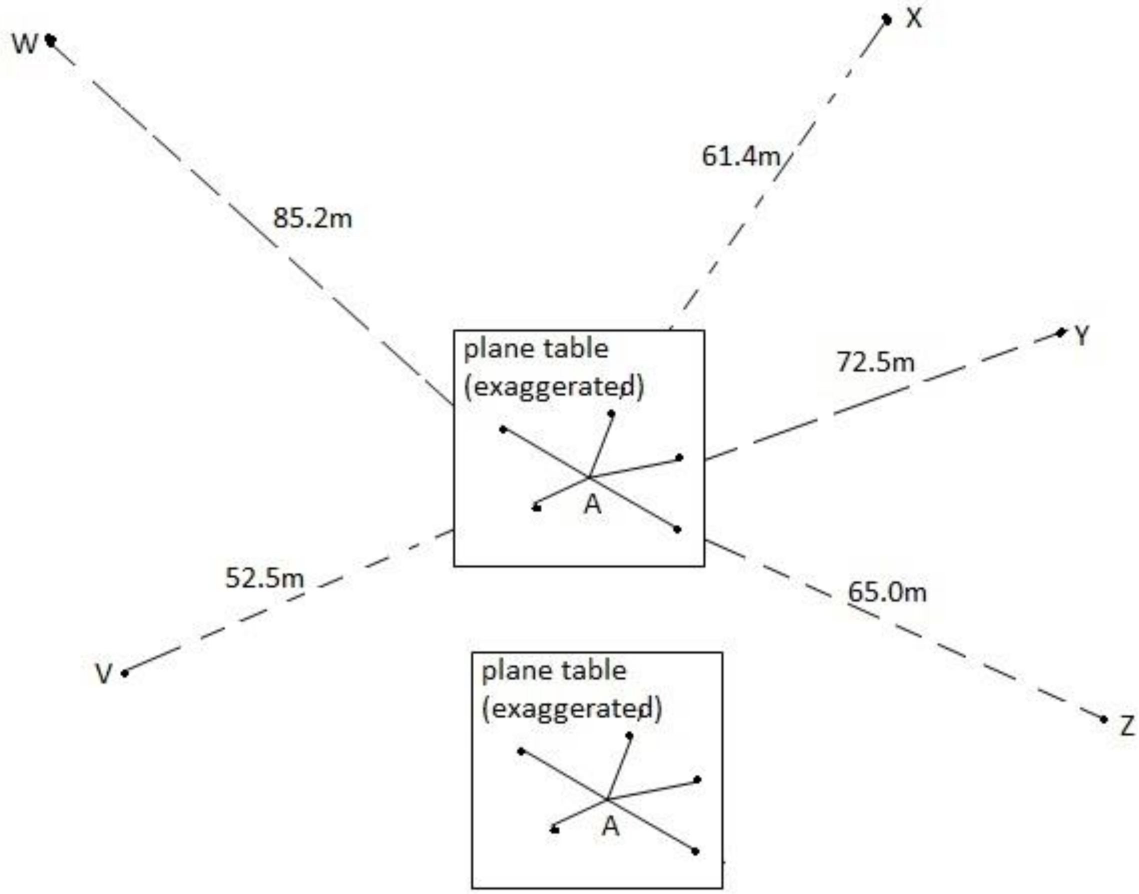
2. 2.Surveyor should set up the plane table at the commanding position. By regarding our visual example the commanding point is at station A and clamp it at station A and clamp it then insert MN line on the paper

3. 3.Stick a pin upright in the centre of the board to represent the position.

4. 4. Layout the edge of the alidade against the pin and sight on each of the objects V, W, Y, Z

5. 5.With tape or chain, measure ground distance from point A to each of the objects in the field. The distance should be converted into smaller unit values in response to scale.

6. 6.The details can be plotted clearly on the drawing paper over the table.




**Intersection method**

It is a technique of plane table survey in which ruling lines (rays) for distance object (s) are obtained by intersection from two different commanding position. The two different commanding positions are set along the same ground base line

**Procedure**

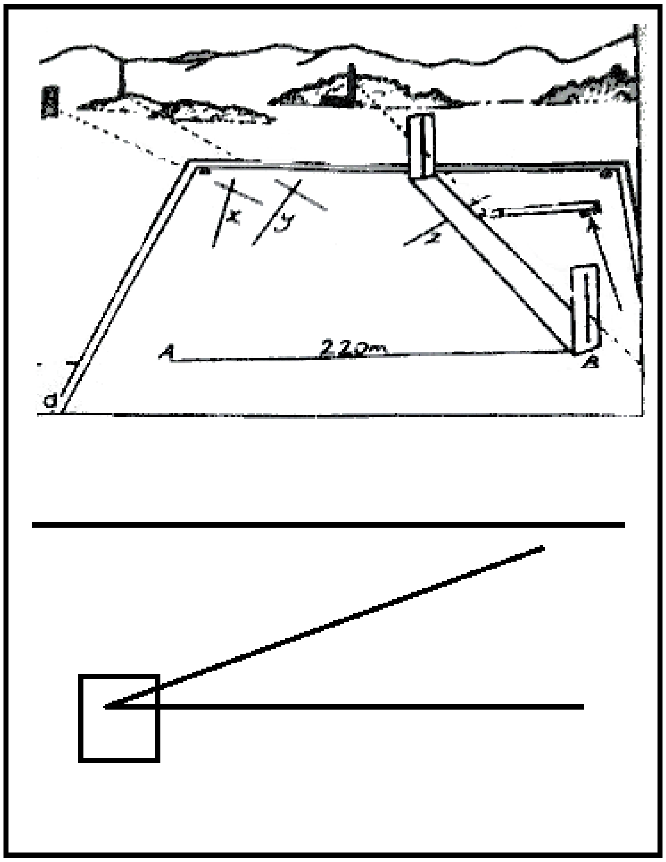
1. 1. Choose a ground baseline which should be on a rather flat areas to be surveyed. The two end points of the base line should be conditionally intervisible and long enough to mark the end points with either permanent features or ranging poles.

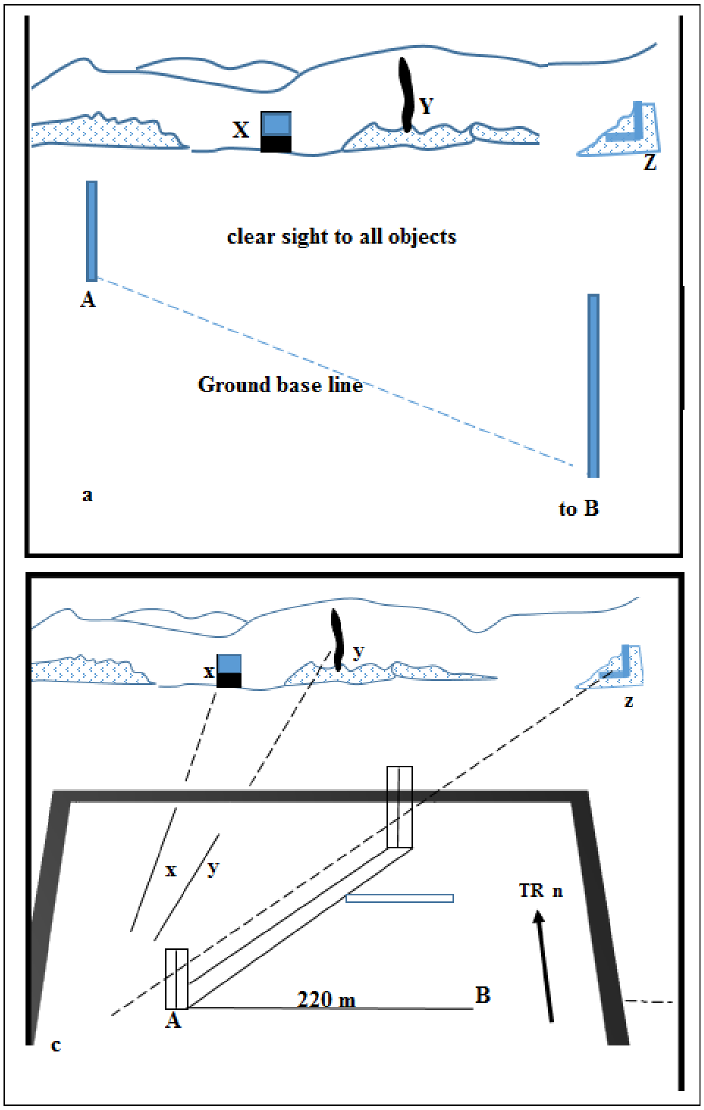
2. 2.Measure the ground base line with either tape or chain.

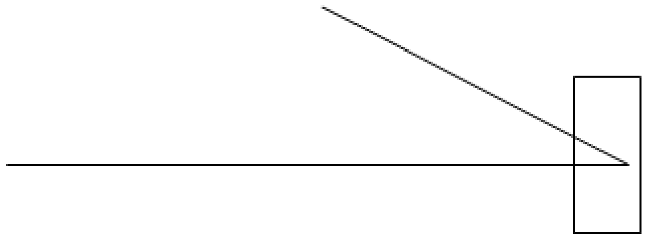
3. 3. Find the suitable scale by considering the length of the ground base line as well as the size of plane table sheet.

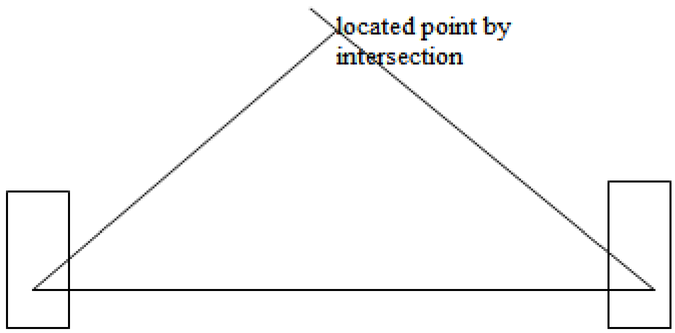
4. 4.Draw the base line on the your drawing paper

5. 5.Points can be then established by intersection from the base line i.e Establish the sight line to the points from one position of ground base line end. Then establish the sight line to the same point from another position of ground base line end. Where the two sight line intersect the position can be established


x
y
z
A
220m
B
d


X
Y
Z
clear sight to all objects
A
Ground base line
a
to B
x
y
z
x
y
TR n
220 m
B
A
c






**Traversing method**

It is a plane table surveying technique employed to develop a traverse compound of interested feature like school, college industry and others,

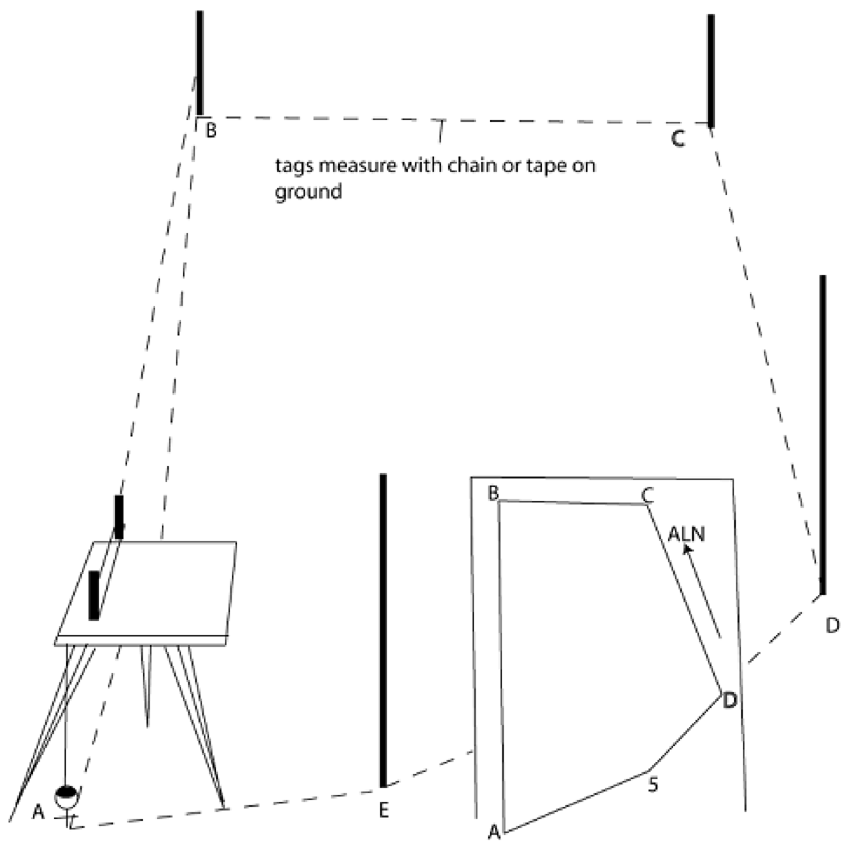
**Procedures**

- -Make pre-visit of the area to be surveyed and identify the important corners of the compound area.
- - Set up the table in one corner of the field so that one side is roughly parallel to the side of the area to be surveyed.
- -Select some objects in the next corner of the area to be surveyed or mark the stations with ranging poles.
- -Choose the suitable scale to the area.
- -Set up the table at A and a drawing towards by to the scale
- - Measure the distance AB and mark B to scale
- - Leaving some thing to mark the station, pick up the table to B and set it up.
- - From B measure the ground distance from B to C.

· -Draw in the ray to C on the paper and mark it C.

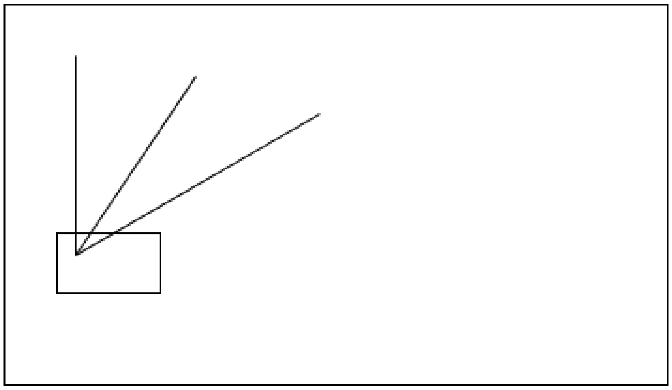
· - Repeat the process at CDE etc, until you are through to all stations.

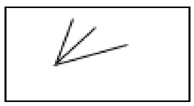
· -Plot the surrounding details by radiation and intersection.




**Resection**

By resection the position of two or more points are located from the same position of pane table and from one commanding position of the plane table other features are located by considering sight lines on the plane table established. It is meant that; ray lines on the plane table established from the same position to different points of interest.





**Advantage of plane table**

- - Is a rapid method of survey no booking is required
- -It permits rapid sketching of details on the map
- -The technique used is an excellent discipline in observation and cartography

**Disadvantage of the plane table survey**

- -The method can not be used during damp or rain season.
- - A simple error in the ground base line measurement could throw out all angle measurement
- -It needs much higher skills to be conducted

**5.5 LEVELLING**

Leveling is the process of determining the difference in elevation of two point

Or

the method of surveying where by the relative heights of a number of points on the earths surface are determined by sighting through a leveling instrument and reading the heights on the leveling staff.

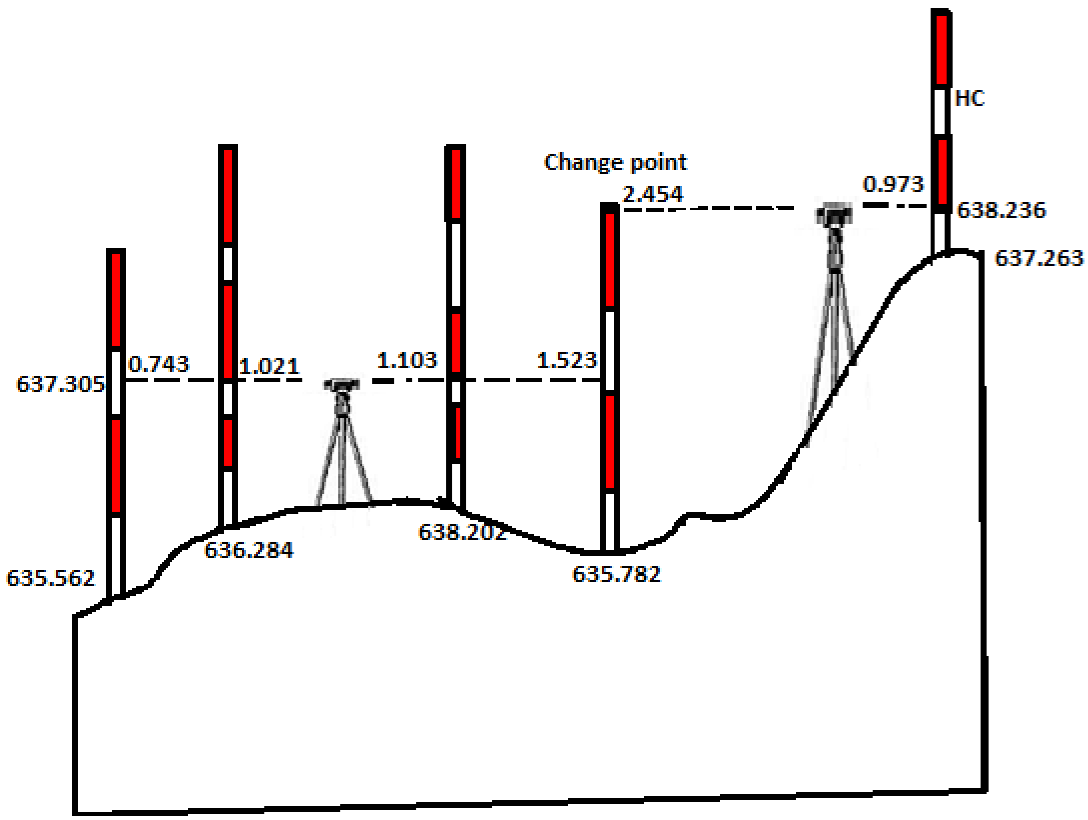
Or

The measurements of height difference between points on the ground

The heights difference between points on the ground

The heights difference to be measured has to be deferred to same reference level. Stable reference points for heights are called benchmarks (BM) which have heights fixed with reference of mean sea level.

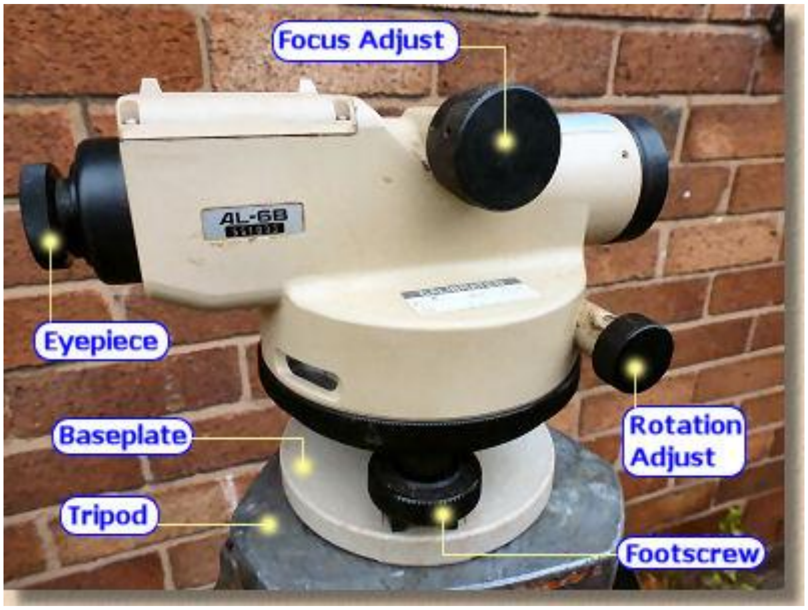
Leveling in cartographic concerns used to establish altitude on maps by contours, spot height, trigonometric points as well as bench marks. All altitudes seen on maps by contours, spot heights trigonometric points and bench marks have been determined by surveying process known as leveling




**Instruments used in leveling**

1. **1. Leveling instrument**

They are level sighting instrument toward the station with leveling staff. There many types of leveling instruments used in leveling including. Dumpy level tilting level, the delete, abbey staff, clinometers alidade and other




2. 2 **Leveling staff:**

It is a long big scaled rod graduated in tenth meters, hundreds meter. It is used together with a leveling instruments to measure the vertical distance above a reference plane.


3. 3 **Chain or tape**

They are used for measuring horizontal distances in the field area.



4. 4**Pegs**

They are popularly known as station pegs and used for marking different station points in the field area

5. 5**Field sheets and pencil**

They are used recording or booking all necessary field work information

6. 6**Arrows**

They are used to mark the end of chain along the survey

**METHODS OF MEASURING HEIGHTS**

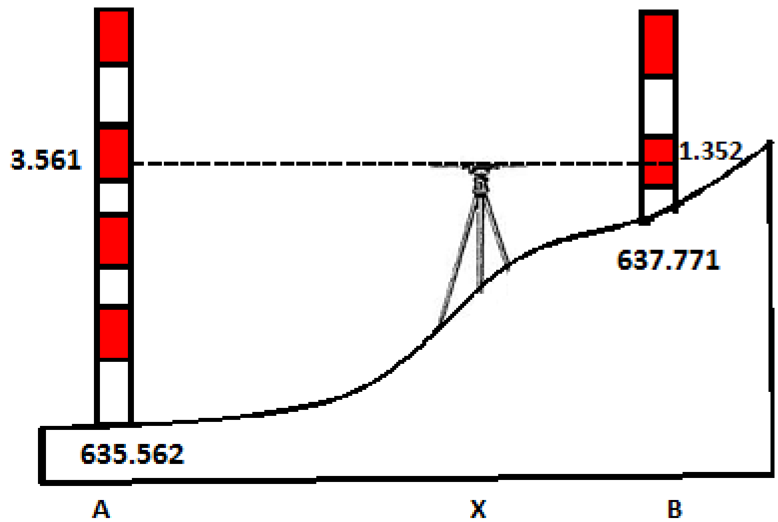
There are two methods of measuring heights;
including

-rise and fall method
-Height of collimation method

**The rise method of leveling**

It is done by considering the reference height to another point. Back sight and fore sight taken and subtracted to get the difference. If the difference is positive it means the land rises hence the height is determined by taking the amount of difference.

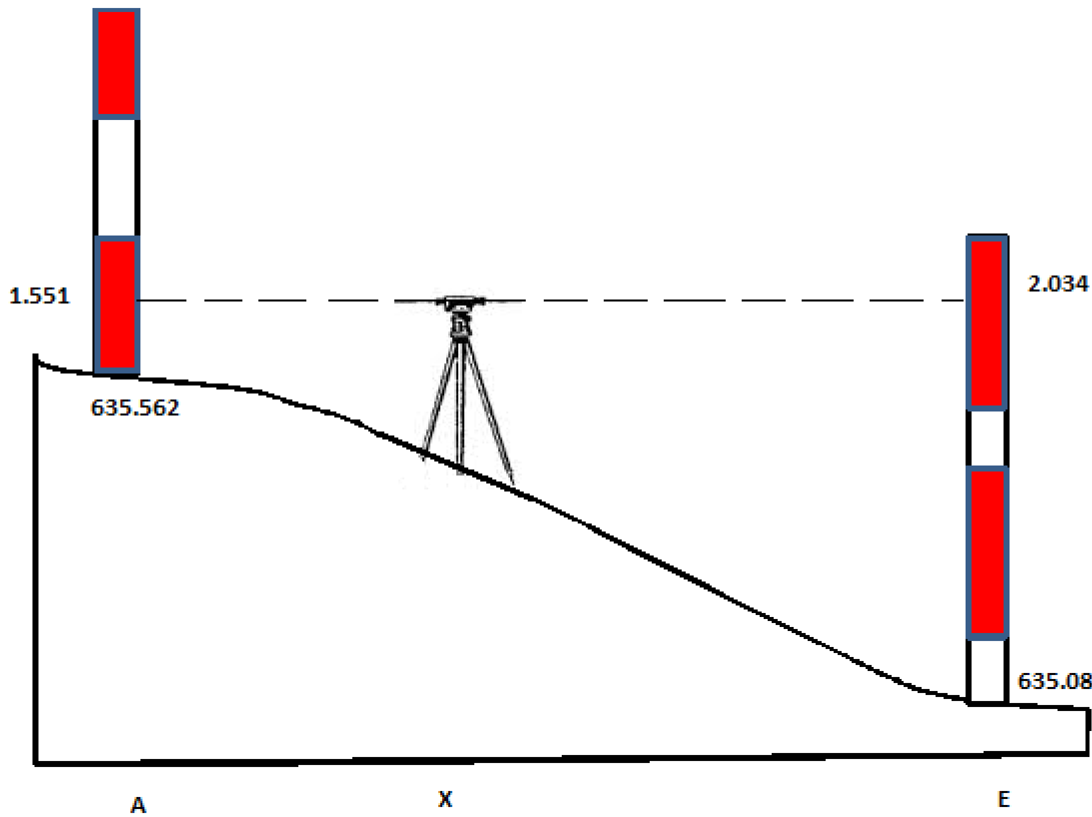
Between BS and Fs added to the amount of reference point
Example




- The travelling instrument is set up on its tripod at X
- He telescopic staff is erected at A and a reading is o bout 3.561m, Such amount of reading of the staring point to thelevelling instrument is known as back sight
- The level is then swung rounding a horizontal plane. The telescopic staff is set as B and a second reading taken is (1.352m)
- The difference is level between A and B is rise of (3.561m) (1.352)= 2.209m
- So long the height of A known the height of B can be calculated as (635.562m +(2.209m)=637.777

**The fall method of leveling**

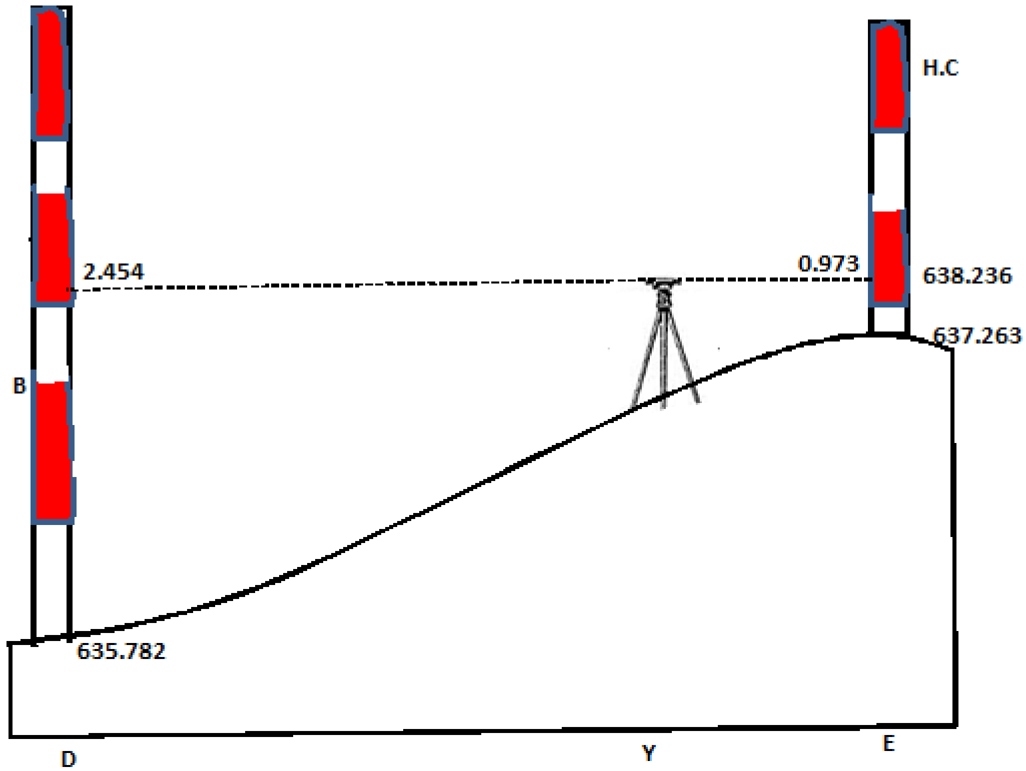
It is also by considering the reference height to another point. Back sight and fore sight taken and subtracted to get the difference. As the difference is negative it means the land falls hence the height is determined by taking the amount of difference between BS and FS (Fall) subtracted from the amount of reference point




**Height of collimation method**

The height of collimation is found by adding the staff reading of a point of known level (back sight) to that point of known height (bench mark) to get height of instrument (HI) Then the HI subtract the fore sight reading to get the height of the recommend ended position.

Example




**Procedure**

By considering the longitudinal section above the height of print by the height of collimation methods done as follows

- The height of D is known and it is of about 635.782m
- The levelling instrument is set up at Y and directed to D to read BS According to above the Bs is of about 2..454
- The known height 635.782 should be added to the amount of Bs 635 + 2. 454 = 6338 (HI)
- The amount on height of instrument should subtract the amount of 633.328.0.973

**TYPES OF LEVELING**

Leveling is of two types up on what measured relatively to heights. The main types include the following

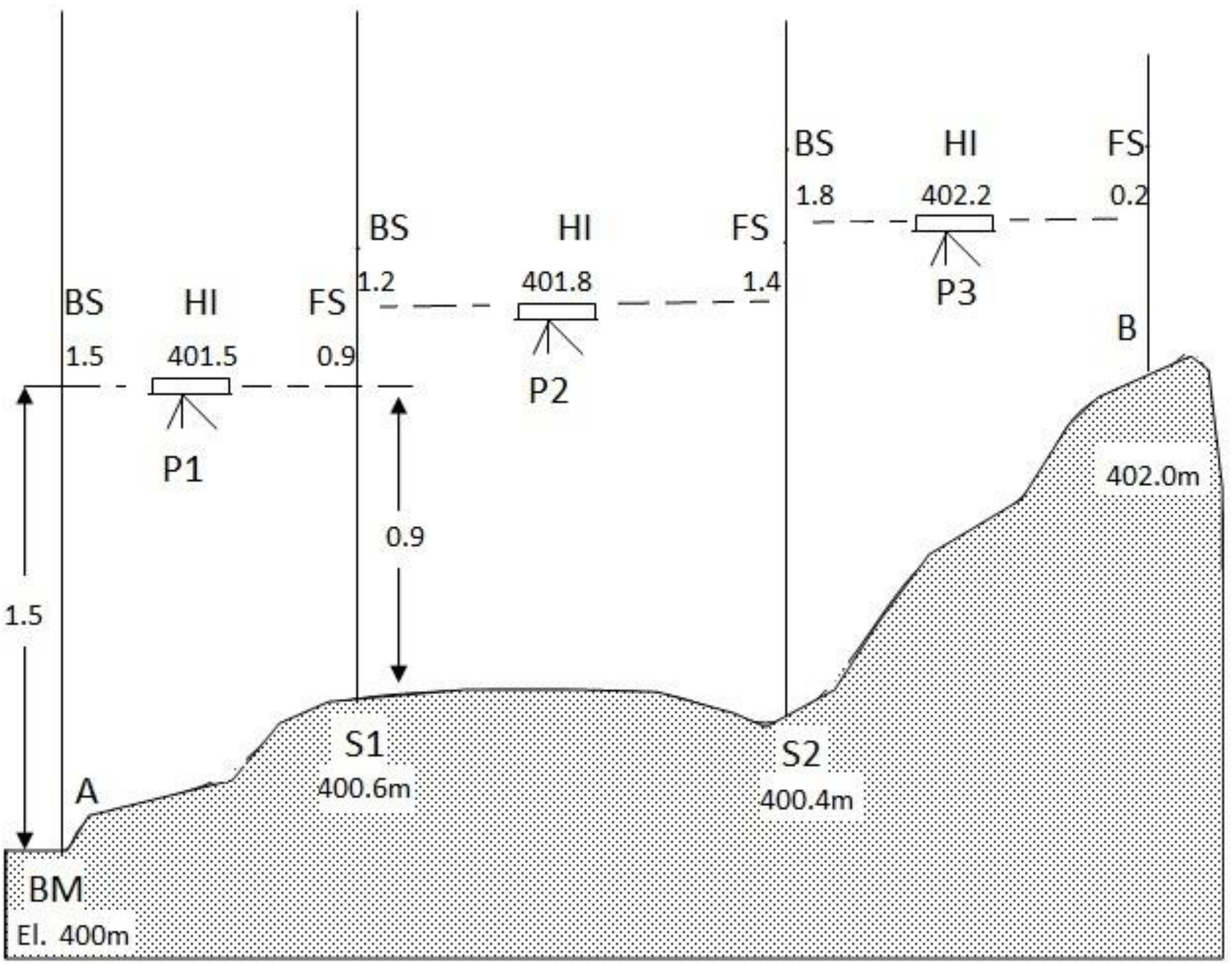
1. Differential leveling
2. Profile leveling

**Differential leveling**

The technique involves the determination of the elevation difference between one point apart.

**Procedure**

It is in an assumption that, we need to know that difference in elevation of point A and B of a farm. Point A is a bench mark whose evection may be known or assume . This can be illustrated as follows




1 Leveling staff is held at A an instrument level is set at the point P the first reading taken at section A is back sight. The readings added to the reading of station A to get the height of the instrument.

2 The staff man moves past position 1 station 1 (51) the instrument is turned so that reading is taken at of station. This is the foresight (FS) Say 0.9m) The elevation of this station is determined by subtraction The FS from the Hi

3 The level man moves to station P2 and sets the instrument to read the staff at station SI (SAY 1.2M) This reading is added to the elevation of station SI to get the new height of instrument i.e Hi 400 + 1.2

4 The staff man moves to station 52 and a foresight reading is taken (say =4) This reading is subtracted form the HI to get the elevation of s2 ie 401.8 – 1.4 = 400

5 The level man moves to position P3 from which reads the back sight from staff at position s5 (say position s2 to get new height of instrument. E. Hi= 400.1.4+1.8=402m

DIFFERENTIAL LEVELING

Bench mark A-B

| Sta | BS | HI | FS | ELEV. | Dist. | |
|---|---|---|---|---|---|---|
| A | 1.5 | | | 400 | | |
| | | 401.5 | | | | |
| S1 | 1.2 | | 0.9 | 400.6 | | |
| | | 401.8 | | | | |
| S2 | 1.8 | | 1.4 | 400.4 | | |
| | | 402.2 | | | | |
| B | | | 0.2 | 402 | | |
| • | | | | | | |
| • | | | | | | |
| • | | | | | | |
| A | | | | | | |
| | | | | | | |
| Check: ∑BS - ∑FS = Final - Initial Elev | | | | | | |
| | | | | | | |
| | | | | | | |

**Profile leveling**

Profile leveling is the process of determining the elevation of a series of points at measured interval along a survey line e.g along route way.

· A bench mark is chosen where the staff level will be stationed to take the reading as back site

· An instrument is set at position X (PX) and reading is taken as back sight (BS) from the beach mark say (0.6m)

· The staff man moves to station A and a reading is take (IS) The elevation of point A is determined by subtracting this reading from the height of instrument ie 600.6 = 599.7m.

· Staff man moves to station s1 and reading (IS) is take (say 1.2m) This reading is subtracted form HI to get the elevation of SI 600.6 – 1.2.

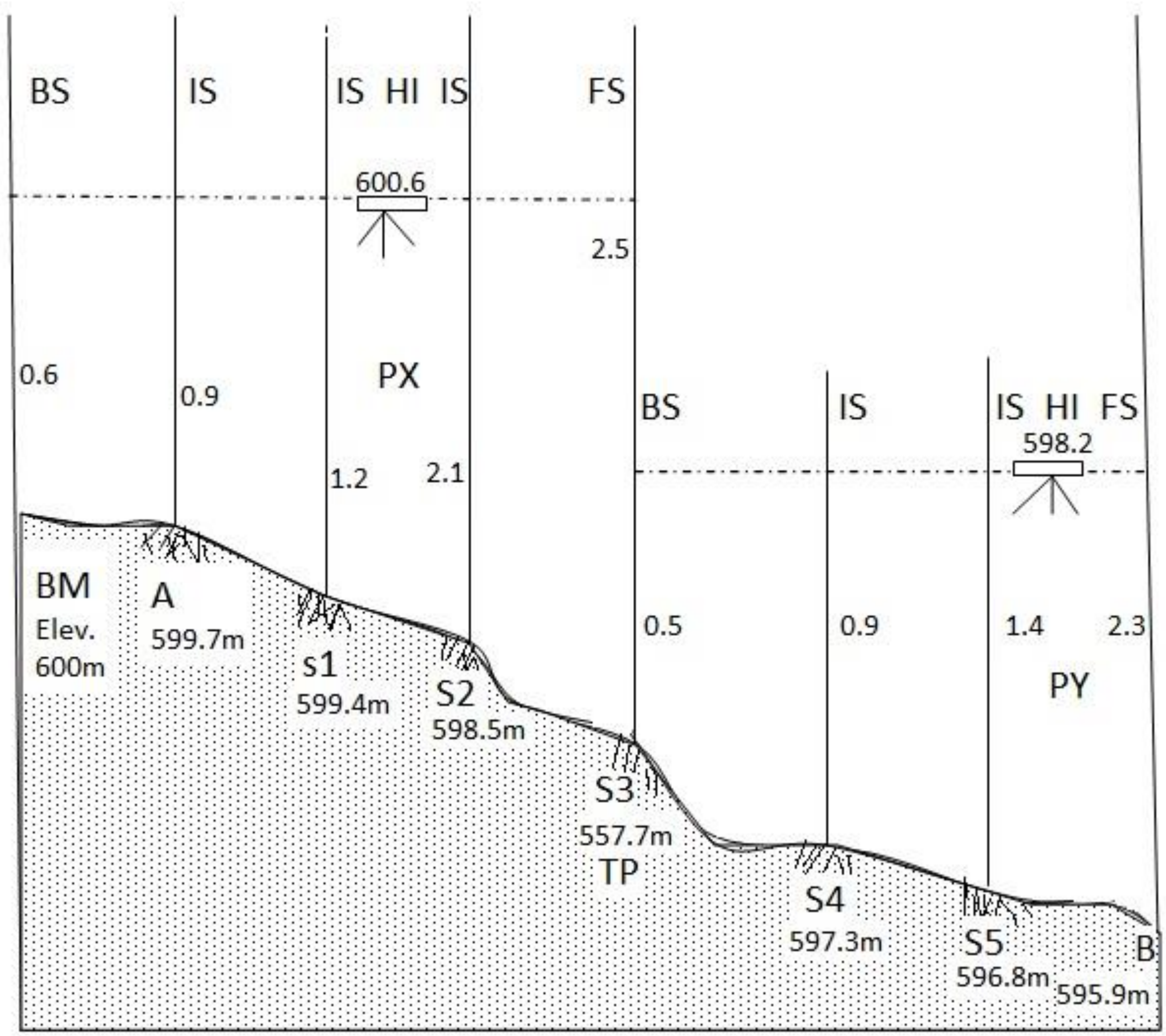
- The staff man moves to station s2 and reading (IS) is taken (say 2.1) This reading is subtracted from Hi to get the elevation o 52 ie 600 6-2= 598.5m.

- The staff man moves to station 53 and a reading (FS) is taken (say 2.9m) This reading is subtracted form HI to get the elevation of point s3 i. 600.6 2.9=597m.

- The level man moves to position PY and sets the level. A reading is taken at s3 as a back sight (BS say 0.5m) piint s3 as a back sight (BS say 0.5) point s3 is called turning point. The reading is added to the elevation of points s3 to get new height of the instrument (HI) ie 597+ 0.9=597.3

- The staff man moves to point s5 and riding is take (IS say 1.4) This is subtracted from the HI to get the elevation of point s5 i.e 598.2-2=596m

- The staff man moves to poking B and a final reading is taken which is a foresight (FS say 2.3m) The reading is subtracted from HI to get the elevation of point B. E.E 598.2-2.3=595m



| Sta | BS | IS | FS | HI | RL |
|---|---|---|---|---|---|
| BM | 0.6 | | | 600.6 | 600 |
| A | | 0.9 | | | 599.7 |
| S1 | | 1.2 | | | 599.4 |
| S2 | | 2.1 | | | 598.5 |
| S3 | 0.5 | | 2.9 | 598.2 | 597.7 |
| S4 | | 0.9 | | | 597.3 |
| S5 | | 1.4 | | | 596.8 |
| B | | | 2.3 | | 595.9 |
| | 1.1 | 6.5 | 5.2 | | 600.0 |
| | -5.2 | | | | −4.7 |
| | -4.1 | | | | |

**Usefulness of leveling**

- Leveling helps to determine the relative heights on land that can be used in contour mapping.
- Housing foundations, the location of industrial sites the routes communication and sitting of codlings can be located and determined with the help of leveling.
- Leveling can be used to determine the heights of land surface such a hills, valleys and plains.
- Leveling is used to develop the longitudinal section of roads, drainage ditches, railways and others

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# FIELD RESEARCH

**FIELD RESEARCH STRATEGIES**

**Definition of research**

Refer to scientific and systematic research for a particular information/data on specific problem facts or ideas on both social and natural science

***Or***

Is the science of collecting, observing, selecting, evaluating and presenting (reporting) of particular information

***Or***

Is the care full and systematic investigation of new fact/ideas of any information

Is the movement from unknown to known

**Geographical field research**

Is the process of seeking, observing, selecting, investigating or experimenting a problem of geographical nature on a field
Is the scientific study of certain geographical phenomena.

**Types of Research**

1. Applied Research/action research
2. Basic research or /pure or /fundamental
3. Quantitative research
4. Qualitative research/descriptive research
5. Analytical research
6. Conceptual research
7. Empirical research
8. Description research

**Note**:Types of research according to the purpose or aim of research are Applied Research/action research and Basic research or /pure or /fundamental.Type of research according to the type or nature of data are Quantitative research and Qualitative research/descriptive research.

**1. Applied research;-**

This is the type of research that aimed at finding the solution of immediate problem that face the society industry or business. The central aim at applied research is to discover solution to some particular pressing problems

- It is a research that is of direct and immediate relevance to decision makeraddress problems that seem to be as important and need to be solved for the benefit of the people concerned.

**2. Fundamental/pure/basic research**

It mainly concern with scientific discovery. It is a type of research carried out for the sake of generating knowledge. It is mainly concerned with generating and formulation of theories and therefore it does not intend to solve any immediate problem

**3. Quantitative research**

This is the information or data, which explain distribution of phenomena in quantity form. It is mainly deals with quantitative values(It deals with numerical form).

**4. Qualitative research**

It is based on the one which explains the data in descriptive manner. It mainly deals with quality than quantity sometimes known as descriptive research.

- This type of research includes surveys and facts finding through inquiries of different kind. The major purpose of descriptive research is to describe the state of affair as it exist at present

**5. Analytical research**

This is the type at research which use facts or information already available and analyze them to make a critical evaluation of material.

This kind of research consists of system of mathematical models or statistical techniques applicable to numerical data. The study in this research aims at testing hypothesis, specifying and interpreting relationships

**6. Conceptual research**

Is the type of research that related with abstract ideas or theory

- It is most applicable on invisible world

- Concern with phenomena that can not be seen, touched, heard e.g moral ,behavior, traditional believes

**7. Empirical research**

Is the type of research that depends on the experience or it is data based and capable at be verified by observation, measurement and experiment

- It is based on the world appearance/visible world

**Characteristics of research**

a. Goal oriented

b. Systematic

c. Logical

d. Imperial

e. Inquisitive

f. Selective

g. Objective

h. Replicable

### (a) Goal oriented

Purposeful for the solving of particular problem e.g. Doctor with patient

### (b) Systematic

It is the scientific in nature based of regular plan, procedure, rules, fixed method of conducting it. It have structure with specific stapes to be taken in sequence for instance

- Collection
- Analyze
- Interpretation

**( c )Logical**

Based on premises (incidences) and conclusion. It is guided by the rules of logical reason and logical process, which are of great values in carrying out research

- In fact logical reasoning makes research more meaningful in the context of decision making (**d) empirical**

It means the conduction or bear evidences of factual that can be verified. Without evidence conclusion can not be made and if made it will be just an opinion

**(e)Inquisitive:**

Means it is investigative in nature based on how and why.

**(f) Selective**

A researcher normally focuses on only one problem ( phenomena) rather than general or several research problem ( specification)

**(g) objectivity**

A researcher must be impartial standing point and been free from a personal interest, influence in conducting research ( avoiding personal interest)

### (h) Replicable

To allow the research finding to be verified by replicating the study so as to make strong base for decision- making

**OBJECTIVE OF RESEARCH**

The main purpose of research is to discover answers to different questions through application of scientific procedure, though each research study has its own specific purpose. The general objective are

1. To develop theories, principles to explain various issues or matters
2. To gain new knowledge to be added to the existing one
3. To solve different social, political and economic problems
4. To fill gaps develop or raised by other researchers
5. To discover answers to different disturbing questions
6. To evaluate success or failure of different projects as the case of environmental project etc
7. To determine the frequency with which something occurs
8. To portray accurately the characteristics of a particular individual, groups or situation. This is basically a description research
9. To gain familiarity with a phenomenon or to achieve new sight into it
10. To test or approve hypothesis of causal relationship between phenomena(variables)

**Advantage/strength/ importance/usefulness/merits of field research**

i. To look for accurate solution to existing problems

ii. to find answers to existing question e.g what is the reason for failure at form IV's

iii. It help to generate new ideas to verify the existing ones

iv. Research helps the consumers of it(e.g policy makers) to evaluate themselves and take rational decision

v. It enable society to make intelligent decision concerning problems facing them in particular life at different times

vi. The methodology of research conduction is helpful in various fields such as government and community social works and business administrative at large

vii. It is useful to one who is preparing for a carrier or further studies

**Disadvantage/weakness/limitation/demerits of fields research**

1. A researcher is to have studied a wide a range of literature and technique before conducting a research.This means it needs skilled people
2. In concentrating on a single problem a researcher may loose sight on broad issues
3. Research is expensive, a lot of money is needed to make a research work. Eg money for food, shelter, accommodation, stationary etc
4. Large amount of data may appear unnecessary and even confusion if the researcher is not scientifically inclined
5. Time consuming .

## QUALITIES OR CRITERIA OF A GOOD SCIENTIFIC RESEARCH

Research is a scientific process carried out systematically to acquire knowledge of the universe or population through stated objectives, whatever may be the type of research work and studies, one thing is that they all meet common grounds of scientific method employed by them.

Research should not be based on Arbitrary methods ( lack of scientific attitude in that, illogical, subjective, uninformed e.t.c )
Scientific research satisfies the following criteria or qualities:-

**I. Research must be cumulative**

Research is built over what has already been done before on the problem under investigation where new knowledge is discovered and added to the existing one

**II. Research must be cyclic**

This is to say research go through various stages include

1. Identification of problem
2. Statement of the problem
3. Formulation of hypothesis
4. Collecting data
5. Organization and tabulation of data
6. Data analysis and interpretation
7. Testing the hypothesis
8. Reporting writing
9. Recommendation and conclusion

**III. Research must be theoretical**

The theory provides a conceptual model for research and in turn research contribute to theory development e.g. I.Q affects performance. In this case conclusion should be confined to those issues for which the data provide an adequate basis

**IV. It must define important terms/concepts**. The purpose of research should be clearly defined and common concepts used in research should be clearly defined

**V. Research should be procedural ( objectivity )**

Research should be carefully planned to yield results that are as objective as possible

**VI. Good research must be systematic**

This means research is structured with specific steps to be taken in specific steps to be taken in specific sequence in accordance with the well- defined set of rule systematic characteristic help to reject the use of guessing and intuition

VII. **A good research should be logical.** This implies that research is guided by the rules of logical reasoning and logical process, which are of great value in carrying out research

VIII. **Goal research must be replicable**. This characteristics allows a research results to be verified by replicating the study and there by building a sound for decision. This is to say methods and procedures used are to be described carefully and clearly so that someone else can be able to reproduce it and use its design in a study.

IX. **Goal research should be empirical**

This implies research is related basically to one or more aspects of the real situation and deals with concrete data which base on observable evidence and research conclusion is researched from the collected data

**Common problem encountered in the field /problems hindering conduct at research**

1. Transportation problem : eg roads, ( infrastructure to arrive at the study area)
2. Financial constrain (costs):High cost, involve in hiring a vehicle. The enumerator or researcher have to work long distance from one responder to the next etc stationery, accommodation
3. Language barrier: Language can be as constraint during the field work when some respondent may sometimes not understand the research language hence translation of the instrument into local language.
4. Un conducive weather condition (climate factor) eg rainfall or in area like central Tanzania temperature sometimes reaches $34^0$c it become difficult to collect data in such condition
5. Remoteness/inaccessibility of the research site
6. Lack of access of strictly confidential information

**PLANNING OF FIELD RESEARCH ( ORGANIZATION)**

Involve the following

I. Choice of a research site

This is the place where research will be conducted or taken depending on the nature/purpose of research and this site should be

- Near

- Accessibility
- Social service must be available

II. Pre- visit or reconnaissance of a research site (To visit before involve on research)

- This help in introducing the researcher to the authorities and respondents, also help researcher to be familiar with a place
- Help a researcher to know the equipment needed
- Help to identity the problem which a researcher may encounter during study
- Help to design the working schedule
- Help the researcher to estimate the cost of study

III. Choice of research tools /methods

This include eg

- Questioner
- Interview
- Checklist group

IV. The researcher welfare consideration

V. Organization of a working schedule. This is a planning of activities to take place at a specific time during research activity

VI. Insure transport and accommodation

VII. Assurance of equipment that should be used in the site

VIII. Drafting a research ( research proposal) it is the systematic plan that bring, together the organized primarily plan that will be needed to accomplish the research process

**RESEARCH PROCESS**

The research process is a series at activities that are to be followed over time when caring out a research. It consist at steps necessary to effective carry out research and the desired sequencing at these steps

What is to note is that there is no precise number of stage agreed by different school at thought

**MAJOR STAGES/STEPS OF THE FIELD RESEARCH**

1. Identification- of the problem

↓

2. Literature review

↓

3. Formation of hypothesis

↓

4. Data collection

↓

5. Data analysis

↓

6. Data recording, presentation and interpretation

↓

7. Testing hypothesis

8. Recommendation and conclusion

## 1. IDENTIFICATION OF THE PROBLEM

This is the first step in research process, it involves knowing the problem, finding the source of the problem.

Research problem refer to some difficulty which a researcher experience in the context of either a theoretical or practical situation and obtain a solution for the same

- Any thing that a person finds unsatisfactory, a difficulty of some sort, a state of affair that needs to be changed, anything that is not working as well

- Personnel experience through living in particular area

**Sources of research problem**

- Personal experience through living in particular area
- Review of literature
- Current social issue
- Deduction from theories
- Practical situation ( land conflict)

**Characteristics of research problem**

(a) Should be testable

(b) Should be new and not been done before

(c) Should be clear and not vague

(d) Should be educative

(e) Should be a familiar or common problem

(f) Should be affordable interm at cost

(g) Should be interested

(h) Should be researchable

## 2. LITERATURE REVIEW

It is a stage involving intensive ready of many relevant literature on the particular problem so as to gain or expand knowledge on the problem to be tackled. Such literature sources includes books, journal's, newspapers, magazine,articles, letters, research reports (dissertation for academic purpose or thesis ) and other relevant materials etc

**"why literature …." Reasons for reviewing literature**

1. To collect more information/data
2. To identify theories that will be tested using the data ( to put the study into perception i.e. Into theory
3. To avoid unnecessary repetition of works which have already been done by other researchers. To avoid plagiarism ( an act of using someone's ideas) works and pretending that they are yours)
4. To select appropriate research design
5. To enable the researcher to formulate hypothesis

**Guideline in making a literature review**

- Have a plan in advance
- Start with recent document /finds
- Read in depth in order to determine the relevant feature at your study
- Acknowledge authors of the material
- Avoid reproducing the same material

Therefore Literature review defined as the process of identifying, locating, evaluating, summarizing and incorporating in the study document having materials which are related to the problem under investigation

## 3. FORMULATION OF HYPOTHESIS/RESEARCH QUESTION

Hypothesis is the researcher own speculation about the problem in question. It is a tentative answer to the problem in question or intelligent guess for the answer of the problem to be researched

Therefore it is a theory or statement of fact which has not get been proved

-The hypothesis must cover the cause of the problem, effect of the problem, possible solution and recommendation
-Hypothesis involving testing of variables and experimentation process.There are two types of Hypothesis

1. **Null hypothesis**

   Is the one stated negatively showing no relationship between two variable Eg. There is no relationship between soil erosion and farming along Uluguru mountain

2. **Alternative/substantive hypothesis**

   It is the one stated positively showing that there is relationship between two variables eg. There is relationship between soil erosion and farming along Uluguru Mountain

   Researcher may use either of the two whenever formatting hypothesis for a study

**Characterizes of hypothesis**

a. It has an element of comparison, where by two or three terms are compared

b. It leaves room for “yes’ or “no”

c. It must be related to the objective of study

d. The quantities words used are easily measurable e.g more,most, majority etc

e. An hypothesis is not obvious

**Function of hypothesis**

1. Enables to relate theories into observation and observation into theories

2. Presents a suggested solution to the problem
3. Present a simple form of a statement of researcher expectations
4. Give researcher direction to the collection and interpretation of data
5. Provide a framework for reporting conclusion of ones study
6. Refine the research problems

**Criteria for a good hypothesis**

a. Should be relevant ( relevance) should reflect the topic or problem of study

b. Should be testable ( testability) there must be some way of acquiring evidence that would confirm or disconfirm the hypothesis

c. Should be compatible ( compatibility) should fit well with what we already believe about natural order of things i.e consist ant to statement of fact, theories or laws

d. Should be simple, clear, precise ( simplicity)

e. Should easily predict the consequences/ out come and be applicable to many other types of circumstance ( predictive power)

f. Should be specific and limited in scope

**Importance of hypothesis**

- It define which facts are relevant and which one are not
- It indicate the type of data required
- The role at hypothesis is to help researcher by limiting area of research
- It determines the most appropriate technique of data analysis
- It contributes to theory development

**Research tool or equipments**

1. Note book
2. Camera
3. Tape recorder
4. Computer
5. Check list
6. Questioner
7. Ruler

**4. DATA COLLECTION**

Data is the body of information presented in numerical form. Can be treated either qualitatively or quantitatively

- At this stage the researcher go to the field and collect data physically

There are two basic sources or types of data

**(a) Secondary data**

These are the data collected by the researcher from existing information such as book, magazine, newspaper, research reports, TV, Radio, photograph, Government reports, census etc

-Is the information obtained from other people's findings, past publications and official records

**(b) Primary data**

These are original or firsthand information collected directly by a researcher in the field. This data is collected through interview, questionnaire, observation and FGD(Focus Group Discussion) also key informative.

**Ways of collecting primary data/method of data collection**

A. **INTERVIEW METHOD TECHNIQUE**

It is a direct discussion between the researcher and the respondent. This method involves verbal interaction between an interviewer and interviewee either face to face conversation or over telephone. Under this, there's presentation of oral verbal stimuli and reply in term of oral- verbal responses

**Types of interview**

**1. Structure (formal) interview**

In this kind of interview question are prior – prepared and the same question are asked to all the respondents or interviewee.

**2. Unstructured (informal)**

A researcher here does not have prior prepared questions but he/she has some topic to cover. Respondent are not asked the same questions and they can answer in whatever the way

**In interview situation what to consider**

· The researcher must understand respondents own situation

· There researcher must grasp the totality of respondent's situation

· There must be a sense of closeness between researcher and respondent

· Some topic which are very sensitive to react on e.g political issues or social affair, researcher must avoid sensitive/irritative questions.

· The interview must take place between two parties only. There must not be a third party or listener as respondent will not be free to give the right answer

· There must be flexibility i.e. A researcher must be able to put him/herself in the situation of respondent

· Time also must be considered. It is better be working hours Or whatever time found favourable.

**Advantage of interview method**

1. It is includes or suitable for both literacy and illiteracy respondents making it to have wide coverage. People who can not read or write are accommodated in the sample.

2. They are flexible. Unlike to questioner which can not change within a time but in interview can change

3. The researcher can give clarification when a question is not well understood. It ensure the researcher whether the respondent understood the question or not

4. Direct contact with the respondent enables the researcher to estimate the accuracy of the responses

5. A researcher can get as many answer as possible due to freeness of the respondent.

6. It can be used to collect data on sudden, issues such as diseases outbreak or an accident. Thus it is very useful to journalist

7. There is high rate of responses as compared to questionnaire method. Due to the fact, interviewers and interviewee have direct contact

**Disadvantage of interview**

1. It is very expensive method especially when large and widely spread geographical sampled is taken

2. Language barrier is a most likely problem that can hinder smooth running of the interview. This results into the need to an interpreter which increase costs

3. Time consuming as the researcher can only talk to one respondent at a time

4. Interview are not effective for researches and respondents with physical disabilities eg dumb and deaf persons

5. Prove to subjectivity there is possibility of the bias of interviewer and that of interviewer

6. It is difficult to conduct where population is scattered as there is always lack of accessibility to respondent. Etc

B. **QUESTIONNAIRE METHOD**

Questionnaire method uses questions inorder together information.

Questionnaire:

Refer to the prepared written questions which are handled or given to the respondents on hand, posted or mailed to be answered so as to provide relevant information for a particular problem of research. This type of research instrument is suitable in gathering information over a large sample or geographical area

There are two types of questionnaire

(a) Closed –ended /rigid/structured questioner

This refer to question which are accompanied by a list of possible alternative from which the respondents select the appropriate answer

E.g. The answer may be limited to "YES' or "NO' True- false etc

The reason for soil erosion in your area is because of:

a)Farming

b)Limbering cutting trees

c) Nature factor

b)open – ended/unstructured question ( guide/direct)

- these also known as lead question. These are types of question that allow the respondents to answers them as seem appropriate

- Here questions are asked and space is provided for respondents to fill in using their own words

- the respondents are given complete freedom of expressing their view

**Advantages of questionnaire**

1. It save time since several questionnaires may be distributed to many respondents and being filled at the same time

2. It is free from the bias of interviewer

3. It is less expensive even for respondents scattered over a wider geographical area because can be posted

4. Easy to analyze as they give minimum explanation

5. The researcher is able to win the respondent's trust or any fears that respondents might have

6. Provide enough chance for the respondents to think carefully and give the best answers

7. Adequate and large quantity of information can be gathered

**Disadvantage of questionnaire**

1. Questionnaire may not be effective when the respondent are illiterate or language barriers

2. There is no opportunity to ask for further information or clarification of some misunderstanding

3. Mailed questionnaires may be lost once they are sent

4. No clean reasons can be given for incomplete responses

5. Accuracy of answers is not assured since the respondent may cheat as the researcher has no direct content

6. Response rate can be quite low

**Observation method**

It is a type of research data collection method under which the information is sought by looking at a phenomena without asking the respondent

or

-Is the systematic method of data collection which involves the use of eyes than voice and ears. Observation is a carefully and accurate watching and recording of the events as they occur in their natural setting. The researcher go to the field with idea of what he/she is going to observe and he/she expect to see everything carefully and closely

-The research should records what he/she sees not what he/she hears

**Kind/type of observation method**

1. **Participant observation method**

Researcher becomes part and parcel of people under observation

-this is the one where researcher joins in the daily life of a group or organization he/she is studying for a period of time e.g. 1-3 months, a year depending on what he/she is studying

2. **Non- participant observation**

Researcher observes without participating in the life of the observed. Here researcher observes actions, behavior and activities of the group he/she is studying without participation in the daily life of the people he/she is studying

**Advantages of observation methods**

a. If observation done accurately, subjectivity is eliminated because it doesn’t involve the respondent

b. It overcome the language barrier

c. The method is independent of the respondent's wiliness to respond

d. The method allows full participation of the researcher in the field research process

e. Help in developing observation skill to researcher

f. It is suitable for both literate and illiterate groups

g. Only the relevant data is collected

**Disadvantages of observation**

a. The researcher is involved in extensive traveling making the exercise tiresome and time consuming

b. It is an expensive method

c. It may not be possible to collect data of past activities

d. Visual impairment may limit effectiveness of this method ( blindness)

e. When people know that they are studied they use to change their behavior

**D. <u>Focus group discussion ( FGD)</u>**

-It is an intensive free discussion where qualitative data on how people in a group or community think about a given situation issue or problem are collected

-the size of the group is small ranging between five and ten people but preferably 6-8 people who share certain characteristics which are relevant to the study

-FGD is a special type of group in term of the propose size, composition and procedures conducting a carefully planned and design as discussion in order to obtain information on the participants beliefs and perception.

-FGD should be composed of homogeneous members of the target population eg similar age, Education level, profession and gender

-Researcher should have specific topic to be discussed and a recording list of the discussion should be made.

-In FGD researcher becomes facilitator and therefore FGD require good planning and training of group moderator

FGD planning

Focus group discussion consist of

1. Facilitator: who is also a researcher ( moderator)
2. Recorder: Is an assistant of the facilitator taking notes
3. Discussion guide: sub topic
4. Report establishment: involving and making good relationship with people
5. Participants: the respondents.
6. Participant selection: formation of homogeneous based on various Criteria

Discussion Procedure

1. Facilitator expressing the general purpose of the discussion
2. Member introducing themselves in order to obtain preliminary information about the group
3. Facilitator allow a free discussion for every individual

4. Facilitation may ask permission to record some important information

5. Recorder going on taking notes while observing participant

6. Before the end of the free discussion the facilitator should be making sure that all discussion guide are adequately tackled and all important data are obtained

**Advantage of FGD**

i. The method is less expensive

ii. Save time because take about 45 minutes

iii. It is the best method for identifying and exploring belief ideas or opinions in a community.

iv. Stimulates free discussion where people can talk and express their view clearly and freely (because they feel sense of involvement In the discussion)

v. FGD can produce a lot of information quickly

vi. Respondents acquire speaking,listening and coordinating skill

vii. Researcher became active person in the discussion compare to questionnaire or observation

viii. It's good for generating hypothesis for larger studies

**Disadvantages of FGD**

a. Only few respondent may be active in discussion and dominate others.

b. This method is not representative since very small sample size of the population is involved

c. It's mostly intended to generate views and not getting correct answers

d. Since it is a surprise**,** members may not be in a good position to participate in discussion and give their contributions.

e. The researcher has less control over the flow of discussion and the results are hard to analyze.

f. Selection of the group may involve subjectivity and biasness

**E. measuring method**

It is a method which uses height, length ( distance) weight method and angle measuring devices in field data collection. This method is accurate and quick. Measurement of scale include, ordinal, nominal, interval and rations.

**F**. **Rapid appraisal method**: This is another kind of discussion where the researcher invited mass conduct of discussion or meeting

## 5. DATA ORGANIZATION AND ANALYSIS

Under this stage the data collected are edited and analyzed to identify relevant and irrelevant data. Data organization means putting the data into some systematic form

- Data analysis refers to the process to examining the coded data critically and making inferences

-Data are tabulated and various satisfied measures such as measure of central tendency are assessed

- The Data are stored by means of paper storage or electronic storage where statistical software package such as word processor, spread sheet or database may be asked

- Under this stage of field research the raw data collected are edited, coded, recorded and analyzed

## 6. DATA PRESENTATION AND INTERPRETATION

Data edited, coded, recorded and analyzed in the previous stage are now presented in various statistical form such as graphs, maps and charts. Also photograph field sketching, tabulation and tallying may be used

Therefore data presentation refers to the way of arranging data to make it clearly understood.

Interpretation is the done using various criteria suitable or reflecting on the problem of the research and the formulated hypothesis of the research

## 7. TESTING HYPOTHESIS

The original hypothesis is then tested against the research results and if the fact/data support the hypothesis generalization may be made. If the hypothesis appears wrong the researcher goes back to the field and start afresh and ways of collecting data must be changed

## 8. RECOMMENDATION AND CONCLUSION

Research gives/his/her opinion and then gives conclusion of all that he has observed

## SAMPLING IN FIELD RESEARCH

- *Sample*

This is a part of population, it is a set of selected elements from a population for study. It must be selected elements from a population for study. It must be selected according to principles of sampling and this will make it move representative of total population

-*Sampling*

Is the process of selecting small number of people or objects or units(sample) to represent the entire population, Example to checking the soil type it may be taken small amount of soil the amount taken is said to be sample

- *Population or universe*

Is the group of individuals ,items, objects from which samples taken for a particular study

It is the targeted group

- *Element*

These include individual persons, objects or units about which information is collected

- *Sample size*

This refers to the total number of item or individual to be selected from the population to constitute a sample. The larger the sample size the lower the likely error in generalization to the population. Also the larger the sample size the more the money and time needed to carry our the researcher

- *Sampling design*

Refers to the part of the research plan that indicates how cases are to be selected for observation

-*Sampling frame*

This is a complete or reliable list of all elements in a population from which a sample will be selected or drawn. It is a complete list of every unit in the universe or population

- *Variable*

This is a logical grouping of the attributes like sex or gender composed of two attributes ie males and female

-Variable are divided into two groups i.e independent and dependent variable

- *Parameter*

This is a summary description of given variables in a population

**Characteristics of a good sample**

1. 1.It must cover wide geographical area

2. It must have enough number of representatives so as to show clearly what is in population

3 It must have a wide range of types of elements to reduce biases

4 It must be selected by the researcher him/her self as he/she know the kind of respondent she/she need and methods he/she will use to obtain it

**Importance of sampling in field research**

i. Sample can save time since can produce result from within short and relative time

ii. it is cheap in terms of cost I serve budget constrains

iii. sampling provide a greatest scope in terms of variable that may be studied

iv. sampling is scientifically and statistically justifiable

v. sampling is an alternative way when population under study contain large number of items' and occupy a vast geographical area

TYPES OF SAMPLING

i. Probability sampling

ii. Non- probability sampling

**PROBABILITY SAMPLING**

-It is a random selection is a sample

- This is a sampling method where selection at sample is done randomly by chance .Here each individual in a population has an equal chance of being included in the sample

Types of probability sampling

1. Sample random sampling
2. Systematic random sampling
3. Stratified sampling
4. Mulit stage sampling
5. Cluster sampling

**a. Sample random sampling**

This gives every possible combination element in a population equal chance of being included in the sample.

It is chance sampling technique where each of every items or individual in the population has an equal opportunity in the inclusion the sample

Method of simple random sampling

I. By lottery method

II. The table of random number

III. Computer method : it is similar to table random number but under this number are picked by computer

**b. Systematic sampling**

Is the type of probability sampling by selecting of individual or items on a given regular interval. It is very applicable when population sample is large and the target population is evenly distributed

For example
formula of sampling interval K = N/n

N- Total number of population

n- sample size
K- sampling Interval

to obtain the sample using systematic sampling

Question.
If the total population is 1000 individual,and the number of people who must be in the sample are 100, what will be sampling interval

**Steps**

I. Calculate sampling interval or fraction

K=Fraction(K) or sampling interval
N = 1000
n = 100

$$K = \frac{N}{n}$$

$$K = \frac{1000}{100} = 10$$

II. Picking the starting point by any method of simple random sampling

III. Picking systematically with the specific interval (k) by adding (k) to the pick number until the required single is achieve

c. **Stratified sampling**

It is a type of probability sampling involving a selection of study sample by dividing the targeted population into the homogeneous sub group(strata) and then simple random sampling in each sub group

E.g suppose the target population consist of 700 male sub population and 300 female sub population

Create male and female sub sample provided that 100 total population sample is required

**Step**

i). Calculate the total number of the population

$700m + 200l = 1000$

ii). Finding the sampling ratio

Given by $K = \frac{\text{sample size}}{\text{population size}}$

$K = \frac{100}{1000} = \frac{1}{10}$ratio

iii). Calculate sub sample of male and female by taking sampling ratio multiple by sample population of each

male = 1/10 x 700 = 70 male

Female = 1/10 x 300 = 30 female

Ø Example 2 ,3000 students, 100staff, 50 non teaching staff,

Using stratified sampling technique prepare sample for a particular studying of 10%

<u>Steps</u>
Calculate sub samples

i. student 10/100 x 3000=300

- teachers 10/100 x 100=10

Non teacher 10/100 X 50=5

- Therefore 300 + 10 + 5 = 315

ii. the sample of the particular study is 315

**advantages stratified**

- It is more representative than simple random sampling of the same size drawn from the same population
- Conclusion from stratified sample are more general sable than simple random.

**Disadvantage**

- The technique is complex because it need researcher to analyze the population carefully to discover its true composition
- Chance that researcher get wrong stratum,subgroup are great

d. **Cluster/area /spatial sampling**

Is the type of at probability sampling used when target population is displaced over a wide geographical area. Under this the total area at study is divided.

The total area into a number at smaller non-overlapping areas, generally called geographical clusters Then a number of smaller areas are randomly elected

All units in these small areas are included in the sample

e. **Multi stage sampling**

This is further development of the idea cluster sampling .This technique is meant for big inquiries extending to a considerably large geographical area like an entire country

Under this, the first stage may be to select large primary sample unit such as state, then region then district,then town and finally certain families within towns

i.e the second sample is selected or drawn from the first sample, the third sample from the second sample etc example: population of 2500 people is spread over Temeke district.A sample of 600 household need to be selected from this population for study

-Researcher will list down all divisions in Temeke district. Let us say there 10 dimension so in this stage he may take five division($\frac{1}{2}$ of them)

- List down all the wards in those five division let us say there are six (6) wards in each division i.e 6 x5 = 30 wards. in the second stage, sample wards $30X\frac{1}{2}$= 10 wards

-List down villages or streets in these 10 wards and the are 10 street or village in each ward. Thus 10 x10 =100 villages in the third stage the villages $100\ x\ \frac{3}{4}$= 25 sample village

- List down house holds of each village and let us say there 100 house hold $= 100X\ 25 = 2500$house holds

In the fourth stage sample the household $2500X\frac{1}{5}$= 500 households

Thus our sample is 500 household

**NON-PROBABILITY SAMPLING**

Is the type at sampling which does not give each items or element in target population equal chance to be included in sampling
Types of non-probability sampling

a. Accidental/chunk/convenience sampling

b. Snow-ball sampling

c. Purposive/judgmental

d. Quota sampling

**I. Accidental sampling**

Under this method, the researcher Collect data from responds for a given research study he/she meets accidentally during the period research

**II. Snow ball sampling**

The researcher starts his/her research with small number of respondents who are available and ask them t o call for other who will fit in the study

**III. Purpose/judgment sampling**

Is the type of Non- probability sampling where researcher purposeful chooses responder whose in his/her own opinion thought are to be relevant of the study

**IV. Quota sampling**

In stratified sampling the cost of taking random samples from individual strata is often expensive that interviewer are simply given quota to be filled from different strata, the actual selection of items for sample being left to the interviewers judgment

- The size of the quota for each stratum is generally, proportionate to the size that stratum in the population

  ( If that stratum is ¼ of the total population then the researcher take a ¼ of individual in that particular stratum

**THE RESEARCH PROPOSAL**

A person who does not plan is always planning to fail.So whenever we want to do something we have to plan how to go about it

- The word" proposal"originated from the word "propose" which means to put forward, suggest or advice. Proposal therefore refer to suggestion, intention , plan or scheme
- A researcher proposal may be defined as a systematic plan, suggestion or request which bring together in organized form the preliminary scheme that will be required to fulfill a particular research project
- The research proposal is used to provide to guideline to the research during the research process and also provide a means of evaluating the research study
- The research proposal is considered to be a plan since puts forward for consideration one's scheme of intent

**PURPOSE OF RESEARCH PROPOSAL**

1. A research proposal is used to administrative purpose. It is a basis for written agreement or contract between the researcher and management (sponsor ). A proposal acts as a record for agreement

2. It helps the researcher to think over important issues about the study. ( about what he/she want to do)

   ( the what, why, how, where and to whom the research to be conducted are thought out and answered at this stage of developing proposal

3. Before conducting a research sometimes a researcher need to get go ahead from his client. A client can be from the organization you are working with, sponsor or university. Eg NGO's Providing funds for research will not sponsor any form of research until they have received and approved a detailed research proposal.

4. Proposal are used to make a choice among the competing suppliers ( researchers) and to influence positively the decision to fund the proposal study

Format of content of a research proposal

It is divided into 3 parts

1. Preliminary pages
2. The main body of the research proposal
3. Back page

1. **Preliminary**

- Title page - title of the study
- Research name

-Degree requirement

- Awarding University or institution
- Year of study

**Main body**

**1.0 Chapter I : Introduction**

1.1 Background of the study

1.2 Statement of the problem

1.3 Objective of the study

1.4 Research hypothesis/question

1.5 Scope of the study

1.6 Significance of the study

1.7 Conceptual or theoretical framework

**2.0Chapter II : Literature review**

This chapter is devoted to a survey of the body of knowledge that already exist and identifying the existing gaps in knowledge which the research intended to fill

- It should point out how the problem under investigation is related to the previous research finding
- It should put into consideration some theories that are elated to the problem under investigation

**3.0 Chapter III: Research methodology**

- It indicate the area of the study
- Population
- Research design
- Sample and sampling technique with will be used
- Data collection method or ( strategy )
- Data analysis technique
- Budget, time frame e.t.c

**Back pages**
**References**

This is the list of all sources that were consulted in writing the proposal.

(they are not numbered, are written in alphabetical order using surname)

**Qualities of an effective research proposal**

It should clearly state:

- What is being proposal or what the project is about
- How it will be carried out
- When it will be carried out
- How much it will cost

· **Research methodology**

Refer to the study of how research is to be conducted involving the development and analysis of the theories, principles, approaches and view to be employed in a particular research

- It concerned with the rational and the philosophical assumption that underlie a given study
- It cover study area, study population, sampling design as well as data gathering and analysis

It involving the principle or rules underlying series of process, admit and task to be performed in a given research study

**RESEARCH DESIGN**

It is conceptual structure within which research is conducted or a logical and systematic plan prepared for directing a research study

- It is the plan structure and strategy of investigation conceived so as to obtain answer to research question. Research design specific the objectives' of the study, methodology and techniques to be applied for achieving the specified research objective
- In a nut shell the design of research provided a systematic plan of the procedures for the researcher to follow

It is blue print for the collection, measurement and analysis of data

Features of good Research design

1. Flexible
2. Appropriate
3. Efficient
4. Economical
5. Accurate ( give minimum experimental error)
6. Yielding maximal information

**Types of research design**

Case study research design :-

1. Case study is an in-depth comprehensive study at a social or natural phenomena in any branch of knowledge

   -Case study aims at studying everything about something rather than something about everything

   -It purpose is to understand the interaction between factors that explain the present status or the development of the study unit over a period of time

   - It involves the study of a single study unit like a family, a community, a group, a class and a specific geographical area

   - The case study design can be classified as an intensive investigation of a single unit or group

**Advantage of a case study design**

1. It is flexible with respect to data collection method
2. It provide an opportunity for the intensive analysis of many specific details that are overlooked in other methods or designs
3. Case study an extend virtually to any dimension of the topic to be studied
4. Case study may be conducted practically to any kind of social and natural settings

5. It gives to the researcher a wide range of insights into human life

6. It is useful for testing the hypothesis about the structural and procedural characterizes of a specific social on geographical unit

**Disadvantage of case study design**

1. It is not suitable in generation at facts and findings ( limited generalization ability) this is because studies are studies of stray cases which are not sufficient enough for making meaningful generalization of larger studies

2. Time consuming

3. It is inadequate for an analysis of a macro problems.

4. There is a danger of researcher's over- confident

**2. Survey research design**

It is a broad based investigation of a phenomena through administration of data collection instrument to a target population or a sample of respondents selected from the target population

- It is extensive investigation of a particular research problem covering a large number of study units

- It is useful for testing hypotheses about large social or geographical aggregates and allows generalization of a study finding if based on a representative sample, the survey of research design if appropriate for making descriptive studying of large population

- Only two methods of data collection can be used. The methods are interview and questions

**3. Experimental research design**

It is a type of research design involving random classification at the respondents or items understudying into experimental group and control group and then conducting an experiment through exposing the experimental group to unusual conditions

- These bases on experimental groups of people or items. Two similar groups are used where one becomes experimental and another control group to see if the deference is worth while

- After the experimental group being given special treatment the researcher is to observe any change that might be taking place to the experimental group or making comparison between the control and experimental so long as the two groups were assumed to be initially equivalent

It consist of

I. Experimental group:

It is the one exposed to some novel Or special condition

II. Control group:

it is the one exposed to normal existing condition

III. Treatment:

It is an object or specific condition subjected to the experimental group to as to see whether an induce or influence some changes to this experimental group

**4. Descriptive research design**

It is a research design used to describe the state of affairs as if exists involving the fact finding and about people's attitude, opinion, habits or any variety at natural or social issue under studying

( state of affair – situational condition)

**5. Historical research design**

It is a research design concerned with the study of past records and other information sources with a view of reconstructing the origin and development of an institution, phenomena or movement or system and discovering the trend in the past

- It is descriptive in nature describing fact on the past situation
- This design depends upon inference and logical analysis of recorded data and indirect evidence rather than upon direct observation

**6. Correlation research design ( causal comparative)**

- This is the research design which enables the researcher to assess the degree of relationship that exists between two or more variable
- It analyses the correlation between two or more variable under study eg compare the geography find exams results of a group of students who

frequently attended geography periods and those who rarely attended geography period

**7. Cross- cultural research design**

This is a research design used to compare the behavior patterns of different culture. Using this design a researcher can perceive how various cultures experience given economical, political, educational and social outcomes.

E.g.:- you can compare urban and rural secondary school students level of computer literacy

**FORMAT OF RESEARCH REPORT**

This is the last stage in conducting a field research whereby the finding, obtained in the research are documented or published and being handed over to the appropriate authority for action to be taken or kept for other to see it,

**It has 3 parts**

(a) Preliminaries

(b) Main body

(c) Reference

**(a) Preliminary**

- Cover page
- Fill the page
- Certification/declaration
- Copyright
- Acknowledgement
- Dedication
- Abstract
- Table of contents
- List of tables and figures
- Abbreviation and acronym

**(b)Main body**

**Chapter1: Introduction**

1.1 . Background of the problem

1.2. Statement of the problem

1.3. Purpose of research study

1.4 . Objective of research study

1.5 . Research question /hypothesis

1.6 . Significance of the study

1.7 .Limitation or scope office study

1.8 .Conceptual framework

**Chapter 2: literature review**

Relevant sub heading

**Chapter 3; Research methodology**

- Study area
- Targeted population
- Sample size
- Sampling strategic
- Research design
- Data collection methods
- Data analysis plan

**Chapter 4: Research findings, presentation and discussion**

**Chapter 5: summary , conclusion and recommendation**

- Summary of the study
- Conclusion

- Recommendation

**(c)Back page**

(iii) Reference

- Appendix

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**STATISTICS**

**1.APPLICATION OF STATISTICS IN GEOGRAPHY**

Statistics refers to a scientific and systematic methods of collecting, recording, summarizing, analyzing and representation of numerical data in precise manner.
Or
The study of methods of collecting,recording,summarizing,analyzing and presentation of data in precise manner by using numbers
Or
A science of observing, collecting, recording, summarizing, analyzing and presentation of data in precise manner by using numbers.
Numerical data understood as a body of information which given in numbers. Or Exact numerical facts or figures collected systematically and arranged for a certain purpose.

1.1 **NATURE OF DATA**

**Statistical data according to their varied nature**

Statistical data according to their varied nature include the following:-

**Discrete data.**

It is a form of statistical data for variables whose values expressed or given in whole numbers. i.e. The data is for cases which do not exist in fractions. For instance; the data for the number of people which can be given as 102 people who can not be divided into either decimal or fractions

**Continuous data.**

The data for the variables whose values can be expressed in fraction or decimals. In this type of data, any value within the range can be given. For instance; the data for temperature, rainfall, pressure, distance, growth rate, and other cases which also reflect the same.They are presented in continuity manner of fraction or decimals

**Individual data.**

The set of data which provides specific value to every item in a sample given. For instance; Juma has weight of 47 kg.They consider every item as an important entity and singly presented

**Grouped data.**

It is a form of data which gives values in range or classes. This type of data is of no precise as exact figures are quoted but values range in groups. The classic example of the grouped data is that of population distribution by age and sex which may appear as follow:-

| AGE | FEMALES | MALES |
|---|---|---|
| 0-9 | 14,897 | 14,567 |
| 10-19 | 15,432 | 14,329 |
| 20 – 29 | 17,987 | 13,098 |
| 30 – 39 | 16,876 | 17,654 |

**Statistical data according to scale of measurements**

This aspect is considerably on how the values of statistical data are given. The scale of measurement include the following.

**Nominal data**

The type of data according to scale of measurement of which the values are given according to the name of items in a given sample. e.g. 10 apples, 5 oranges, 7 mangoes, 5 banana and 2 cherish.

**Ordinal data**

The data of which the values are given in an order of magnitude of observation in such a way the numbers indicate the rank order among objects. i.e. the values are commonly given in either ascending or descending order e.g. 91, 82, 79, 74, 68, 67, 58, 54 and 49.

**The interval data**

The data of which values are given in range at regular distance by being grouped. e.g. The data for population distribution by age and sex expressed in interval scale.

**Ratio data**

The data of which the values given show the number of times items of has relatively to another e.g. 1:3, 2:5, 3:7. e.t.c.

**VARIABLES**

Variable is an attribute that has values of which fluctuate under a given condition . For instance; production is a considerable variable as whose values change under conditions of policies lie; climate, technology, marketability and other which may make the same.

Variables are considerably varied and are classified into dependent and independent variables.

**Dependent variable**

Dependent variable is the one whose values fluctuate due to the force of another variable. i.e. the variable whose values change irregularly as controlled by another variable. For instance; production is one among the most pronounced variables as changes due to the force of other variables like climate, level of technology applied, demand of the products produced, and others which might cause it to change.

## 1.2 CLASSIFICATION OF STATISTICS.

Statistics being the scientific and systematic methods dealing with numerical facts is broadly categorized into two depending on how data handled. The main broad categories include; descriptive and inferential statistics.

***Descriptive Statistics***

Descriptive statistics deal with recording, summarization, analyzing and presentation of numerical facts that have been actually collected. The actual collection of data can be like to population by conducting census.

***Inferential statistics***

Inferential statistics deal with recording, summarization, analyzing and presentation of numerical facts that have been handled by quantifying the uncertainties through prediction e.g. the likely harvest output in the next year or season.

**STATISTICAL DATA**

As already pointed out, statistical data are  understood as the exact numerical facts or figures collected systematically and arranged for a certain purpose or body of information which is usually treated in numerical values.

Statistical data assessed being extremely varied and thus recognized be of different types. The categories of statistical data recognized with regards to their derived sources, varied nature and scale of measurements.

**Statistical data according to their varied sources**

Data by sources classified into two and include **primary** and secondary **data.**

**Primary data**

These are the numerical facts collected from the field or handled for the first time. i.e. They are the first hand or original information. The data are not available in the existing sources like books. Primary statistical data are handled by the techniques of interview, the use of questionnaires, observation, counting, measurements and other methods.

**Secondary data**

These are the numerical facts derived from the stored sources. The data were compiled by  other people who carried out research. The sources of this type of data include; text books, reference books, magazines, maps, video tapes, audio tapes, and other sources which deliver the same.

**Independent variable**

Independent variable is the one whose values change on its own without being influenced by another variable. i.e. the variable whose values change steadily and regularly e.g. distance.

**1.3 SOURCES OF**

**STATISTICAL DATA**

The sources of statistical data are simply the techniques employed to gather the numerical facts. These are broadly two and include; the numerical facts. These are broadly two and include; primary and secondary sources. Some of the primary techniques (sources) providing statistical data include the following:-

- Interview method
- Questionnaire
- Scheduling
- Field observation method
- Literature review

**Interview method**

The technique of interview involves the collection of data through the asking of questions verbally by researcher to a respondent.

Or

Is a verbal interaction between an interviewer and interviewee designed to list the information, news, opinion and feelings they have on their own. Generally an interview is an oral organization of questions asked to respondents by a researcher.

**Questionnaire method**

Questionnaire is a set of research questions printed on a piece of paper then presented to respondents to replay the questions in writing. It is thus; questionnaire method is a way (means) of gathering statistical details done with the use of questionnaires given to the respondents to answer.

**Field observation method**

It is a method of gathering primary research data which done by a researcher looking over the phenomena. It is of two types and include; **participant** and **non participant observation**.

**Scheduling method**

This method of data collection is very much familiar to questionnaire. But it has little difference to questionnaire. The difference is that, schedule involves a prepared set of questions which are filled in by enumerators who are especially appointed for the purpose and of which carefully selected and trained enough to perform their job well. This method of data collection is very useful for carrying out population census.The secondary sources providing statistical data include

**Literature review method**

It is a systematic survey of the past documentary sources prepared by other researchers related to the study. The documentary sources include; text books, statistical obstruct census report, research articles, journals, news paper, and official reports.

Other methods for data collection include; measurements, counting and the carrying out of experiments.

Strengths of statistics application in Geography

**Application of statistics in geography offers the following vital significance.**

- Summarizes massive information by making more simple and thus, enable the geographers to handle large sets of data.
- Statistics facilitate the process of data computation techniques possible in geography
- Statistics make easy the process of data comparison. It is so; as it is impossible to make comparison without statistics of the variables to be compared.
- Statistics application facilities the process of drawing relationship between the geographical variables like; climate and production, population and time; rainfall and temperature etc.
- Application of statistics makes easy the process of data storage inform of numbers, tables, graphs, diagrams, and maps.
- Application of statistics makes the geographical data be clearly understood and easy for being analyzed and interpreted.
- Statistics enhance validity testing of the geographical models, theories, and concepts to the real world situations.

**1.4 STATISTICAL MEASURES**

Numerical values which make statistics are analyzed or examined to judge their implication (results) by taking into consideration of the statistical **measures**. It is thus; statistical measures refer to the computed numerical values used to make data analysis as related to other values in a data set provided.

Statistical measures are numerous but with regards to their nature and roles, broadly divided into the following categories.

- Measures of central tendency
    - Measures of variability

**MEASURES OF CENTRAL TENDENCY.**

These are the measurements which show the central values and include; arithmetic mean, mode and median.

**ARITHMETIC MEAN**

Arithmetic mean is an average of all values in a set of distribution. It is determined by adding up all values and divided by the sum of observation added. Arithmetic mean is used to assess the distribution value weather was high or low.

**Computation of the arithmetic mean**

Computation of the arithmetic mean depends up on the nature of data given whether ungrouped or grouped.

For the ungrouped data set; arithmetic mean is computed by applying the following formula

$$\boxed{\text{Arithmetic mean} = \frac{\sum X}{N}}$$

Where by:

$$\sum X = \text{The sum of all values in the data set given}$$

N = The total number of observation added.

**Example:**

Find the arithmetic mean for the following set of data.

5,7,10,12,13,14,15,7, and 2.

**Solution**

The arithmetic mean for the given set of data above is calculated as follow:

$$\boxed{\text{Arithmetic mean} = \frac{\sum X}{N}}$$

$$\sum X = X_1 + X_2 \_X_R$$

5+7+10+12+13+14+7+2=85

$\sum X = 85$

N = 9

$\frac{85}{9} = 9.4$

**Thus: The Arithmetic mean = 9.4**

For the grouped data set; the arithmetic mean is calculated by the following application:

$$\boxed{\text{Arithmetic mean} = \frac{\sum fX}{\sum f}}$$

Where by;

X = Class mark

f = Frequency

**Example:**

Find the arithmetic mean for the following s cores of marks

| Class Interval | F | X | fx |
|---|---|---|---|
| 91-95 | 0 | 93 | 0 |
| 86-90 | 1 | 88 | 88 |
| 81-85 | 6 | 83 | 498 |
| 76-80 | 10 | 78 | 780 |
| 71-75 | 15 | 73 | 1095 |
| 66-70 | 34 | 68 | 2312 |
| 61-65 | 22 | 63 | 1386 |
| 56-60 | 10 | 58 | 580 |
| 51-55 | 2 | 53 | 106 |

Solution:-

$$\text{Arithmetic mean} = \frac{\sum fX}{\sum f}$$

According to the given data;

$\Sigma$ = 6845

$\Sigma$ = 100

$$\frac{6845}{100} = 68.45$$

Thus; the arithmetic mean = 68.45

**Advantages of the Arithmetic mean**

- It is easy to calculate and the majority of people use to understand it
- It is used to check the values if high or low
- It can be used for further calculation. For instance; arithmetic mean is used to calculate standard deviation.

**Disadvantage of the arithmetic mean**

- Arithmetic mean has a big weakness of being pulled towards an outlier (extreme scores).
- It needs high mathematical knowledge to calculate arithmetic mean for the grouped data set.

**MODE**

Mode is a value number which occurs most frequently in a data set given

Or

Is the most commonly attained measurement value in a data set

Or

Is the measurement value that appears most in a particular variable among a sample of subjects.

Mode helps us to know concentration of values which can stimulate scientific investigation.

**Calculation of a mode**

Determination of a mode is depend much up on the nature of data set whether ungrouped or grouped.

For the ungrouped data set; mode is obtained by taking the number that appears most frequently or the one that has highest frequency than the rest

**Example;**

Determine the mode for the following data set.

2, 4, 2, 2, 5, 6, 4

| **Value** | **Concentration** |
|---|---|
| 2 | 3 |
| 4 | 2 |
| 5 | 1 |
| 6 | 1 |

Thus; the mode for the data set given = 2

**Note**

Sometimes; a given data set may have more than one modes or no more at all. The one mode obtained in a set of distribution is known as unimodal or monomodal. If two modes obtained from data set; described as bimodal.

Example:

(1) 2, 5, 4, 3, 5, 6, 6, 8, 5, 6.

The modes for the data set are 5 and 6

(2) 4, 9, 8, 5, 6, 7

The given data set has no mode.

For the grouped data; mode is assessed by the following application.

$$\text{Mode} = L + \frac{t_1}{t_1 + t_2} \times (i)$$

Whereby:

- L = The lower limit of the modal class
- $t_1$ = The excess of the modal frequency over the frequency of the next lower class
- $t_2$ = the excess of the modal frequency over the frequency of the next higher class
- (i) = the class interval

**Example;-**

The tabled data below shows the score of marks in geography subject test form V students

| **Class interval** | **Frequency** |
|---|---|
| 40 - 44 | 7 |
| 45 - 49 | 8 |
| 50 - 54 | 11 |
| 55 - 59 | 10 |
| 60 - 64 | 4 |

**Solution**

The mode for the given data set above is calculated as follow:-

$$\text{Mode} = L + \frac{t_1}{t_1 + t_2} \times (i)$$

According to the given data set;

L = 49.5

$t_1$ = 3

$t_2 = 1$

i = 5

Then;

$$49.5 + \frac{3}{3+1} \times 5$$

$$49.5 + \frac{3}{4} \times 5$$

49.5 + (0.75 x 5)

49.5 + 3.75 = 53.25

**Thus; the mode = 53.25**

**Advantages of a mode**

- It helps to make determination of predominance of a certain geographical feature in a place.
- It helps to know number of occurrence of the values in data set.

**Disadvantages of a mode**

- It needs high mathematical knowledge to calculate mode for the grouped data set
- It is unreliable measures of central tendency as a data set may have more than one modes or no mode at all.

**MEDIAN**

Median refers to a point value that divides the other values in a set of distribution into two equal parts after to have been arranged in ascending or descending order.

**Computation of the median**

The computation of the median chiefly depends on the nature of data set given if ungrouped or grouped.

For the ungrouped data set, the calculation of median should further take into account the nature of data set given whether odd or even.

If the ungrouped data set is odd; the median is just the middle value and it is obtained after the value numbers to have been arranged in ascending or descending order.

E.g.

1, 2, 1, 4, 6, 5, 3

**Solution**

The ascending order of the values is as follow:-

1, 1, 2, 3, 4, 5, 6

**Thus; the median = 3.**

If the data set is even; median **is the average of the two middle values** and obtained after the value numbers to have been arranged in ascending descending order.

E.g.

1,4,5,2,7,8,3,2

The ascending order for the values is as follows:-

1,2,2,3,4,5,7,8

$$\frac{3+4}{2} = \frac{7}{2} = 3.5$$

Thus; the median = 3.5

**Median determination for the grouped data**

For the grouped data; median is determined by applying the following formula:-

$$\boxed{\text{Median} = L + \left\{\frac{\frac{N}{2} - n_b}{n_w}\right\} * i}$$

Where by:-

L = The lower limit of the median class

N = Total number of observation

$n_b$ = the number of elements in the classes below the median class

$n_w$ = number of elements in the median class

i = class interval

**Example:-**

The tabled data below: shows the score of marks in geography subject for form V students.

| Class interval | Frequency |
|---|---|
| 40 - 44 | 7 |
| 45 - 49 | 8 |
| 50 - 54 | 11 |
| 55 - 59 | 10 |
| 60 - 64 | 4 |

**Example:-**

The tabled data below; shows the score of marks in geography subject for form V students.

According to the given data
L = 49.5
N = 40

$n_b$ = 15

$n_w$ = 11

i = 5

$n_b$ = the number of elements in the classes below the median class

$n_w$ = number of elements in the median class

i = class interval

$$\frac{49.5 + (20 - 15)\ x\ 5}{11}$$

$$\frac{49.5 + 5}{11}$$

49.5 + (0.45 x 5)

49.5 + 2.25 = 51.75

Thus the median = 51.75

**Advantages of median**

· It helps to understand the middle value among of the numerous values in a certain data set.
· It is easy to make determination particularly for the simple data set.

**Disadvantages of the median**

· If the values are numerous, it becomes cumbersome to arrange in ascending or descending order to get the median
· It needs high skill to determine median for the grouped data set.

**MEASURES OF VARIABILITY**

These are the ones which asses the variation of values in data set. The common measures of variability include the following:-

· Range

· Standard deviation

· Variance

· Mean deviation

**RANGE**

Range is the difference between highest and lowest values in a given set of distribution. It is used to assess the existing variation between the highest score and lowest score.

**Calculation of the range**

Calculation of a range also considers the nature of a data set given whether ungrouped or grouped.

**For the ungrouped data set**, range is calculated by subtracting the lowest value from the highest value in a data set given.

**Example:-**

Determine the range for the following data set 4, 2, 3,5, 6,4, 8

**Solution**

The range for the data set given is computed as following:-

| Range = Highest value – lowest value |
|---|

According to the given data set:-

- Highest value = 8
- Lowest value = 2
- 8 – 2 = 6
- Thus; The range = 6
- With the result of range; If it is high implies greater variation. If the range is small, it implies there is small variation.

For the grouped data; range is calculated by subtracting the lowest class mark from the highest subtracting the lowest lower boundary from the highest lower boundary or by subtracting the lowest higher boundary from the highest higher boundary.

**Example:-**

Determine the range for the following data set.

| **Class interval** |
|---|
| 10 – 14 |

| |
|---|
| 15 - 19 |
| 20 - 24 |
| 25 - 29 |
| 30 - 34 |
| 35 - 39 |

**Solution**

The range for the data set given is calculated as follow:

| Range = Highest class mark – Lowest class |
|---|

Determination of the class mark

| Class interval | Class marks |
|---|---|
| 10 – 14 | 12 |
| 15 – 19 | 17 |
| 20 – 24 | 22 |
| 25 – 29 | 27 |
| 30 – 34 | 32 |
| 35 – 39 | 37 |

According to the computed class marks

- Highest class mark = 37
- Lowest class mark = 12

37 – 12 = 25,

**Thus, the range = 25**

**Advantages of a range**

- Range gives a quick rough estimate of variability
- It is simple to calculate and the majority are much aware with it.

**Disadvantages of a range**

- It considers only two values of highest and lowest and thus not sensitive to the total distribution
- It is affected by the extreme values

**STANDARD DEVIATION**

Deviation is the difference between the value and the mean. It is computed by subtracting a the mean from the value.

$$\boxed{\text{Deviation} = \bar{X} - X}$$

Whereby:-

X = value given in a set of distribution

X = average of all values

**Standard deviation** refers to the common difference of all values from the mean. It is the root mean square deviation from the mean. It is the measure which determines how far or scattered are the values from the mean.

Standard deviation is represented by sigma symbol of $\delta$

**Computation of a standard deviation**

Calculation of a standard deviation also depends on the nature of dataset given whether ungrouped or grouped.

For the ungrouped data; standard deviation is calculated by the following application.

$$\text{Standard deviation} = \sqrt{\frac{\Sigma(X-\bar{X})^2}{N}}$$

Where by:-

X = value in a set of distribution

$\bar{X}$ = Average of all values in a set of distribution

N = The total number of observation

**Example:-**

Calculate the standard deviation for the following data set.

3, 2, 1, 4, 6

**Solution**

$$\text{Standard deviation} = \sqrt{\frac{\Sigma(X-\bar{X})^2}{N}}$$

Mean determination

$$\boxed{\text{mean} = \frac{\Sigma X}{N}}$$

$$\frac{3+2+1+4+6}{5} = \frac{16}{5} = 3.2$$

| | | | | | |
|---|---|---|---|---|---|
| X | 3 | 2 | 1 | 4 | 6 |
| X-$\bar{X}$ | -0.2 | -1.2 | -2.2 | 0.8 | 2.8 |
| X-X$^2$ | 0.0.4 | 1.44 | 4.84 | 0.64 | 7.84 |

$$\sum(X-\bar{X})^2 = 11.8488$$

Then;

$$\sqrt{\frac{11.848}{5}}$$

$$\sqrt{2.37696} = 1.541$$

Hence; The SD = 1.541

For the grouped data set; standard deviation is computed by the following application:-

$$SD = \sqrt{\frac{\sum fd^2}{N}}$$

$$d^2 = (X - \bar{X})^2$$

**Example:-**

Calculate the SD for the following set of grouped data.

| **Class interval** | **Frequency** |
|---|---|
| 40 - 44 | 7 |
| 45 - 49 | 8 |
| 50 - 54 | 11 |
| 55 - 59 | 10 |
| 60 - 64 | 4 |

**Procedure:**

- Determination of the mean

$$\boxed{\text{Mean} = \frac{\sum fX}{\sum f}}$$

| Class interval | F | X | Fx |
|---|---|---|---|
| 40 - 44 | 7 | 42 | 294 |
| 45 - 49 | 8 | 47 | 376 |
| 50 - 54 | 11 | 52 | 572 |
| 55 - 59 | 10 | 57 | 570 |
| 60 - 64 | 4 | 62 | 248 |

$$\sum \text{fx} = 2060$$

$$\frac{2060}{40} = 51.5$$

Hence; 51.5

Then:-

| X | 42 | 47 | 52 | 57 | 62 |
|---|---|---|---|---|---|
| X - X | -9.5 | -4.5 | 0.5 | 5.5 | 10.5 |
| $(X-X)^2$ | 90.25 | 20.25 | 0.25 | 30.25 | 110.25 |
| $F(X - X)^2$ | 631.75 | 162 | 2.75 | 302.5 | 441 |

$\sum \text{fd}^2$ = 1540

$\sum \text{fd}$ = 40

$$\sqrt{\frac{1540}{40}}$$

$\sqrt{38.5}$ = 6.204

**Thus; The SD = 6.204**

**Note:-**

The square root of SD is known as variance. Its computation is done by the following applications which also consider the nature of data set whether ungrouped or grouped.

For the ungrouped data; variance is computed by the following application:-

$$\text{Variance} = \frac{(x-\mu)^2}{N}$$

**MEAN DEVIATION**

Mean deviation is the average of all deviation values. Or is the amount by which the individual values deviate from mean irrespective of its sign. It is computed by dividing the sum of all deviations irrespective of signs by the number of observation.

**Calculation of mean deviation**

Calculation of a mean deviation also depends on the nature of data set given whether ungrouped or grouped.

For the ungrouped data set; the mean deviation is calculated by the following application:-

$$\boxed{\text{Mean deviation} = \sqrt{\frac{\Sigma\,|X-\bar{X}|}{N}}}$$

Example:-

Determine the mean deviation for the following data set. 4, 7, 8, 2, 9, 6

Solution

Mean determination

$$\text{mean} = \frac{\sum X}{N}$$

4 + 7 + 8 +2 + 9 + 6 = 36

$$\frac{36}{6} = 6$$

Hence; the mean = 6

Deviations determination

| X | X - $\bar{X}$ | D |
|---|---|---|
| 4 | 4 - 6 | 2 |
| 7 | 7 - 6 | 1 |
| 8 | 8 - 6 | 2 |
| 2 | 2 - 6 | 4 |
| 9 | 9 - 6 | 3 |
| 6 | 6 - 6 | 0 |

The sum of deviations determination.

$$\sum d = d_1 + d_2 + d_3 + \_\_\_\_\_\_\_\_ d_n$$

· 2 + 1 + 2 +4 + 3 + 0 = 12

Then; $\frac{12}{6} = 2$

**Thus; the mean deviation = 2**

For **the grouped data set**, mean deviation is computed by the following application:-

$$\text{Mean deviation} = \sum \frac{f\,|X - \bar{X}|}{N}$$

**Example:-**

| Class interval | Frequency |
|---|---|
| 40 - 44 | 7 |
| 45 - 49 | 8 |
| 50 - 54 | 11 |
| 55 - 59 | 10 |
| 60 - 64 | 4 |

Determination of the mean

$$\text{Arithmetic mean} = \frac{\sum fX}{\sum f}$$

| Class interval | F | X | Fx |
|---|---|---|---|
| 40 - 44 | 7 | 42 | 294 |
| 45 - 49 | 8 | 47 | 376 |
| 50 - 54 | 11 | 52 | 572 |
| 55 - 59 | 10 | 57 | 570 |
| 60 - 64 | 4 | 62 | 248 |

$$\sum fx = 2060$$

$$\sum f = 40$$

$$\frac{2060}{40} = 51.5$$

Hence; The mean = 51.5

Determination of the deviations.

$$\text{Deviation} = x - \bar{x}$$

Where by:

X = Class mark

$\overline{X}$ = The mean

| X | X - $\overline{X}$ | D | F | Fd |
|---|---|---|---|---|
| 42 | 42 - 51.5 | 9.5 | 7 | 66.5 |
| 47 | 47 - 51.5 | 4.5 | 8 | 36 |
| 52 | 52 - 51.5 | 0.5 | 8 | 36 |
| 57 | 57 - 51.5 | 5.5 | 10 | 55 |
| 62 | 62 - 51.5 | 10.5 | 4 | 42 |

· The sum of (fd) determination

$$\boxed{\sum d = fd_1 + fd_2 + fd_3 + \_\_\_\_\_\_\_\_ fd_n}$$

66.5 + 36 + 5.5 + 55 + 42 = 205

Then;

$$\frac{205}{40} = 5.125$$

Thus; The mean deviation = 5.125

**1.5 METHODS OF PRESENTING DATA**

As it has been introduced in the chapter one; the numerical data after being collected, summarized and analyzed; are presented to provide **pictorial view (visual idea).** One of the useful ways for presenting the numerical facts is by **diagrams.** It is thus; statistical diagrams designed to illustrate values of geographical items and in turn allow quantitative analysis.

The most useful statistical diagrams for the illustration of quantitative data include the following.

· Pie chart

- Proportional semi divided circles
- Divided rectangle
- Proportional circles
- Scatter diagram
- Wind rose
  - Polar chart

**PIE CHART**

Pie chart is also known as **divided circle** or **pie graph.** It is a method of drawing a circle of any convenient size divided proportionally into a number of segments to show the values of items in percentages. The number of segments the circle is divided into depends on the number of items whose have to appear in the circle. The proportional size of segments is determined by the degree values of the percentages.

**Construction of pie chart**

Consider the given data below for world production of cocoa by countries in 1968.

| Country | Production |
|---|---|
| Brazil | 1,936,297 |
| Ghana | 4,042,988 |
| Nigeria | 2,308,066 |
| Ecuador | 805,499 |
| Cameroun | 1,270,211 |
| Ivory coast | 1,796,883 |
| Others | 33,304,430 |

**Procedures:-**

(a) Total values determination.

$$\sum x = x_1 + x_2 + x_3 + \_\_\_\_\_\_\_\_ x_n$$

1,936,297 + 4,042,988 + 2,308,066 + 805,499 + 1,270,211 + 1,796,883 + 33,304,430 = 15,490,374

(b) Percentage values determination

$$\boxed{\%X = \frac{X}{\sum X} * 100}$$

$$\text{Brazil: } \frac{1,936,297}{15,490,374} \text{ x } 100\% = 12.5\%$$

$$\text{Ghana: } \frac{4,042,983}{15,490,374} \text{ x } 100\% = 26.1\%$$

$$\text{Niger: } \frac{2,308,066}{15,490,374} \text{ x } 100\% = 14.9\%$$

$$\text{Ecuador: } \frac{805,499}{15,490,374} \text{ x } 100\% = 8.2\%$$

$$\text{Cameroun: } \frac{1,270,211}{15,490,374} \text{ x } 100\% = 11.6\%$$

$$\text{Ivory Cost: } \frac{1,796,883}{15,490,374} \text{ x } 100\% = 11.6\%$$

$$\text{Nigeria: } \frac{2,308,066}{15,490,374} \text{ x } 100\% = 14.9\%$$

$$\text{Others: } \frac{33,304,430}{15,490,374} \text{ x } 100\% = 21.5\%$$

(c) Degrees of the percentage values determination:

$$\text{Degree values} = \frac{x\%}{100} \times 360^{\circ}$$

$$\text{Brazil}: \frac{12.5}{100} \text{ x } 360\% = 45^{0}$$

$$\text{Ghana}: \frac{26.1}{100} \text{ x } 360\% = 93.6^{0}$$

$$\text{Nigeria}: \frac{14.9}{100} \text{ x } 360\% = 53.6^{0}$$

$$\text{Ecuador}: \frac{5.2}{100} \text{ x } 360\% = 18.7^{0}$$

$$\text{Cameroun}: \frac{8.2}{100} \text{ x } 360\% = 29.5^{0}$$

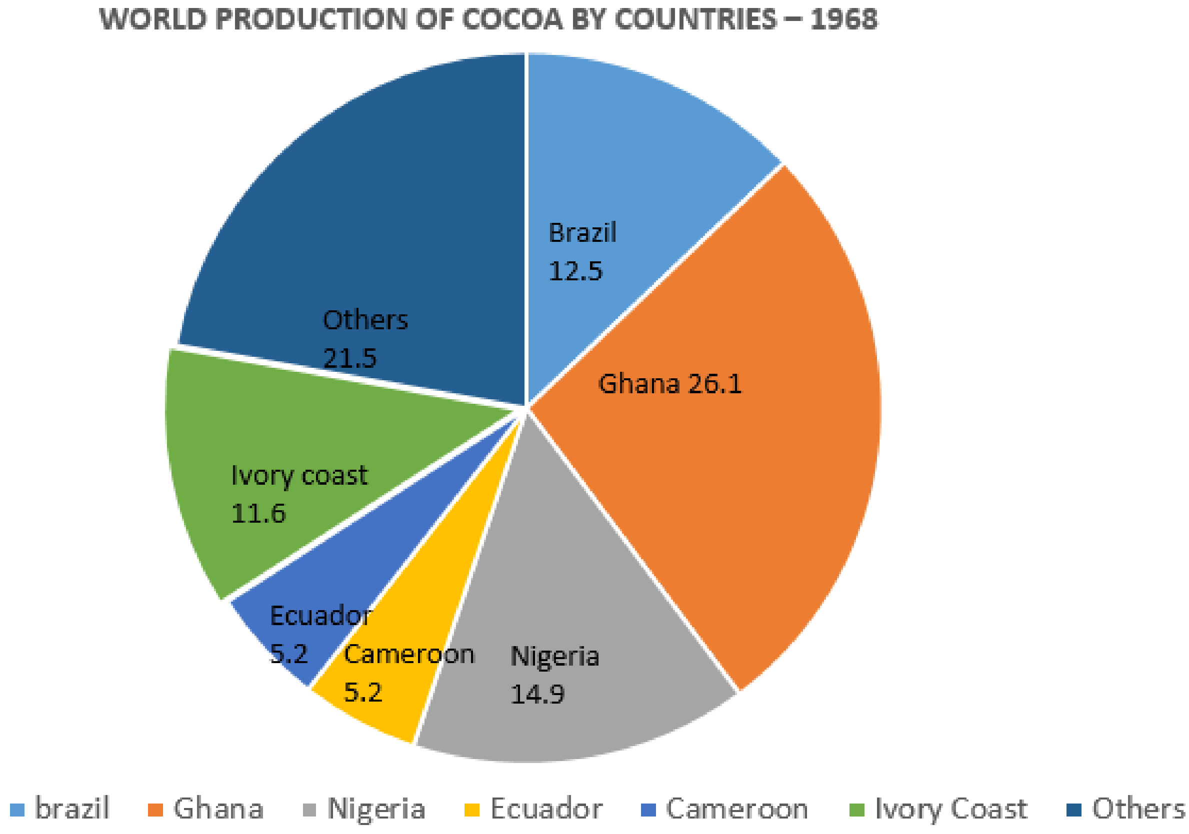
$$\text{Ivory cost}: \frac{11.6}{100} \text{ x } 360\% = 41.8^{0}$$

$$\text{Others}: \frac{21.5}{100} \text{ x } 360\% = 77.4^{0}$$

| **Country** | **Production** | **X%** | **$X^0$** |
|---|---|---|---|
| Brazil | 1,936,297 | 12.5% | $4^0$ |
| Ghana | 4,042,988 | 26.1% | $93.6^0$ |
| Nigeria | 2,308,066 | 14.9% | $53.6^0$ |
| Ecuador | 805,499 | 5.2% | $18.7^0$ |
| Cameroun | 1,270,211 | 5.2% | $29.5^0$ |
| Ivory coast | 1,796,883 | 11.6% | $41.8^0$ |
| Others | 33,304,430 | 21.5% | $77.4^0$ |

(d) The circle of any convenient size should be drawn. It should be divided into proportional segments with respect to the computed degree values. Too small circle is not required.

It is thus; the pie chart for the data appears as follow.




**Strengths of the pie chart**

- The method is more pleasing to eye and it is one among the most popular methods in statistics for data representation.
- The values given by the method are more simplified as appear in percentages.
- It allows the easy making of quantitative analysis.

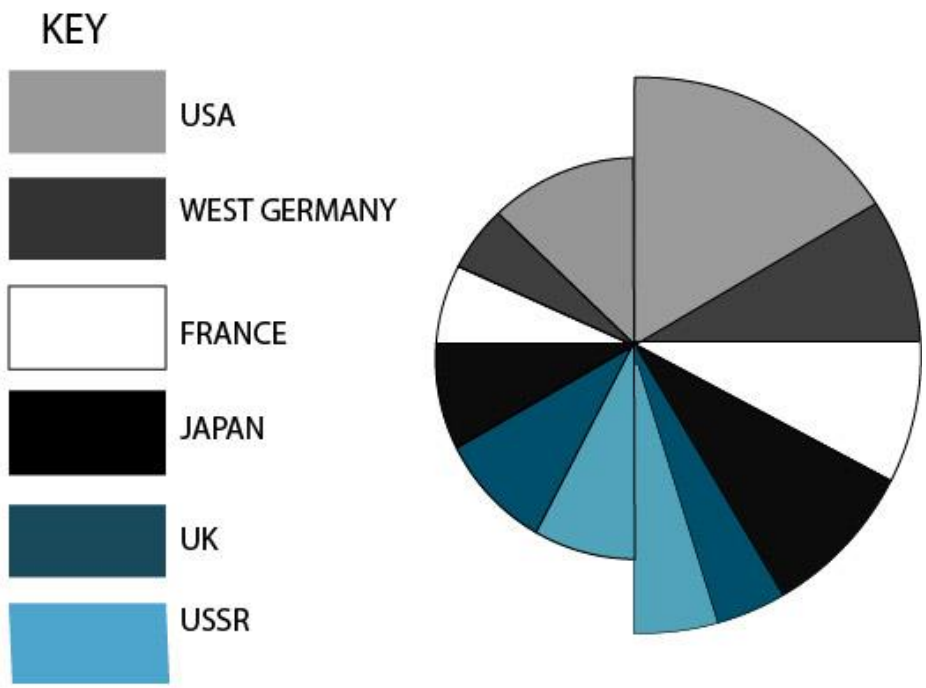
**Setbacks of the pie chart**

- It does not give the absolute values of items represented
- It consumes much of time to prepare. Hence it is tedious enough.
- It needs high skill to prepare it
- A problem may arise in selecting the varied shade of textures.

**PROPORTIONAL SEMI DIVIDED CIRCLE**

This pictorial method, involves the drawing of two semi circles linked to one another and each is proportional to the total quantity represented. Each semi circle is proportionally divided into segments and the number of segments the semi circle is made to have, depends on the number of items. In making the segments in the semi circle, $180^0$ is used as the total degree for each semi cycle.

The method is very useful in making comparison of items for two major cases like dates or places.




**Construction of the proportional semi divided circles**

Consider the following tabled data showing motor vehicles production for passengers and commercial in the industrialized nations.

| | *W. total* | *USA* | *W. Germany* | *Japan* | *U.K.* | *France* | |
|---|---|---|---|---|---|---|---|
| Comm | 6530 | 1896 | 241 | 2052 | 409 | 242 | 750 |
| Passe | 21720 | 8222 | 2862 | 2055 | 1816 | 1832 | 280 |

Procedure:-

(a) Find the total values for each variable
Commercial: 1896 + 241 + 2052 + 409 + 242 + 750 + 940 = 6530

Passengers: 8222 + 2862 + 2055 + 1816 + 1832 + 280 + 4653 = 21720

(b) Angle determination of the segments

**Commercial:-**

$$\text{USA}: \frac{1896}{6530} \text{ x } 180^0 = 52.3^0$$

$$\text{West germany}: \frac{241}{6530} \text{ x } 180^0 = 6.6^0$$

$$\text{Japan}: \frac{1896}{6530} \text{ x } 180^0 = 56.6^0$$

$$\text{UK}: \frac{409}{6530} \text{ x } 180^0 = 11.3^0$$

$$\text{France}: \frac{242}{6530} \text{ x } 180^0 = 6.7^0$$

$$\text{USSR}: \frac{750}{6530} \text{ x } 180^0 = 20.7^0$$

$$\text{Others}: \frac{940}{6530} \text{ x } 180^0 = 6.6^0$$

(c) **Passengers.**

$$\text{USA}: \frac{8222}{21720} \text{ x } 180^0 = 63.1^0$$

$$\text{West germany}: \frac{2862}{21720} \text{ x } 180^0 = 23.7^0$$

$$\text{Japan}: \frac{2055}{21720} \text{ x } 180^0 = 17^0$$

$$\text{UK}: \frac{1816}{21720} \text{ x } 180^0 = 15^0$$

$$\text{France}: \frac{1832}{21720} \text{ x } 180^0 = 63.1^0$$

$$\text{USSR}: \frac{280}{21720} \text{ x } 180^0 = 2.3^0$$

$$\text{Others}: \frac{4653}{21720} \text{ x } 180^0 = 38.6^0$$

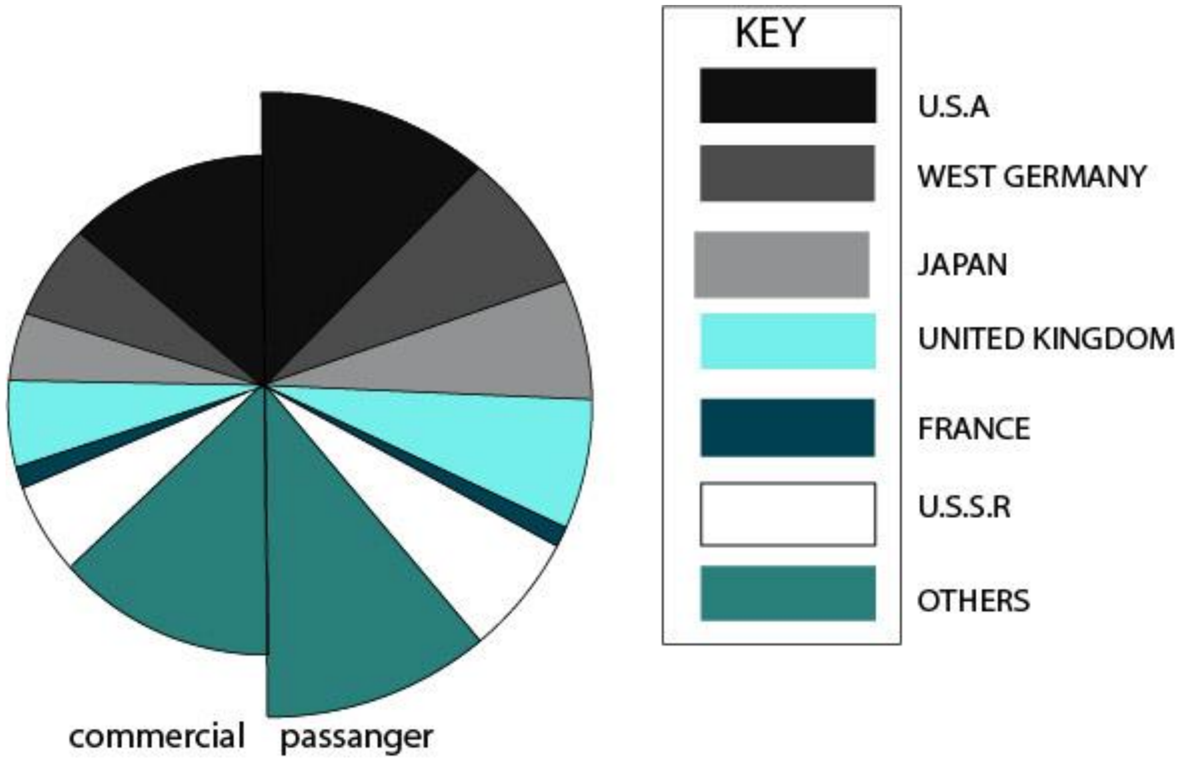
(d) Estimation of the diameters of the two proportional semi circles. It is much up on specific scale. The scale is developed by proposing specific value to be represented by 1cm. Le say 1cm should represent 20000 motor vehicles.

$$\text{Passenger}: \frac{21720}{2000} = 10.86 \text{ cm}$$

$$\text{Commercial} : \frac{6530}{2000} = 3.2 \text{ cm}$$

Thus the proportional semi divided circle for the data given appears as follow:-

**WORLD PRODUCTION OF MOTOR VEHICLES BY COUNTRIES (000)**




**Diameter scale:-**

1cm represents 2000 motor vehicles.

**Merits of the semi divided proportional circles.**

- It is useful technique for showing comparison of item values for two major cases
- It provides visual idea
- It allows the making of quantitative analysis

**Setbacks of the proportional semi divided circles.**

- It needs high skill to extract actual values from the diagram
- It consumes much time to prepare
- It needs high skill to be prepared
- It encounters a problem shade textures selection

**DIVIDED RECTANGLE**

It is one among the most useful and versatile method of statistical presentation of data. However it is not frequently used. By this method, the total quantity is presented by a rectangle which is then sub divided to represent the constituent parts.

Depending on the function, the divided rectangle is of two types including:-

- Simple divided rectangle
- Compound divided rectangle

## SIMPLE DIVIDED RECTANGLE

It is a rectangle drawn to have a length proportional to the total quality represented, then divided into proportional segments to show the values of the cases.

**Construction of the simple divided rectangle**

Consider the following data of coffee production in Tanzania in '000' tons in 1980.

| REGION | PRODUCTION |
|---|---|
| Arusha | 9 |
| Kilimanjaro | 10 |
| Bukoba | 18 |
| Ruvuma | 11 |
| Mbeya | 7 |
| Tanga | 5 |

(a) Determine the scale value to be used in drawing the rectangle.

$$\boxed{\text{Scale} = \frac{\text{Cummulative value}}{\text{Rectangle length}}}$$

$$\frac{60}{10} = 6$$

Hence; 1 cm represents 6 tons.

(b) Determine the length of the values along the rectangle

$$\textbf{Proportional Length} = \frac{\textbf{Value}}{\textbf{Scale value}}$$

Arusha : $\frac{9}{6} = 1.5$ cm

Kilimanjaro : $\frac{10}{6} = 1.7$ cm

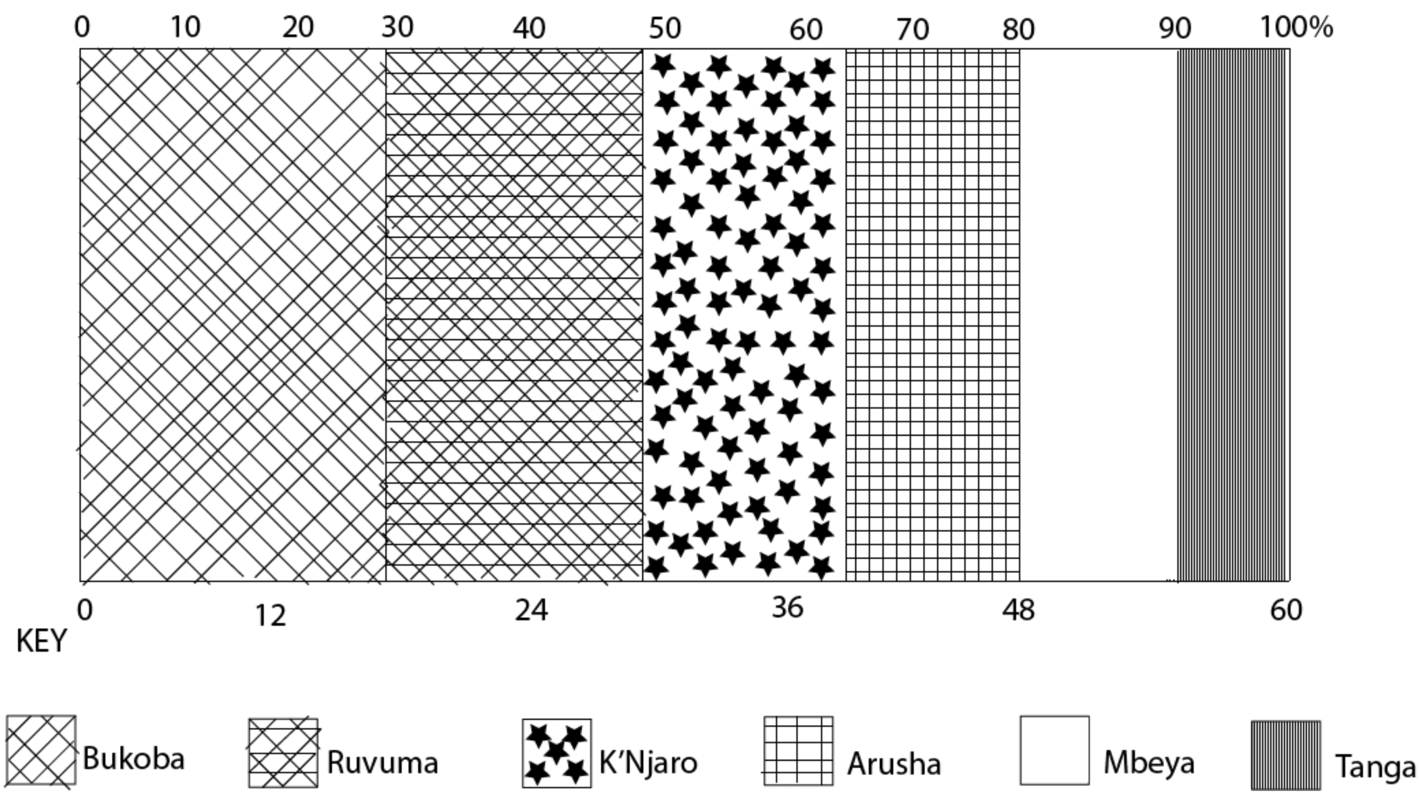
Bukoba : $\frac{18}{6} = 3$ cm

Ruvuma : $\frac{9}{6} = 1.5$ cm

Mbeya : $\frac{7}{6} = 1.2$ cm

Tanga : $\frac{5}{6} = 0.8$ cm

Thus; the simple divided rectangle for the given data appears as follow:-



Simple divided rectangle coffee production in '000' tons from 1980 to 1985

**COMPOUND DIVIDED RECTANGLE**

By the compound divided rectangle, each proportional strip in the rectangle is also proportionally divided to show further information of the cases represented. This is drawn with two scales. One scale is for horizontal dimension, and it is designated as the horizontal scale; the other is for the vertical dimension and is designated as vertical scale. It is much better for the two scales graduated in separate values. The horizontal scale is absolute values and the vertical scale be in percentage.

**Example:-**

Consider the given data below showing land use partners for the six village:-

| COUNTRIES | SIZE LANDUSE OF TOTAL AREA '000' KM$^2$ | | | |
|---|---|---|---|---|
| | **Westland** | **Pasture** | **Arable** | **forestry** |
| Ruvu Darajani | 166.5 | 27 | 31.5 | 225 |
| Vigwaza | 94.4 | - | 40.4 | 202.2 |
| Buyuni | 226.8 | - | 32.4 | 64.8 |
| Kidogozero | 7.7 | 5.2 | 21.5 | 8.6 |
| Visezi | 8.5 | 13.3 | 6.8 | 5.4 |
| Kitonga | 8.8 | 8.2 | 10 | 7 |

**Procedure:-**

(a) Cumulative values determination.

Ruvu Darajani:- 166.5 + 27 + 31.5 + 225 = 450

Vigwaza:- 94.4 + 40.4 + 202.2 = 337

Buyuni:- 226.8 + 32.4 + 64.8 = 324

Kidogezero:- 7.7 + 5.2 + 21.5 + 8.6 = 43

Visezi:- 8.5 + 13.3 + 6.8 + 5.4 = 34

Kitonga:- 8.8 + 8.2 + 10 + 7 = 34

(b) The percentage values determination

- **Ruvu Darajani:-**

$$\text{Waste land : } \frac{166.5}{450} \text{ X } 100\% = 37\%$$

$$\text{Pasture : } \frac{27}{450} \text{ X } 100\% = 6\%$$

$$\text{Arable : } \frac{31.5}{450} \text{ X } 100\% = 7\%$$

$$\text{Forestry : } \frac{225}{450} \text{ X } 100\% = 50\%$$

- **Vigwaza:-**

$$\text{Waste land : } \frac{94.4}{337} \text{ X } 100\% = 12\%$$

$$\text{Arable : } \frac{40.4}{337} \text{ X } 100\% = 28\%$$

$$\text{Forestry : } \frac{202.2}{337} \text{ X } 100\% = 60\%$$

- **Buyuni:-**

$$\text{Waste land : } \frac{226.8}{324} \text{ X } 100\% = 70\%$$

$$\text{Arable : } \frac{32.4}{324} \text{ X } 100\% = 10\%$$

$$\text{Forestry : } \frac{202.2}{337} \text{ X } 100\% = 60\%$$

- **Kidogezero:-**

$$\text{Waste land : } \frac{7.7}{43} \text{ X } 100\% = 18\%$$

$$\text{Pasture : } \frac{40.4}{337} \text{ X } 100\% = 12\%$$

$$\text{Arable : } \frac{21.5}{43} \text{ X } 100\% = 50\%$$

$$\text{Forestry : } \frac{8.8}{43} \text{ X } 100\% = 20\%$$

- **Kitonga:-**

$$\text{Waste land}: \frac{8.8}{34} \text{ X } 100\% = 26\%$$

$$\text{Pasture}: \frac{8.2}{34} \text{ X } 100\% = 24\%$$

$$\text{Arable}: \frac{10}{34} \text{ X } 100\% = 29\%$$

$$\text{Forestry}: \frac{7}{34} \text{ X } 100\% = 21\%$$

(c) Scale determination

(e) Horizontal scale

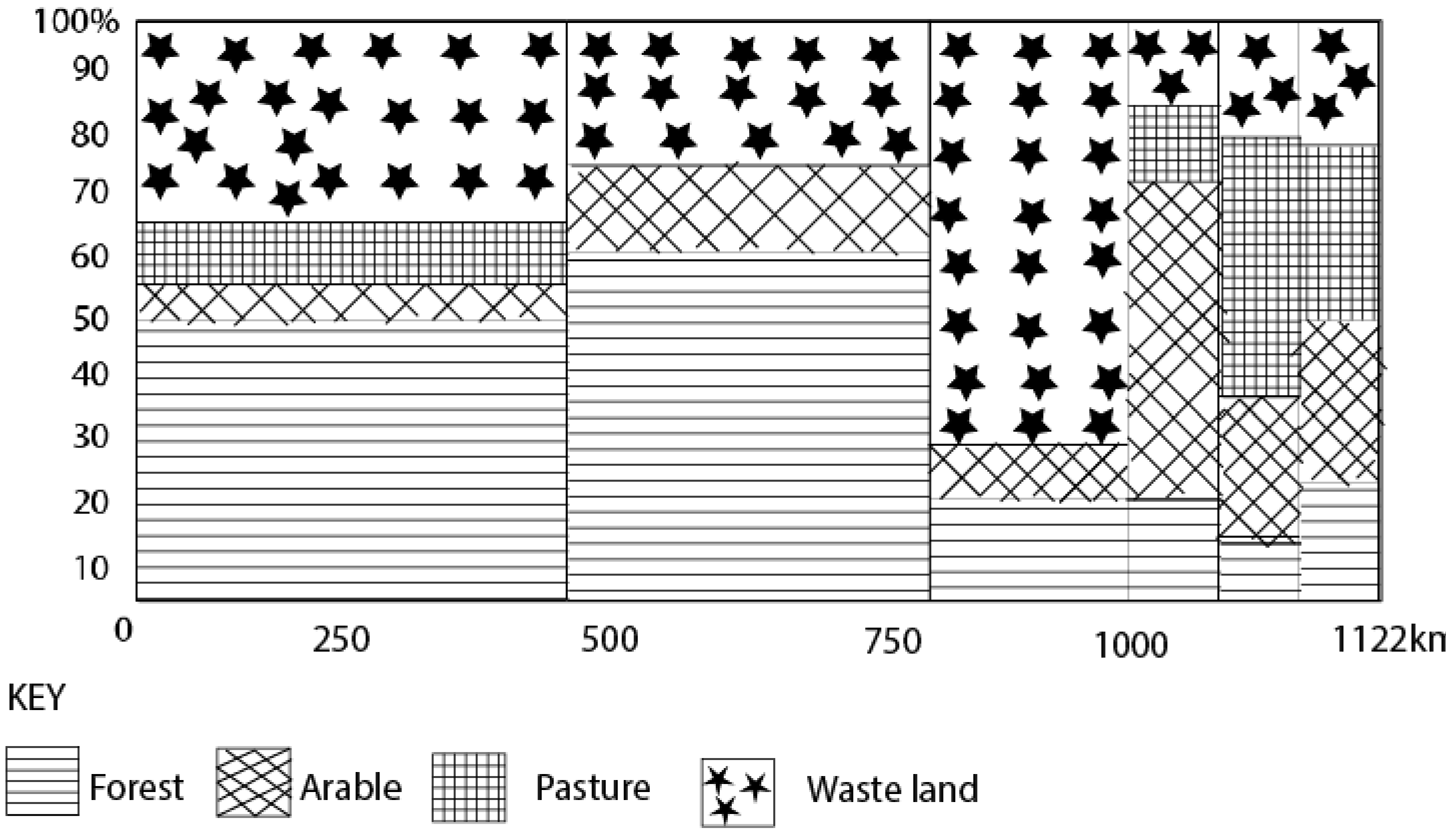
$$HS = \frac{\textbf{The sum of cummulative values}}{\textbf{Rectangle Length}}$$

$$\frac{1222}{10 \text{ cm}} = 122 - 125\%$$

Hence; Horizontal scale: 1 cm represents 125%

(f) Vertical scale

$$\frac{100\%}{10 \text{ cm}} = 10\%$$




**Merits of the divided rectangle**

- It is useful method for showing cumulative values
- It is more illustrative as it provides visual idea to the users in statistics
- It allows the easy making of quantitative analysis
- The data represented by compound divided graph can also be represented by percentage bar graph.

**Set backs of the divided rectangle**

- It is not much pleasing to people
- It consumes much time to prepare especially the compound divided rectangle
- It needs high skill to prepare the compound divided rectangle
- It needs high skill to prepare the compound divided rectangle

- It is much less used for statistical data representation
- A problem can be encountered in selecting the varied textures provided items are numerous.

**PROPORTIONAL CIRCLES**

It is diagram with circles whose size proportional to the quantity represented. The area size of a circle is calculated by the following application:-

$$\pi r \ \text{i.e}\ \frac{22}{7}\ \text{x radius}$$

But in our case; π is ignored. The radius varies with the quantity to be represented. Hence; proportional circles are drawn with radii proportional to the square root of the quantity represented.

**Construction of proportional circles**

**Consider the given data below:-**

Hydroelectricity production for some stations in country X.

| HEP Station | Production in MW |
|---|---|
| A | 100 |
| B | 144 |
| C | 255 |
| D | 400 |
| E | 625 |

**Procedure:**

(a) The values should be arranged in ascending or descending order. i.e. 100,144, 255, 400, 625.

(b) Find the square roots of the values.

$\sqrt{100} = 10$

√255 = 15

√400 = 20

√625 = 25

(c) Estimate the radius value scale to be used for all proportional circles. In the estimation, propose the highest radius to be used. Then the highest square root should be divided by the proposed highest radius.

$$\text{Value Scale} = \frac{\text{Highest square root}}{\text{Max Radius Length}}$$

$$\frac{25}{5} = 5$$

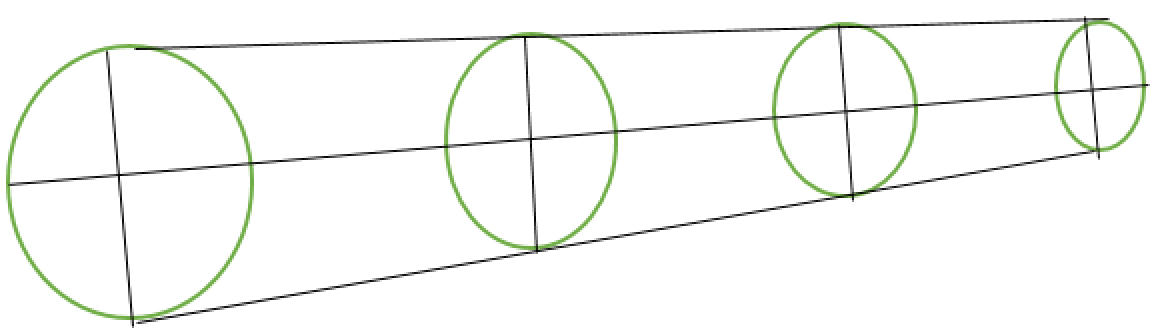
Thus; 1 cm to 5 square root.

(d) The proportional circles should be drawn accordingly.

In *drawing* the proportional circles; the following procedure should be followed.

- The circles are drawn proportionally to the quantity represented depending on the scale that has been decided.
- The two perpendicular lines should be drawn to follow the arrangement of the circles.
- The central line should be drawn through all circles.

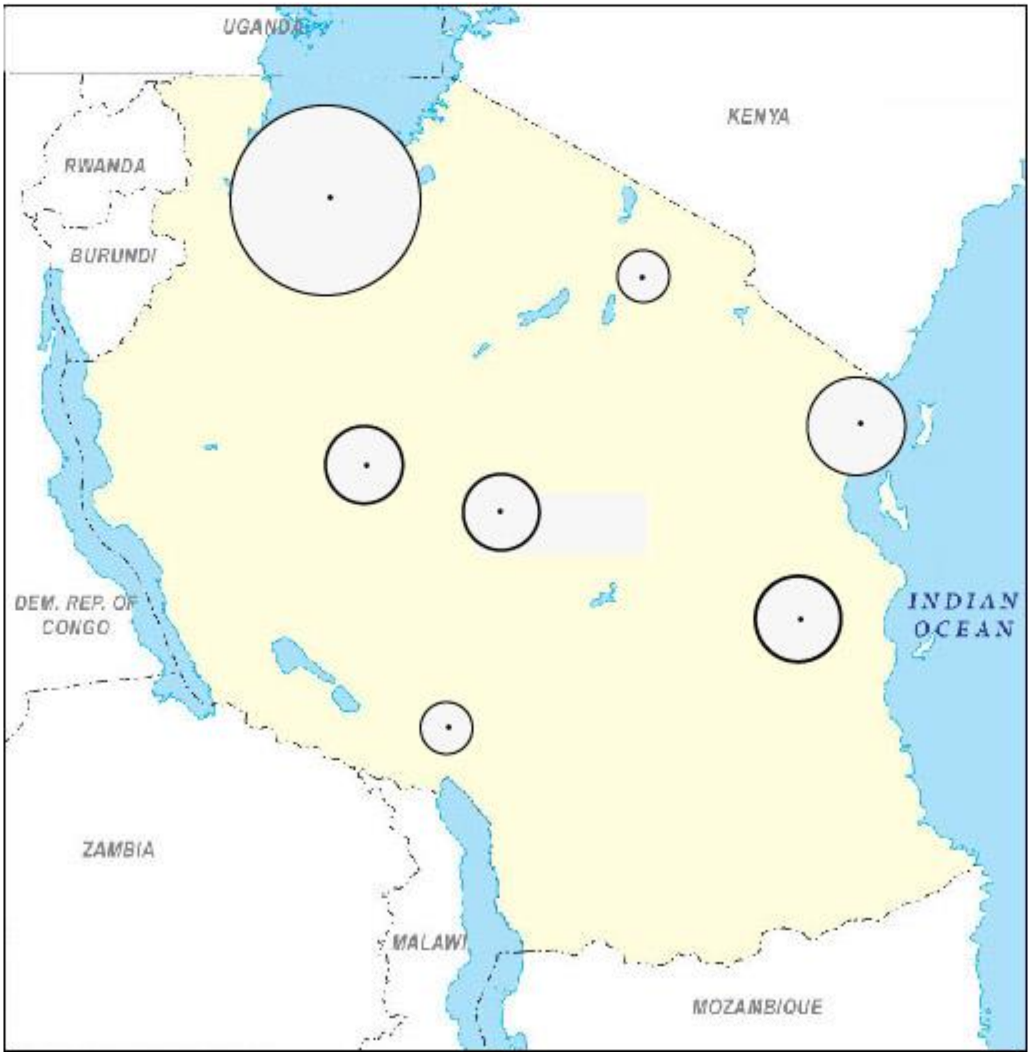
**PROPORTIONAL CIRCLES SHOWING HEP PRODUCTION FOR THE STATIONS**



**Note**

The proportional circles can be drawn on a map. This is done under the recommendation of showing values of places which appear on the map. The proportional circles on the map, sometimes may overlap. This is not a problem. But if it is possible, the best should be tried to minimize the size of the circles. One of the ways is to minimize the scale size.

Consider the map with proportional circles on the next page.




**Advantages of proportional circles**

· It is a good method of comparing absolute values

· The proportional circles give good visual impression

**Disadvantages of the proportional circles**

· It is much tedious in construction

· It becomes difficult to determine the exact values from the circles.

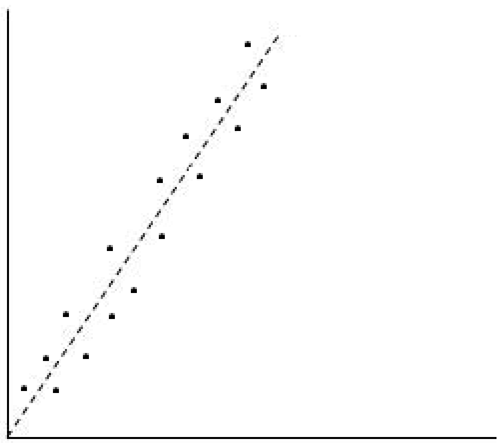
**SCATTER DIAGRAM**

This method is also known as scatter graph. It is a statistical diagram designed to show correlation between two types of data. The diagram is made to have two lines axis. The vertical axis is used to show the values for the dependent variable; while the horizontal axis is used to show the values for independent variable.

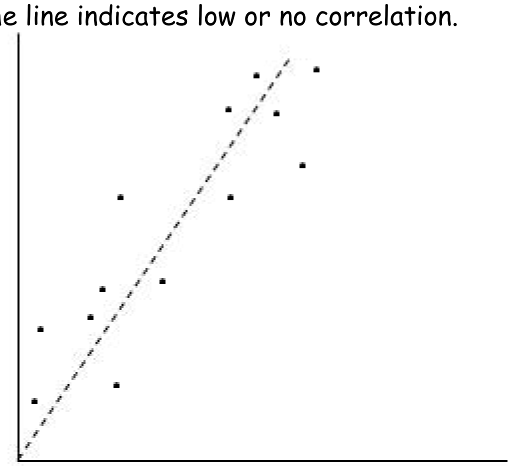
On the diagram; a straight line is drawn to follow the distribution of dots.

· If the plotted dots appear closer to straight line, indicates greater correlation

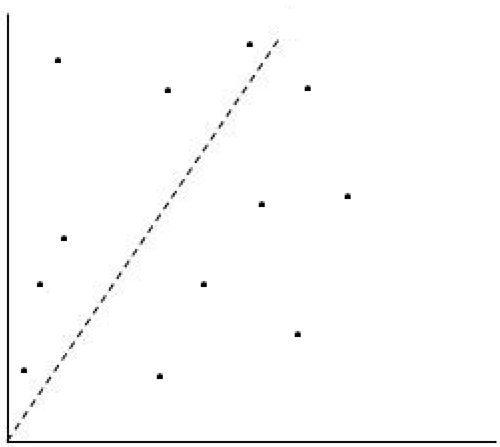
· If the plotted dots appear widely scattered from the line indicates low or no correlation.



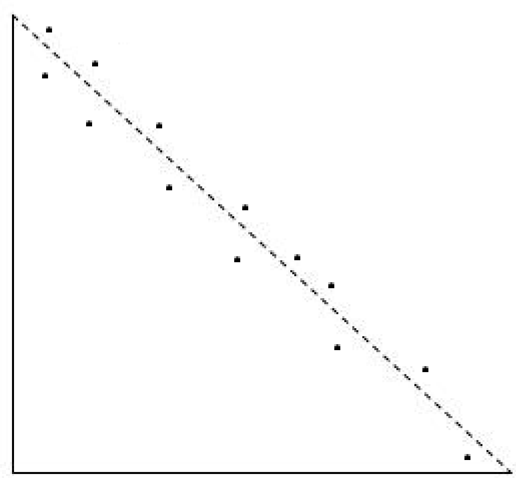
Greater correlation



Lower correlation



No correlation



Negative correlation

**Construction of the scatter diagram**

Consider the given data below showing the amount of rainfall at varied altitudes.

| Altitude (m) | Rainfall (mm). |
|---|---|
| 500 | 600 |
| 600 | 800 |
| 700 | 1200 |
| 800 | 1500 |
| 900 | 1700 |
| 1000 | 2000 |
| 1100 | 2400 |

Procedure:

(a) Identify the variables

- Dependent variable - Rainfall distribution values
- Independent variable - Altitude

(b) Estimation of both vertical and Horizontal scales

$$\boxed{\text{VS} = \frac{\textit{Highest Value}}{\textit{Graph Space}}}$$

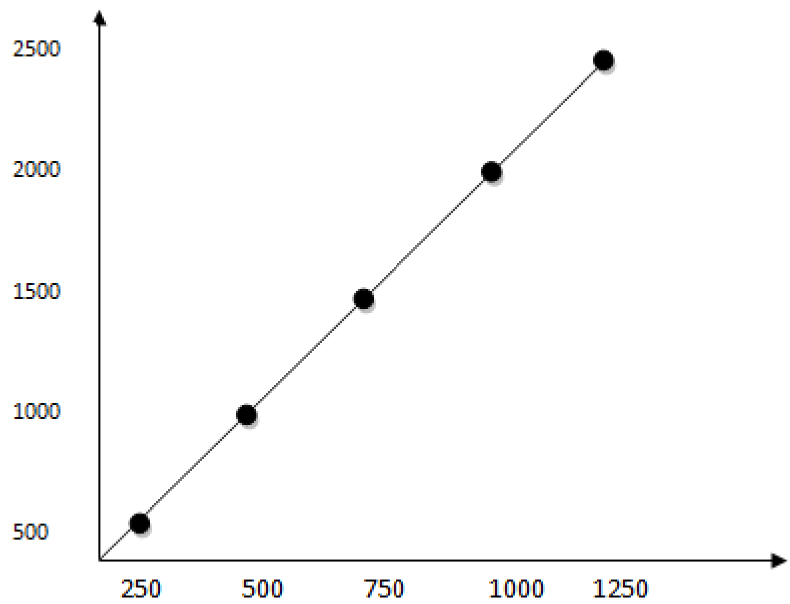
$$\frac{2400}{5\ \text{cm}} = 480 - 500\text{mm}$$

Hence; VS 1cm represents 500mm

$$\boxed{\text{HS} = \frac{\textit{Highest Value}}{\textit{Graph Space}}}$$

$$\frac{1100}{5\text{ cm}} = 220 - 250$$

Hence; HS 1cm represents 250m




According to scatter diagram above, the plotted dots are much closer to the line, This shows greater positive correlation between rainfall and altitudes. i.e. rainfall greatly influenced by altitude.

**WIND ROSE**

It is a statistical diagram designed to show the number values of wind blow frequencies per varied direction and speed in a given month as it was recorded at a certain weather station.

Wind rose is of two types including simple and compound wind roses.

**SIMPLE WIND ROSE**

Simple wind rose only shows number of wind blow frequencies per directions. It is made to have octagon sides or a circle of any convenient size. If octagon used; on each side, a rectangle of equal or varied length to others is drawn to represent the directions from which winds were blowing. If rectangles are made to have equal length, in each, small lines established to represent the number of wind blow frequencies. If are made of not equal length, each whose length is made proportional to the number of wind blow frequencies. The number of days which didn't experience wind blow (calm days) written in a circle inside the octagon.

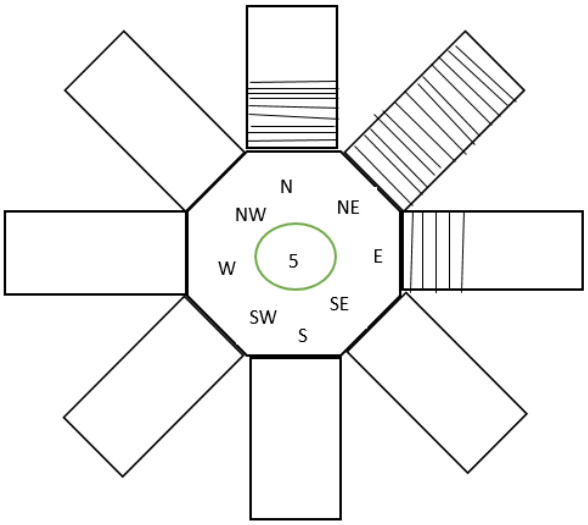
**Example:**

Construct the simple wind rose to represent the following data.

Wind blow frequencies at X weather station for the month of June.

| DIRECTION | N | NE | E | SE | S | SW | W | NW |
|---|---|---|---|---|---|---|---|---|
| WIND Fq | 5 | 4 | 4 | 1 | 3 | 4 | 3 | |

**WIND ROSE FOR X WEATHER STATION**




**COMPOUND WIND ROSE**

Compound wind rose is employed to show the average wind blow frequencies per varied direction and speed commonly in percentage of a given month for station weather station.

**Example:**

Construct the compound wind rose to present the following data.

Wind blow frequencies at X weather station for the month of June in percentages.

| Wind speed/Direction | N | NE | E | SE | S | SW | W | NW |
|---|---|---|---|---|---|---|---|---|
| Less than 4kph | 2 | 2 | 3 | 3 | 4 | 2 | 5 | 4 |
| 4 – 12 kph | 3 | 4 | 2 | 5 | 2 | 3 | 4 | 2 |
| 13 – 22 kph | 2 | 2 | 1 | 1 | 3 | 2 | 2 | 3 |
| Total | 11 | 10 | 9 | 11 | 11 | 10 | 15 | 11 |

Calm days = 18%

The compound wind rose for the given data is constructed as follow.

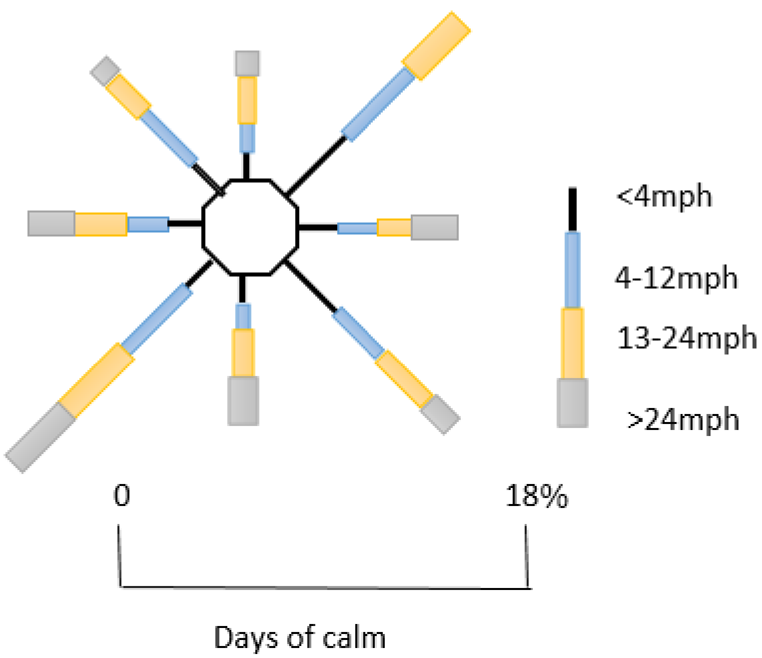
· Scale value determination

$$\text{Value Scale} = \frac{\text{Highest commulative frequency}}{\text{Graph space}}$$

$$\frac{15}{3} = 5$$

Hence; 1cm represents 3% frequency

Thus; the wind rose appears as follow:-




$$Scale: 0.5cm\ to\ 2hrs$$

**Advantages of wind rose:**

· It gives a visual impression of wind frequencies

· It is relatively easy to construct and takes a short time provided a scale is well assessed

· It is easy to understand information represented.

**Disadvantages of a wind rose**

· Numerical values not easily extracted as it needs measuring and calculating using the given scale.

- One cannot know the exact time or day when wind blew from a particular, direction since the wind rose is a summary of the conditions over a period of time.

- The pattern of wind blow over a given period cannot easily be seen from the diagram.

**POLAR CHART**

The graph is also known as circular graph or clock graph. It is a graph in circular form designed to have bars and circular line to show two attributes whose values appear in vaired unit. It is basically employed to illustrate the amount of temperature and rainfall together in a year. However polar chart can also be used in other cases of distribution recorded in a year.

For the case of showing climatic records, polar chart employ the use of both bars and line to illustrate rainfall and temperature values respectively.

The circle is divided into twelve equi angular radii.

**Construction of the circular graph**

The following tabled data show the climatic condition for certain weather station in Jerusalem.

| Month | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp °C | 8 | 9.1 | 12.2 | 17 | 21 | 22 | 23 | 24 | 23 | 21 | 17 | 12 |
| Rain mm | 150 | 160 | 70 | 30 | 18 | 00 | 00 | 00 | 00 | 22 | 80 | 90 |

Steps

Estimation of the value scales to be used.

$$\textbf{Rain value scale} = \frac{\textbf{Highest value}}{\textbf{Graph pace}}$$

$$\frac{182mm}{5cm} = 36.4 - 40mm$$

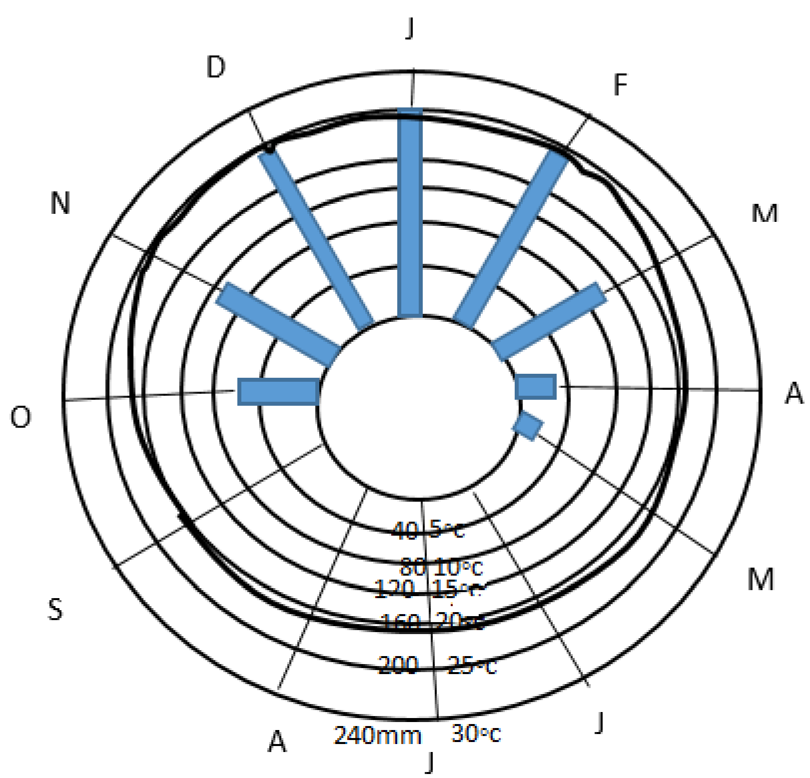
Thus, the value scale for rain fall is 1cm to 40 mm

$$\text{Temperature value scale} = \frac{\text{Highest value}}{\text{Graph pace}}$$

$$\frac{24°C}{5cm} = 4.8 - 5°$$

Hence; the temperature vertical scale; 1cm represents $5^0$c

The polar chart has to be drawn as follow:-




Strength as of the circular graph

- It is useful graphical method for showing the distribution values of climate
- It is more illustrative, as it provides visual idea to the users in statistics
- It allows the easy making of quantitative analysis

Setbacks of the circular graph

- It needs high skill to make quantitative analysis from the Graph
- It is time consuming graphical method in construction
- Needs high skill to construct the graph

**STATISTICAL GRAPHS**

These are the graphs designed to illustrate values of geographical items by means of lines or bars and in turn allow quantitative analysis.

The most useful statistical graphs for the illustration of values include the following.

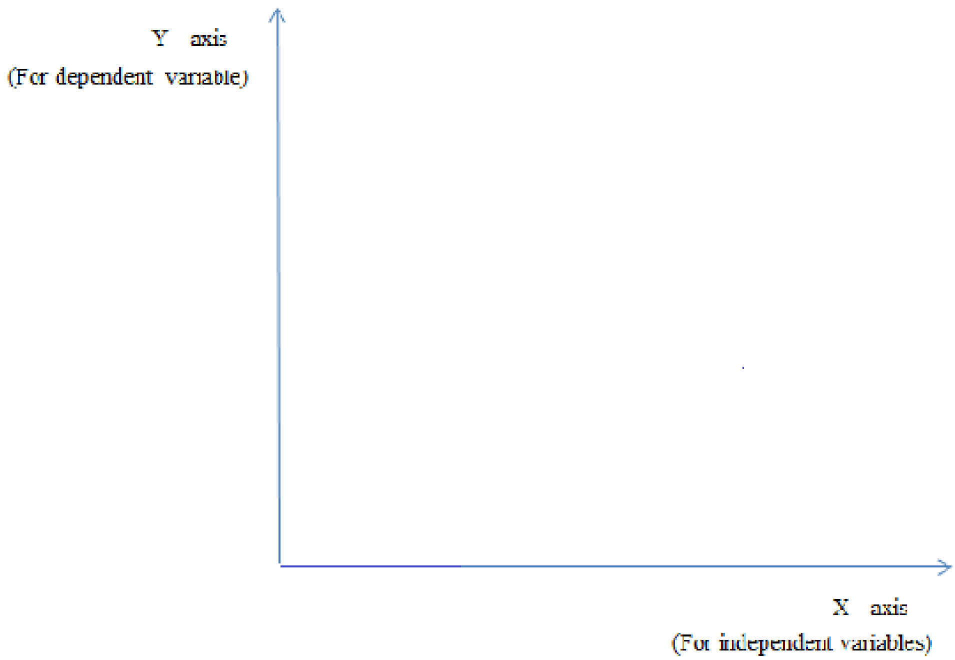
- Line graphs
- Bar graphs
- Combined bars and line graph

**LINE GRAPHS**

These are the graphs which use line (s) to illustrate the values of items to give quantitative analysis.

Any line graph has two axes of the following:-

- X – axis; This is also known as **the base or horizontal axis**. It is used principally to show the value of independent variable like **date** or **places.**
- Y – axis: This is also known as **the vertical axis**. It is used show the values for the dependent variable of like output of crops, minerals etc.




**TYPES OF LINE GRAPHS**

Linear graphs are extremely varied. They are differently deigned to meet varied functions (roles). With respect to this consideration, linear graphs recognized to be of the following forms:

- Simple line graph
- Cumulative line graph
- Divergent line graph
- Group line graph
- Compound line graph

**Simple line graph**

It is a form of line graph, designed to have one line to illustrate the values of one item in relation to dependent and independent variables. i.e. It is designed to show the values of one item per varied date or places.

**CONSTRUCTION OF THE SIMPLE LINE GRAPH**

Consider the given hypothetical data below showing maize production for country X in 0,000 metric tons (1990 – 1995).

| YEAR | PRODUCTION |
|---|---|
| 1990 | 100 |
| 1991 | 250 |
| 1992 | 300 |
| 1993 | 150 |
| 1994 | 500 |
| 1995 | 400 |

**Procedure**

(a) Variables identification

Dependent variable ….. production values

Independent variable ….. Date (Years).

Y – axis …… production values

X – axis ……. Years

(b) Vertical and horizontal scales estimation

$$\text{Vertical scale} = \frac{\text{Highest value}}{\text{Graph space}}$$

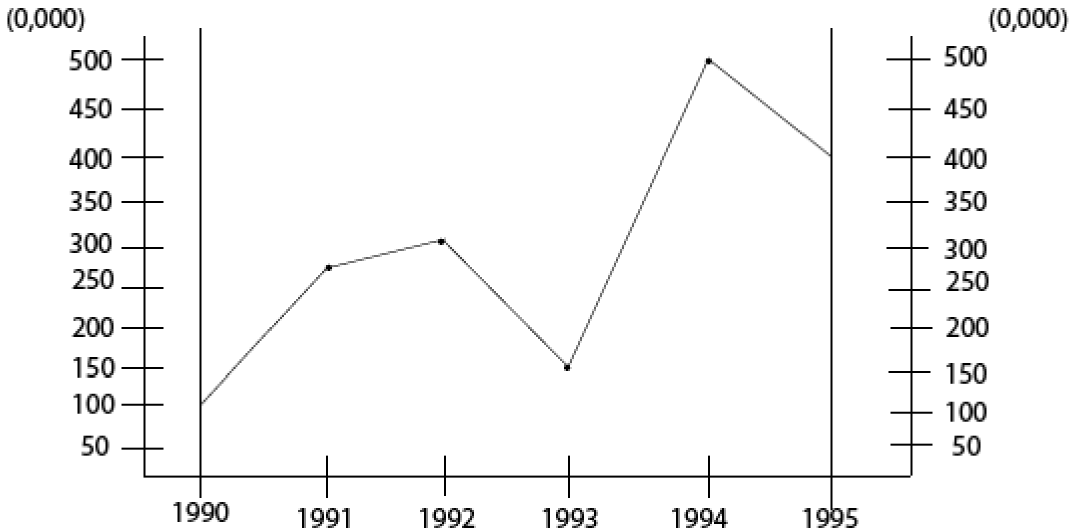
$$\frac{500}{10\text{ cm}} = 1\text{ cm to }500{,}000\text{ tons}$$

Hence; VS is 1 cm to 50000 tons.

Horizontal scale is up on decision

Hence; 1cm represents 1 year

**MAIZE PRODUCTION FOR COUNTRY X IN (0,000) Metric tons**




Scales:

VS: 1 cm to 50 tons

HS: 1cm to 1 year

**Source:**

Hypothetical data

**Strengths of the simple line graph**

- It is much easier to prepare as it involves to complicated mathematical works, and also a single line establishes the graph.
- From the graph, the absolute values are extracted
- It is comparatively easier to read and interpret the values
- It has perfect replacement by simple bar graph

**Setbacks of the simple line graph**

- It is a limited graphical method as only suited to represent the value for one item.
- Sometimes it becomes difficult to assess the vertical scale if the variation between the highest and lowest values appear wider enough.

**Cumulative line graph**

It is a form of line graph designed to show the accumulated total values at various dates or possibly places for a single item. This graphical method has no alternative graphical bar method as it can be compared to other linear graphical methods.

**Construction of the cumulative line graph**

Consider the given hypothetical data below showing maize production for country X.

| YEAR | PRODUCTION |
|---|---|
| 1990 | 50 |
| 1991 | 40 |
| 1992 | 90 |
| 1993 | 100 |
| 1994 | 90 |
| 1995 | 130 |

**Procedure**

(a) Variables identification

· Dependent variable ……….. production values

· Independent variable ---- Date (Years)

Y - axis ………. Production values

X – axis ………..Years

(b) Vertical and horizontal scales estimation

$$\text{Vertical scale} = \frac{\text{Highest value}}{\text{Graph space}}$$

(c) Determination of the cumulative values.

| YEAR | PRODUCTION | CUM VALUES |
|---|---|---|
| 1990 | 50 | 50 |

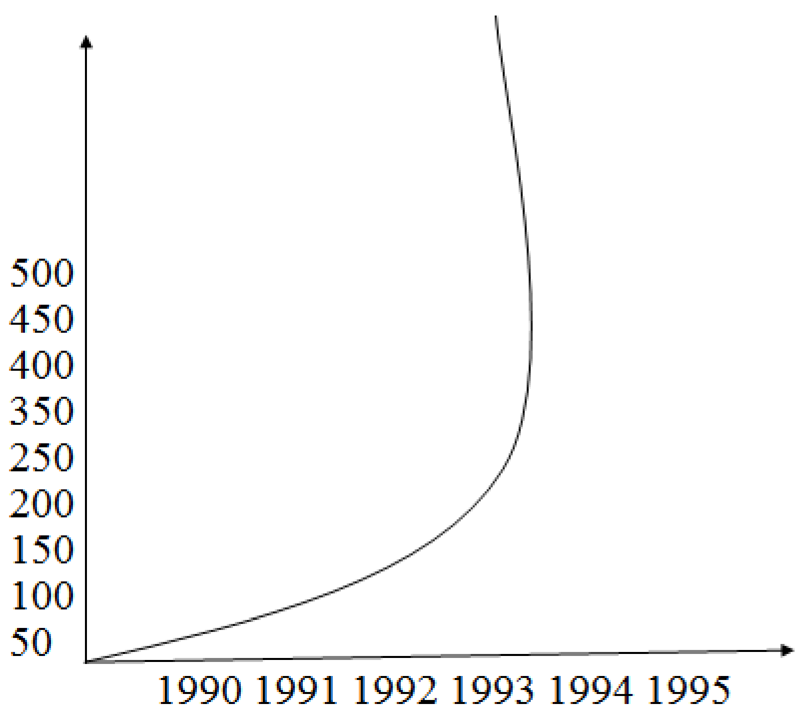
| | | |
|---|---|---|
| 1991 | 40 | 90 |
| 1992 | 90 | 180 |
| 1993 | 100 | 280 |
| 1994 | 90 | 370 |
| 1995 | 130 | 500 |

$$\frac{500}{10} = 50$$

Hence: VS; 1cm represents 50 tons

Thus; the cumulative lien graph appears as follow.

Cumulative line graph: Maize production for country X.




SCALE:-

VS….. 1cm represents 50 tons

HS ….. 1cm represents 1 year

Source ….. Hypothetical data.

**Merits of the cumulative line graph**

- The graphical method shows cumulative values
- From the graph the values can be revealed and quantitatively analyzed

**Setbacks of the cumulative line graph**

- The graphical method is not suited to show cumulative values for more than one item, it is thus; the graphical method limited for showing the values of a single item.
- It needs high skill to reveal the actual values of the item represented
- It has no alternative graphical bar method.

**Divergent line graph**

It is a form of line graph designed to illustrate the increase and decrease of the distribution values in relation to the mean. The graph is designed to have **upper and lower sections** showing **positive and negative values** respectively. The two portions are separated by the steady line graduated with zero value along the vertical line. The steady line also shows the average of all values.

**Construction of the divergent line graph**

Consider the following tabled data which show export values of coffee for country X in millions of dollars.

| YEAR | EXPORT VALUES (000,000 dollars) |
|---|---|
| 1952 | 345 |
| 1953 | 256.5 |
| 1954 | 283 |
| 1955 | 500 |
| 1956 | 335 |

| | |
|---|---|
| 1957 | 330.5 |

(a) Variables identification

- Dependent variable ……….. Export values
- Independent variable ---- Date (Years)

Y - axis ………. Export values

X – axis ………..Years

(b) Computation of the arithmetic mean

$$\boxed{\text{Arithmetic mean} = \frac{\sum X}{N}}$$

$$\boxed{\sum x = x_1 + x_2 + x_3 + \_\_\_\_\_\_\_\_ x_n}$$

- 345 + 256 + 283 + 300 + 335 + 330.5 = 1850

Then;

$$\frac{1850}{6} = 308$$

Computation of the deviation values

$$\boxed{\textbf{Deviation} = X - \bar{X}}$$

1952 345-308 = 37

1953 256.5 – 308 = 52.5

1954 283-308 = -25

1955 300 – 308 = -8

1956 335 – 308 = 27

1957 330.5 – 308 = 22.5

(c) Estimation of the vertical scale.

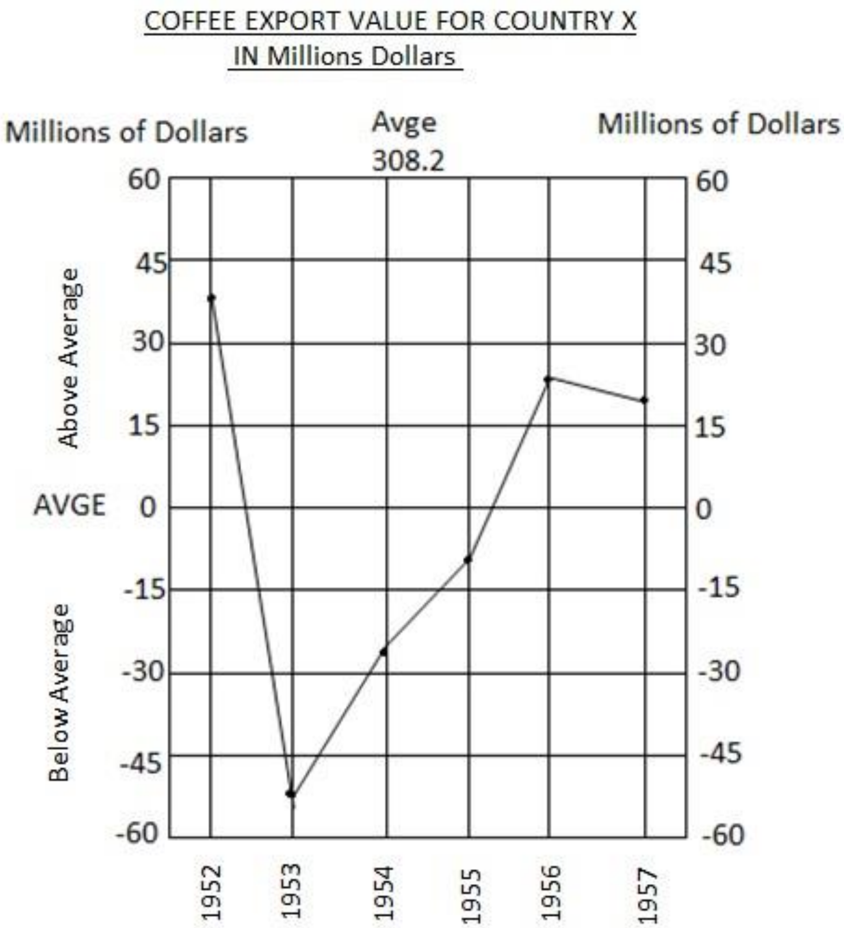
$$\text{Vertical scale} = \frac{\text{Highest deviation value}}{\text{Graph space}}$$

$$\frac{52.5}{4} = 13 - 15$$

Thus: the vertical scale

1cm represents 15 or -15 million dollars

(d) The graph has to be redrawn accordingly as follows:-




**Source:-**

Hypothetical data

**Scales:-**

Vertical scale 1cm represents 15 or 15 tons

Horizontal scale 1cm represents 1 year

**Merits of the divergent line graph**

- The graphical method is useful for showing increase and decrease of the values.
- The graphical method shows the average of all values
- It has perfect replacement by divergent bar graph

**Setbacks of the divergent line graph**

The graphical method is not suited to show the increase and decrease values for more than one items, it is thus; the graphical method is limited to a single item.

It needs high skill to reveal the actual values of the item represented.

It is time consuming graphical method as its preparation involves a lot of mathematical works.

It requires high skill to construct the divergent line graph.

**Group line graph**

It is a form of statistical line graph designed to have more than one lines of varied textures to illustrate the values of more than one items. Group line graph is alternatively known as composite, comparative, and multiple line graph.

**Construction of the group line graph**

Consider the given data below showing values of export crops from Kenya (Ksh Million).

| Crop/Year | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|
| Tea | 24,126 | 32,971 | 33,065 | 35150 | 34,448 |
| Coffee | 16,856 | 12,817 | 12,029 | 11,707 | 7,460 |
| Horticulture | 13,752 | 14,938 | 17,641 | 21,216 | 19,846 |
| Tobacco | 1,725 | 1,607 | 1,554 | 2,167 | 2,887 |

(a) Variables identification
Dependent variable …… export values

Independent variable …. Date (years)

Y - -axis………. export values

X – axis………..Years

(b) Verticals identification
Dependent variable……..export values

Independent variable …… Date (Years)

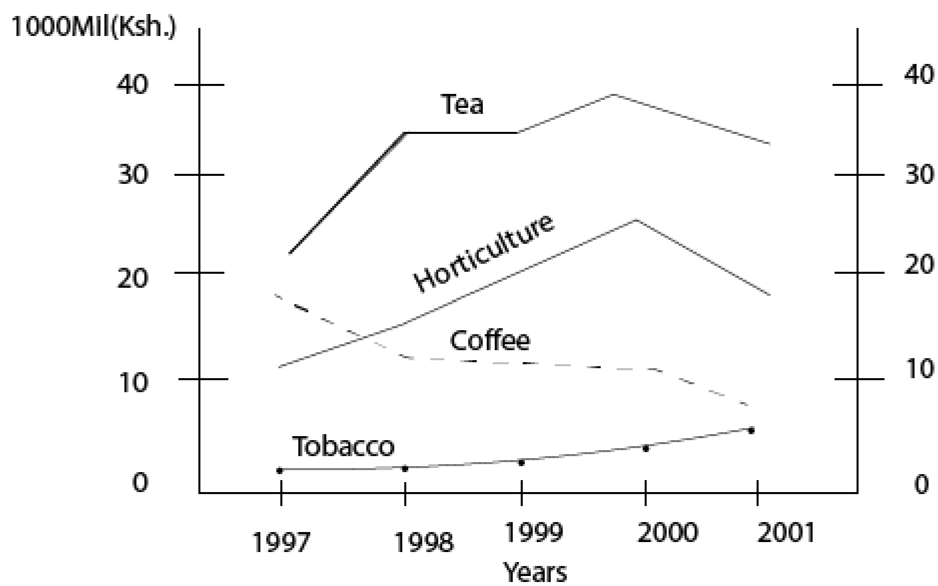
$$\text{Vertical scale} = \frac{\text{Highest value}}{\text{Graph space}}$$

$$\frac{35150}{8\text{ cm}} = 4393.75 - 5000$$

Hence; VS 1cm represents 5000 export value

Thus; the group line graph appears as follows:-

**KENYA: CROPS EXPORT VALUES**




**Scales:-**

Vertical scale: 1cm to 5,000 export values

Source: Kenya Economic Survey 1969

**Strengths of the group line graph**

- It is much easier to prepare as it involves no complicated mathematical works
- It is useful graphical method for showing the values of more than one cases.
- From the graph, the absolute values are extracted as the values directly shown
- It is comparatively easier to read and interpret the values.
- It has perfect replacement by group bar graph.

**Setbacks of the group line graph**

- Some times; it becomes difficult to assess the vertical scale if the variation between the highest and lowest values appears wider enough
- Crossing of the lines on the graph may confuse the interpreter.
- A problem may arise in the selection of the varied line textures.

**Compound line graph**

It is a line graph designed to have more than one lines compounded to one another by varied shade textures to show the cumulative values of more than one items.

**Construction of the compound line graph**

Consider the given data below showing cocoa production for the Ghana provinces in 000 tons.

| YEAR/PROV | TV Togoland | E. province | W. province | Ashanti |
|---|---|---|---|---|
| 1947/48 | 40 | 40 | 30 | 35 |
| 1948/49 | 50 | 60 | 45 | 100 |
| 1949/50 | 45 | 46 | 89 | 110 |
| 1950/51 | 45 | 47 | 44 | 124 |
| 1951/52 | 47 | 23 | 50 | 100 |
| 1952/53 | 51 | 14 | 57 | 118 |

**Procedure**

(a) Variables identification

Dependent variable…… export values

Independent variable ….. Date (Years)

Y - -axis……….export values

X – axis……….Years

(b) Cumulative values determination for the dates.

1947/48 40+40+30+35 = 145

1948/49 50+60+45+100 = 225

1949/50 45+46+89+110 = 290

1950/51 45+47+44+124 = 260

1951/52 47+23+50+100 = 220

1952/53 51+14+57+118= 240

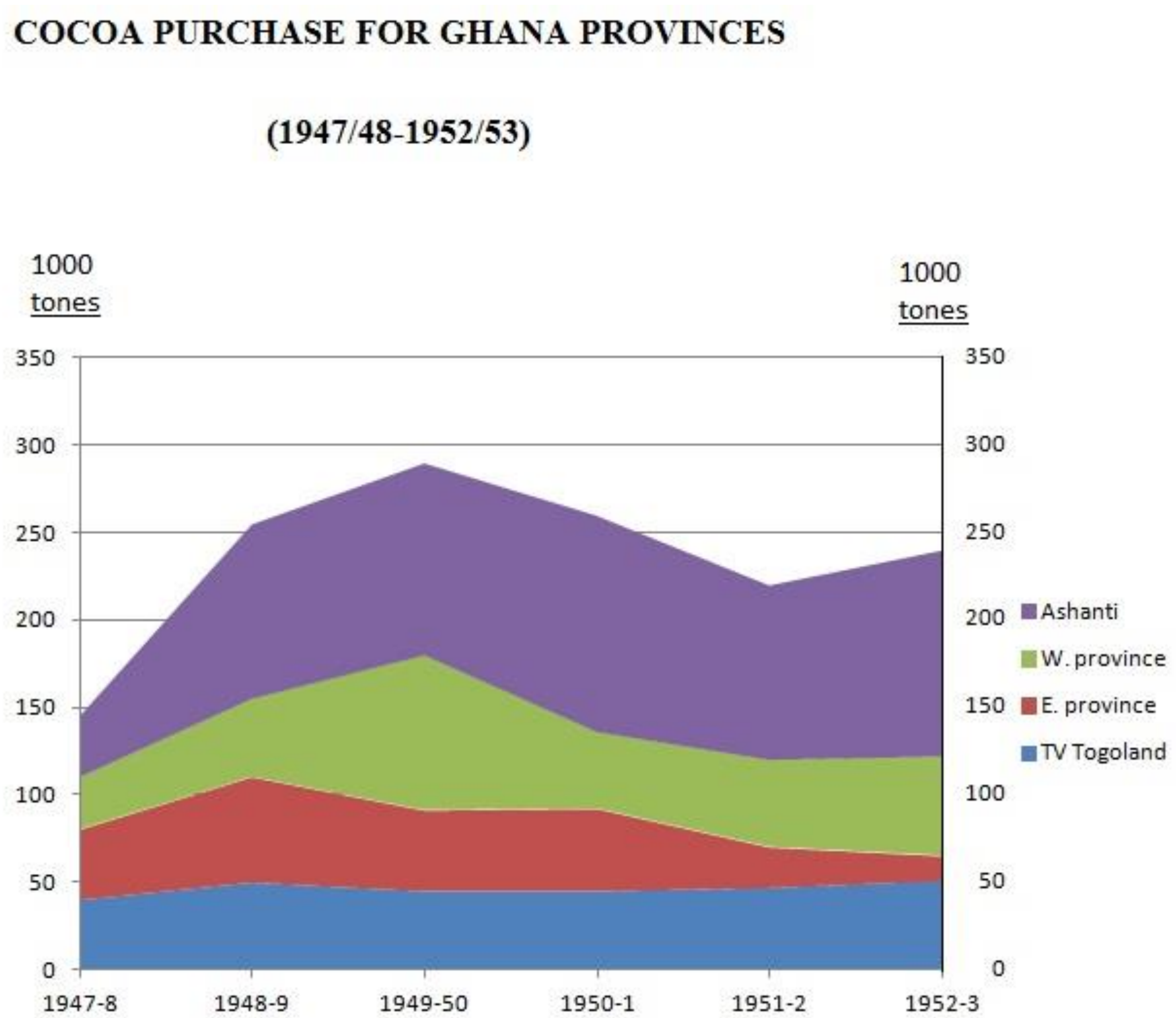
(c) Vertical and horizontal scales determination

$$\boxed{\text{Vertical scale} = \frac{\text{Highest commulative value}}{\text{Graph space}}}$$

$$\frac{290}{6\text{ cm}} = 48.3 - 50$$

Hence; The vertical scale, 1cm represent 50 tons

Thus the graph appear as follow:-




**Strengths of the compound line graph**

- It is useful graphical method for showing the cumulative values of more than one case.
- Depending on the skill the interpreter has, from the graph, the absolute values are extracted as the value directly shown.
- It has perfect replacement by compound bar graph
- It is comparatively easier to assess the vertical scale to be used.

Setbacks of the compound line graph

- It needs high skill to interpret the graph
- It needs high skill to construct the graph

- A problem may arise in the selection of the varied line textures.

**BAR GRAPHS**

These are the graphs which use bars to illustrate the values of items to give quantitative analysis.
Any bar graph has two axes

- X-axis; This is also known as the base or horizontal axis. It is used principally to show the values of independent variable like date or places.
- Y – axis; This is also known as the vertical axis. It is used show the values for the dependent variable of like output of crops, minerals etc.

**TYPES OF BAR GRAPHS**

Like line graphs, bar graphs are also extremely varied as differently designed to meet varied functions. With respect to this consideration, bar graphs categorized into the following:-

- Simple bar graph
- Divergent bar graph
- Group bar graph
- Compound bar graph
- Percentage bar graph
- Population pyramid

**Simple bar graph**

It is a form of bar graph, designed to have bars of similar texture to illustrate the values of one item in relation to dependent and independent variables. i.e. It is designed to show the values of one item per varied date or places.

**Construction of the simple bar graph**

Consider the given data below showing cocoa purchase by areas, in 000 metric tons (1953)

| Province | Purchase |
|---|---|
| Ashanti | 104 |
| W-Province | 39 |
| E-Province | 45 |
| TV Togo land | 22 |

**Procedures**

(a) Variable identification
Dependent variable …… Purchase

Independent variable …. Provinces

Y - -axis………purchase values

X – axis………..Provinces

(b) Verticals identification

Dependent variable……..export values

Independent variable …… Date (Years)

$$\boxed{\textbf{Temperature value scale} = \frac{\textbf{Highest value}}{\textbf{Graph pace}}}$$

$$\frac{104}{6} = 17.3 \sim 20$$

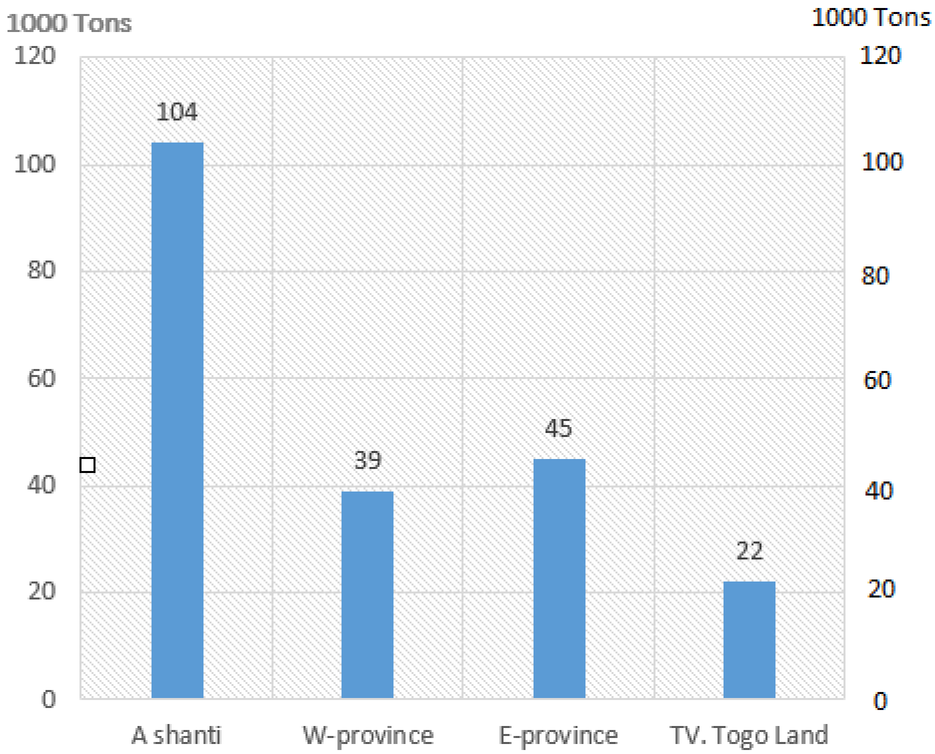
Thus; the vertical scale: 1cm represents 20,000 tons.

Bar width – 1cm

Bar space = 0.5 cm

The graph has to be constructed accordingly.

**COCOA PURCHASE BY PROVINCES (1953/54**




Vertical scale; 1cm represents 20000 tons.

**Strengths of the simple bar graph**

- It is much easier to prepare as it involves no complicated mathematical works, and also bars of similar texture established in the graph.
- From the graph, the absolute values are extracted.
- It is comparatively easier to read and interpret the values
- It has perfect replacement by simple line graph.

**Setbacks of the simple bar graph**

- It is a limited graphical method as only suited to represent the values for one item
- Some times; it becomes difficult to assess the vertical scale if the variation between the highest and lowest values appear wider enough.

**Divergent bar graph**

It is a form of bar graph designed to illustrate the increase and decrease of the distribution values in relation to the mean. The graph is designed to have **upper and lower sections** showing **positive and negative values** respectively. The two portions are separated by the steady lien graduated with zero value along the vertical line. The steady lien also shows the average of all values.

**Construction of the divergent line graph**

Consider the following tabled data which show export values of coffee for country X in millions of dollars.

| YEAR | EXPORT VALUES (000,000 dollars) |
|---|---|
| 1952 | 345 |
| 1953 | 256.5 |
| 1954 | 283 |
| 1955 | 300 |
| 1956 | 335 |
| 1957 | 330.5 |

(a) Variable identification

Dependent variable …… Export values

Independent variable …. Date (Years)

Y - -axis………. Export values

X – axis……….Years

(b) Computation of the arithmetic mean

$$\boxed{\text{Arithmetic mean} = \frac{\sum X}{N}}$$

$$\boxed{\sum x = x_1 + x_2 + x_3 + \_\_\_\_\_\_\_\_ x_n}$$

345 + 256 + 283 + 300 + 335 + 330.5 + 1850

$$\text{Then, } \frac{1850}{6} = 308$$

(c) Computation of the deviation values

1952 345 - 308 = 37

1953 256.5 - 308 = 52.5

1954 283 - 308 = -25

1955 300 – 308 = -8

1956 335 – 308 = 27

1957 330.5 – 308 = 22.5

(d) Estimation of the vertical scale

$$\boxed{\text{Value Scale} = \frac{\text{Highest Deviation value}}{\text{Graph space}}}$$

Thus: the vertical scale 1cm represents 15 or –15 million dollars

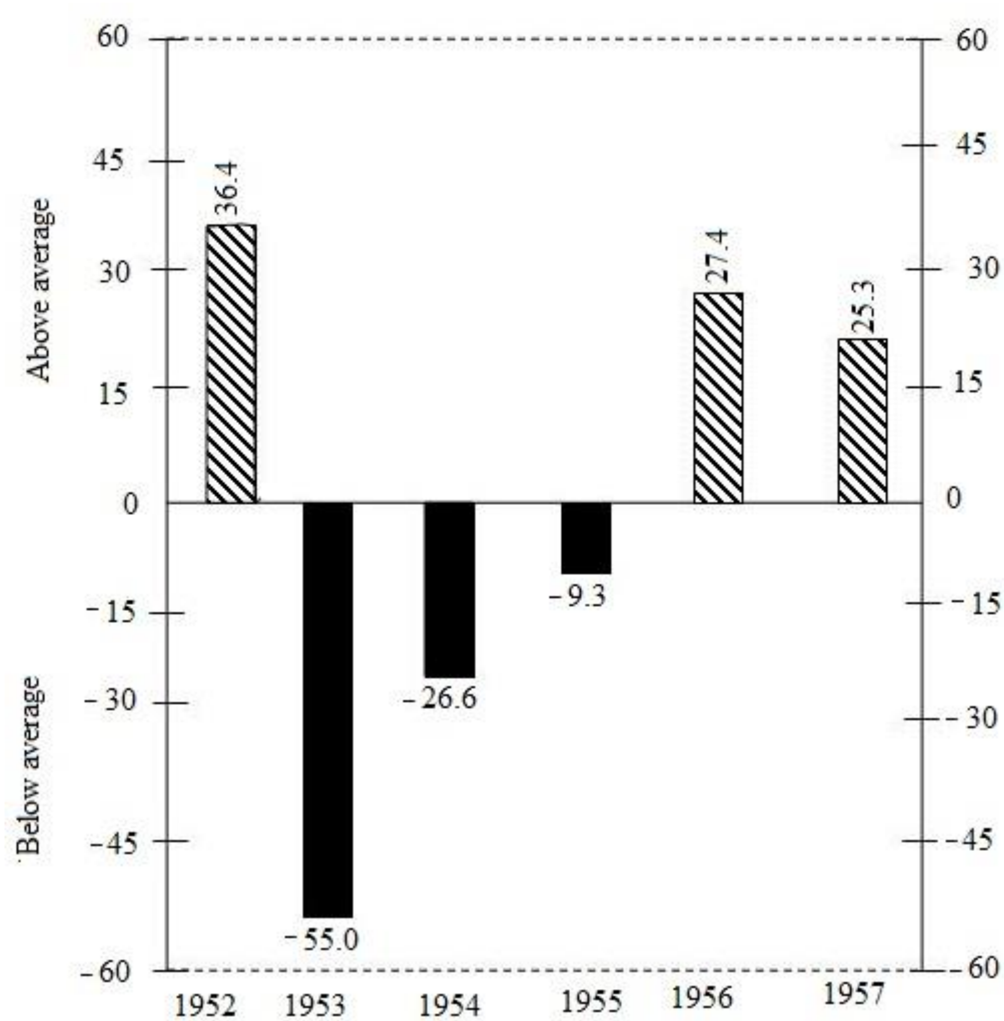
Bar width – 1cm

Bar space – 1cm

(e) The graph has to be redrawn accordingly as follows.

**COFFEE EXPORT VALUES FOR COUNTRY X**

**In million dollars**




**Scales:-**

Vertical scale 1cm represents 15 or – 15 tons

Horizontal scale: 1cm represents 1 year

Source:- Hypothetical data

**Merits of the divergent bar graph**

- The graphical method is useful for showing increase and decrease of the values
- The graphical method shows the average of all values
- It has perfect replacement by divergent line graph.

**Setbacks of the divergent bar graph**

- The graphical method is not suited to show the increase and decrease values for more than one item, it is thus; the graphical method is limited to a single item.
- It needs high skill to reveal the actual values of the item represented.
- It is time consuming graphical method as its preparation involves a lot of mathematical work.
- It requires high skill to construct the divergent bar graph.

**Grouped bar graph**

It is a form of statistical bar graph designed to have more than one bars of varied textures to illustrate the values of more than one items.

Grouped bar graph is alternatively known as composite, comparative, and multiple bar graph.

**Construction of the group bar graph**

Consider the given data below for cocoa purchase by provinces in Ghana (1947/48 – 1950/51)

| YEAR/PROV | TV Togoland | E. province | W. province | Ashanti |
|---|---|---|---|---|
| 1947/48 | 20 | 54 | 28 | 106 |
| 1948/49 | 26 | 80 | 46 | 126 |
| 1949/50 | 24 | 67 | 40 | 116 |
| 1950/51 | 22 | 72 | 45 | 123 |

(a) Variables identification

Dependent variable…… purchase values

Independent variable ….. Date

Y - -axis……… .purchase values

X – axis……….Date

(b) Vertical scale estimation

$$\text{Vertical scale} = \frac{\textit{Highest value}}{\textit{Graph space}}$$

$$\frac{126}{7\text{ cm}} = 18 - 20$$

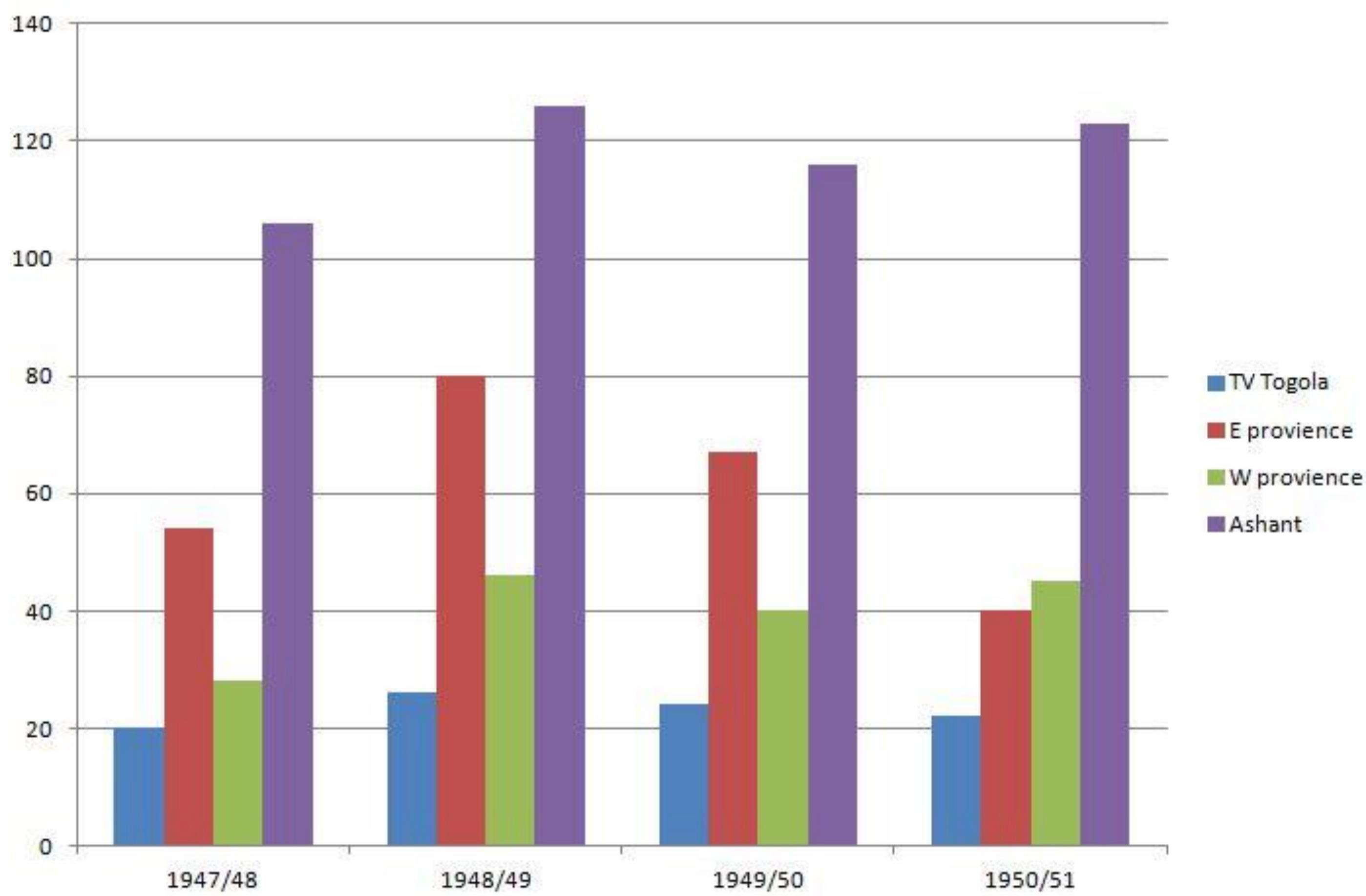
Hence; Vs, 1cm to 20,000 tons

Bar width = 1cm

Bar space = 1cm

(c) The graph should be drawn accordingly.

**COCOA PURCHASE BY PROVINCES (1953/54)**



**Strengths of the grouped bar graph**

- It is much easier to prepare as it involves no complicated mathematical works
- It is useful graphical method for showing the values of more than one cases.
- From the graph, the absolute values are extracted as the value are directly shown
- It is comparatively easier to read and interpret the values.
- It has perfect replacement by group line graph.

**Setbacks of the grouped graph**

- Some times; it becomes difficult to assess the vertical scale if the variation between the highest and lowest values appear wider enough.
- A problem may arise in the selection of the varied bar textures.

**Compound Bar graph**

It is a bar graph designed to have bars divided proportionally showing the cumulative values of more than one items per varied dates or places

Compound bar graph is alternatively known as **divided bar graph**, or **superimposed bar graph**.

**Construction of the compound bar graph**

Consider the given data below showing cocoa production for the Ghana provinces in 000 tons.

Consider the given data below showing cocoa purchase by provinces (1947/48 to 1950/51)

| REGION/YEAR | 1947/48 | 1948/49 | 1949/50 | 1950/51 |
|---|---|---|---|---|
| Ashanti | 106,000 | 126,000 | 116,000 | 123,000 |
| W.province | 28,000 | 46,000 | 40,000 | 45,000 |
| E.Province | 54,000 | 80,000 | 67,000 | 72,000 |
| T.Volta | 20,000 | 26,000 | 24,000 | 22,000 |

**Procedure**

(a) Variable identification

Dependent variable ….. export values

Independent variable … Date (Years).

Y - -axis………. purchase values

X – axis………..Years

(b) Cumulative values determination for the dates.

1947/48……….. 106,000 + 28,000 + 54,000 + 20,000 = 208

1948/49………… 126,000 + 46,000 + 80,000 + 26,000 = 278,000

1949/50 ………… 116,000 + 40,000 + 67,000 + 24,000 = 247,000

1950/51…………..123,000 + 45,000 + 72,000 + 22,000 = 262,000

(c) Vertical scale determination.

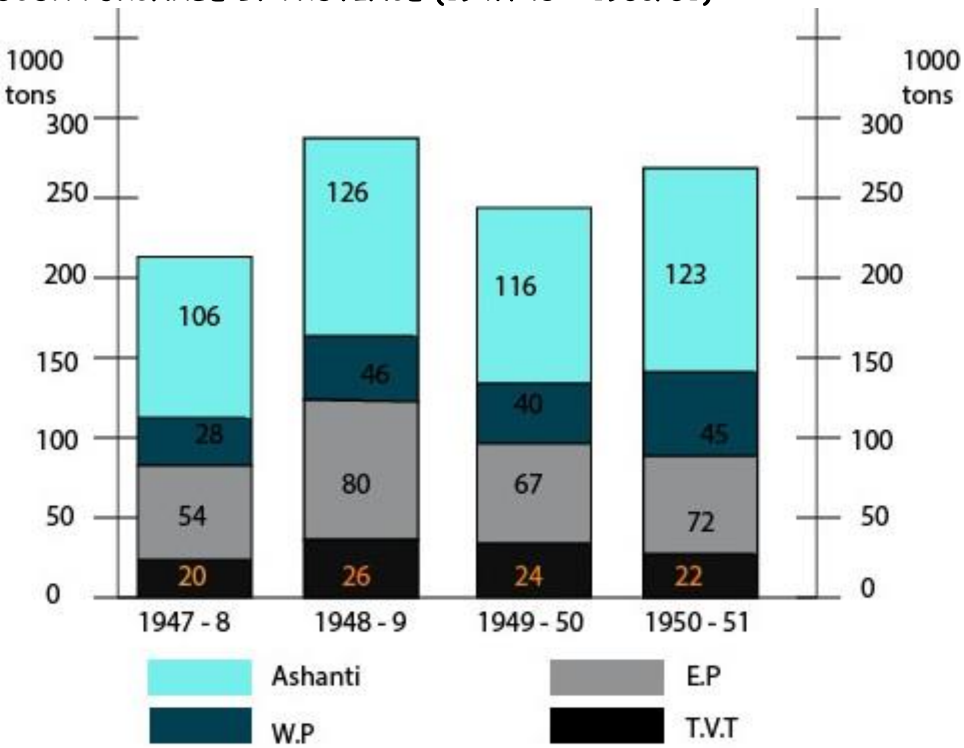
$$\boxed{\text{Value Scale} = \frac{\text{Highest Comulative value}}{\text{Graph space}}}$$

$$\frac{278{,}000}{6\text{ cm}} = 463{,}000 - 50{,}000$$

Thus; the VS … 1cm represents 50,000 tons.

The graph should be drawn accordingly.

**COCOA PURCHASE BY PROVINCE (1947/48 – 1950/51)**




**Strength of the compound bar graph**

- It is useful graphical method for showing the cumulative values of more than one cases
- Depending on the skill the interpreter has, from the graph, the absolute values are extracted as the value directly shown.
- It has perfect replacement by compound line graph
- It is comparatively easier to assess the vertical scale to be used.

**Setbacks of the compound bar graph**

- It needs high skill to interpret the graph
- It needs high skill to construct the graph
- A problem may arise in the selection of the varied textures of the proportional segments

It is very fedious /tiresome as it involve mathematical calculation

It is time consuming in preparation

**Percentage bar graph**

In percentage bar graph, all bars must be drawn on the same height representing 100% and suitable scale is chosen such as 5, 10, 20 etc, and marked along the sides. The percentages of the total each area stands for must start from zero line. Also it is advised to include the actual percentages of the face of the bars.

**Construction of the Percentage bar graph**

Consider the given data below showing cocoa purchase by provinces (1947/48 to 1950/51)

| REGION/YEAR | 1947/48 | 1948/49 | 1949/50 | 1950/51 |
|---|---|---|---|---|
| Ashanti | 106,000 | 126,000 | 116,000 | 123,000 |
| W.province | 28,000 | 46,000 | 40,000 | 45,000 |
| E.Province | 54,000 | 80,000 | 67,000 | 72,000 |
| T.Volta | 20,000 | 26,000 | 24,000 | 22,000 |

**Procedure**

(a) Variables identification
Dependent variable ….. export values
Independent variable … Date (Years).
Y-axis………. purchase values
X-axis………..Years

(b) Cumulative values determination for the dates.
1947/48……….. 106,000 + 28,000 + 54,000 + 20,000 = 208

1948/49………… 126,000 + 46,000 + 80,000 + 26,000 = 278,000

1949/50 ………… 116,000 + 40,000 + 67,000 + 24,000 = 247,000

1950/51…………..123,000 + 45,000 + 72,000 + 22,000 = 262,000

(c) The percentages by provinces in each year determination.
**1947/48**:

$$\text{Ashanti}: \frac{106,000}{208,000} \text{ x } 100\% = 51\%$$

$$\text{W. province}: \frac{28,000}{208,000} \text{ x } 100\% = 13.4\%$$

$$\text{E. province}: \frac{54,000}{208,000} \text{ x } 100\% = 26\%$$

$$\text{Tv/T}: \frac{20,000}{208,000} \text{ x } 100\% = 9.6\%$$

**1948/49**:

$$\text{Ashanti:} = \frac{126,000}{278,000} \text{ x } 100\% = 45.3\%$$

$$\text{W. Province:} = \frac{46,000}{278,000} \text{ x } 100\% = 16.5\%$$

$$\text{E. Province:} = \frac{80,000}{278,000} \text{ x } 100\% = 28.77\%$$

$$\text{Tv/T:} = \frac{26,000}{278,000} \text{ x } 100\% = 9.4\%$$

**1949/50:**

$$\text{Ashanti:} = \frac{116,000}{247,000} \text{ x } 100\% = 47\%$$

$$\text{W. Province:} = \frac{40,000}{247,000} \text{ x } 100\% = 16.2\%$$

$$\text{E. Province:} = \frac{67,000}{247,000} \text{ x } 100\% = 27.1\%$$

$$\text{Tv/T:} = \frac{24,000}{247,000} \text{ x } 100\% = 9.7\%$$

**1950/51:**

$$\text{Ashanti:} = \frac{123,000}{262,000} \text{ x } 100\% = 46.94\%$$

$$\text{W. Province:} = \frac{45,000}{262,000} \text{ x } 100\% = 17.17\%$$

$$\text{E. Province:} = \frac{72,000}{262,000} \text{ x } 100\% = 27.48\%$$

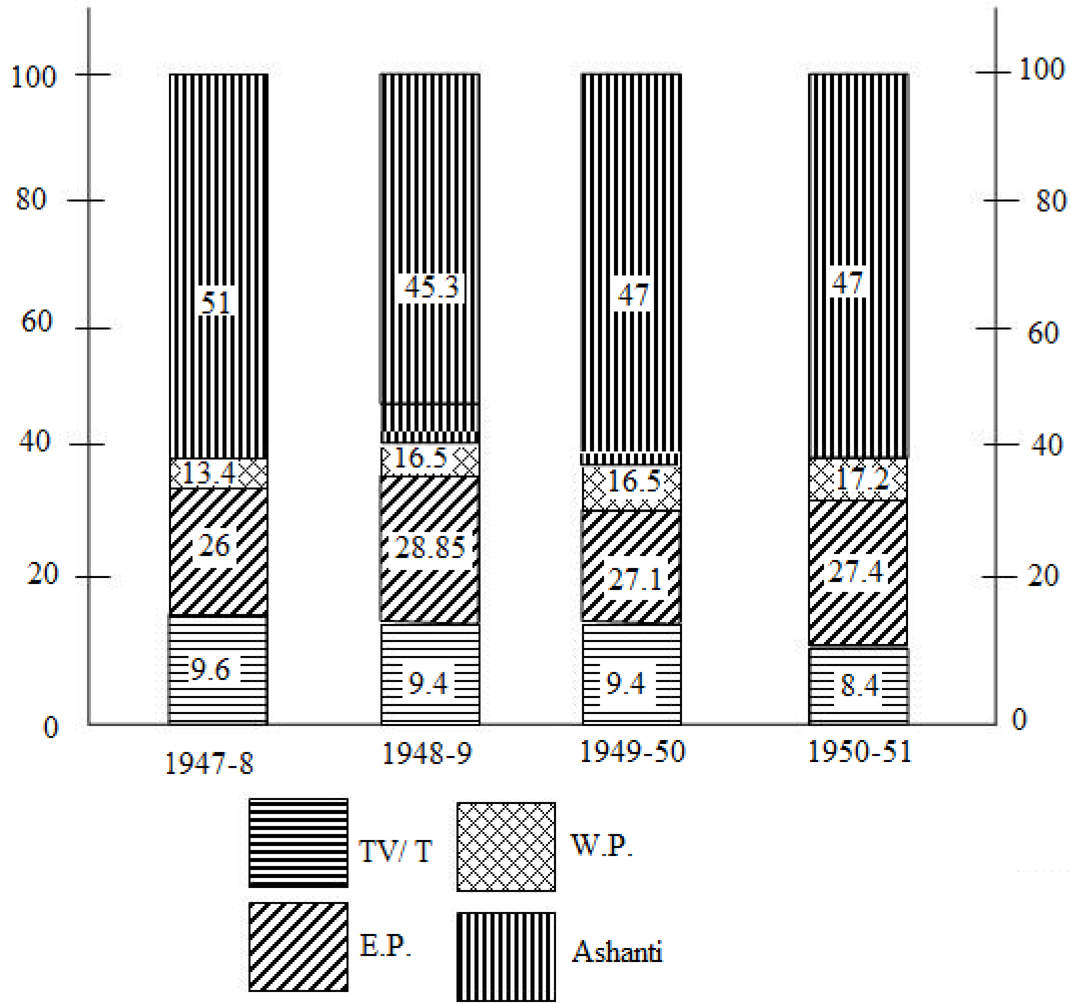
$$\text{Tv/T:} = \frac{22,000}{262,000} \text{ x } 100\% = 8.4\%$$

$$\text{Vertical scale} := \frac{100}{\text{Graph space}}$$

$$\frac{100\%}{5\ cm} = 20\%$$

Hence; VS; 1 cm represents 20%
The percentage bar graph should be drawn accordingly as follow:-

**COCOA PURCHASE BY PROVINCES (1947/48 – 1950/51)**




Vertical scale; 1cm represents 20%

**Strengths of the percentage bar graph**

- It is useful graphical method for showing the values of more than one cases
- The data represented appear in a more simplified form as given in percentages.
- It is comparatively easier to assess the vertical scale to be used

**Setbacks of the percentage bar graph**

- It does not give the absolute values
- It needs high skill to interpret the graph

- It needs high skill to construct the graph
- A problem may arise in the selection of the varied textures of the proportional segments
- It consumes much time to be prepared.

**Population pyramid graph**

- It is a form of bar graph designed to show population distribution by age and sex. It **is a double bar chart showing the age sex structure of the population**. It consists of two sets of horizontal bars; one is for each sex showing either the p percentages or absolute numbers.

**Rules for drawing the population pyramid graph**

- It is a principle in drawing population pyramid; the number of male population illustrated by the left set of bars; while that of females by the right set of bars.
- The young population distribution is always at the bottom while that of old at the top.
- Usually the last age group should be left open handled because; some people may survive beyond 100 years and their number have been omitted.
- The bottom scale can be graduated as percentages or absolute numbers.
- If percentages are opted to be used; the total population of both combined sexes should be used to compute the percentages.
- After all the bars have been drawn, they can be shaded in one colour or separated colours for each sex.

**CONSTRUCTION OF THE POPULATION PYRAMID**

There are two techniques of drawing the horizontal bars of an age sex pyramid.
In the first technique, the bars are drawn proportionally to the actual population numbers (absolute values).
In the second technique, the bars are drawn to represent percentages.

| Age group | Male | Female | Total |
|---|---|---|---|
| 0 – 4 | 2291936 | 2242966 | 4534902 |
| 5-9 | 2000580 | 1962556 | 3963136 |
| 10-14 | 2034980 | 2003655 | 4038635 |
| 15-19 | 1681984 | 1721194 | 3403178 |
| 20-24 | 1328529 | 1504389 | 2832918 |

| | | | |
|---|---|---|---|
| 25-29 | 1094909 | 11664594 | 2259503 |
| 30-34 | 840692 | 845230 | 1685922 |
| 35-39 | 695263 | 723749 | 1419012 |
| 40-44 | 516502 | 516989 | 1033491 |
| 45-49 | 419841 | 418987 | 838828 |
| 50-54 | 344639 | 340167 | 684806 |
| 55-59 | 223691 | 236325 | 460016 |
| 60-64 | 194513 | 214715 | 409228 |
| 65-69 | 140969 | 160364 | 301333 |
| 70-74 | 118601 | 135524 | 254125 |
| 75-79 | 79166 | 81620 | 160786 |
| 80+ | 95300 | 121038 | 216338 |
| Age not stated | 103487 | 86956 | 190443 |
| All ages | 14205589 | 14481018 | 28686607 |

**The absolute value technique**

The following steps are followed when constructing a population pyramid using absolute values.

- Decide a suitable scale for the horizontal axis (baseline) by considering the values of the biggest and smallest age group, as well as the size of the paper on which the pyramid is to be drawn. Horizontal scale is determined as follows.

$$\boxed{\text{Horizontal scale} = \frac{\text{Highest value}}{\text{Graph space}}}$$

$$\frac{2291936}{6} = 381989.3 - 400{,}000$$

Hence by considering the data in the table, scale of 1cm to represent 400,000 people would be suitable.

- Choose a suitable scale for the vertical axis. This scale will determine how wide the bars will be and also the interval between the age groups. The width of the bars should not exceed 6mm otherwise the pyramid will look untidy.

· Take a clean graph paper and on it draw horizontal axis at least 3 cm from the bottom of the page. Draw two vertical axes of 1 cm apart and about 10 cm long, until they touch the horizontal axis.

· Where the vertical axes touch the horizontal axis, mark as zero. On the horizontal axis, and at intervals of 1cm from the zero mark on the both sides, mark of the values representing the female and male populations.

· In the middle column, fill in the age groups starting with the youngest at the bottom. The age groups should be within the width of the horizontal bars.

· Using the horizontal scale, and starting with the first age group for females, draw a bar from the vertical axis on the right hand side of the central column towards the right to represent the female population of that group. The scale chosen in step 1 above will determine the length of the bar.

· From the left hand side of the vertical axis, draw a bar representing the male population of the same age group. Steps 6 and 7 should be repeated for all the subsequent age group until the last one has been represented.

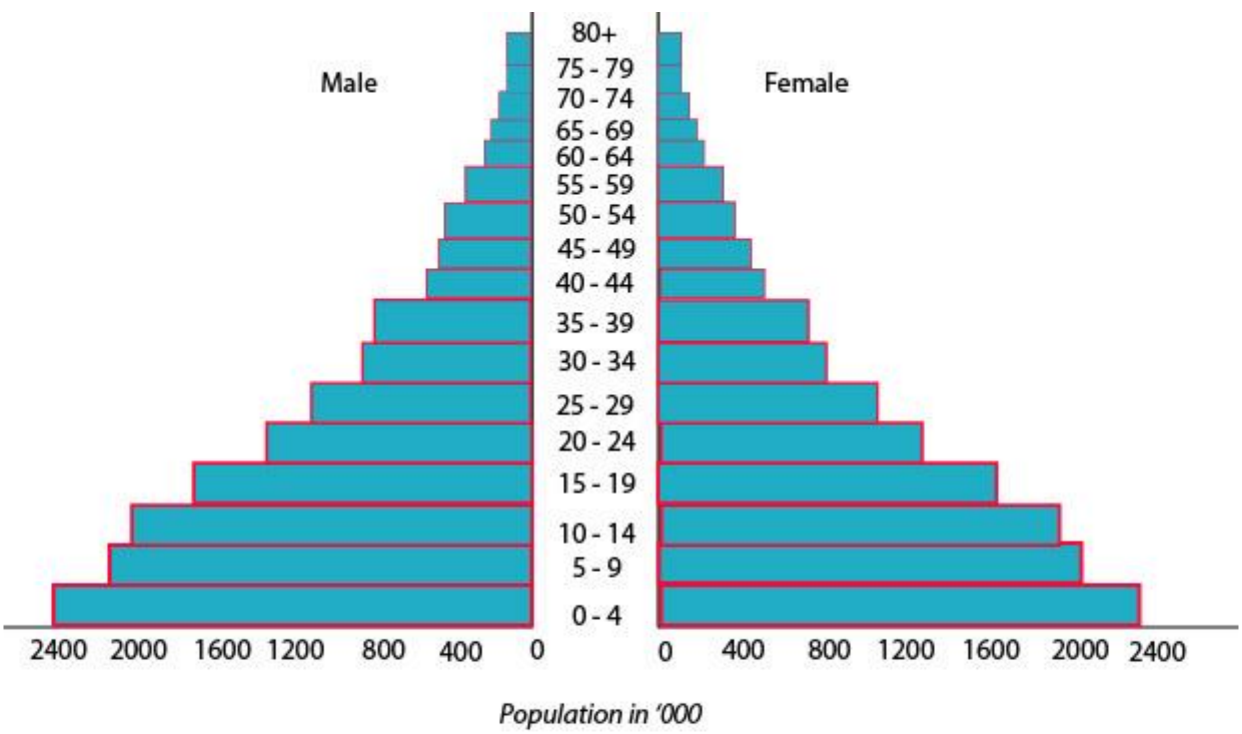



*Fig. 1.1 Kenya: Population by age and sex, 1999*

**The percentages technique**

By this technique, the values for population distribution by age and sex given in percentages. The percentages of each female or male group over the total populations is calculated from the absolute values in our example and a new set of data will be derived from data in the table. This new data will be used to draw the graph.

An example on how to calculate the percentage values is shown below.
The application for calculating the percentage is as follows.

$$\text{percentage value} = \frac{\text{Population}}{\text{Total population size}} \text{ x } 100\%$$

**For instance:**
The absolute values for the females aged between 0-4 years from the table is 2242 966, while that for males is 2291936. The total populations according to the 1999 census, was 28686607.
Therefore the percentage of females is as follows:-

$$\frac{2242966}{28686607} \text{ x } 100 = 7.8\%$$

The percentage of male is as follows:-

$$\frac{2291936}{28686607} \text{ x } 100 = 8.0\%$$

The worked out percentage values from the figure in the table are given in the table next page.

| Age Group | 5male | %female | Total |
|---|---|---|---|
| 1-4 | 8.0 | 7.8 | 15.8 |
| 5-9 | 7.0 | 6.8 | 13.8 |
| 10-14 | 7.1 | 7.0 | 14.1 |
| 15-19 | 5.9 | 6.0 | 11.9 |
| 20-24 | 4.6 | 5.2 | 9.8 |
| 25-29 | 3.8 | 4.1 | 7.9 |
| 30-34 | 2.9 | 2.9 | 5.8 |
| 35-39 | 2.4 | 2.5 | 4.9 |
| 40-44 | 1.8 | 1.8 | 3.6 |
| 45-49 | 1.5 | 1.5 | 3.0 |

| | | | |
|---|---|---|---|
| 50-54 | 1.2 | 1.2 | 2.4 |
| 55-59 | 0.8 | 0.8 | 1.6 |
| 60-64 | 0.7 | 0.7 | 1.4 |
| 65-69 | 0.5 | 0.6 | 1.1 |
| 70-74 | 0.4 | 0.5 | 0.9 |
| 75-79 | 0.3 | 0.3 | 0.6 |
| 80+ | 0.3 | 0.4 | 0.7 |

After the calculation of the percentages, the following steps should be taken to come up with the age – sex pyramid.

- Choose a suitable scale for the horizontal axis by considering the highest and the lowest percentages in the table. According to the values I the table, a scale of 1cm is representing 1% would be suitable.

- Follow step 2 and 3 as outlined under the absolute values techniques discussed earlier.

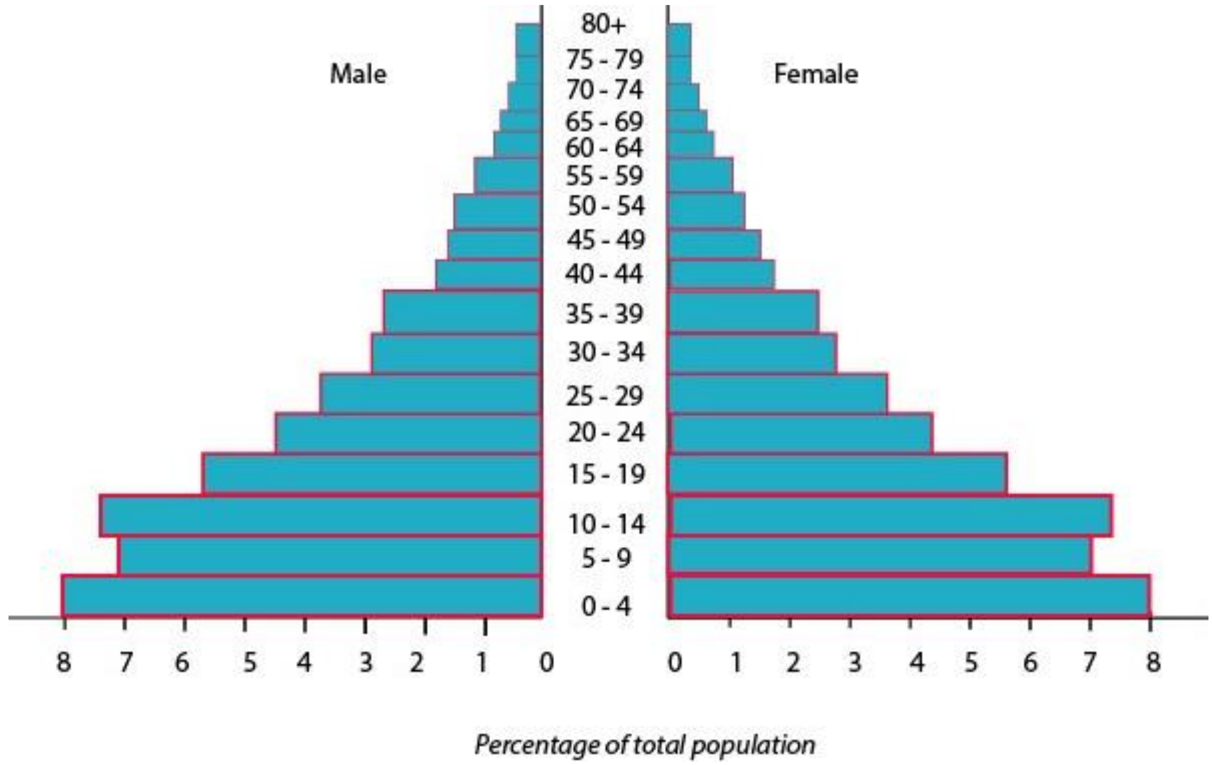
- Where the vertical axis touch the horizontal axis, mark zero and at intervals of 1cm, mark of the percentage value towards the right for females, and towards left for the males.

- The age group should be indicated in the middle column just as we did when constructing an age sex pyramid using absolute values..

- Using the horizontal scale and starting with age group 0-4 draw a bar on the right hand side to represent the percentage values of the female population in this age group. In our example, the percentage is 7.8 Draw a similar bar on the left hand side to represent the value of the male population, which in our case is 0.8.

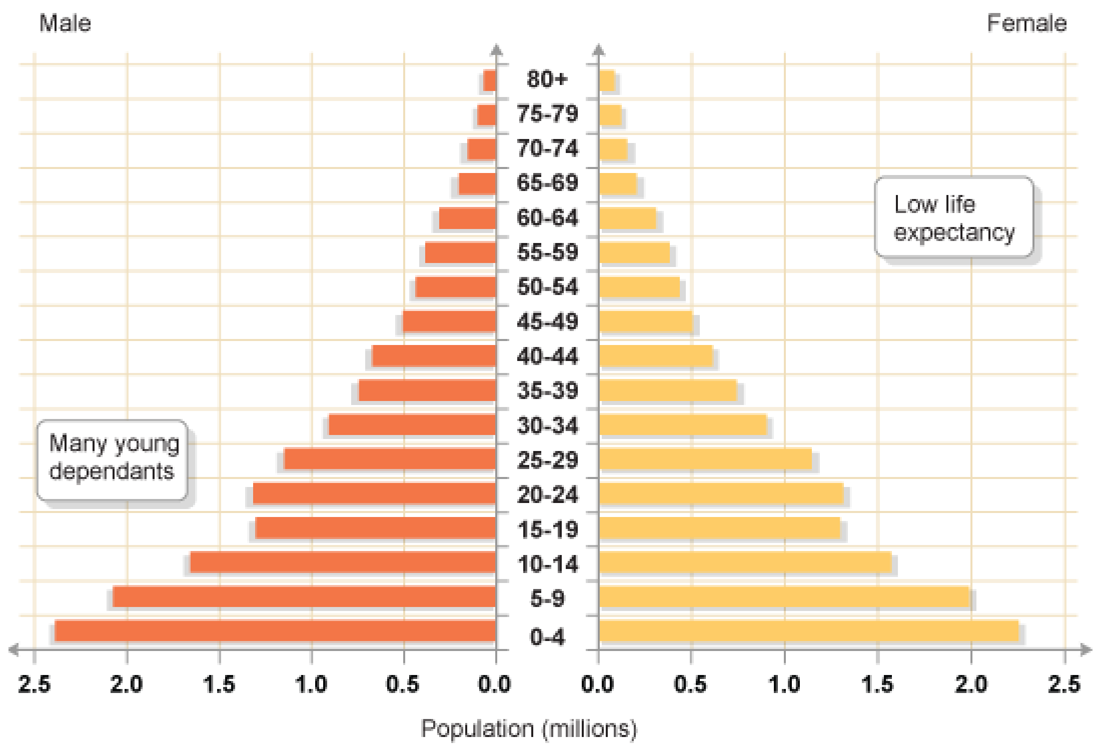
- Draw bars to represent all the age groups follow steps 9 and 10 under the absolute value technique to complete the pyramid.

**Kenya population by age:**




**Note**

Pyramid may also be for the purpose of making comparison either in terms of time or location. This can be by means of a double combined population pyramid. The double combined population pyramid looks as follows.




**Advantages of the age-sex pyramid**

· It is visually attractive method of presenting data.

· A variety of information is shown on the same graph. The details include; age, sex and number of people.

· It can be used to compare the age sex structure of number of countries

· It gives a clear picture and summary of the population composition of a country.

**Disadvantages of the age-sex pyramid**

· It is tedious to construct because it involves many values.

· It is difficult to tell the exact values represented because of the small scale of the horizontal axis.

· Reasons for the differences in population numbers cannot be obtained from the graph directly. Therefore additional information has to be thought from elsewhere.

**COMBINED BAR AND LINE GRAPH**

It is a form statistical graph designed to have both bars and line to show two attributes whose values appear in varied unit. It is basically employed to show the values of rainfall and temperature

together in a year.
In the graph, the bars used to illustrate the values on amount of rainfall in mm or inch, while the line is used to illustrate the values on amount of temperature in $^0$C or $^0$F. This is also known as **climo graph**.

**Construction of the bar and line graph**

Consider the following climatic data for Dar-win weather station Australia.

| Month | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temp °C | 28.9 | 27.8 | 28.9 | 29 | 26.7 | 26 | 25.1 | 26.4 | 28.1 | 29.7 | 29.8 | 29 |
| Rain(mm) | 388 | 330 | 246 | 114 | 17.8 | 5 | 2.5 | 2.5 | 12.7 | 53.3 | 132 | 261 |

**Procedure**

(i) Identification of the variables

- Dependent variable – Rain and temperature values
- Independent variable – Data (months).

Y - -axis – Rain and temperature values

X – axis………..months

(ii) Estimation of the vertical scale to be used

$$\text{Rainfall vertical scale} = \frac{\text{Highest value}}{\text{Graph space}}$$

$$\frac{388 \text{ cm}}{8 \text{ cm}} = 48.5 - 50 \text{ mm}$$

**Thus; the vertical scale for rainfall is 1cm to 50mm.**

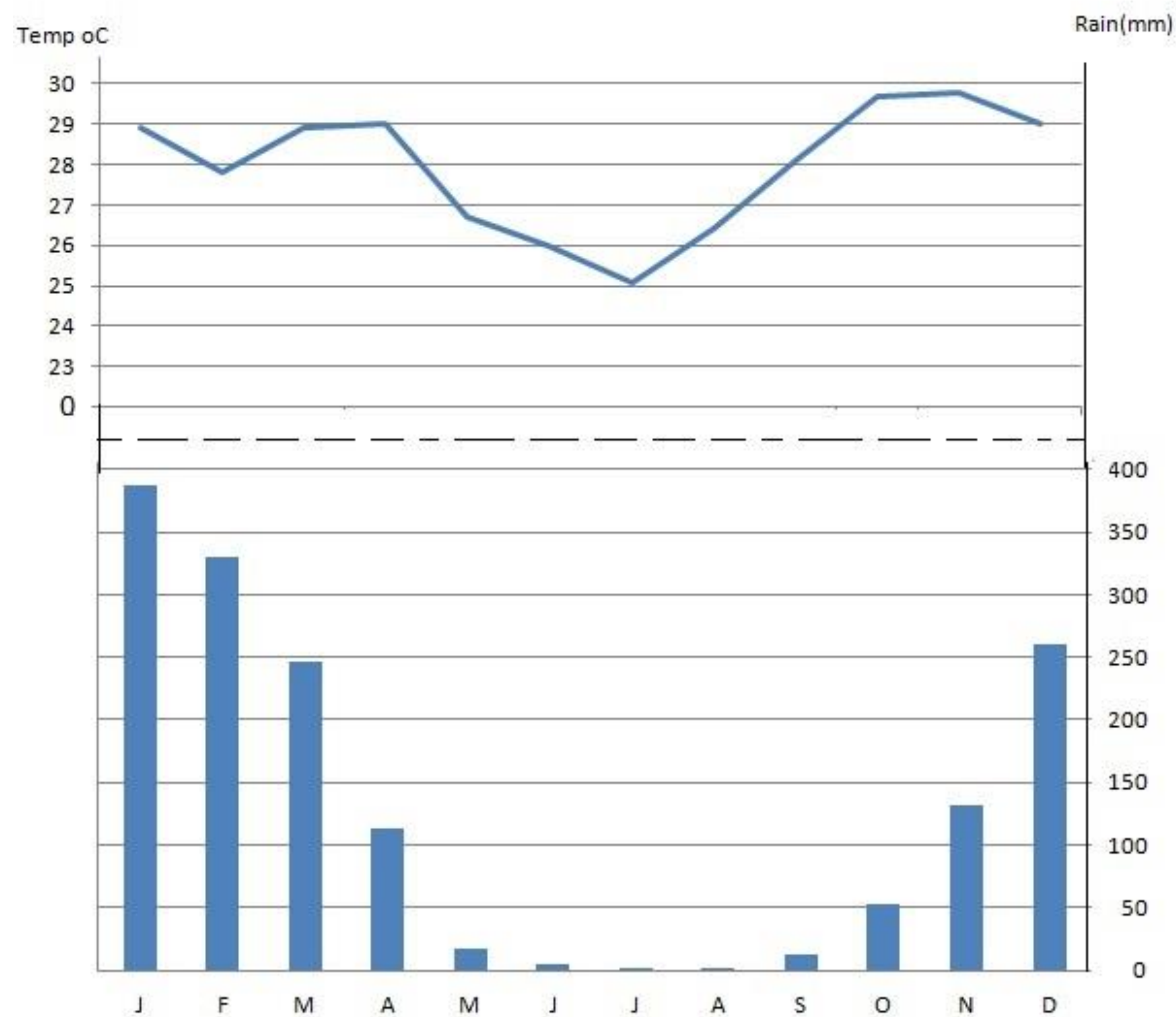
$$\text{Temperature vertical scale} = \frac{\text{Highest value}}{\text{Graph space}}$$

$$\frac{29.8\text{c}}{3 \text{ cm}} = 9.6 - 10$$

**Thus; the vertical scale for temperature is 1 cm to 10 c**

(iii) The graph has to be drawn as follows;

**CLIMATIC CONDITION FOR DARWIN AUSTRALIA**




**Strengths of the combined bar and line graph**

· It is useful graphical method for showing the distribution values of climate

· It is more illustrative, as it provides visual idea to the users in statistics.

· It allows the easy making of quantitative analysis

**Setbacks of the combined bar and line graph**

· It is more illustrative, as it provides visual idea to the users in statistics

· Needs high skill to make quantitative analysis from the graph

· It is time consuming graphical method in construction

· It needs high skill to construct the graph

. It is tedious as it involves mathematical calculation

**STATISTICAL MAPS**

As it has been introduced in the chapter one; the numerical data after to have been collected, summarized and analyzed; are presented to provide **pictorial view (visual idea).** One of the useful ways for representing the numerical facts is by maps. The method of maps is established with an emphasize of showing distribution values of phenomena of places over the earth's surface. Moreover; the places whose values to be shown on maps should lie adjacently to one another in such a way they can all appear on a similar map. It is thus; statistical **maps are the ones designed to show the values on spatial distribution of geographical events (phenomena).**

Or

**The maps designed to show spatial distribution of certain geographical events in quantitative manner and in turn allow quantitative analysis.**

The main useful statistical maps which allow quantitative analysis include the following.

· Choropleth maps

· Dot maps

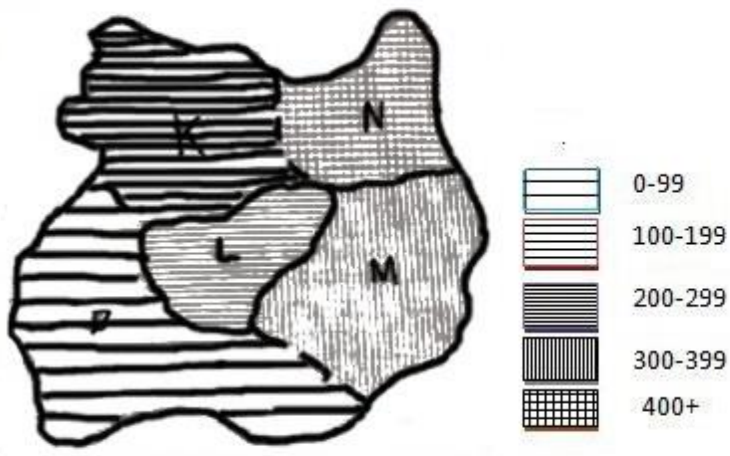
· Flow line maps

· Isopleths maps

**Choropleth maps**

These **are the statistical maps which use the system of varied shade textures to illustrate the density spatial distribution values of a certain phenomena for the places**. The maps mostly designed to show population density of places. On the map, places with similar shade texture have almost the same distribution density.

Eg.




**Construction of the choropleth map**

(i) Obtain the base map with suitable scale. The map should have the boundaries of administrative areas. The scale is used to asses the size of the administrative areas which then are related to the amount of distribution.

(ii) Obtain the data and summarize into the table. The tabled data should show clearly the names of administrative areas, area size and amount of distribution.

(iii) Determine the density values of distribution for areas

(iv) The worked densities should be grouped using regular interval. In this respect; more than one classes should be selected and all should have the worked densities. It is also important that; the classes should not be numerous.

**Example:-**

Use the following data to prepare the choropleth map:-

| **Province** | **Population** | **Land area (km$^2$)** |
|---|---|---|
| Nairobi | 2,143,254 | 696 |
| Central | 3,724,159 | 13,220 |
| Coast | 2,487,264 | 82,816 |
| Eastern | 4,631,779 | 153,473 |
| North Eastern | 962,143 | 128,124 |
| Nyanza | 4,392,196 | 12,547 |
| Rift valley | 6,987,036 | 182,539 |

| | | |
|---|---|---|
| Western | 3,358,776 | 8,264 |

Calculation of the population densities for the regions.

$$\text{Population Density} = \frac{\text{Population size}}{\text{Area size}} \text{ then :}$$

$$\text{Nairobi} = \frac{2143254}{696} = 3079 \ \frac{\text{person}}{\text{Km}^2}$$

$$\text{Central} = \frac{3{,}724{,}159}{13220} = 282 \ \frac{\text{person}}{\text{Km}^2}$$

$$\text{Coast} = \frac{2{,}487{,}264}{82{,}816} = 30 \ \frac{\text{person}}{\text{Km}^2}$$

$$\text{Eastern} = \frac{4{,}631{,}779}{153{,}473} = 30 \ \frac{\text{person}}{\text{Km}^2}$$

$$\text{Northern Eastern} = \frac{962{,}143}{128{,}124} = 8 \ \frac{\text{person}}{\text{Km}^2}$$

$$\text{Nyanza} = \frac{4392196}{12547} = 350 \ \frac{\text{person}}{\text{Km}^2}$$

$$\text{Rift valley} = \frac{6{,}987{,}036}{182{,}539} = 38 \ \frac{\text{person}}{\text{Km}^2}$$

$$\text{Western} = \frac{3{,}358{,}776}{8{,}264} = 406 \ \frac{\text{person}}{\text{Km}^2}$$

The suggested interval is of 100 and thus; the groups include:- 0-99, 100-199, 200-299, 300-399, 400-499 and 500.

With regards to the groups, the choropleth map appears as follows:

**KENYA: DENSITY POPULATION BY PROVINCE 1999**


**Advantages of the choropleth map**

- It is most suited to show distribution values of a certain geographical phenomena in relation to area size i.e. It is the most suited to show densities over space.
- The data can be analyzed quantitatively from the map
- It provides visual idea (impression) to people on varied densities of distribution.

**The disadvantages of choropleth map**

- The shades indicated on the map remove the political boundaries
- It is tedious enough in construction as it involves many values. i.e. preparation consumes much time.
- If no topographical map provided the map may give wrong picture about the distribution of the phenomena.
- Problem may occur in deciding the varied shade textures to be used on the map.
- The map might be realized to show abrupt change of distribution area to area some thing which is not realistic

· It is not possible to obtain absolute values or exact densities from the map because the shades represent categories of densities.

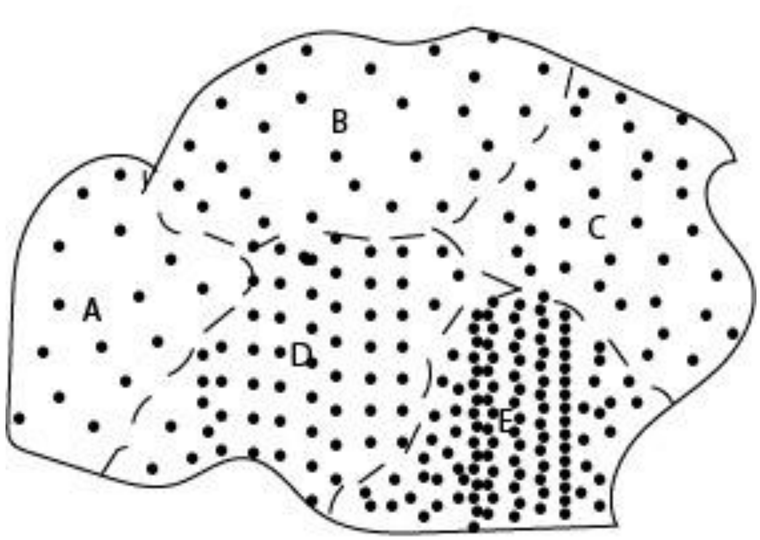
· It is not possible to insert additional details on the map.

**Dot maps**

Dot map is a **considerable form of statistical map which involves the use of fixed size dots to show the spatial distribution of a certain geographical phenomena like people, cattle etc.**

Or

**A map which shows the spatial distribution numerical quantities using dots**. A dot is a simplest symbol used in representing quantities on maps. A dot represents fixed amount similarly to others.




**Construction of a dot map**

(a) Take into consideration the base map given. The base map should have the clear boundaries of the administrative areas.

(b) Obtain the data and summarize into a table. The tabled data should show the names of administrative areas and their amount of distribution for the phenomena.

(c) Make decision on dot value. In this, it is important for the dot value should not be too small or too large. With too large dot value, there is a possibility for the regions with small amount of distribution to lack dots and thus; may impress that, the areas less occupied. If too small dot value chosen, may cause a problem of dots overlapping. It is thus; the dot value should be reasonable.

(d) Determine the number of dots to be allocated in the administrative areas on the map. It is by diving the amount of distribution to dot value.

(e) Insert the dots on the map accordingly. It is important for all dots to have the same size and evenly distributed.

**Example:-**

| **Province** | **Population** |
|---|---|
| Nairobi | 2,143,254 |
| Nairobi | 2,143,254 |
| Central | 3,724,159 |
| Coast | 2,487,264 |
| Eastern | 4,631,779 |
| North Eastern | 962,143 |
| Nyanza | 4,392,196 |
| Rift valley | 6,987,036 |
| Western | 3,358,776 |

Procedure:-

(i) Dot value determination

According to the given data; 1 dot represents 100,000 people

(ii) Number of dots determination

$$\text{Number of Dots} = \frac{\text{Amount of Distribution}}{\text{Dot value}}$$

$$\text{Nairobi} = \frac{2143254}{100000} = 21 \text{ dots}$$

$$\text{Central} = \frac{3,724,159}{100000} = 37 \text{ dots}$$

$$\text{Coast} = \frac{2,487,264}{100000} = 25 \text{ dots}$$

$$\text{Eastern} = \frac{4,631,779}{100000} = 46 \text{ dots}$$

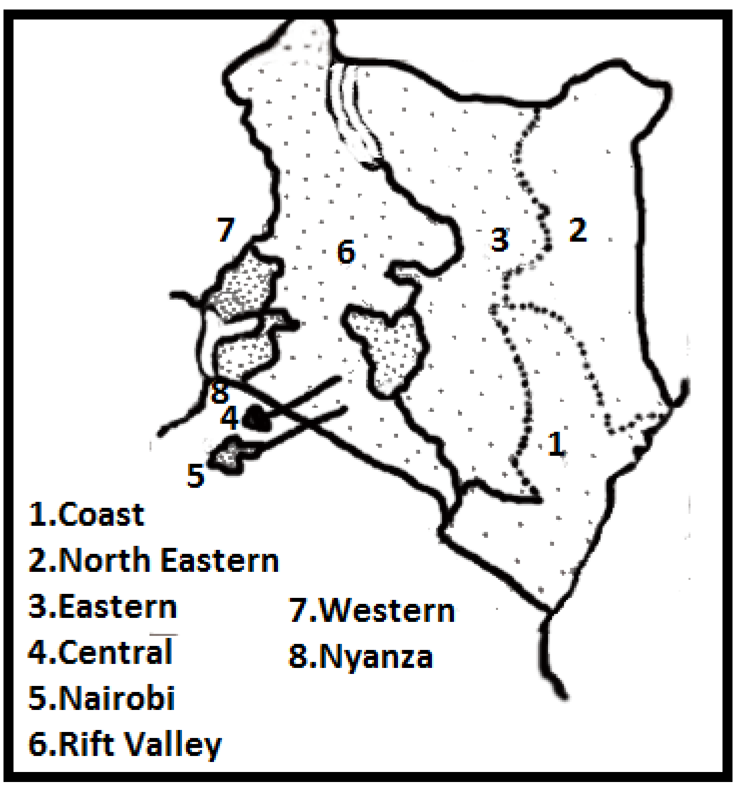
$$\text{Northern Eastern} = \frac{962,143}{100000} = 10 \text{ dots}$$

$$\text{Nyanza} = \frac{4392196}{100000} = 44 \text{ dots}$$

$$\text{Rift valley} = \frac{6,987,036}{100000} = 70 \text{ dots}$$

$$\text{Western} = \frac{3,358,776}{100000} = 34 \text{ dots}$$

KENYA:POPULATION BY PROVINCES 1999 (* 100,000 people).




*Fg. 1.3 Kenya: Population by provinces, 1999 (100,000 people)*

**Advantages of dot maps**

· The data can be analyzed quantitatively from the map.

· It is easy to get the amount of distribution of each area by considering the number of dots present and the dot value.

· Preparation of the map is fairly easy

· The map provides visual impression

· They are the most widely used statistical maps for showing distribution.

**Disadvantages of dot maps**

· The map is facing a problem of double counting during of making quantitative analysis. This give wrong quantitative picture.

· If no topographical map provided, the map may give wrong picture about the distribution of the phenomena

· With larger or smaller dot values, problem may occur in representing distribution on the map.

· Fractional values may not be represented on the map

· Drawing many dots of uniform size is difficult. Special pens may be needed for this purpose.

**FLOW LINE MAPS**

These are the maps which illustrate the volume of goods or number of vehicles, people, cattle e.t.c. moving between points or areas along established routes of like roads, railways, canals, or air and sea routes.

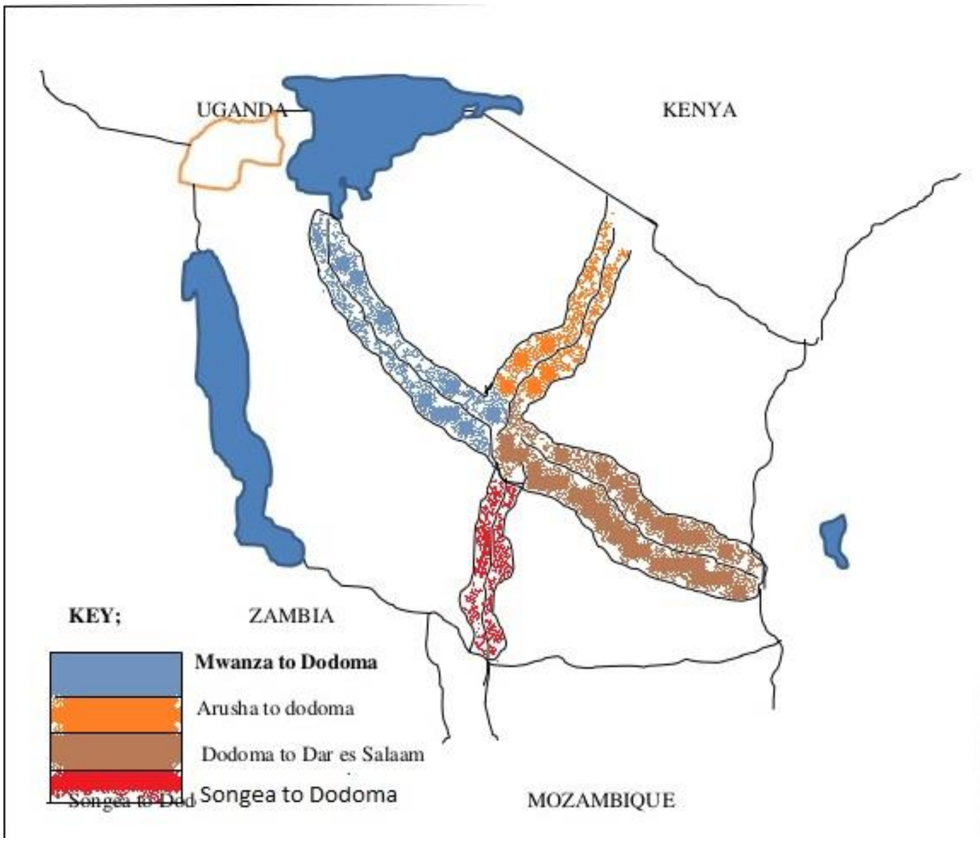
Or

A statistical map designed to show the movement of the geographical phenomena from one place to another through an established route way of like road, railway, water way, airway and others.

With the flow line map, a line shows the direction of the movement; while, the amount of movement is by varied width line. The character of the movement can be by varied shade textures or colours.

It has to be noted that; the direction of the movement and the distance involved have no significance as far as quantities are concern.

E.g.




**Construction of the flow line map**

(a) Draw the base map of route ways

(b) Asses the data given. The data should have names and amount of movement between the check points (stations) along the route way.

(c) Decide the width scale value. This has to take into consideration the highest and lowest values. It is much better to avoid too large or too small scale values. Too large scale values makes very fine flow lines and too small scale value may result into wider flow lines.

(d) With respect to the decided scale, draw the flow lines along the routes on the map.

**Example:-**

Use the data and map given, to show the amount of movement of the passengers between the check points along the route ways.

| CHECK POINTS | PASSENGERS |
|---|---|

| | |
|---|---|
| A - B | 10,000 |
| B - C | 8,000 |
| B - D | 7,000 |
| B - E | 7,000 |
| E - F | 3,000 |
| E - G | 2,000 |

**Procedure**

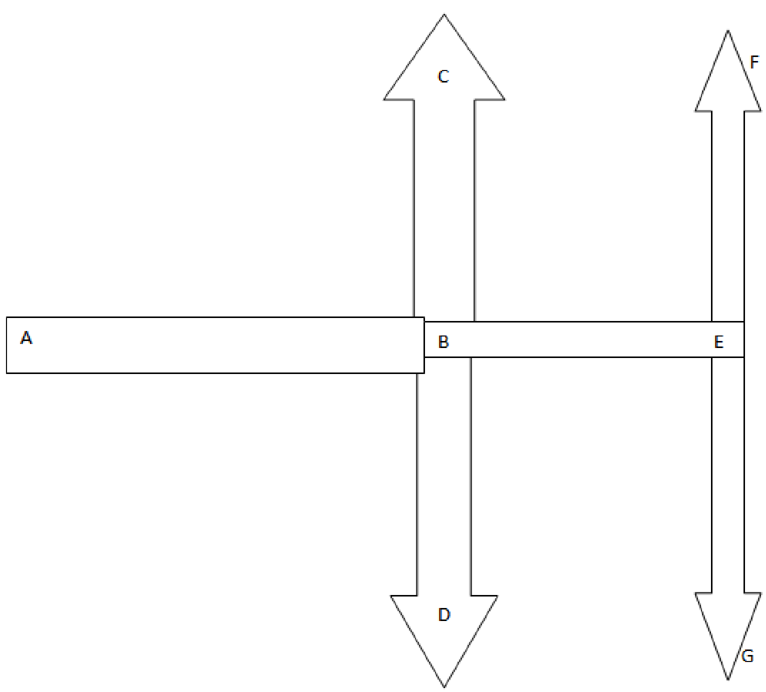
Scale value determination:

$$\text{Value Scale} = \frac{\text{Highest value}}{\text{Highest flow line width}}$$

$$\frac{100000}{1\text{ cm}} = 100{,}000$$

Thus; along the flow line; 1mm represents 1,000

The flow lien map for the data given appears as follows.



**Advantages of the flow line map**

- The map is most useful for showing the amount (volume) of movement between the check points along the route ways.
- The data from the map can be quantitatively analyzed by regarding the width of the flow lines and the value scale.
- It provides visual impression to people
- Calculation and drawing of it is fairly easy once the scale value has been decided.

**Disadvantages of the flow line map**

- Wide variation between the highest and the lowest values given difficult to assess the scale value
- The volume (amount) of movement cannot be exactly analyzed from the map.
- Difficult may arise in drawing the double flow lines
- The very small values always are not accurately represented on the map.

**ISOPLETH MAPS**

It is form of statistical map which uses the system of lines to show amount of distribution of phenomena. The lines on the map are drawn to connect points of equal values and the lines are called isolines.

Isopleths maps are also called isoline map, isarithm map and isometric map.

Examples of isopleths maps include; relief map by contours, meteorological maps showing atmospheric pressure, rainfall, temperature, etc. and maps which show depth of water bodies.

The isolines established on the isopleths map have special terms for specialized purposes.

- Isotherms - Temperature
- Isobars – Atmospheric pressure
- Isohyets – Rainfall
- Isoneph – cloudiness
- Isobaths ocean depth

· Isohaline – salinity

**Construction of the Isopleths maps**

1. Obtain the outline base map and the appropriate data and mark in the points and their values in pencil on the map.

2. Decide the interval to be used

3. Select the critical values. These are the ones which correspond (match) with the chosen interval.

4. Join the critical values with smooth lines according the chosen interval.

**Advantages of isopleth map**

1. It provides good visual impression if it is well presented
2. It is useful for showing distribution of phenomenon particularly climate.
3 The map preparation is fairly easy.
4. It can be analysed qualitatively

**Disadvantage of isopleth map**

1 .It is time consuming in preparation especially drawing
2. It is difficulty to quantify the data presented
3.It needs high skills to interpret data presented

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**THE DYNAMIC-EARTH AND CONSEQUENCE**

**<u>THEORIES</u>**
**THEORY OF ISOSTASY**

Denudation has been going on the continents where tons and tons of materials are removed from mountains and hills and get deposited in ocean; but the hill of mountains are not reduced to the sea level.

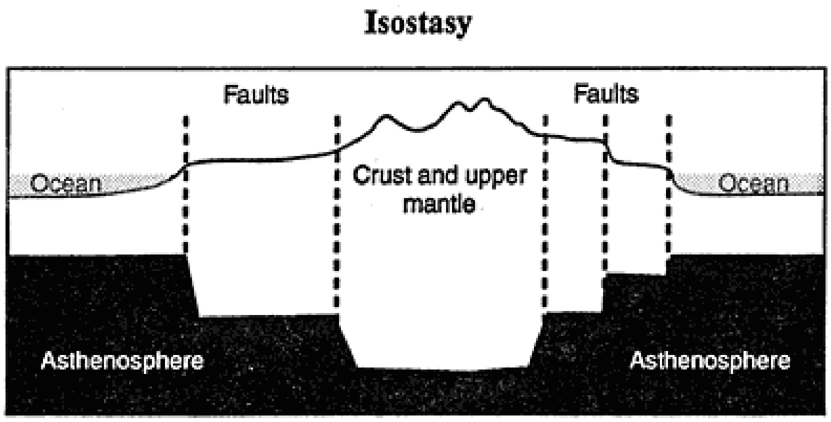
**<u>WHY THIS IS SO?</u>**

The phenomena can be explained by the theory of Isostasy.

Origin of the term is Greek; Made of 2 words meaning 'Equal standing' is a state of equilibrium or balance in the earth's crust with equal mass underline equal surface area. Therefore there is a state of equilibrium.

*The theory suggest that the continents and their major features are maintained in a sort of equilibrium or are moving towards that equilibrium.*

**ISOSTATIC EQUILIBRIUM**




**Isostatic equilibrium can be disturbed**

How? Processes on the surface of the continents.

1) **Denudation**

-Weathering/mass wasting, transportation, and erosion.e.g removal of material which lower the surface.

2) **Deposition** -Building up process (rising of the land)

3) **Accumulation** of ice masses and melting of ice masses.

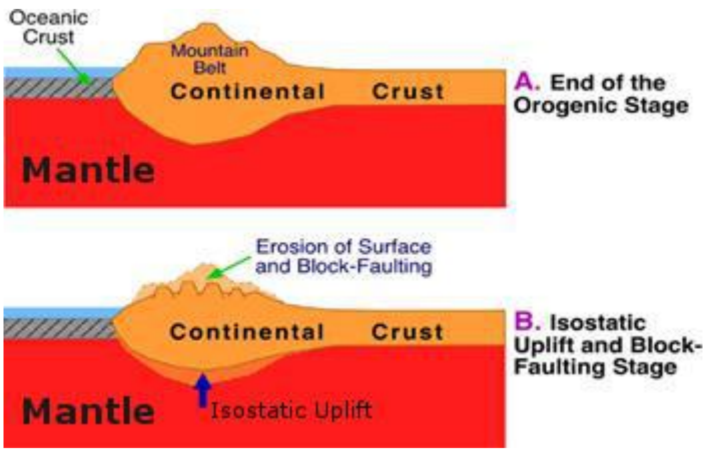
For example

When denudation removes the material from mountains there is pressure released, uplift occurs where the material is removed and there is no Isostatic balance.

If the material is deposited on the sea bed there is compression which result in sinking (vertical movements) these vertical movements causes horizontal movements of simatic material from there is compression has taken place to where there was pressure release

**In such process a state of equilibrium is restored.**

## EFFECT OF DISTURBANCE AT SURFACE AND READJUSTMENT OF ISOSTATIC EQUILIBRIUM




## EFFECTS OF DISTURBANCE OF ISOSTATIC EQUILIBRIUM

1. Earth quakes- Earth movements (gradual)

2. Subsidence +uplift (submerged coast /raised beaches)

3. Faulting -Result to rift valleys or block mountains, lift blocks

4. Fold- Fold Mountains

5. Volcanic eruptions forming different volcanic feature (volcano)

6. Displacement of lithosphere leading to plate tectonic

## Evidences of Isostatic movements

1. The depression of the crust in the northern part of America and Europe was due to the weight of ice sheets of vast thickness during the ice age.

2. After the melting these ice sheets, the crust has been rising.

Slowly for example, there are numerous former beaches that occur around the coast of Scandinavia. They now lie between 8m-30m above the present day beaches. These old beaches have been raised because of the uplift of the land.

3. The continental shelf around Antarctica is covered with water to a depth of about 750m compared with 180m around other continents.

4. The presence of Rias and Estuaries between the coast lands of Gambia and Sierra Leone.

5. The submergence of forests on the shores of Britain.

**IMPORTANCE OF THE THEORY**

1) It provides the knowledge on the dynamic state of the earth's crust that is the earth's crust is not static but it is always dynamic as it tends to balance itself after some disturbances with the influence of the gravitational force.

2) The analogy that the crust floats on the mantle, just like the iceberg floats on and the ocean or sea water, is so crucial in the understanding of the theories of plate tectonics and continental drift.

3) The theory also helps in deciphering (understanding) how different landforms were formed.

4) It also gives the basic for predicting the future of the crustal state at any particular place on the earth's surface.

5) It can also help human being in taking some precautions depending on the nature of the phenomena that might have been observed in the course of time, like the occurrence of ice sheets and melting of ice.

**2 THEORY OF CONTINENTAL DRIFT**

**There are 7 continents**

Origin of these continents

Propounders

- Francis Bacon (1620) Expanded earth
- F .B Taylor
- Alfred Wegener 1912.

According to his theory ,about 280 million years,the present day continents were united in a single block called Pangaea and sorrounded by ocean called Panthalassa.He believed that Pangaea was located near the South pole.Later Pangaea split into two (2)Super-continental i.e Gondwanaland(south Pole) and Laurasia(along the equator in the northern hemisphere).

These two Super-Continents were separated by a narrow water body i.e Tethys sea.He assert that

Laurasia split to form present day N.America,Asia,Europe,and numerous landmasses found in northern Hemisphere-Greenland,Iceland and United Kingdom.

Gondwanaland split to give present day Africa,S.America,Australia and Indian sub-continent,Antarctica and other islands in the southern Hemisphere.

**Drift:**

Since that time the continents have been drifting apart to occupy their present positions. And the drifting is a very slow one about 2cm per year. The drifting is still in progress.

**Evidence to support Wegeners theory of Continental Drift**

1. ***Structural evidence ( Jig saw fit)***

   If the continents were to be brought together it will form one single landmass called Pangaea. Hence proves that all the continents come from one land mass. For example S. America could fit into Africa, N. America into Europe, Antarctica, Australia, India and Malagarasy formed in a single landmass with S. America.

2. ***Geological evidence :***

Similar rock types in the coastal margin of the continents for example if you take the rocks of west Africa coastal margin and those of Eastern coast Brazil coastal margin the rocks will be the same (similar ) These rocks where one before the split. (Similar type, age, structure, formation)

**3. *Biological evidence :***

The study of earlier life in sedimentary rocks. That reveals life similar fossils of different time where found in different places. Similar animals, plants and e.g. .These fossils are found in all continents hence prove that they all come from one landmass

4. ***Geomorphologic evidence:***

Structure of mountains ( fold mountains) e.g. The Alps and Atlas have similar features and where also formed under similar conditions, type of rocks the mountain case, structure, alignment and were formed when Africa moved north wards ending up colliding with the European continent. This gives evidence that the drifting movement took place.

5. ***Pale-climatic evidence:***

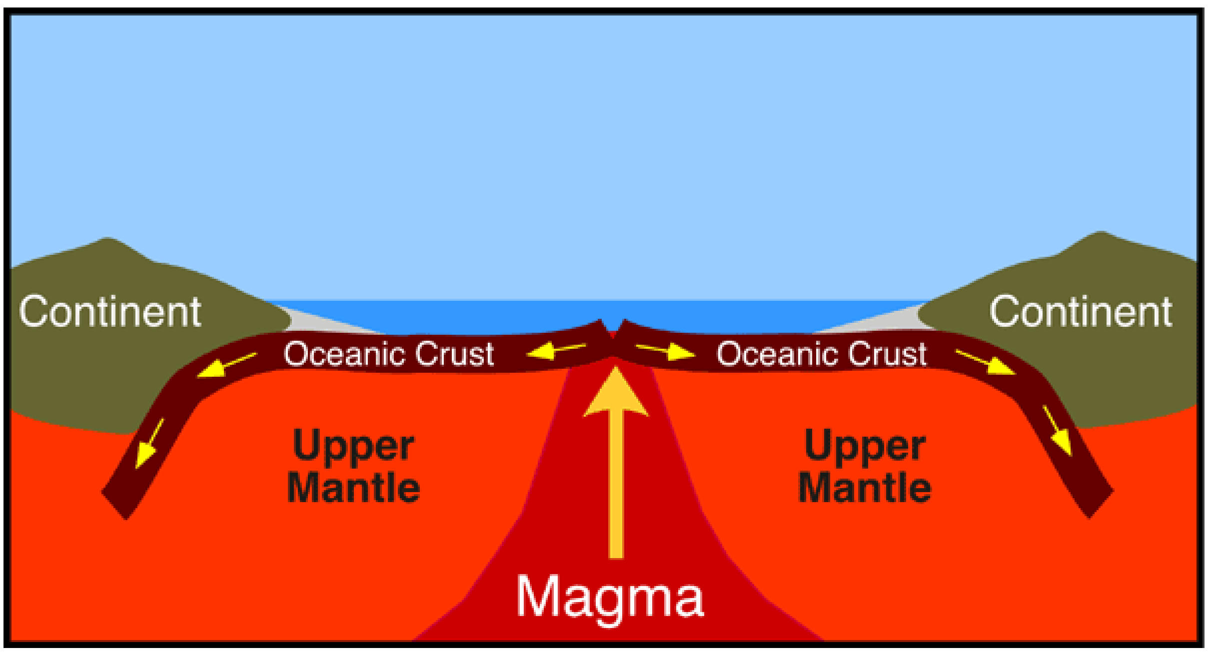
The discovery of ancient is in the Congo basin where the climate is warm is used as evidence that the Africa continent drifted from parts which were cold to the current warm parts. For example, Africa has been shifting north wards from the south likewise coal deposit found beneath Antarctic ice caps and Greenland show that they were deposit when the continents had not drifted led to those places when the climate coast warm. This is because the organisms that led to the formation of those deposits cannot east in areas where there is very low temp.

6. ***Paleo magnetism (palae-magnetic evidence).***

This is the most conclusive proof of the continental drift which was done through pale magnetic dating. When the rocks cooled they were magnetized in the same direction (magnetic North) but pale magnetic dating shows that rocks older than 200,000 years ago from different parts of the earth, have shifted their relative positions magnetic fields show new paths representing relative migration of the earth's materials

**This is evidence that the continents have drifted or have been drifting.**

7. ***Ocean floor spreading.***




***Weakness of Wegener / critiques of the theory***

1) He did not explain how the movement has occurred / the continental drift processes.

2) He was not a geologist but meteorologist hence he was criticized to have involved in the field where he was probably less informed.

3) Not all continents are able to fit exactly as argued in the jig-saw fit theory, but the theory does not account for this aspect.

4) Other scientists argue that the plant remains might have been spread by aspects like wind, blowing from one continent to another.

5) Wegner failed to explain the development of glacier in the hot arid Australia.

**4.2 PLATE TECTONIC THEORY (Unifying theory)**

It takes the combination of theory of theory of isostacy, continental drift and ocean floor spreading.

*According to this theory,the earth has an outer shell(lithosphere) made up of several rigid piece called tectonic plates.*

I) Geometrical part - The crust is made up of segment called plates, which are of various sizes, Large and small plates. pacific, N. American, Nazca, S. American, Africa, Indian, Antarctica plates

II) Moments- Movement of the plates. The plates are in motion. Either they are diverging or converging cause of movement – Convectional currents from the interior of the earth's especially aesthnosphere.

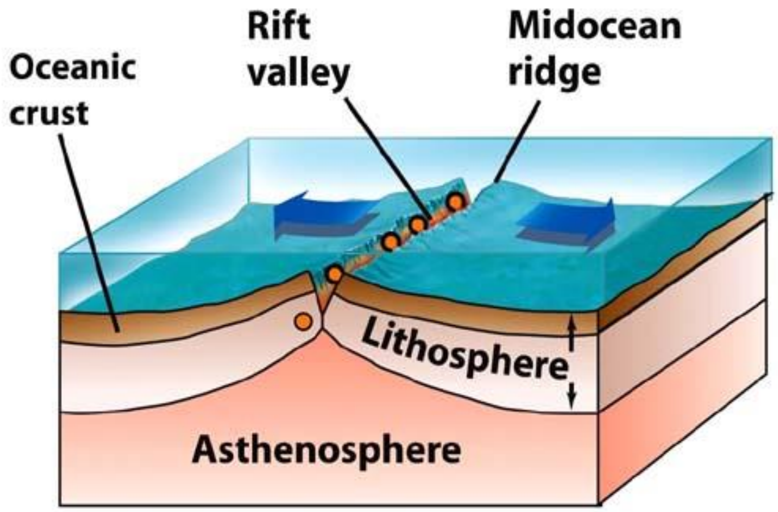
The movements can cause plates to collide or slide past one another. The rate of motion is very slow of the plates relative to one another 1cm to 2cm per year.

**TYPES OF PLATE BOUNDARIES:**

1) **Divergent boundary** - Is a boundary which is created when the plates are moving away from each other. This normally occurs in the ocean, where there are mid-oceanic ridges.

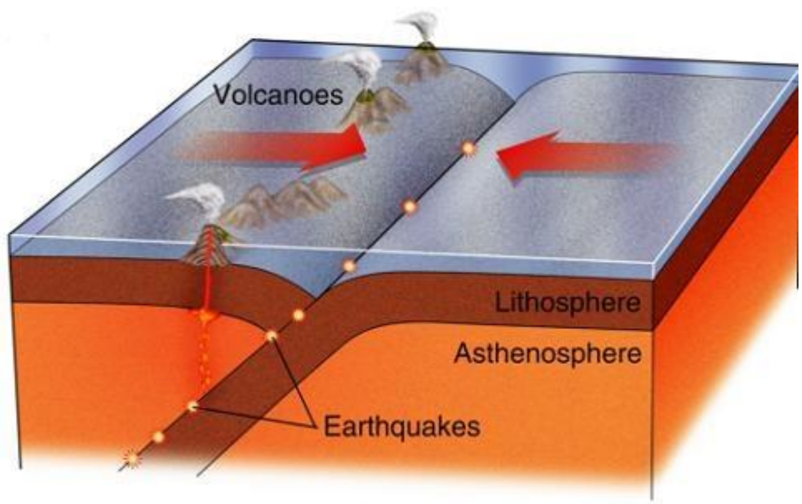
Example

- Mid Atlantic ridges
- Island Arcs ( volcanoes)
- Rift. valley Graben



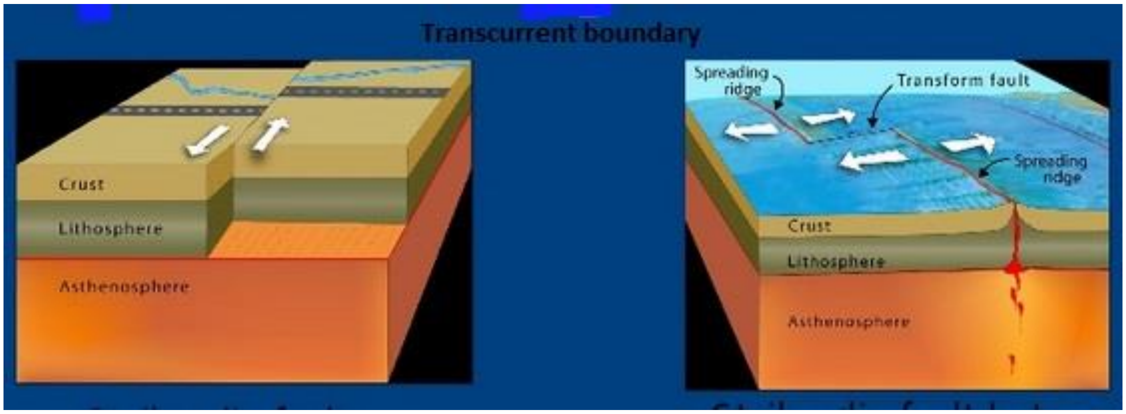
DIVERGENT BOUNDARY

2) **Convergent boundary** - Is boundary where by the plates are moving towards one another



Convergent boundary

3) **Neutral / trans current boundary-** This occurs when plates are sliding past one another. Normally occur on the Transform faults. (No uplift or submerge of the land (crust)




**MECHANISMS OF THE PLATE MOVEMENTS AND THE PLATE BOUNDARIES:**

Plates are either continental or oceanic.

Oceanic plates are simatic (denser).

Continental Plates are Sialic (light).

**CONVERGENT PLATE BOUNDARY**

i) **Continental and continental** - Both will go uplifted and result to folds and faults

ii) **Oceanic and continental** -The denser will down lift and lighter will uplift and may result to volcanic eruption and subduction result to trenches for the denser plate.

iii) **Oceanic and oceanic** - Convergent boundary ( subduction result to trenches both will move down)

Plate Tectonic Theory states that "The lithosphere is made up of rigid segments called the plates and the plates are in constant state of motion relative to one another"

**CAUSES OF MOVEMENTS**:

I) Convectional current - During mantle convection some materials rise due to the influence of radioactive heat generation and later moves laterally below the lithosphere. The lateral movements drag the lithosphere leading to the plate tectonic movements. On cooling the materials sink down to the lower level of the mantle where they melt again due to the constant motion of the plates

II )Upwelling of magma in the lines of weakness for example in the mid-oceanic ridges where by the magma is pushed out of the surface through the weak lines of the crust, in order to form a new crust. This may result to the cause of movements

III) Isostatic adjustment - May cause slight movement when trying to create balance.

IV) Cooling and heating of the crustal rocks -Expansion and contraction of rocks. The heat in the interior of the earth (mantle) causes rocks inside to expand and when the heat reduces, the rocks
cool. This process causes the rocks to crack hence leads to the disturbance of the crust and causes movements.

**EFFECTS OF PLATE MOVEMENT:**

Changes on the plate boundaries which are lines of weakness and on these boundaries, major landforms of the earth's surface are going to be formed.

**a) Diverging plates**

I) **Oceanic**

- Mid oceanic ridges
- Oceanic Islands
- Rifts e.g. Red sea

II)**Continental**

-Volcanic mountain

- Block mountains

-Rift valley

b) **Convergent plate boundary**- Collision may lead to subduction and uplift.

i) Oceanic - oceanic trends (Marianna trenches, Japan trenches )

ii) Oceanic and continental-Volcanic mountains on the coastal boundaries and also result into trenches.

iii) ( Continental )- Formation of Fold Mountains. Himalayas ( Indian and Russian plate formed)

c) **Neutral / Trans current boundary** - There is neither uplift nor seduction. There is lateral displacement of the plates. N. America, San Francisco - San Andrea's faults displacement of features of about 1000km.

The plate tectonic areas are areas of instabilities which results to earth quake, volcanoes.

**The theory of plate tectonic can help to explain almost all of the landforms on the surface of the earth.**

I. Deep sea Trenches: A sea trench is a long deep valley along an ocean floor.they form along a convergent destructive term of depth.the Mariana in the western Pacific with a depth of more than 36000ft.

II.Mid Oceanic Ridge: It refer to a giant undersea mountain range made up mostly basalt.It may be more than 80000km long and 1500 to 2500km wide and it may rise to 2.3km above the ocean floor.The feature is associated with a divergent plate boundary.As plate diverge,magma rises repeated and eventually cools to form the mid oceanic ridge.

**Example:** East Pacific as Nazea and Pacific diverges North Atlantic as North America diverges the Eurasian.

III.Island Arcs:Sometimes basalt eruption along the ridge or near may build up volcanoes that protrude above sea level to become *Oceanic Island*.They may vary in size.Example:Iceland,Japan,Hawaiian is lands, Mauna Loa,Easter Islands near the East Pacific ridge,west Indies.

IV. Magmatic Arc:It refers to island arcs at sea and belts of igneous activity on the edges of continents such as batholiths in mountain belts. Example:Aleutian Island.cascade volcanoes of the pacific North West,along Andes.

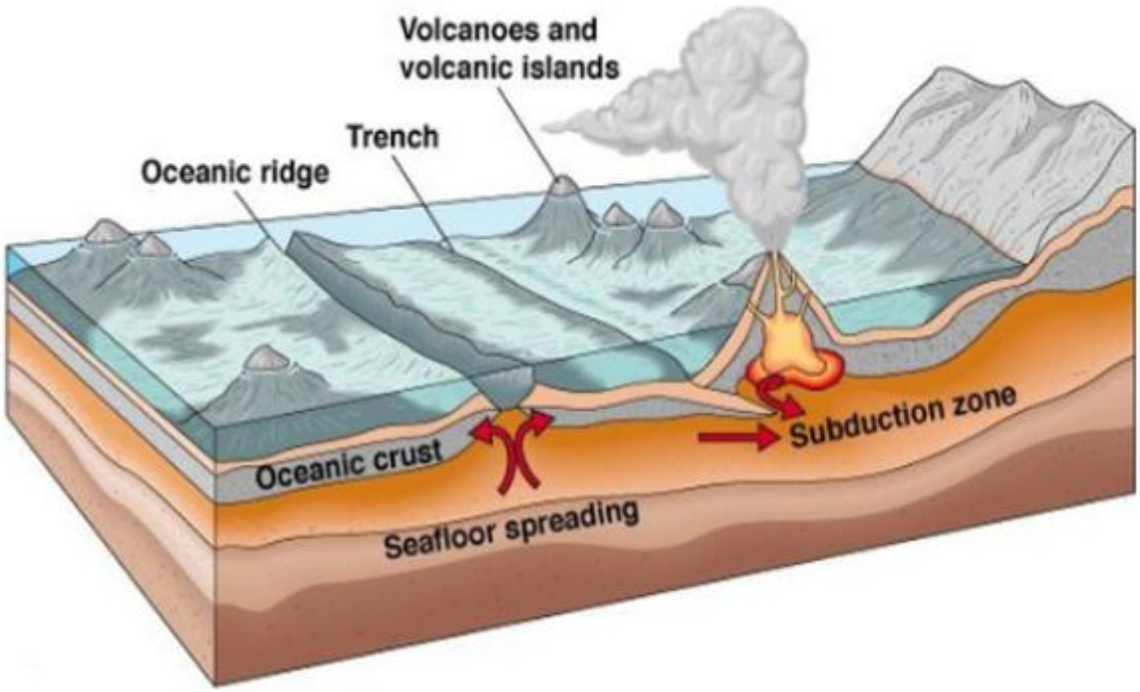
V. Mountain Belts:At a convergent collision boundary,the sea floor is denser and will be subducted making the ocean thinner and narrower hence collision of the continents.Eventually the oceanic lithosphere breaks off leaving the continental crumple to form mountain ranges.

The thick sequences of sedimentary rocks that had built upon both continental margins are intensively.**Example** The Himalayas as India collided lided, Alps as African and Europe ,Atlas in Northern Africa.In addition to that at a convergent destructive boundary,young mountain like the Andes form due to the folding of the young sediments.

VI.Rifting and associated features:At a passive divergent plate boundary ,the continental crust is stretched and thinned producing faulty landforms like the great *East Africa Rift Valley*.The faults may be path associated volcanic landforms.This may explain the volcanic landforms in the rifted areas of East Africa.

Due to thermal expansion emanating from rising mantle plume,it causes uplift of landscape.

VII.New Oceanic Crust:This is associated with a divergent plate margin where the would be gap is filled with the up welled magma to form a new oceanic crust.




**4.3 MATERIALS OF THE EARTH'S CRUST**

**What is an element?**

A substance which cannot be split into simple substances by physical or chemical means. Elements are made up of atoms. Atoms are made up of protons which are positive (+ve) charges, electron which have negative (-ve) charge and neutrons which do not have any charge

-Elements are about over 100 elements known so far

-About 90 elements exist naturally some elements exist naturally but they do not exist themselves they combine to form a compound (some exist independently which others are compound of more than one element.)

-Of the 90 element, 8 element are the most a bund and in the crystal rocks.

These are:

**Element**

1 .oxygen

2. Silicon

3. Aluminium

4. Iron

5. Calcium

6. Sodium

7. Potasium

8. Magnesium

**What is a mineral?**

-Is composed of atoms arranged in a specific order which is 3 dimensional (crystalline) in structure.

OR

-Are naturally occurring inorganic substance made up of elements or compounds which is 3 dimensional (crystalline) in structure.

**Properties of Minerals**

- Definite shape (crystalline)

- Is inorganic (naturally occurring substance)

- Minerals must be solid

- Made up of element or compound

**N.B: Only minerals which are inorganic are minerals. Coal is not a mineral because it is not inorganic.**

**IDENTIFICATION OF MINERALS**

**In the field:**

1) Its colour-Minerals have different colours

2) Luster -How a rock reflects the light. (Metallic luster they glitter and non-metallic luster are dull)

3) Streak -Powder which is obtained by rubbing the rock with a harder substance
For example: Iron will remove a darker streak than the colour of the iron .But if it is not a non-mineral, the streak will be lighter than the substance.

4) Cleavage -If break the rock it will split into definite shape (definite pattern) e.g. mica break into sheet pattern.

5) Crystalline - In 3 dimensional

6) Specific gravity- All mineral have higher specific gravity than water. $H_2O$ is $1g/cm^3$

7) Hardness -Minerals differ in hardness obtained through scratch test; there is a soft test & hardest test (Moh's scale hardness; 10 minerals starting from softest of hardest.)

**WHAT IS A ROCK?**

- Is a more or less uniform mass made up of grains of one or more mineral which is found naturally on the earth crust.

  - Are aggregates of minerals.

**ROCK CLASSIFICATION**

They can be classified according to :-

(a)Mode of formation
(b)Geological Age
(c)Structure

**A. ROCK CLASSIFICATION ACCORDING TO MODE OF FORMATION**

According to mode of formation/origin , rock can be classified as Igneous, Sedimentary and Metamorphic.

**1. IGNEOUS ROCKS:**

These are crustal rocks formed by cooling either within or outside of the earth's crust. (Formed by cooling and solidification of molten materials from the interior of the earth)molten materials can solidify intrusively or extrusive (endogenically or exogenically)when molten material are still within the earth crust they are referred as magma, and when reach the surface they are called lava. Examples; basalt granite, Quartzite, Gabbro cools and solidifies to form volcanic rock

***Igneous rock*** Is referred to as mother rock, due to the following reasons.

1) It is the rock from which other rock owes their origin. This means that other rocks are formed after some forces have operated on the igneous rock. Such forces are like **weathering process** which led to the formation of sedimentary rocks and metamorphic.

2) It forms the base for soil formation (pedogenesis) whose minerals composition, structure, texture and depth depend on the nature of the igneous rocks. E.g. soft igneous rocks, soil becomes deep and if a rock is hard the soil shallow.

3) The igneous rocks constitute the large proportion of the earth crust i.e.: 99%

***CLASSIFICATION OF IGNEOUS ROCKS***

1.) Extrusive rocks (volcanic) :

These are formed when the molten materials (lava) solidifies on the surface.

These rocks have small crystals because they cool fast due to exposure. Examples include

Basalt, Andesite, rhyolite, obsidian and etc.

2.) Intrusive rocks-

These are formed when the molten magma solidifies within the earth crust. They can be classified as hypabyssal igneous rocks, when they are formed near the earth's surface and plutonic igneous rocks when they are formed deep inside the crust.

***Categories of intrusive igneous rocks***

2(i) Hypabyssal igneous rocks-:

These are the rocks which are formed when magma cools and Solidifies inside but near the surface of the earth. They have medium size and examples are like granophyres, Porphyries, and dolerite. These can be exposed after erosion has taken place to form some rock masses like lopoliths and laccoliths which are usually hypabyssal. Basalt also quartz.

2(ii) Plutonic igneous rocks:

These have solidified deep in the crust and they are seen on the surface only after being exposed by prolonged erosion. Example granite, gabbro, pumice and peridotite.

## CLASSIFICATION OF IGNEOUS ROCKS BY THEIR CHEMICAL COMPOSITION

**Felsic (acidic)igneous rocks**:

Consist great amount of silica and feldspar with very little or no iron or any other metallic minerals examples are granite, granophyres, rhyolite, and obsidian. They are acidic in nature.

**Mafic (basic) igneous rocks:**

Consist of large amount of magnesium iron and other mineral like aluminium. They are basic in nature because of presence of metallic minerals e.g. gabbro, basalt

**Ultra-mafic(ultra basic):**

Consist of very large amount of metallic minerals like iron, magnesium and a little amount of silica less than 45% e.g. peridotite.

**Intermediate Igneous rocks** - With silica content between basic and acidic degree. That is, both acidic and basic oxides are in equal proportions. E.g. Diorite, Andesite.

## CHARACTERISTICS OF IGNEOUS ROCKS:

1) They are hard, they are semi precious.
2) They are formed by cooling and solidification of molten materials i.e. Magma or lava.
3) They differ in chemical composition depending on the amount of silica contained in them.
4) They are crystalline in nature (made of crystal)
5) They may undergo metamorphism to form metamorphic rocks.
6) They may undergo weathering process and sedimentation to form sedimentary rocks.

7) They contain minerals like iron, magnesium etc.

8) They don't have fossils; therefore they do not contain the remains of skeletons' of animals. Because they are made from the interior of the earth.

## 2.SEDIMENTARY ROCK:

Are rocks formed from sediments deposited either by water or by wind or by ice. These rocks are formed by the process of the sedimentation. (Deposition of accumulation and lithification of some weathered particles and other materials). The sediment were laid down in layers or strata, one on top of the other and in time these layers turned into rocks as they became hardened by compression. These are called stratified rock.

-The plane between two layers is called the bedding plane.

-The angle of the titled strata to the horizontals called the dip

All sedimentary rocks are non-crystalline and many contain fossils. Some sedimentary rocks are formed in water .e.g. Inorganic-Sandstone and mud stone; Organic-Chalk, limestone and coral, and peat and coal (formed in swamps). Some are formed on land e.g. boulder cay, moraines and loess (all inorganic).

Those formed in water developed from inorganic sediments some sedimentary rocks are formed chemically and not from sediments.

**There are three (3) types of sedimentary rocks;**

1) **Mechanically formed**;

These are the rocks which have been formed by compaction and these are also referred as classic rocks because they consist of fragments of rocks and rocks materials. Examples; clay, gravels and alluviums (all deposited by water), moraines, boulder clay and gravels (deposited by ice), and loess (deposited by wind).

2) **Organically formed**;

These rocks have been formed by the accumulation, consolidation and cementation of the remains of died organisms. They include calcareous rocks like limestone and chalks formed from the shells and skeletons. Coral reefs are so common along the East African coast. These are also carbonaceous rocks formed from plant and remains buried a thousand of years ago under heat and the overlying pressure, the plant remains turned into rocks. Example Coal.

Also there are siliceous rocks formed as the result of the remains of organisms like

Diatoms and radiolarians, whose skeletons are rich in silica, Example diatomite rocks.

Example; Chalk and Coral (formed from animals), and peat, coal and lignite (formed from Plants). Rocks formed from organic sediments which are plants and animals remains which accumulate, compact and cement.

3) **Chemically formed**; these are the rocks which formed by chemical process. They include the following:-

a**) Carbonates.** Like travertine found in the form of stalagmites and stalactites due to the precipitation of calcium bicarbonate, trona due to the hydration of sodium carbonate solution after the evaporation of water.

b) **Sulphate.** As the result of desiccation and evaporation. Rocks like gypsum, which are hydrated calcium sulphate, may be formed as result of rapid evaporation.

c) **Chlorides.** Which include rocks salt is formed due to evaporation.

d) **Silicates.** Which include flint, sinter and cherty are formed due to the accumulation of silica followed by its compaction.

e) **Iron stones.** Are formed when iron oxide is deposited under a water body and compressed. Examples of such rocks include limonite and haematite (red ferric oxide).

| MECHANICALLY FORMED | ORGANICALLY FORMED | CHEMICALLY FORMED |
|---|---|---|
| Shale | Lignite coal | Gypsum |
| Mudstone | Bituminous coal | Rock salt |
| Siltstone | Anthracite coal | Potash |
| Grit | Coral reef | Flint |
| | Limestone | Trona |
| | Chalk | Ironstone |

**CHARACTERISTICS OF SEDIMENTARY ROCKS**

1. They are stratified and young rock layers overlying the old rock layers.
2. They are non- crystalline.
3. They contain fossils as the result of the accumulation of skeletons and shells of once living organisms.
4. They may undergo changes to form metamorphic rocks, when they are influenced by pressure and or temperature.
5. They consist of some fragments, which were deposited and then cemented to form the rocks.
6. They are soft (not hard).

**3.METAMORPHIC ROCKS**

These are rocks which are formed when one type of rock changes form after having been subjected to either intense heat, pressure or both. Any rock may undergo changes to form metamorphic rocks e.g.

**Sedimentary rocks to metamorphic rocks are:-**

1. Sandstone to Quartzite
2. Limestone to Marble
3. Coal to Graphite
4. Shale or Clay to Slate.
5. Mudstone to Slate.

**Metamorphic to Metamorphic rocks**

1. Slate to Schist

**Igneous rock to metamorphic rock**

1. Augite to hornblende

2. Granite to gneiss.

**Causes of Metamorphism**

1. Great heat -High temp. Acting on the existing rock. E.g. Bricks there from mud, also the intrusive igneous rocks can change to metamorphism.

2. Pressure- Rock can be compressed to form other rock resulting from earth movements.

3. Chemical reaction.

4. Pressure + Temperature can form sedimentary rocks to change to metamorphic.

**Metamorphism** The process of changing the rock from either Igneous, Sedimentary or Metamorphic rock to metamorphic rock.

**Types of Metamorphism**

1) **Contact metamorphism** -Rock change by contact, e.g. Intrusive magma will affect other rock and form metamorphic rocks Localized because it is not extensive it only affects the rocks which surround it.

2) **Regional/ Dynamic Metamorphism** - Result from pressure of internal movement which will compress the rocks to change their form. They cover a large area.

3) **Thermal/dynamic Metamorphism** - Combination of heat and pressure which can combine and change the form of the rock.

**TYPES OF IGNEOUS ROCKS**

| TYPE | FORMED AT | RATE OF COOLING | CRYSTALLINE NATURE | EXAMPLES |
|---|---|---|---|---|
| VOLCANIC | The surface | Fast | Small Crystals | Basalt |
| | | | | Rhyolite |
| | | | | Trachyte |
| | | | | Andesite |

| | | | | |
|---|---|---|---|---|
| | Shallow | Medium | Medium | Quartz |
| **HYPABYSSAL** | Depth | | size Crystals | Porphyry |
| | | | | Dolerite |
| | Great | Slow | Large | Granite |
| **PLUTONIC** | depth | | Crystals | Syenite |
| | | | | Gabbro, diorite |
| | | | | Diorite |

**TYPES OF METAMORPHIC ROCK**

| Original rock | Metamorphic rock |
|---|---|
| Granite becomes | Gneiss |
| Sandstone | Quartzite |
| Clay | Slate |
| Shale | Schist |
| Limestone | Marble |

## Example of Metamorphism

| Rock type | category | Metamorphism | |
|---|---|---|---|
| 1. Granite | Igneous | → | Gne |
| 2. Limestone | Sedimentary | → | Mar |
| 3. Shale | Sedimentary | → | Schi |
| 4. Coal | Sedimentary | → | Grap |
| 5. Schist | Metamorphic | → | Sla |

## ROCK FORMING MINERALS

These are common minerals which make up large percentage of the rock of the earth's crust.

These rocks are **silicates.**

1) **Feldspar** - Most abundant of all minerals in rocks. There are 2 varieties

i. Orthoclase feldspar of complex chemical formula $KALSi_3O_8$ a compound of Potassium, Aluminum, and Silicate.

ii. Plagioclause feldspar which contains sodium or calcium instead of potassium as in orthoclase.

: . you have $NaALSi_3O_8$ or $CaAL_2Si_2O_8$ (plagioclase feldspar) e.g. Basic rock, basalt, gabbro

Feldspar have S.G (specific gravity) of 2.5g/cm$^3$

2. **Quartz** -Second most abundant

- Chemical formulate ($SiO_2$) Silicon dioxide

- Hardest common mineral

- S.G 2.7

- Has no cleavage

- Used for making concrete glass and as a semi precious stone.

3. **Mica.** Can be composed of many elements .e.g. aluminum, silicon, oxygen, iron, magnesium, hydrogen, or potassium.

-It is flat shiny rock most found in rocks like granite, gneiss or schist.

4. Carbonates: e.g. $CaCo_3$ found in limestone and marble (Dolomite) Camg $(co_3)_2$

5. Horn blend: Common rock forming mineral dark crystalline mass associated with igneous + metamorphic rocks.

- composed on calcium, iron and magnesium silicate.

6) Magnetite: (magnetic iron oxide) $Fe_3O_4$

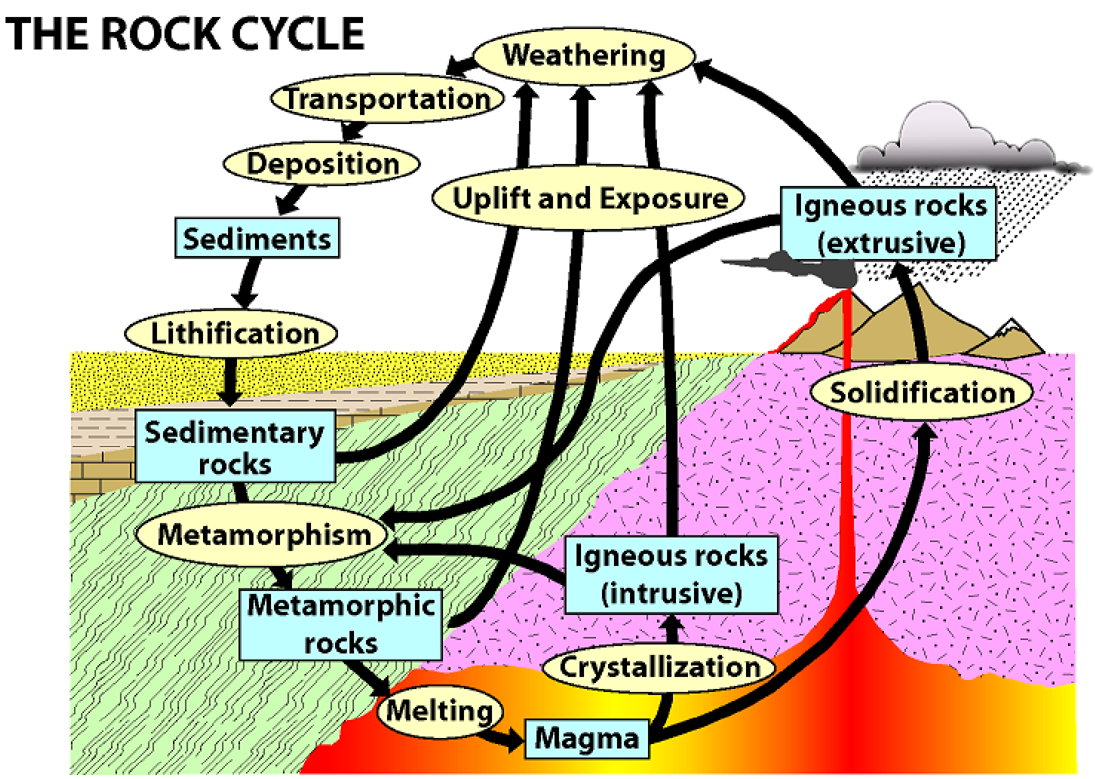
**ROCK CYCLE:**

Is the relationship in which rocks tend to change from one type of rock. For example, a rock can change from igneous rock to sedimentary or to metamorphic and then go back to igneous rock again.

**Processes in the rock cycle**

1. At first, the igneous rocks may be formed due to cooling and solidification of magma or lava.
2. Then igneous rock can be attacked by the weathering agents to form sediments which on being deposited and compacted may form sedimentary rocks.
3. Either igneous rocks or sedimentary rocks may undergo metamorphism due to the influence of either pressure or temperature or both to form metamorphic rocks.
4. Metamorphic rocks may undergo weathering and sedimentation to form sedimentary rocks.
5. Likewise, metamorphic rocks may undergo further metamorphism to form other more consolidated metamorphic rocks, like the change from slate to schist.
6. Lastly, rocks that are either sedimentary or metamorphic when subjected to very high temperature, they melt and on cooling form igneous rocks.

This process goes on repeatedly and is an endless process. No types of rock remain unchanged for a very long time.




**Igneous Rocks -**
Rocks that form from the cooling of motlen rock (magma), Example: granite and basalt

**Sedimentary Rocks -**
Rocks that are fromed from pieces of other rocks, Example: sandstone, or that are deposited from the ocean by chemical processes, Example: limestone

**Metamorphic Rocks -**
Rocks that are changed by heat and pressure without melting, Example: gneiss

## IMPORTANCE OF ROCK

1. Rocks are important in the formation of soil which is essential for agriculture and plants growth.

2. Storing underground water. Water is stored in the water the water holding stratum of impermeable rocks and can come out as spring.

3. Some rocks are used as fuel like coal and mineral oil.

4. Rocks are also used for building and construction. Rocks like limestone, sandstone e.t.c are used for building houses and roads construction. Limestone is used for manufacturing of cement.

5. Salt extraction. Various Salts are obtained from rocks occurring in some places. E.g. in Tunisia, Morocco there is large deposited.

6. Manufacturing of chemicals, some rocks have salts such as nitrates or phosphates while others have potash. These Salts are used for making dyes fertilizers and medicines. Gypsum is used for making the plaster of Paris and Sand is used for making glass.

7. Mineral deposits. Mineral ores occur in veins of some rocks such as rocks. These ores were formed when magma cooled, valuable mineral extracted from rocks include gold, lead, copper, tin silver, zinc, aluminium calcium and manganese.

8. Some rocks are so impressive such that they attract some tourists to come and view them. In doing so the country gets foreign currency. E.g. Coral reefs.

9. Some rocks such as marble are used in decorating floors of some important buildings such as banks e.t.c.

**How does metamorphism manifest (Shows) itself in rocks**

1) By foliation - where by the rock has a distinct grain shown by the alignment of mineral particles, usually resembling stratifications but often in wavy lines.

2) By cleavage – Which resembles foliation although the direction of cleavage may be quit independent of stratification

3) By the development of new materials which were not present in the unaltered rock; precious stones and valuable ores may be produced by metamorphism.

4) By the development of a crystalline structure- in rocks which were originally amorphous rocks.

5) By the change of rocks which had originally a crystalline structure in to amorphous rock; e.g. marble (metamorphosed limestone and chalk). Slate metamorphosed shales.

**B. CLASSIFICATION OF ROCKS BY GEOLOGICAL AGE**

Rocks can also be classified according to age

I. **Relative age.**

II. **Absolute age**

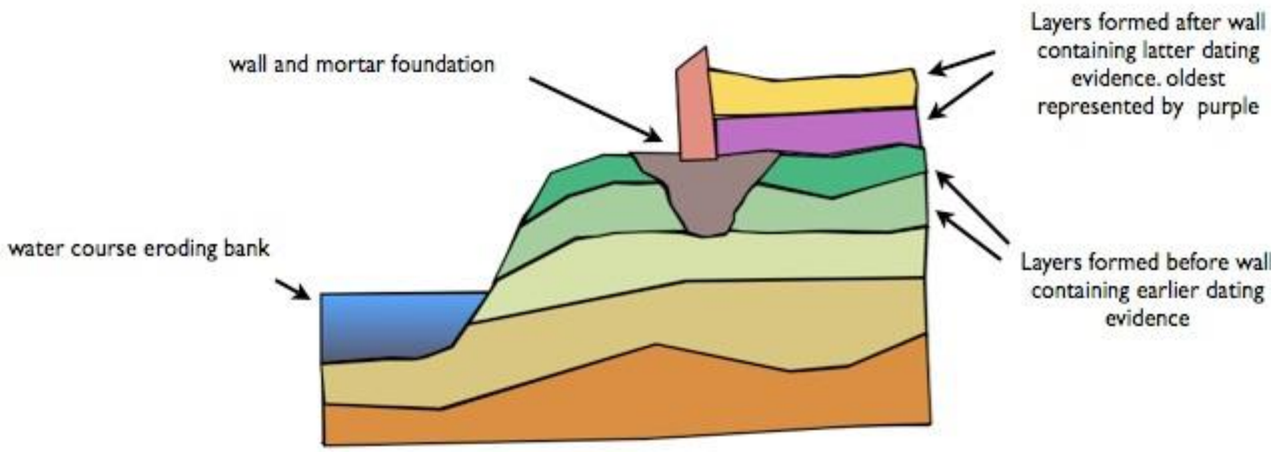
1) **RELATIVE AGE**

Sedimentary rocks only where by the age of rock is done through the deposition.

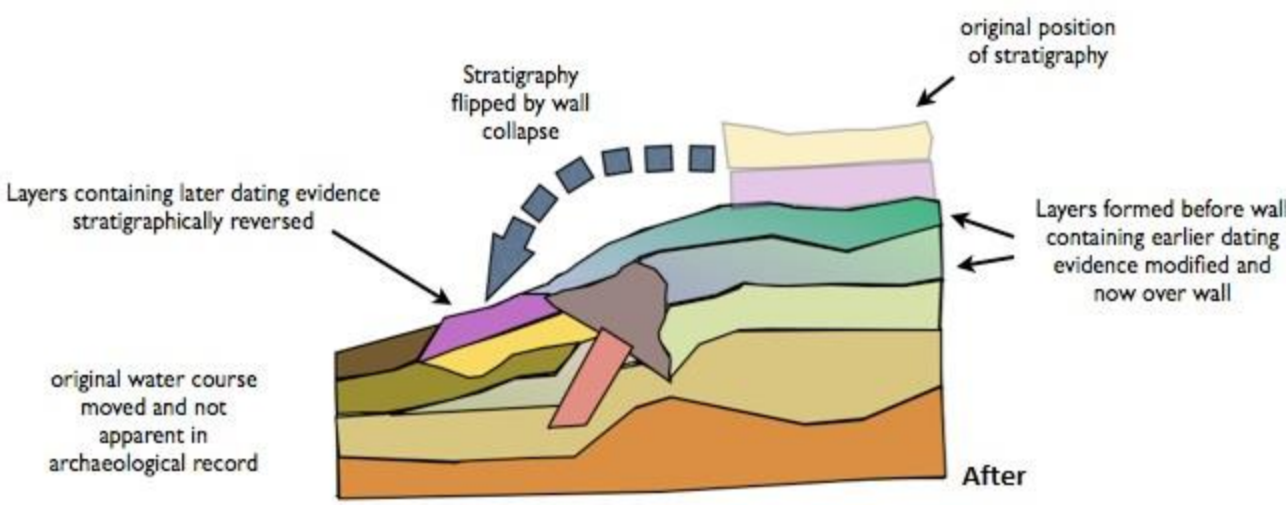
a)Stratigraphy- stratigraphical sequences

- Arrangement of rock layers (Law of superposition). The rocks which are below are the oldest and the above are the youngest (the new ones)

DIAGRAM Assume that the entire layer has deposit at the same time.




**before**




**After**

- This is only true where earth movement have not distorted the rock layers

b) **<u>Palaeontology</u>** -The study of earlier life as evident in sedimentary rocks. (Fossils)

- By studying with the earlier life brought about a **<u>GEOLOGICAL TIME SCALE</u>**

**What is a geological time scale?**

- Is a table dating in a chronological order the past events of the earth's history?

# Geologic Time Scale

| Era | System & Period | Series & Epoch | Some Distinctive Features | Years Before Present |
|---|---|---|---|---|
| CENOZOIC | Quaternary | Recent | Modern man. | 11,000 |
| | | Pleistocene | Early man; northern glaciation. | 1/2 to 2 million |
| | Tertiary | Pliocene | Large carnivores. | 13 + 1 million |
| | | Miocene | First abundant grazing mammals. | 25 + 1 million |
| | | Oligocene | Large running mammals. | 36 + 2 million |
| | | Eocene | Many modern types of mammals. | 58 + 2 million |
| | | Paleocene | First placental mammals. | 63 + 2 million |
| MESOZOIC | Cretaceous | | First flowering plants; climax of dinosaurs and ammonites, followed by Cretaceous-Tertiary extinction. | 135 + 5 million |
| | Jurassic | | First birds, first mammals dinosaurs and ammonites abundant. | 181 + 5 million |
| | Triassic | | First dinosaurs. Abundant cycads and conifers. | 230 + 10 million |
| PALEOZOIC | Permian | | Extinction of most kinds of marine animals, including trilobites. Southern glaciation. | 280 + 10 million |
| | Carboniferous | Pennsylvanian | Great coal forests, conifers. First reptiles. | 310 + 10 million |
| | | Mississippian | Sharks and amphibians abundant. Large and numerous scale trees and seed ferns. | 345 + 10 million |
| | Devonian | | First amphibians; ammonites; fishes abundant. | 405 + 10 million |
| | Silurian | | First terrestrial plants and animals. | 425 + 10 million |
| | Ordovician | | First fishes; invertebrates dominant. | 500 + 10 million |
| | Cambrian | | First abundant record of marine life; trilobites dominant. | 600 + 50 million |
| | Precambrian | | Fossils extremely rare, consisting of primitive aquatic plants. Evidence of glaciation. Oldest dated algae, over 2,600 million years; oldest dated meteorites 4,500 million years. | |

Note: m y = million years

- There a four ERA, Cainozoic, Mesozoic, Palaeozoic and Pre –Cambrian
- Each era ends with a geological evolution which is seen in rocks and conformists recognized through different rock formation and change in type of life as evidence in fossils.
- The eras are divided in periods and periods are subdivided into epoch and this is divided into series and formation.
- In ERA,PERIOD and EPOCH process occur at some time and way across the world
- Processes occurred before splitting of the continents started from series.
- Each ERA varies from another there is variation in time where by pre –Cambrian takes 70% of the GTS.
- Major geological event are affecting Africa continent mountains, building ,volcanism , glaciations and e.t.c
- GTS gives relative age of rock but do not give the exact years of the rock.

2) **<u>ABSOLUTE AGE OF ROCKS.</u>**

<u>Modern method of determining age of rocks radio metric dating</u>

- This method is based on radioactive element which when they produce heat and another new substance which we call **daughter element**.
- When the daughter element is produced the reaction of decaying stops.
- The rate of decomposition disintegration from parent element two daughter element is constant
- The new substance produced is used to calculate the age of the rock.
- The time taken for parent element to disintegrate to form daughter element is called <u>half life</u>

**Example:**

Uranium $\xrightarrow{\text{disintegrate}}$ lead

(Parent element) (Daughter element)

(Un stable) $U^{238} \longrightarrow Pb^{206}$ (stable)

$U^{(92 \text{ protons})} \longrightarrow Pb^{206}$

142 disintegration

-10 protons 82 protons

-22 neutrons 124 neutrons

(Half life)

- How is it used to find the age of rock.

It has been taken that 1gm of uranium yields 1 â^• 760,000,000 of lead a year.

.: A rock containing burn in it e.g. igneous rock and the weight of lead derived from it is found then age rock = (weight of lead â^• weight of uranium) x 7,600,000,000.

Example: lead – Uranium ratio in urinite crystal form pegmatite rock is 0.10

The age of that rock will be

0.10 x 7,600,000,000 = 760,000,000

Other elements used to determine the age of rocks.

| Isotope | Half life | Daughter element |
|---|---|---|
| 1. K – 40 | 1.3 billion years | Ar – 40 |
| 2. $U^{238}$ | 4.5 billion years | Pb – 206 |
| 3. $Rb^{87}$ | 49 billion of years | Sr – 87 |
| 4. $C^{14}$ | 5730 billions of years | $N - ^{14}$ |

- This method provide the absolute age of the rock.

- Give a critique on the geological time scale.

**<u>Importance of the Geological Time Scale</u>**

1. It depits the age of the rocks by showing the time when certain types of the rocks were formed and how were formed e.g. some were formed by glacial deposition while others were formed by volcanic eruption.

2. It also helps in understanding when and how different land forms were formed e.g. the mountains of different types like volcanic and Fold Mountains have been accounted for.

3. By studying the geological Time scale one is able to predict the occurrence of crystals deformation that are likely to take place e.g. by knowing that certain areas have old rocks one may conclude that faulting is likely to occurs in case any disturbance or stress.

4. Geological Time Scale also revel the life record for the plant and animals. This records help in understanding the relationship that exists between living things and the geological time scale process. Plants emerged when the soil had developed and animals came into existence when plants had already existed to provide food take on man emerged.

**Weaknesses**

1.The methods that were used in determining the age of the rocks were largely based on estimate due to the limited power of the instruments which were used

2. Another problem pertaining to age determination has been caused by crustal deformation like over folding, gaps caused by denudation (unconformities) and the intrusions of magma.

3. There are some modifications made locally in the geological time chart. For example unlike the former geological time chart the current shows that Cainozoic era include the quaternary period. Also some other authorities do not indicate the Paleocene period in their geological time chart.

**C. ROCK CLASSIFICATION ACCORDING TO STRUCTURE**

It is the 3rd approach of rock classification.This involve the description of the rock.It may involve colour,size,hardness etc.However in order to classify rocks under this category,we use the term Permeability.

Permeability refers to the rate at which rocks can store water or the ability for water to pass through.Permeability can be divided into;

**Primary Permeability or Porosity:**

This involves rocks which have pore spaces.The size,alignment determine how much water can be absorbed.Porosity is greatest in Coarse-grained such as gravels,sands,sandstone and lowest in fine grained such as clays,granite.

When all pores are filled with water,the rock is saturated.Permeable rocks which store water are called Aquifers.

**Secondary Permeability or Pervious:**
These are rocks which have joints and fis-sures along which water can flow.The most pervious rocks are those whose joints have been widened.E.g

Carboniferous limestone o by cooling E.g Basalt.

Where rocks are porous or pervious,water,leaving the surface dry and without evident drainage e.g Chalk and Limestone regions.Impermeable rocks .E.g Granite,neither absorb nor allow it to pass through them.

**GEOMORPHOLOGY**

Is the science which deals with development of land forms, (relief features).

**MAJOR PROCESS WHICH SCULPTURE THE EARTHS CRUST**

There are two major forces;

i. Endogenetic /internal processes

ii. Exogenetic /external processes

## i. ENDOGENETIC PROCESS.

These are force which takes place beneath under the surface of the earth, and they are categorized as;

a. Earth movement:

$$\left.\begin{array}{l} -\,Faulting \\ -\,Folding \end{array}\right\} \text{ this can result to vertical or lateral movement.}$$
$$-\,Wraping$$

b. vulcanism

## ii. EXOGENETIC PROCESS

These are external force taking place on the earth surface.

These are force of gradation;

i. Destructive process(denudation)

(Degradation)

ii. Aggradations (constructive process.

(Deposition)

**A. INTERNAL FORCE.**

***Earth movements;***

*a) Lateral and Vertical movements*

**Diastrophism:** Is the movement of the solid crust (lithosphere which is made up of upper mantle and crust).The movement can be gradual or rapid. Gradual is the slow movements like what happens in the isocracy.

Can be rapid or sudden as it occurs during earthquakes.

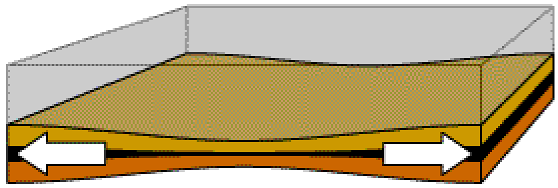
***Effects of diastrophism***

**a. Tension**

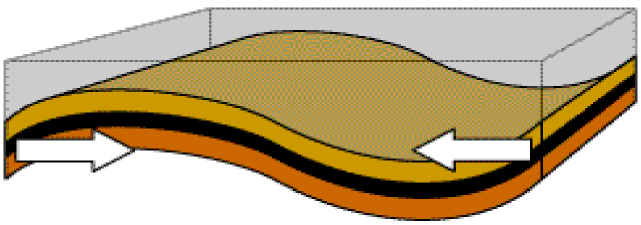
**b. Compression**

**c. Shear**

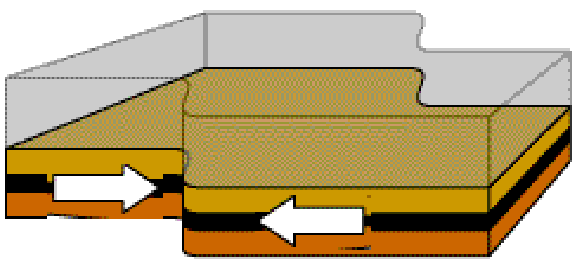
a) **Tension**: When two forces move /act away from each other, the result strain is called tension which involves the extension of the surface of
the crust to produce joints and normal fault



b) **Compression:** When two force moves toward one another, it result into compression which involve contraction of the crustal rocks to produce fold and thrust fault.



d) **Shear**: When two forces acting parallel to each other through in opposite direction the result is called shear.



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**Causes of diastrophism**

1) Conventional current- in the aesthnosphere
2) Isostasy -maintenance of equilibrium
3) Expansion and contraction of rocks due to heating (intrusion of magma between crustal rocks )

A) **FAULTING**

**What is a fault?**

- Is a fracture or a crack on the crustal rocks caused by tensional or compression forces.
- Compressional will lead to bending and breaking of the rocks
- Faulting is the process whereby will result into vertical or horizontal displacement of the crustal rock. Either shear, normal fault.

**Types of faults**

**1. Normal fault** - is caused by tensional forces in such a case; Foot-wall – Is the upper rock face on the lower side on the fault, it is marked by a low angle (less than $90^0$).
- Caused by tensional forces.

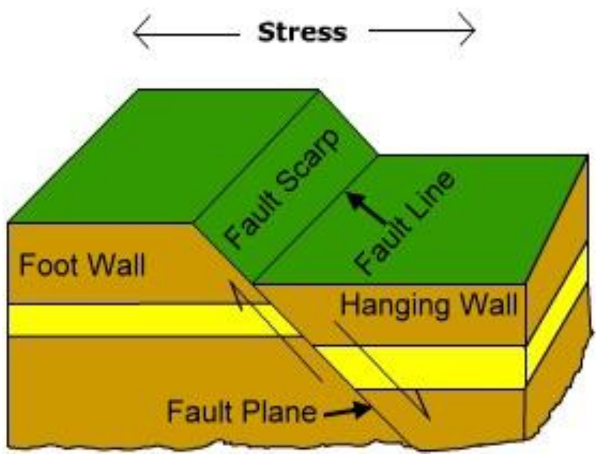
There is an up throw and down thrown which bring the displacement of the hanging wall relative to the foot wall, hanging wall is brought down while foot wall is brought up.

**Hanging wall** - Is the upper rock face on the upper side on the fault wall. It comes out with a very high angle. Any angle more than $90^0$.

**Foot wall hanging wall**

**Foot wall-**Is the upper rock face of the lower side the upper rock. Marked by low angle.

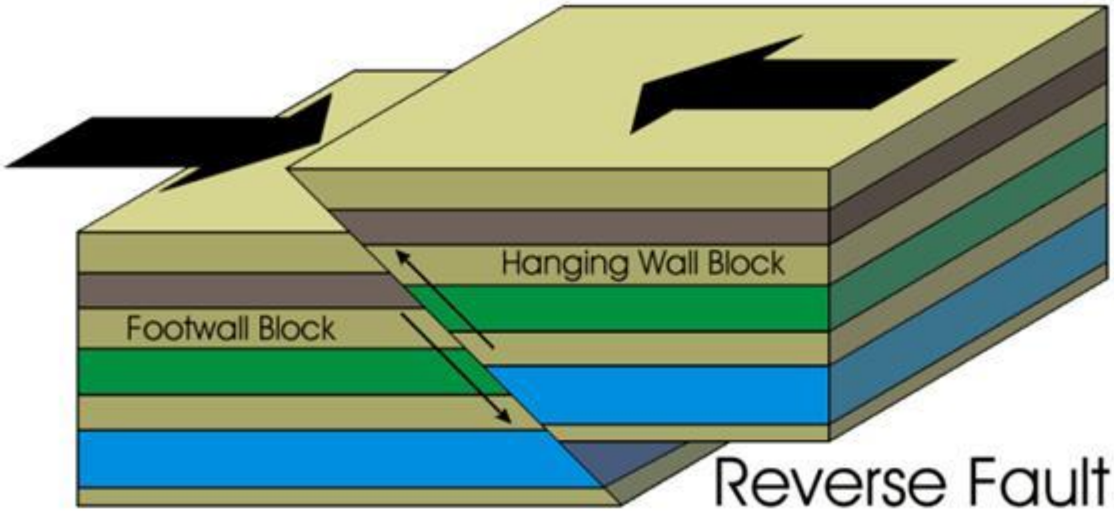
**NORMAL FAULT**




2. **Thrust/Reversed fault**

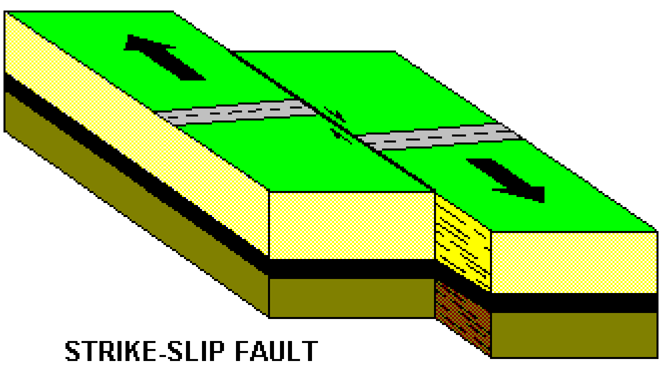
Is the reverse of the normal fault. /is the opposite of normal fault.

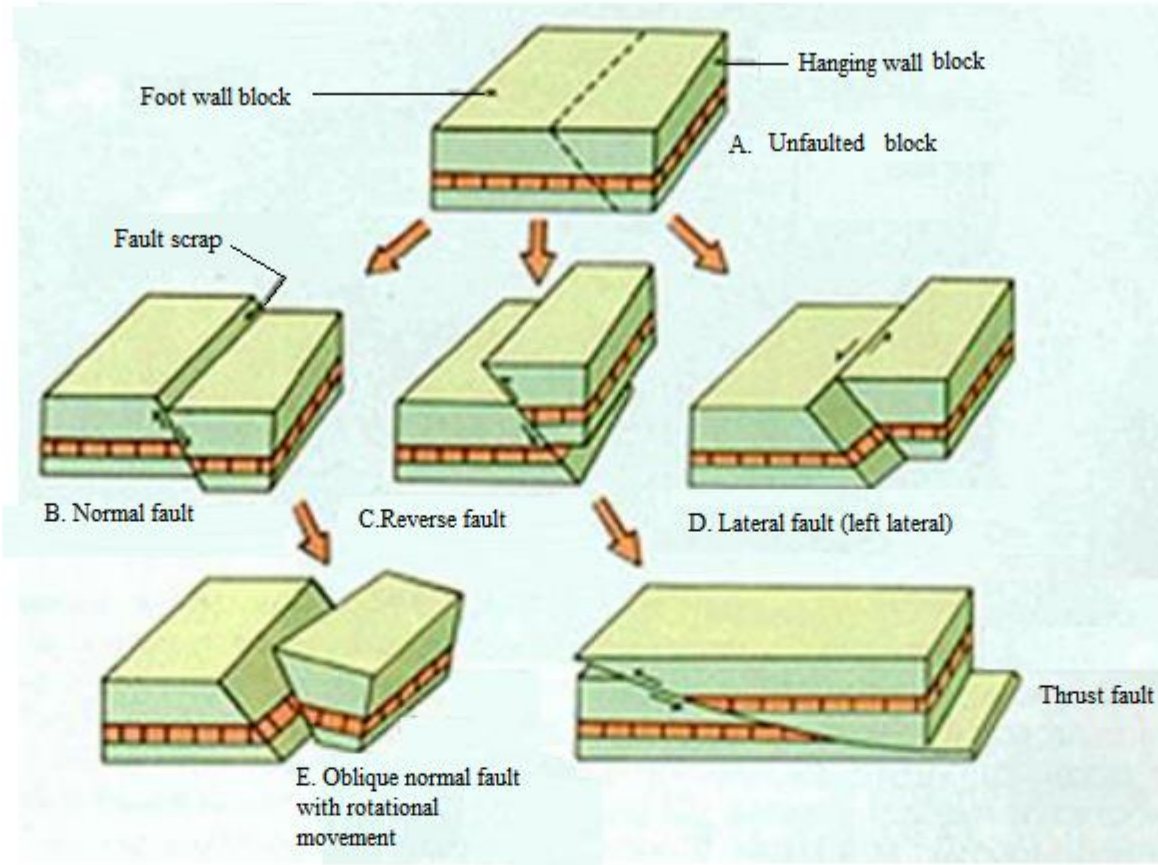
- This is caused by compression forces.
- Hanging wall is displaced upward relative to the foot wall. (Low angle of dip)




3. **<u>Tear / strike / Trans current faults</u>**.

- This is a vertical structure. The fault plain is vertical or almost vertical. It is caused by shear forces. There is lateral displacement of the crustal rocks. (Parallel but opposite directions).
  - Caused by shear forces






**Terminologies which are associated with faulting**

1. Shift – Is the total movement of the rock along the fault line.

   It involves both slip (the movement along the fault) and throws (the vertical change on the level of the strata).

2. Heave is the lateral rock block displacement.

3. Hade is the angle of inclination of the fault plane from the vertical.

4. Hanging wall is the rock face on the upper side of the fault.

5. Foot wall is rock face on the lower side of the fault.

6. Up throw is the mass of rock which has moved upward along the fault.

7. Down throw is the mass of rock which has moved downward along the fault.

**Landforms resulting from faulting**

1. **Rift Valley.**
2. **Block mountains**
3. **Plateau and basins**
4. **Fault scarps**
5. **Tilt blocks**
6. **Depressions**

1. **RIFT VALLEY** – An elongated trough bounded by in facing fault scarps along more or less parallel faults

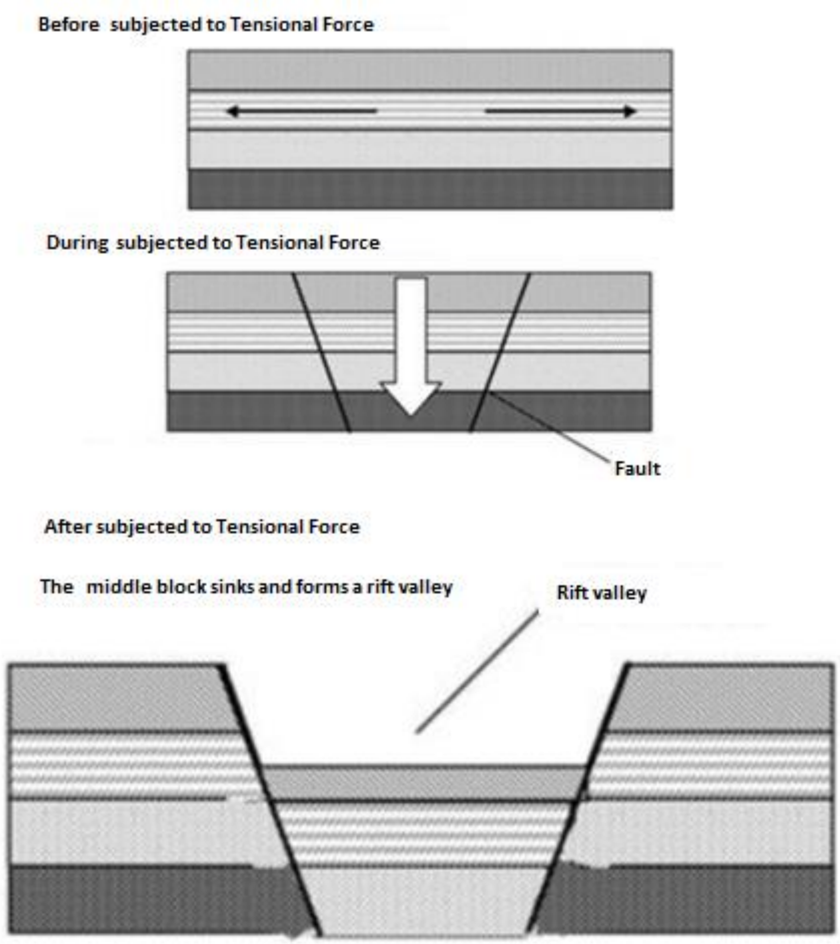
**Formation of a rift valley**

Theories on formation of the rift valley; There are Many theories but popular ones are 3;

i. Rift valley by tension
ii. Rift valley by compression
iii. Place tectonics

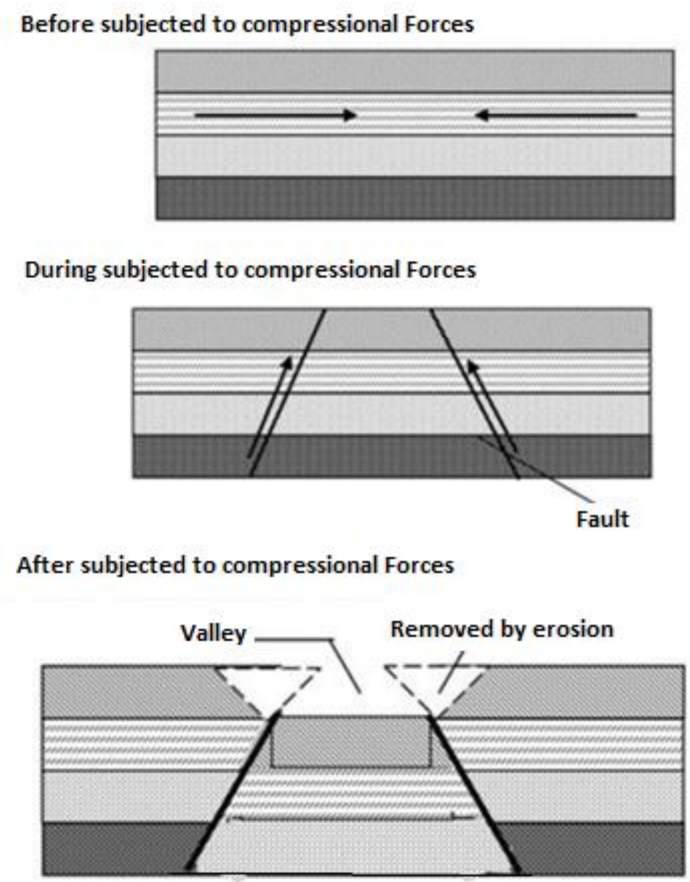
**i. Rift valley by tension**

-Rock layers are subjected by tension
- Faults develop / development of faults



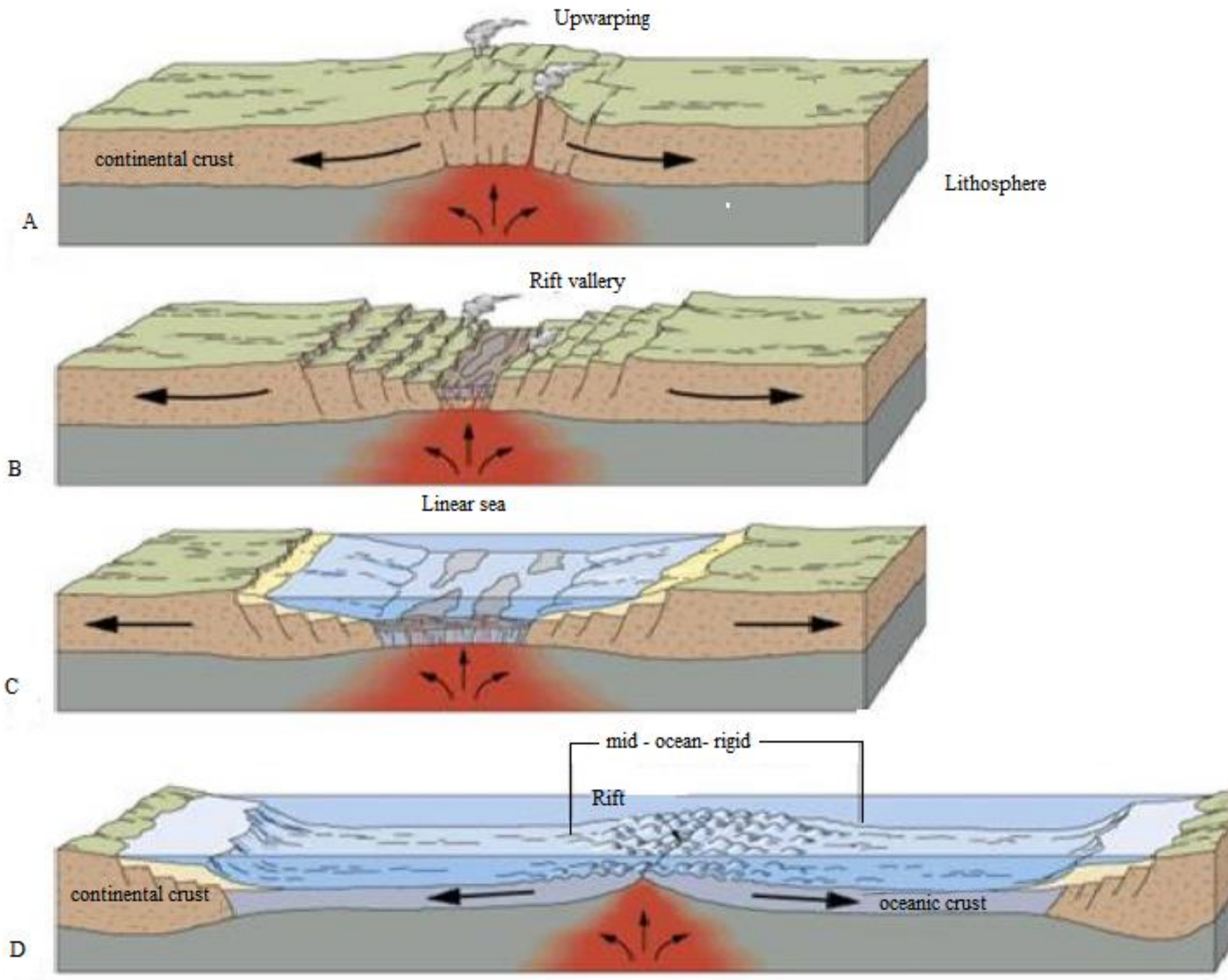

**ii.** **<u>Rift valley by compression</u>**

- Rock layer are subjected by compression
- The side blocks are unstable whereby there is upthrust over the middle block / masses on either side the faults were thrust up higher than the central block (side blocks slide upwards and leave behind the central block)
- A rift valley is formed where by the sharp edges are attacked by erosion.




iii. **<u>Rift valley by plate tectonic</u>**

Rift valley from a single fault. This is from 2 blocks which have a gap in between where by the plates are diverging and magma will well up and attach itself with the diverging plates and the gap the remains will form a rift valley.




**Examples of Rift valley**

1. The great African Rift valley
2. Rhine rift valley (it is between block mountains, Vosges and black forest block mountains)
3. Mid-Atlantic rift valley
4. Red sea rift valley

5. Jordan rift valley

**Great African rift valley**

- One of the most outstanding physical graphic features on the continent.
- Extension: starts from the middle east (Jordan – river Jordan)

It extends south wards to River Zambezi (Mozambique). (Beira) its length is 7200km of which 5000km are in Africa.

- In East Africa the Rift Valley breaks / splits into 2 branches; Eastern branch it is marked by some lakes; lake Turkana, Lake Magadi, Lake Victoria, Lake Natron, Lake Manyara, Lake Nyasa.

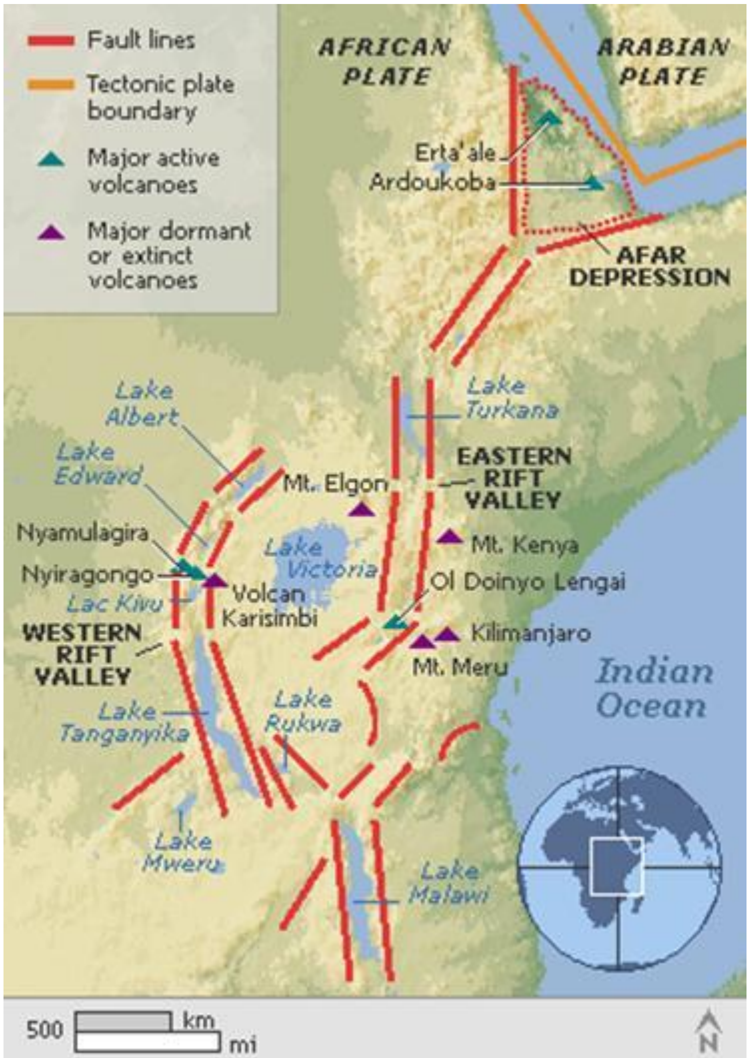
The Western branch is marked by lakes; Lake Tanganyika, Lake Albert, Lake Edward.

- The Western branch disappears in Uganda and not noticed in Sudan.

**Characteristics of Great Africa Rift Valley**

1. It is bounded by series of fault scarps which are evident in parts of Kenya and N. Tanzania (Manyara)
2. The floor is almost flat but there are some features which are higher above the sea level like Ruwenzori Mountain which are about 500m above the sea level. And also deep depression likes Lake Tanganyika which is 650m below sea level and the second deepest lake in the world.
3. The lakes in the rift valley are narrow and deep because they follow the shape of the fault.
4. The width of the floor of the rift valley varies from place to place from 50 km to 100 km. .
5. The sides the great R.V have the highlands like mountain adjusted on the sides volcanic mountains.

**A MAP OF EAST AFRICA SHOWING THE GREAT AFRICAN VALLEY**




## 2. BLOCK MOUNTAIN (HORSTS).

These are local / isolated landforms which have been elevated above / raised above the general level of the land. They stand high above the ground like blocks which are flat topped with steep sides. These landforms are common in areas of faults.

Formation

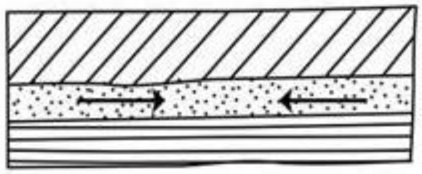
***There are two theories;***

i. By tension

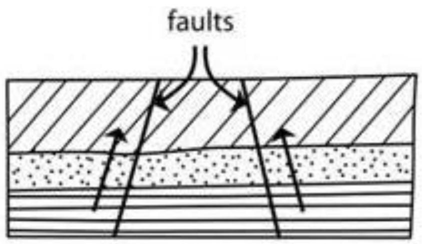
ii. By Compression

**i.By Tension**

a) Rock layers are subjected to tension



b) Development of parallel faults

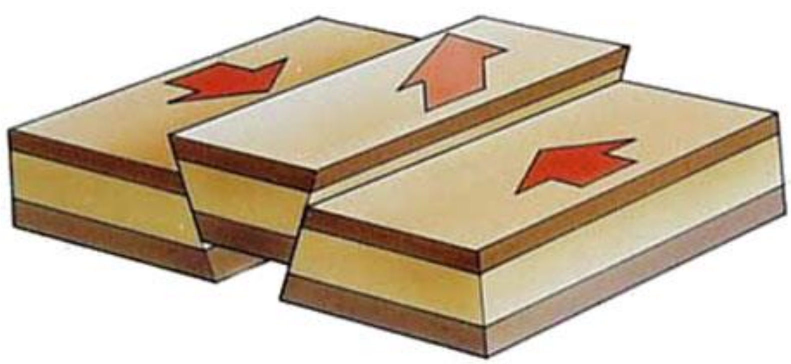



c) The side blocks will subside and leaving the middle block higher than the others by compression.

a) Rock layers are subjected to compression

b) Development of parallel fault

c) The middle block is unstable and is squeezed up.



**Example of Block Mountains**

1. Uluguru mountain

2. Usambara mountain

3. Rwenzori mountain

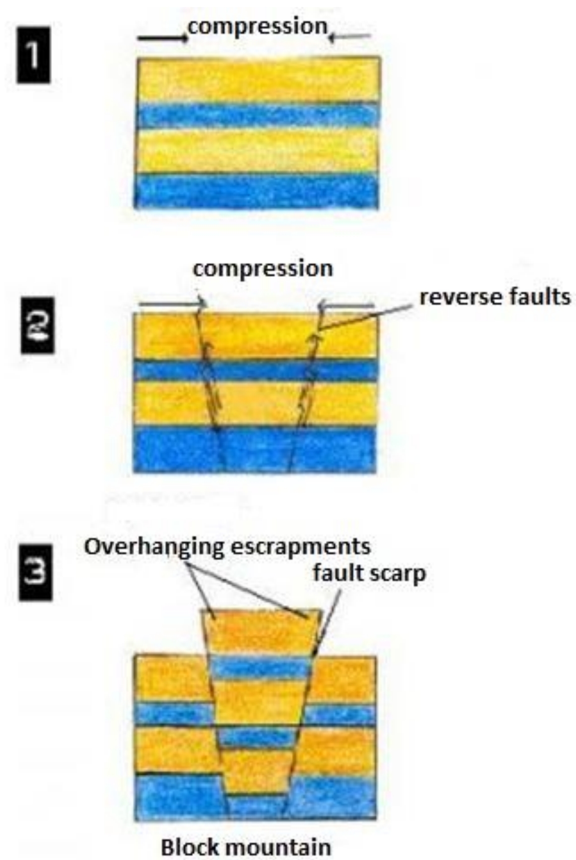
4. Black forest and Vosges mountain

5. Sinai mountain

### 3. FAULT SCARPS (Escarpment)

Are steep slopes where the land falls abruptly from higher levels to lower levels caused by vertical movements of the crust along the fault line. Can be caused by tension or compression but can be modified by denudation.

**Example: Chunya - Tanzania**




A fault scarp which occurs across a river result into waterfalls.

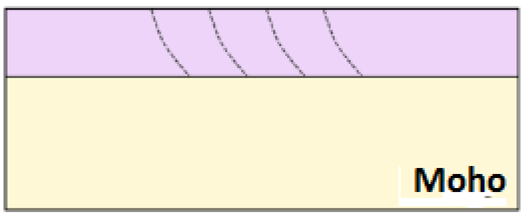
4. **<u>TILT BLOCKS</u>**

The landscape of angular ridges and depressions formed by series of tilt fault blocks.

<u>Example.</u>

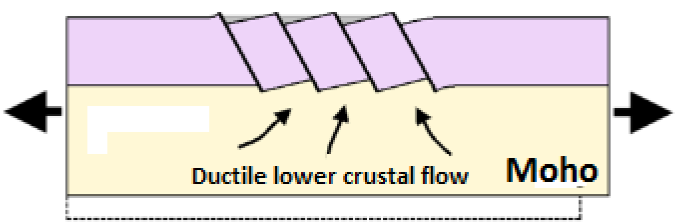
1. **U.S.A Rocky mountain**
2. **Somali**

A.



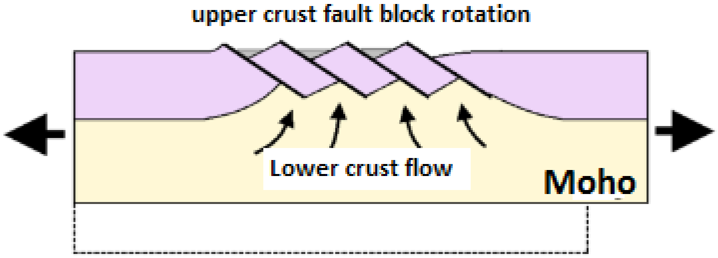

B.

**Developing normal faults with extensional basins**




C.

upper crust fault block rotation




Dominated by faults raised

4. **<u>PLATEAU</u>**- extensive raised land with sleep sides (table land) e.g. East Africa generally is a plateau / Africa is a plateau in general
5. **<u>BASINS</u>** – are the down warping (sagging). Intermountain basins.

**A basin examples: L. VICTORIA, L. KYOGA, GREAT BASIN IN NEVADA, ZAIRE BASIN**.

**Study Question**.

**With examples discuss the effects of faulting in East Africa**.

Fault is a fracture or a crack on the crustal rock caused by tensional or compression forces. Faulting is the process whereby will result into vertical.

**Positive effects**

1. i Formation of rift valleys e.g. East Africa rift valley

   ii Formation of block mountains i.e. Uluguru

   iii Formation block of plateau and basins. Lake Victoria

   iv. Formation of escarpments. Chunya/ kalambo fall in Zambia

1. Formation of the $H_2O$ falls where fault scraps occur across the river course lakes from basins of lakes rift valley lakes / river Kagera has change.

2. River reverse direct due to faulting / the direct due to basins which were formerly flowing west ward and forced flow east ward.

3. Faulting caused the development of rectangular patterns as tributaries forces to flow through the broken rocks and gets converge to the main river.

4. Occurrence of hot springs. Spring is the natural outflow of water from the ground in an areas there is weakness i.e. in mbeya Tanzania

5. Displacement of features e.g. San Andreas fault

6. Leads to earthquake

**b) FOLDING**

Compression forces and folding

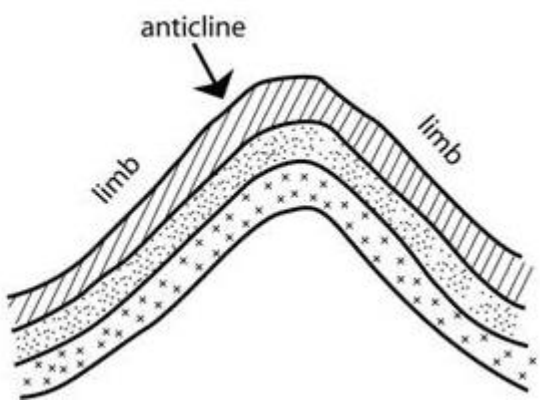
- compression forces can cause folds of the rock layers (strata)
- The degree of folding will depend on the intensity of operating forces and the nature of rock.

**There are several degrees of fold / types of folds**

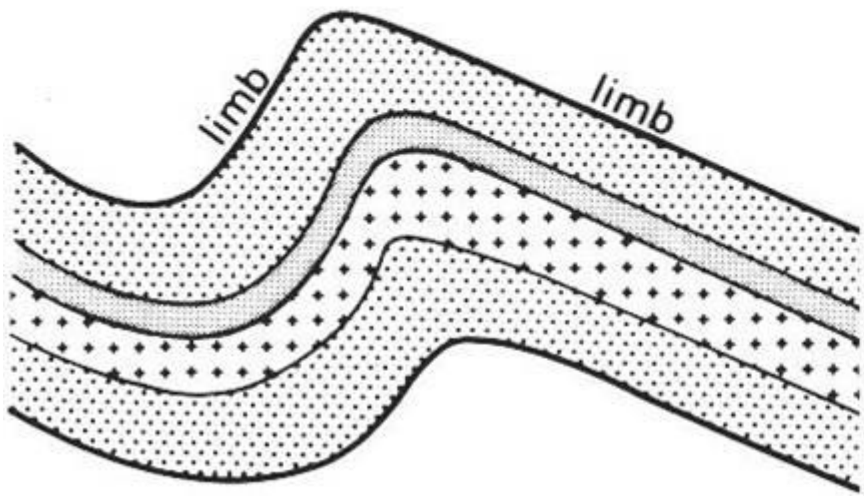
i **Simple fold** – is a symmetrical fold resulting into upthrow called anticline and a down throw called syncline.

This type of fold has more or less equal limbs, where we have the axis which divided the fold into more or less equal limbs. (Limbs are the sides of a fold) (Symmetrical fold).

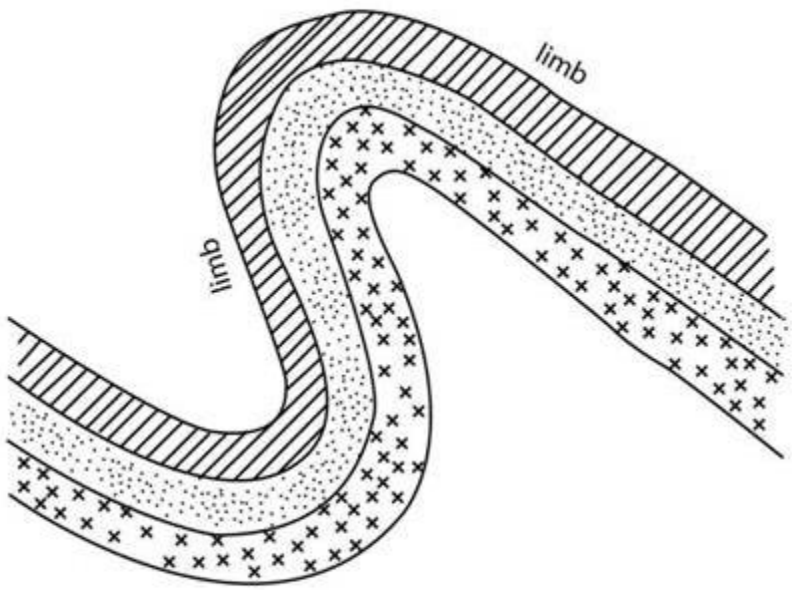
**Compression force**



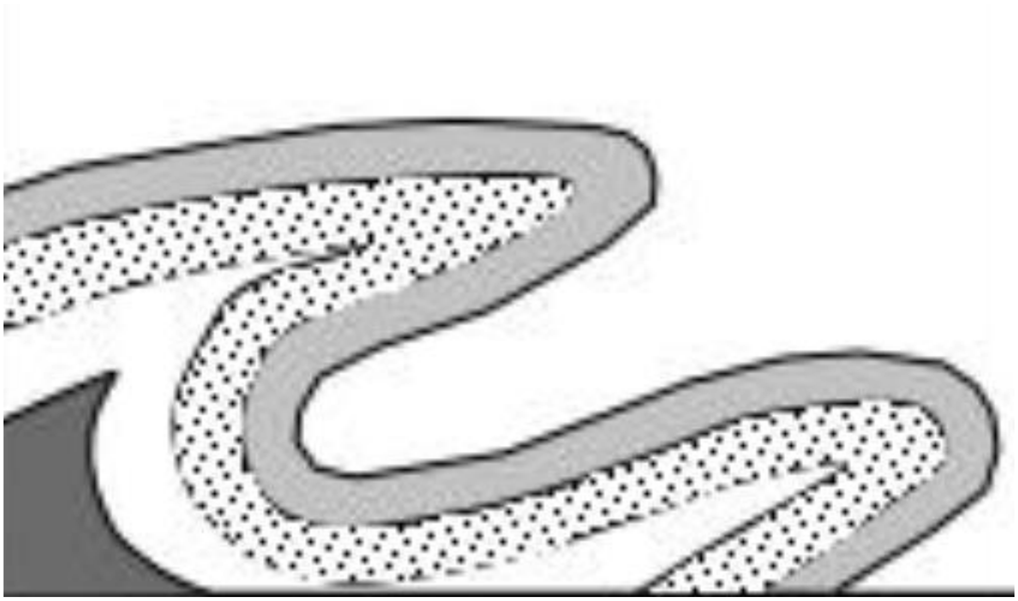

ii Asymmetrical fold – Is a greater degree. One limb of the fold is longer than the other. (And gentler) unequal limb. The other is shorter and steeper.



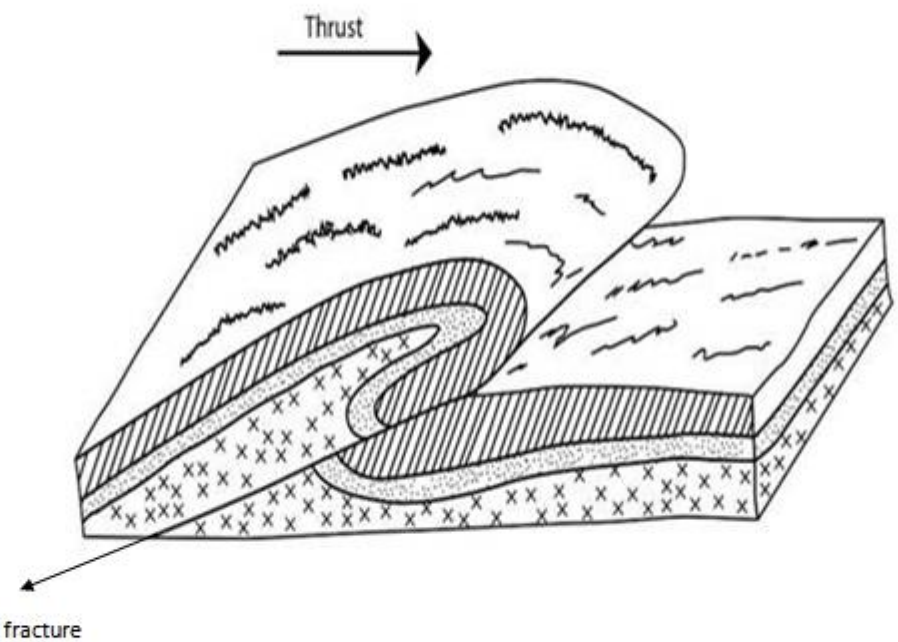

iii Over fold – One limb / asymmetrical limb is pushed over the other limb.




iv. Recumbent fold – This is a complex fold where one limb on the fold is almost inverted over the other limb, to greater degree. Almost horizontal to the surface.



v. Over thrust (napped) fold – When the pressure is very great a fracture can occur in the fold (along the crust plain) and one limb is pushed forward over the other limbs. NW highlands of Scotland.




***Effect of folding on the earth's crust***

The major effects is the formation of Fold Mountains where three are anticlines and depressions (geosynclines) where there is down fold (syncline).

**Fold Mountains**

Are categories into old fold mountains and young fold mountains.

Formed during per-Cambrian era e.g. Appalachian, cape ranges, Europe Mountains Ural.

**Young Fold Mountains** – Recently formed, examples the Rocky, Andes, Atlas, Alps, Himalayas and etc. They form highest peaks over the earth surface e.g. Mount Everest highest peak point, on the Himalayas (over 8000mts).

Global distribution of Fold Mountains

**AFRICA**: 1. Atlas – N.W Africa

2. Cape ranges – S.A

**N. AMERICA**: 3. Rocky Mountain – western part

4. Appalachian – Eastern Part of USA

**S. AMERICA**: 5. Andes Mountain – Western side

**EUROPE**: 6. Alps Mountain – Central Europe

7. Ural Mountain – Separates Asia and Europe

**ASIA**: 8. Himalayas – Central Asia

**AUSTRALIA:** 9. Great Dividing Ranges

**Characteristics of Fold Mountains**

1. They are very extensive – covering thousands of kilometers over continents, they are not isolative.
2. They are high (height) especially young fold mountains make the highest peak e.g. Mount Everest.
3. Age some are young (narrow and long) and some are old fold mountain.
4. Some have undergone complex processes that is or genesis like volcanism, denudation (effects of geomorphic processes)

**Economic importance of fold mountain positive and negative aspects**

1. They are climatic modifiers in terms of temperature and rainfall. By forming high peaks where by the peaks have snow although they lie on tropics.

2. Have dense forests of the world like Asia, North America. They produce hard and soft woods which are used for various uses. (timber-lumbering)

3. Tourism – tourist attraction

4. Source of the major rivers of the world. Rockies and Appalachian (Mississippi river) River Ganges, Indus, Irrawaddy in the Himalayas', Australia River, China – {R.Sikiang, river Hwang Ito, Yangtze Kiang.}

5. They are source of minerals especially in the Rockies like copper, gold etc. South America also

6. Barrier to communication

7. Topography of some mountains discourages settlement.

**DISTRIBUTION OF FOLD MOUNTAINS AND MOUNTAIN ROOTS**

Fold Mountains are not uniformly distributed in the continents. They are distributed along the margins of the continents where plates collided. The young fold mountains form their own belts and the old fold mountains also form their own belts as well.

Distribution of Young Fold Mountains

Young fold mountains from the alpine chains. The Alpine chain are the active mountain making belts and they constitute the narrow zones most of which lie along the continental margins. The mountains in these belts were formed during the Cainozoic era. They are curved and each curve is called an alpine arc. These arcs are linked in sequence to form two principal mountain belts as follows:

a) **Circum – Pacific Belt**: This rings the Pacific Ocean. In the North and South America, this belt is largely on the continents and includes Andes and Cordilleran ranges. In the western part of the Pacific Ocean, they take form of Island arcs running through Aleutians, Japan and the Philippines.

b) **Eurasian – Indonesian Belt**: This starts from the west at Atlas Mountains in North Africa, through the near East and Iran to join Himalayas. Then it continue to South Eastern Asia into


The world distribution of young fold mountains, active volcanoes and earthquake zones.

**4.4 THE IMPACT OF EARTH QUAKES**

- Is the shaking of the ground due to the sudden vibrations.
- Are vibrations of the earth crust caused by volcanic eruptions.
- Sudden vibration of the earth caused by rupture and sudden movements of rocks that have been strained beyond their elastic limit.
- It takes a short time, hardly reaches 5 minutes.

**Causes of earth quakes;**

1} **Diastrophic movement**

- Movement of plates one tectonic plate sliding over or past another plate

2} **Volcanism**

- Intrusion between crustal rocks can cause sudden vibrations intrusion or extraction causes vibration

3} **Human activities**

- E.g. explosion of bombs for example atomic nuclear bombs which can cause shaking in a very large area.
- A transportation large airplane trains.
- Dynamites

**Major causes are diastrophic movement:**

- This can be explained by the theory of elastic rebound.

- There are compressions forces which make the crustal rocks bend.
- The forces build up strain when the strain is so great it will result into breakage of the crustal rocks to release energy. The energy will cause seismic waves. The seismic waves will cause the shaking vibration of the earth.
- The place where earth quake occurs /origin of earth quake the point where the breaking occurs is called focus.
- This breakage only occurs in the solid part of the earth (earth crust) between 8-100km beneath the surface of the earth.
- From the focus, seismic waves are sent to all directions and the point vertically above the focus is called epicenter (on the earth crust) point of the surface of the earth vertically above the focus .Epicenter refers to the point where the effect of the earth quake is the greatest

**Types of seismic waves**

**Two main types of seismic waves;**

**i) Body waves**
**ii) Surface waves**

i) ***Body waves***

- Travel through the crust. There of two types

**a) Primary (p) waves**

- These are compression waves. These can be transmitted through solids, liquid s and gasses. They are transmitted to all.
- Can be pass on the center of the earth and be felt on the other
- They are fastest can travel 8km/sec.
- Crustal rocks move back and forth in the direction of wave movements

**b) Secondary (s) waves**

- These are shear waves. These can only pass through solids. They are slower, when they reach the mantle there reflect (bend). They speed is 4km, sec.
- The crustal rock to move from side to side perpendicular, at right angle to the direction of wave movement.
- Produces shadow zone to the area which the secondary waves do not pass

ii) **Surface waves**

- These travel through the surface rocks and are of two types,

a) Love (L)waves (b)Rayleigh (R)waves

**a) Love (L)wave**

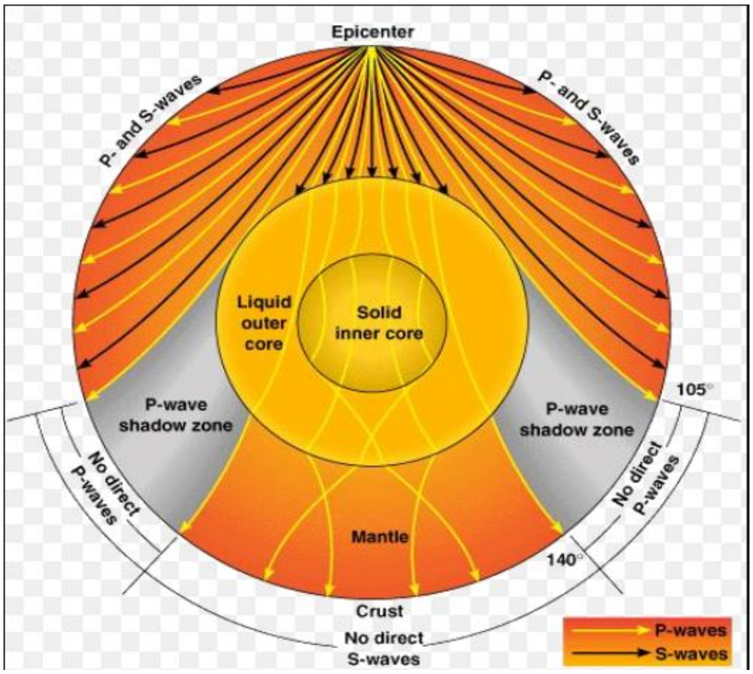
- Move from side to side at right angles to the direction of wave movement.

**b) Ray Light ® waves**

– Have a vertical circular movement very similar to that of water in sea wave. They move Up and down.

- The energy moves form one point to the next.

**THE STRUCTURE OF THE EARTH SHOWING THE PATHS OF EARTH QUAKE WAVES BASED ON VARIOUS GEOPHYSICAL MEMOIRS.**




MEASUREMENT OF SEISMIC WAVES

i. ***Magnitude:*** - The size of quake is measured on Richter scale (size of magnitude is measured on Richter scale) ranges 0 – 8.9
Total energy released which is transmitted to all direction is measured on Richter scale.

ii. ***Intensity*** – The effect / damage experienced on the surface or on the ground / destruction. Measure on Mercalli scale which ranges from 1-12.
- 1 is the smallest effect detected by seismograph
- 12 is the most catastrophic effect.

**Global distributions of earth quakes**

## MAP OF THE WORLD SHOWING THE ZONES OF E.Q

The majority of E.Q occurs in narrow belts which mark the boundaries of tectonic plates. The main types of regions where they occur are:

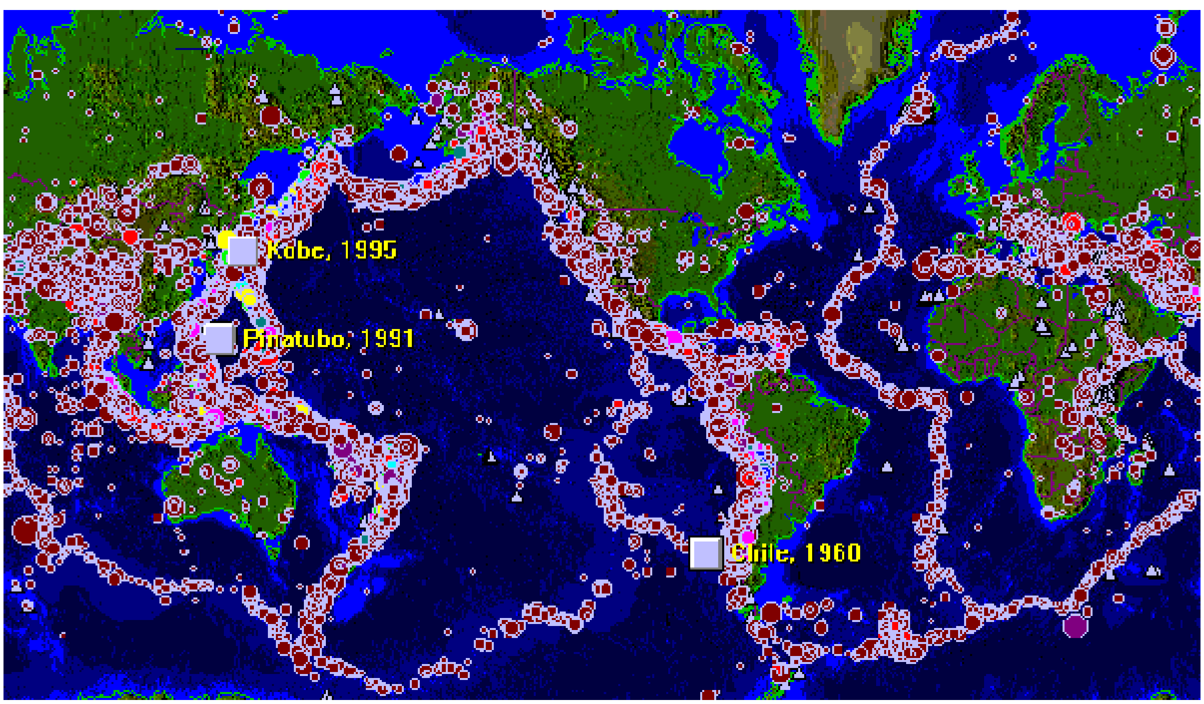
1. **The mid-ocean ridges**

2. **The ocean deeps and volcanic islands**

3. **Regions of crustal compression**

- Major E.Q are caused by the movement of tectonic plates e.g. the North American and Pacific Plates result in Horizontal movements along San Andreas Fault in California.
- The only parts of Africa which have E.Q are located in the Great Rift Valley Region of East Africa and in parts of North – West Africa. Most of the E.Q occurring in Africa is relatively mild. However, serious earthquakes occurred in El Asnam in 1954 and in Agadir in 1960.

## THE MAJOR EARTH QUAKE AND VOLCANIC BELTS ON THE WORLD




Effects of Earth quakes

1. Destruction of life. For example in Iran, 20 thousand people died, In Morocco. Chile.

2. Destruction of property, breaking of buildings example in Morocco where building and transportation system collapse.
3. Can cause faulting / joints e.g. San Andreas in California.
4. Displacement of crustal rocks can be vertical or lateral. (Land can be uplifted) e.g. San Andreas.
5. Can cause land slide which can cause some blockage on transport system or rivers. Also open up deep cracks in the surface rocks eg. The El Asnam E.Q in Algeria.
6. Devastation especially in cities.
7. Tsunami. Great seismic waves which are caused on the ocean flow due to earth quakes.

**Precautions against Earthquake**

Natural disaster, how to reduce its negative impact.

i. Discourage settlement on those areas which are frequently prone to earth quake.
ii. Run to open space
iii. Build houses which are shock absolve.
iv. Do not build tall buildings on areas prone to Earthquake.
v. Avoid using explosives especially exploding atomic bombs, nuclear bombs.
vi. Seismologist(seismographers) should detect the Earthquake and inform the people

## B. EXOGENETIC FORCES WHICH SCULPTURE THE SURFACE OF THE EARTH.

These are external forces. They operate on the surface of the earth.

**a) Denudation:**

These are destructive forces which lower the earth's surface

i. Weathering / mass wasting
ii. Erosion
iii. Transportation

b) **Deposition** – Constructive process which raise the eland

**4**

### .5 VULCANICITY (VULCANISM)

- Is a process whereby molten (magma) material from the interior of the earth is injected into between the crustal layers the earth crust rocks or ejected on the earth surface.
- This material can be inform of gases where gaseous material or in liquid or solid.
- Material which is injected between rock layers form intrusive igneous rock while that which is ejected out in the surface form extrusive igneous rock.
- Intrusive magma form intrusive features of Vulcanism while extrusive magma form extrusive features of Volcanism (lava). The shape of the features form depends on the nature and weakness or strength of the bedrock.

**VULCANICITY**

Vulcanicity includes extrusive and intrusive while volcanicity is a subset / part of vulcanicity (surface manifestation of vulcanicity).

**Causes of Volcanism**

1. **Intensive Pressure: –**

This pressure is so high and it finds the line of weakness where it can come out. The line of weakness is found on the boundaries of tectonic plates. Pressure causes high temperature and hence it tends to release with molten material and this causes.

**Intrusive features of vulcanism;**

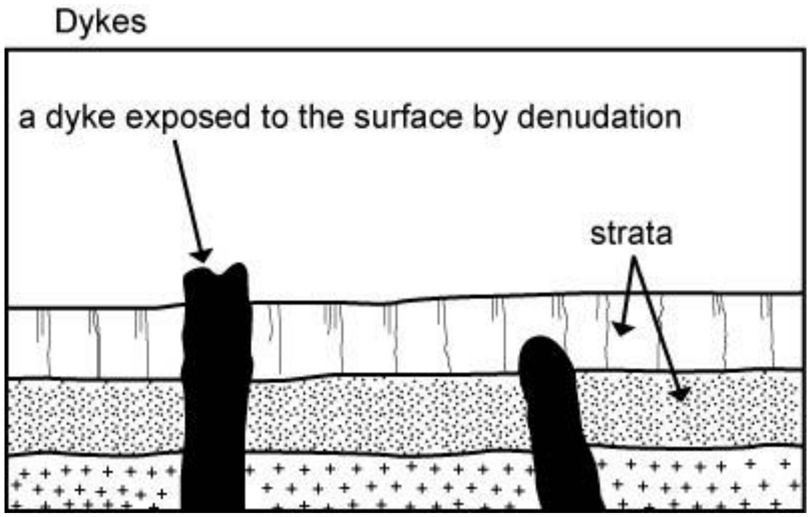
1.Dykes 2.Sill 3.Lacolith 4.Batholith 5.Lopolith 6.Phacolith 7.Minor features.

-The shape of the intrusive features depends on nature and strength or weakness of the bedrock.

- Fluidity which is very fluid it will move very far and form linear features.
- Thick, accumulate (viscous) and solidify and form features.

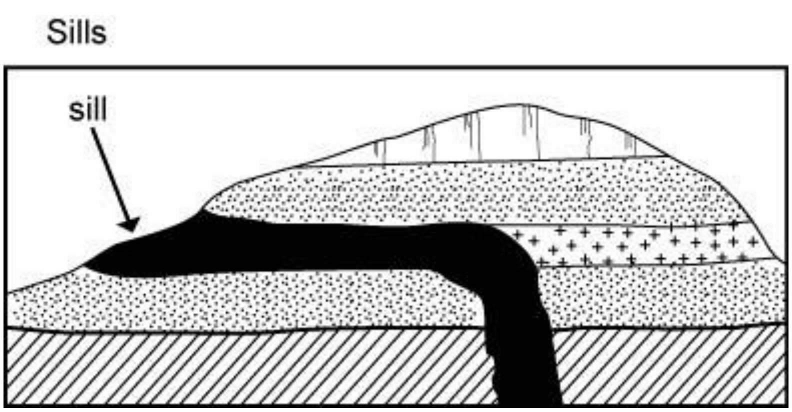
1. **Dykes:** Intrusion of magma which solidify vertically across bedding rock strata or can be inclined magma.

- They are pillar like structures.
- These dykes can be exposed by denudation. It depends if the rocks of the dyke is more resistance (harder) than the surrounding rocks, the surrounding rocks will be eroded and form a rigid.
- And if the dyke is soften than the surround rock it will be eroded and form a depression.
- **Example:** The dyke which give rise to waterfalls or rapids such as Howick falls on the River Mgeni in S.A, Dyke ridges on the S W side of the Kaap Valley S.A, West of Lake Turkana (Rudolf) where dyke form trenches in sedimentary Turkana grits.




2. **Sill:** Is a horizontal sheet of intrusive rocks where magma has solidified between rock layers / bedding layers.

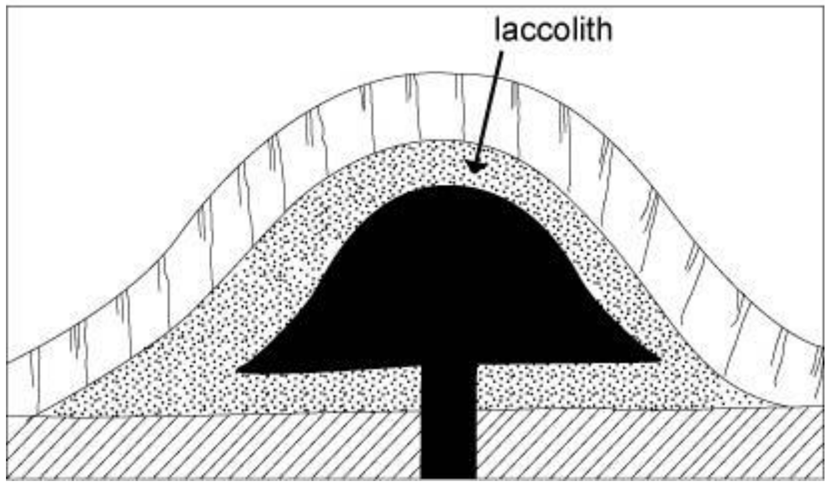
- The magma is very fluid and moves very far
- If it cuts across a river, it can cause a water fall. Due to erosion the river erodes the surface but when crossing the dyke or sill the rocks are hard to erode but after crossing the rock it will erode faster and after many years will form $H_2O$ fall.
- **Examples:** In Cape Province of S.A are buttes which have a sill capping, Kinkon falls in Guinea.




3. **Lacolith:** is a dome shaped of intrusive magma (caused by accumulation of viscous magma which pushes the overlying rock layers to bend upward.

- Laccoliths are near the surface
- Examples: Fonjay massif and Ambereny massif in Madagascar, Henry Mountains in southern Utah to the west of the Colorado River.

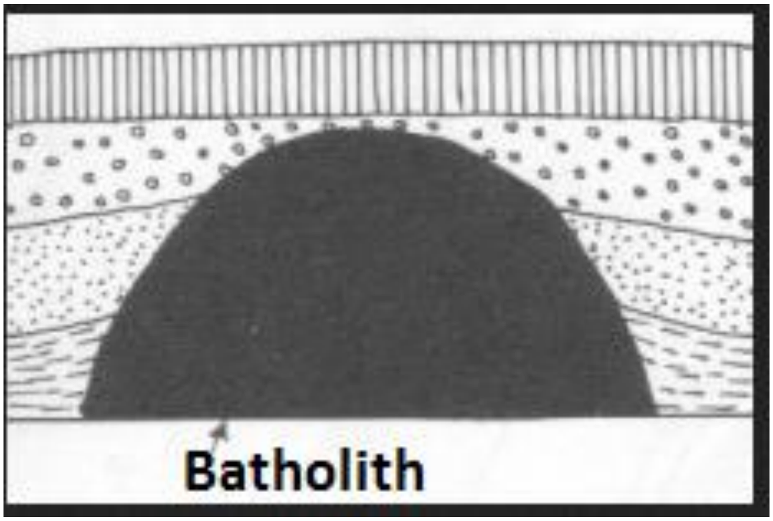
Laccolith




4. **Batholiths:** Are very large masses of igneous rock which are formed deep in the crust (plutonic).

- Examples are granites which are made up of large crystals because cooling has taken a very long time.
- They normally form roots for mountains.
- Batholiths' can be exposed by denudation.
- Examples: Granite batholiths in S.w peninsula of England and in beuttany,Tanzania batholith in Mwanza and Iringa,sinda batholith, East Zambia, Cape coast batholith in Ghana and Sinso batholiths in

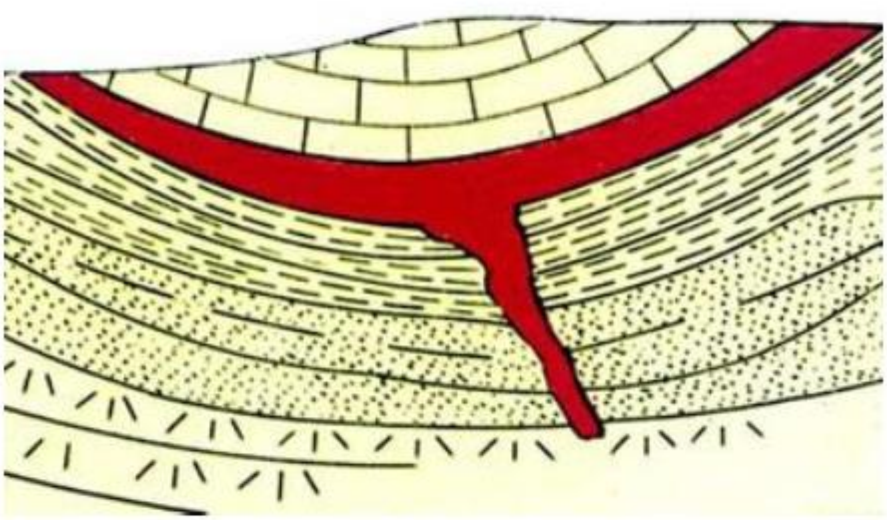
Uganda.



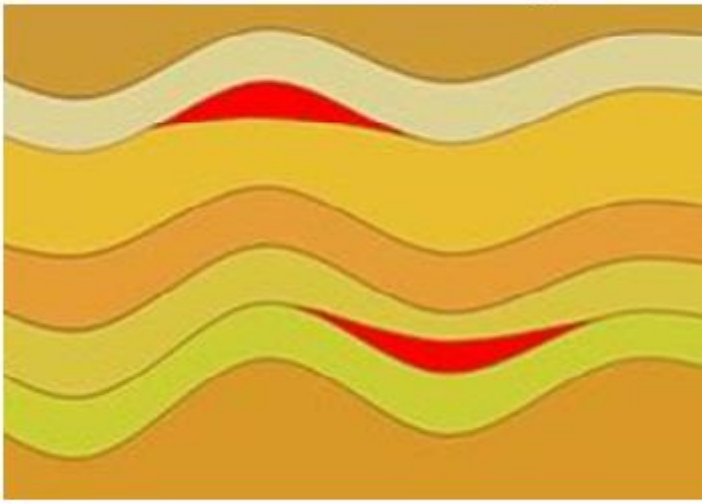

5. **Lopolith:** They are saucer like feature formed by sagging.

- Very large saucer shaped intrusion shape may be due to increased weight causing sinking. After denudation the upturned edges sometimes form out facing scarps.

**Examples**: the bushveld basin in the Transvaal in S.A, sierra lione peninsula.



6. **Phacolith:** These are intrusive solidification of magma on the anticlines and synclines of rock strata.



***Extrusive features of volcanism:***

- Magma which reaches the surface is called lava

  **LAVA**: Can come out in two ways;

**(i) Through fissure eruption/linear**

- Magma wells up and pours out into the surface through a crack or a whole

(Explosion) quietly

**(ii) Vent eruption**: Magma is forced out through a vent or central opening violently.

**Types of materials given out during eruption**

i) ***Gaseous Materials*** – Gases are emitted during the course of an eruption include gaseous compound of sulphur, hydrogen, carbon dioxide.

ii) ***Liquid*** – There is lava which can be mobile (flow faster) or viscous tephra (accumulate and flows).

- Acidic Lava

-Basic Lava

iii) ***Solid*** – Solid materials are ejected, some are fragment of the country rock; e.g. Scoria, pumice, cinder (lapilli), volcanic bombs.

Those which come out explosively will spread out far. But will fall and cool and build landforms.

Some of these materials will cool and accumulate and build landforms.  Those which come out slowly build up a volcano.

**VOLCANO** - Is a mould or a cone like features or a circular in shape build up through volcanic activity (is a result from volcanic activities)

Types of Volcano

Active Volcano
Domant Volcano
Extint Volcano

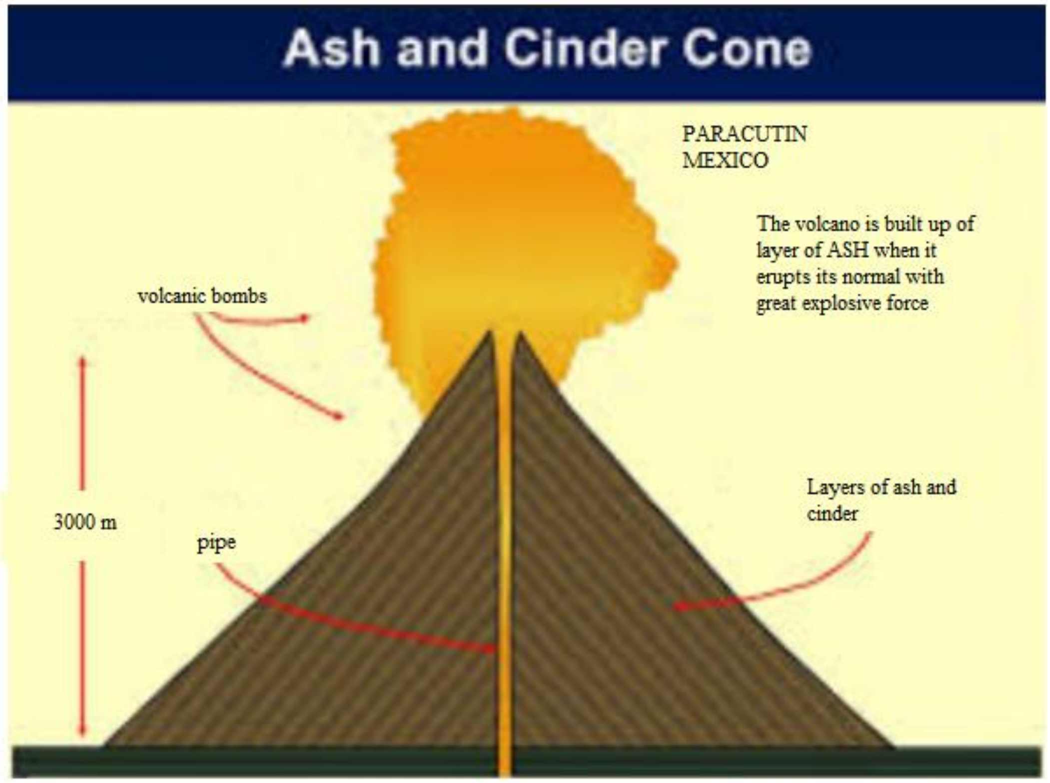
**Volcanic Landforms**

***Ash and Cinder cone (scoria cones).***

- These cones are building up by pryroclastic material solidifying around the vent.

- Formed by vent eruption cinder are small round particles either from the interior of the earth or have solidity after being exposed out of the crust. Examples: South of L. Turkana in Kenya, Likaiyu and Teleke (both under cinder cone) and Nabuyatom (ash cone)

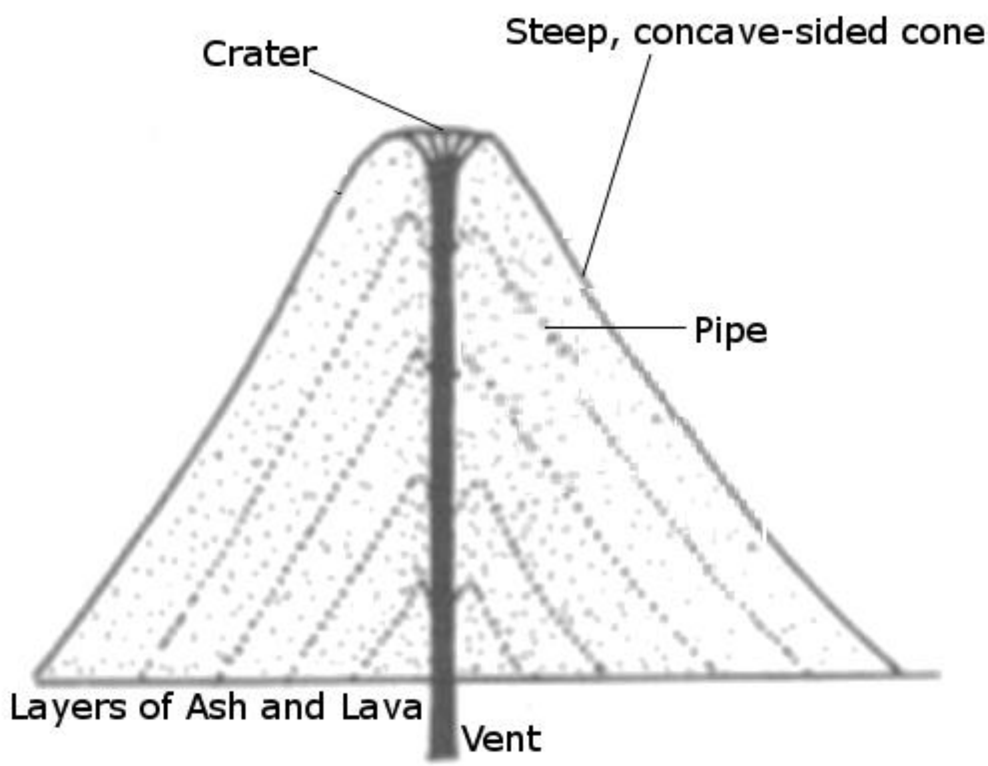
**The structure of an ash and cinder cone**




1. ***Lava Cones*** – A hill or type of a cone which is formed by lava (cumulo dome)

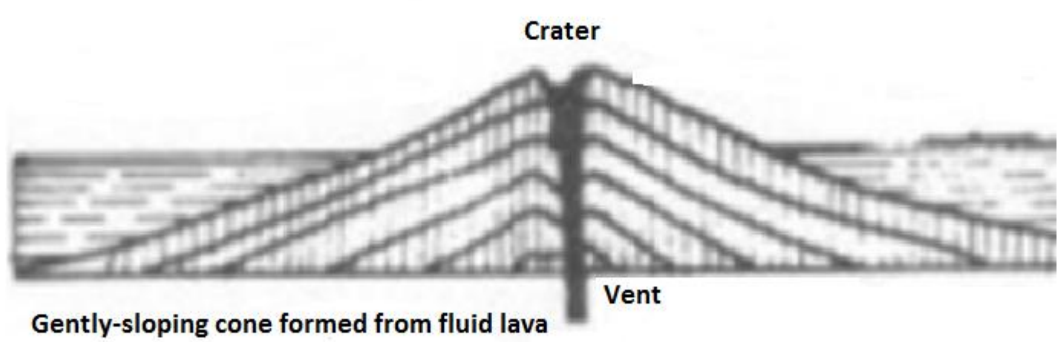
(a) **Acidic Lava** – This is viscous and will not flow very far from the vent but accumulates around the vent to form sleep sided cones. Viscous lava can form a spine (is a steep hill) has more silica.

Example: Mount Pelee Martinique West Indies.



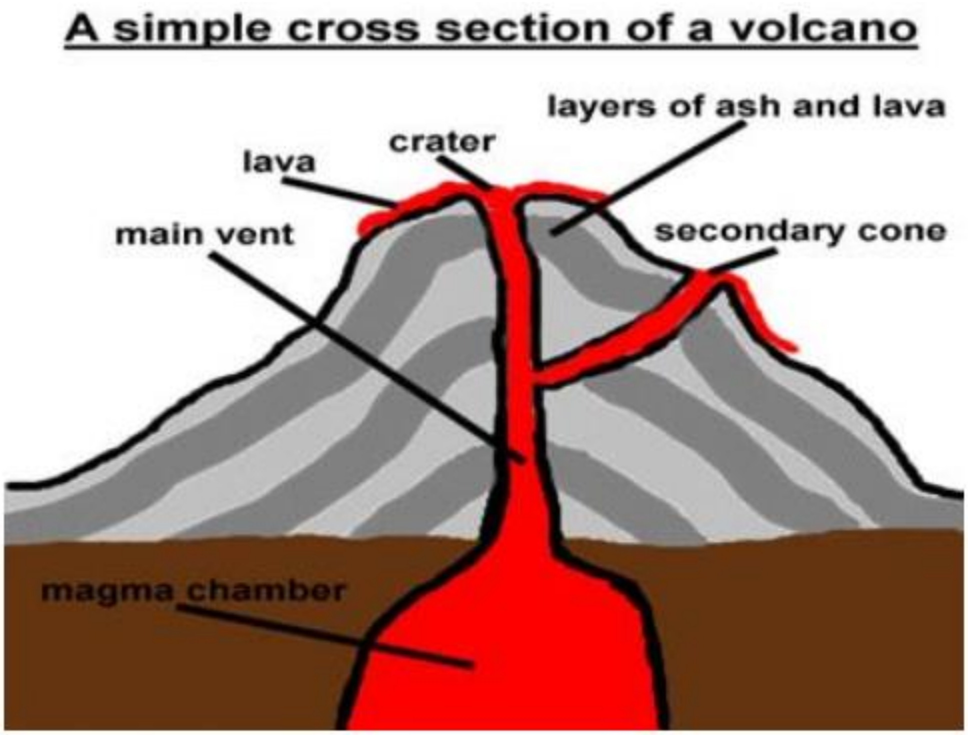

(b) **Basic Lava Cone** – Is very fluid, mobile. It spread far from the vent and it builds up gentle sloping cones.

Example: Mauna Loa – Hawaii.

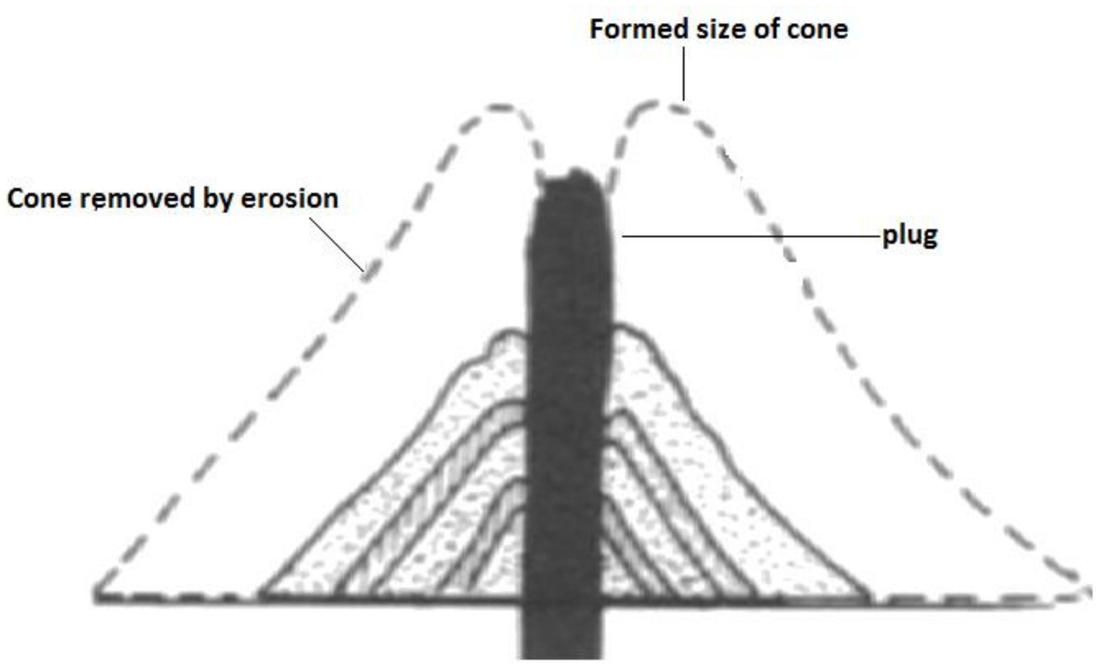



iii. **Composite cone** – This is formed by alternating layers of ash and lava

Note: These composite cones forms high composite peaks – (give highest peaks on the surface of the earth) e.g. Mountain Cameroon, Mount Kilimanjaro, Mount Vesuvius.




Iv. **Plug Volcano (Volcanic neck)** – They are cylinder like shaped it occupies the vent of a dormant or extinct volcano. It solidifies on the vest, and blocks the mountain forming dormant volcano.



**Caldera (Basal Wreck**) – Is a large shallow cavity (depression) on the top of the volcano.

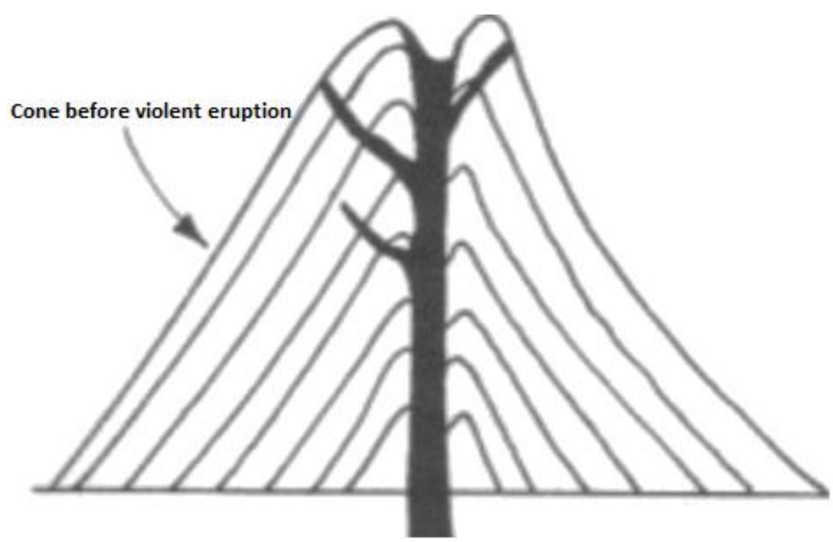
**How formed**

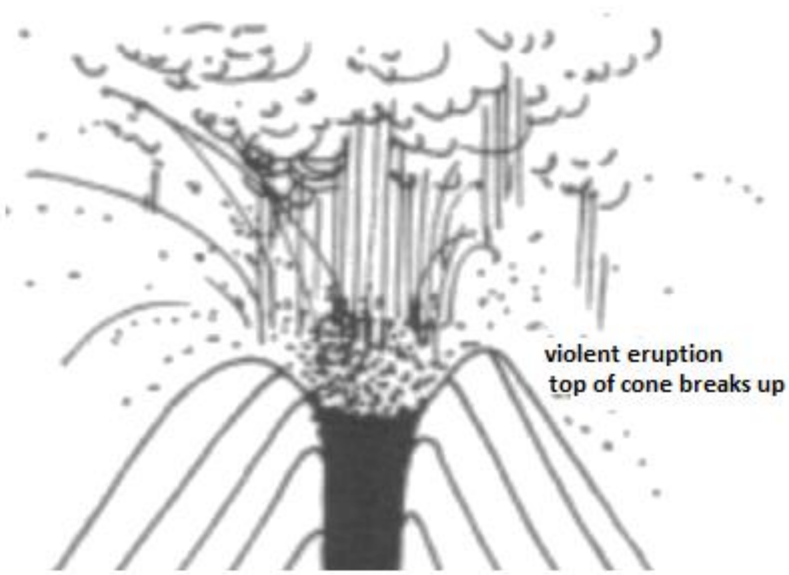
Formed by violent eruptions which remove the former top of the volcano.

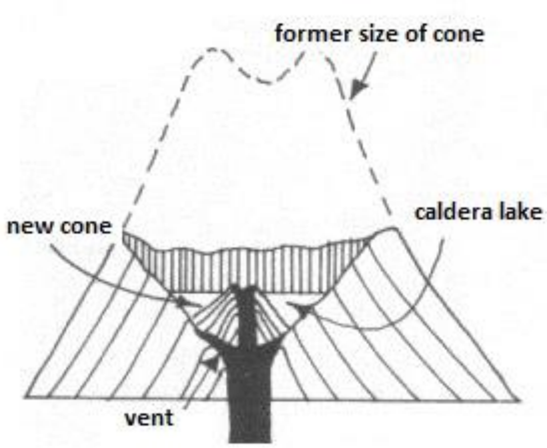
**NB:** Water can accumulate in the caldera and form Caldera lakes e.g. Lake Toba in Sumatra (Indonesia) and Crater Lake in USA and Bosumtwi in Ghana

Caldera; Ngorongoro in Tanzania, Mount Meru in Tanzania, Longonot in the Eastern Rift S.W of Kenya.

**<u>Stages in the formation of a caldera</u>**





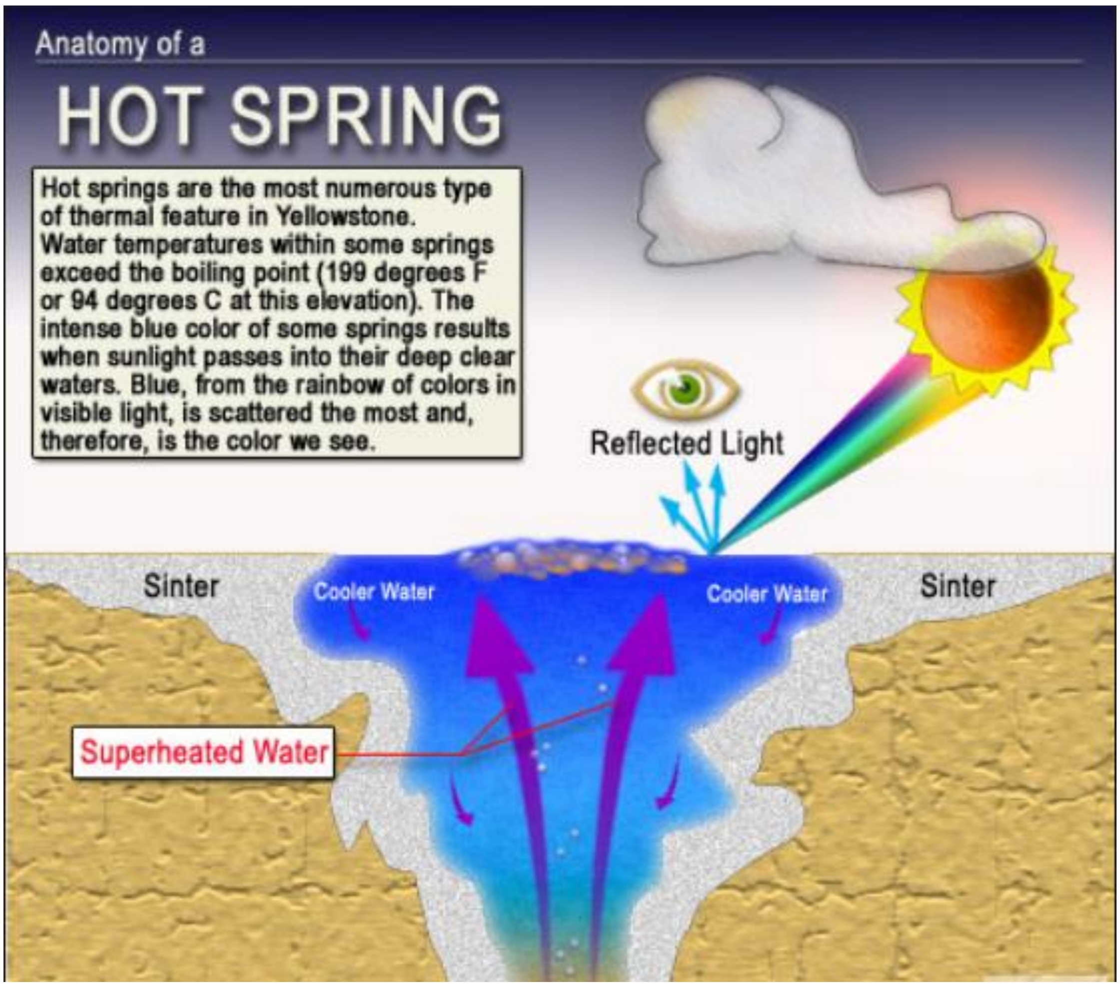




v) **Lava Plateau** – Result from fissure eruption. When lava is up welled then spreads to a wide area and when it solidifies forms lava plateau. (fairly high level lava plateau) (Basalt plateau which is acidic in nature). E.g. In Sahara, Algeria, Morocco and in S.S – Drakensberg Plateau, North America – Snake plateau, Deccan plateau in India.

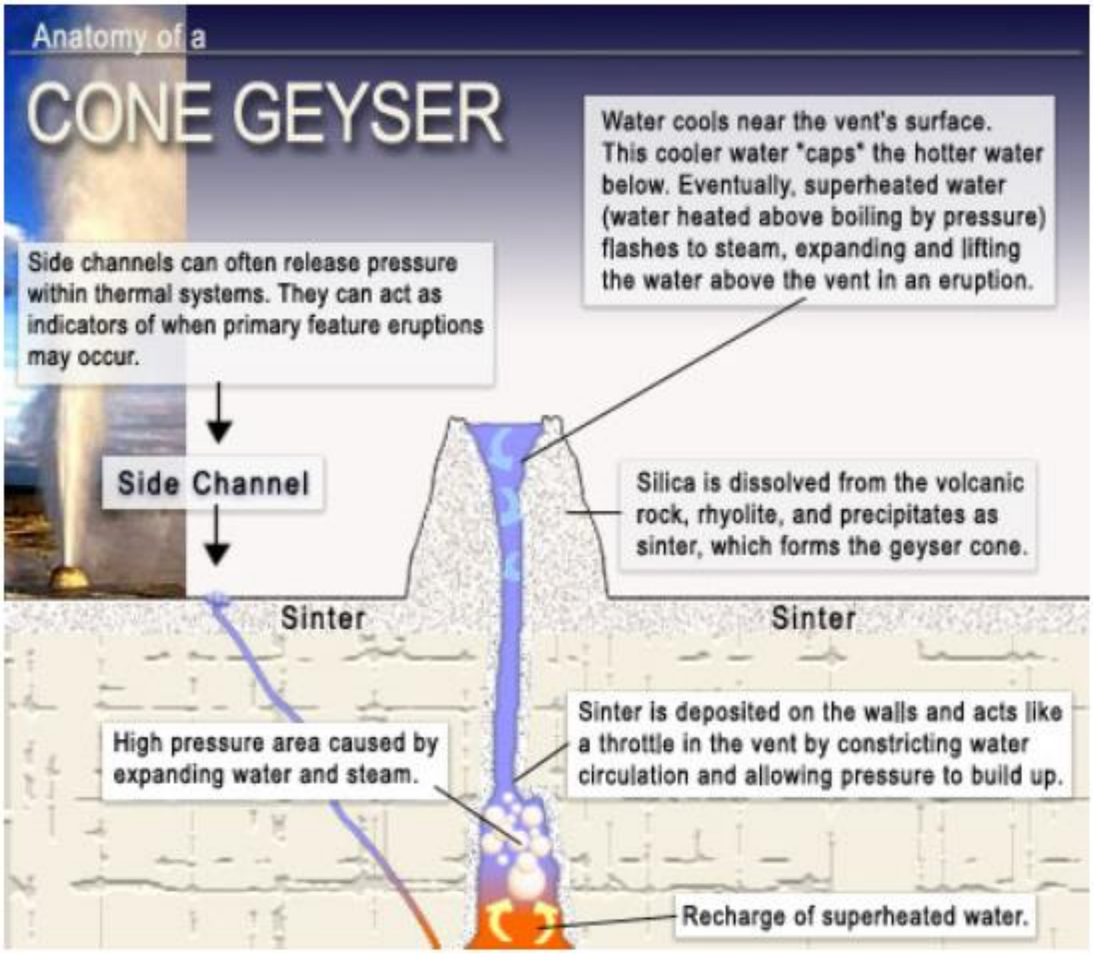
vi) **Other minor features associated with volcanism**.

a) **Hot spring** – Natural outflow of hot $H_2O$ from the ground. E.g. In Mbeya, Arusha, Mara – Majimoto.

| | |
|---|---|
| -The hot water contains minerals dissolved from the rocks .The $H_2O$ is believed to be good for rheumatism and similar culments which has resulted in spas ( health results) developing at many hot springs. | - If the steam contains much dissolved sulphurous gas, the vent becomes surrounded by yellow sulphur deposits .This type is known as sollatara. |




**FORMATION OF GEYSERS**




a) **Geysers** – Superheated $H_2O$ and steam is drawn out with great force and sometimes explosively in comes periodically.

b) **Solfatara** – Is a volcano which releases only steam and gas. The large % of gas is sulphur.

c) **Fumaroles** – Emission of steam

d) **Mofatte**– Emission of carbon dioxide.

***Stages / life cycle of Volcano.***

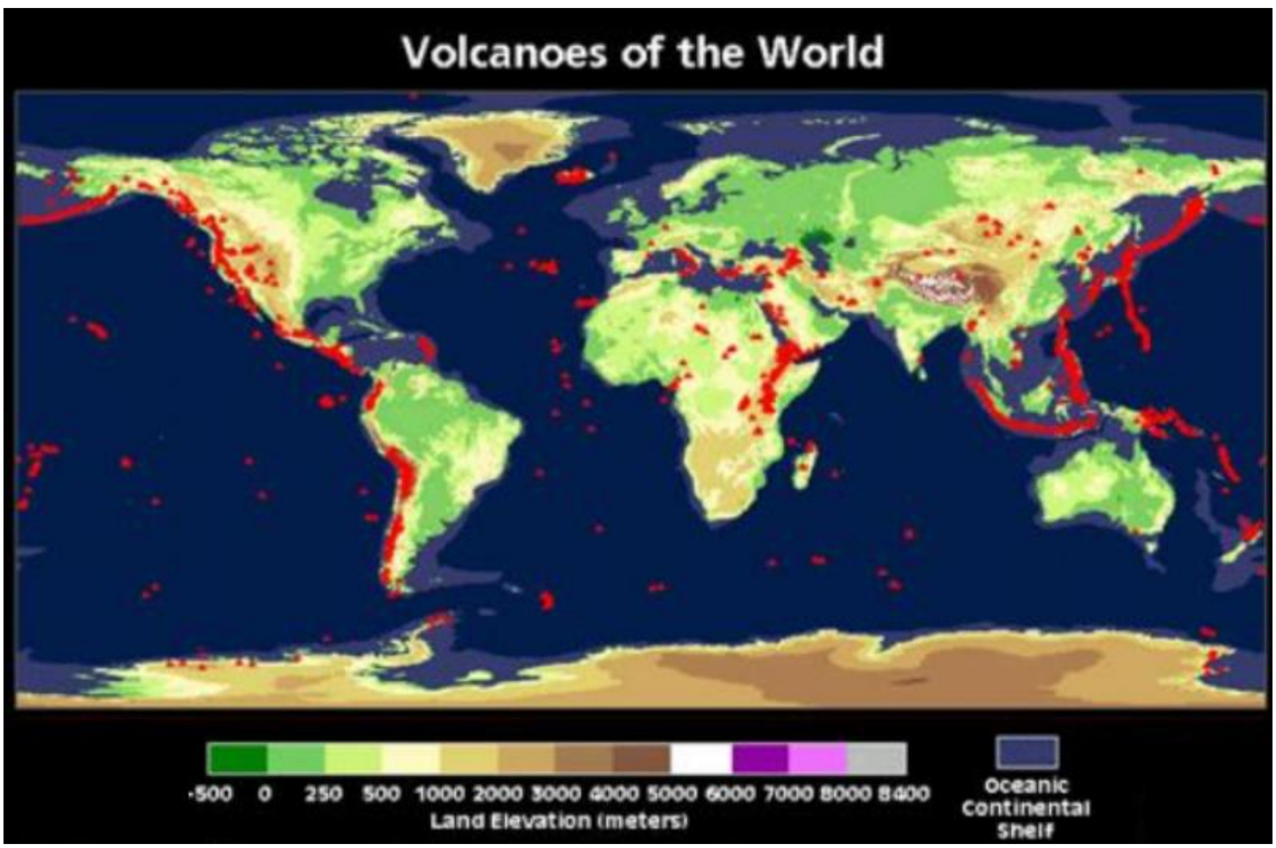
1. ***Active volcano*** – One which is definite / takes place periodically in recent time. Example oldonyo in Tanzania, Mufungiro in Uganda, Italy Vesuvius.
2. ***Dormant Volcano (sleeping)*** – Has erupted before but has stayed dormant for a long while and not sure if it will erupt again or not. E.g. Mount Kilimanjaro, Mount Meru, it has signs of eruption
3. ***Extinct (dead) Volcano*** – A volcano which has remained dormant and doesn't have any signs of eruption.

**Global Distribution of Volcanoes and lava Plateau**

Vulcanicity occurs in areas where the earth's crust disturbed. These are the areas where weaknesses in the crustal rocks provide an easy passage for volcanic materials to escape into the earth's crust or onto the surface of the earth. For this reason volcanic features and active volcanicity are associated with weaker parts of the crust. These include;

- They are common along the zones of plate tectonic convergence mainly to oceanic and continental plate where the oceanic place subjected into aesthnosphere and get heated producing magma then rises through the line of weakness.
- A long the zones of divergence where the crust spread apart giving to a line of weakness through which magma pass.
- In regions of faulting like along the great East African rift valley.
- In regions where folding as fractured the crustal rocks.

**WORLD DISTRIBUTION OF VOLCANOES AND LAVE PLATEAUS**




**Economic importance of Vulcanicity**

***Positive importance:***

1. Some lava out – Pouring have weathered to give fertile soils. These regions are of important agriculture value. E.g. Deccan plateau in India.
2. Volcanic activity sometimes results in the formation of precious stones and minerals. These occur in some igneous and metamorphic rocks e.g. Diamonds of Kimberley, Copper deposits of U.S.A.
3. Some hot springs are utilized for heating and supplying hot water to building in New Zealand and Iceland.
4. Volcanic eruptions also provide geothermal power, which can be utilized for electric generation. Geothermal power is used in Kenya and Ethiopia
5. Volcanic eruption can attract tourists and lead to the development of tourist industry in the country.
6. The calderas resulting into lakes can be useful for fishing, irrigation.
7. Volcanic activities result into the formation of different volcanic land forms such as Volcanic Mountains, which are attractive to tourists.

***Negative significance***

1. Volcanism leads to migration of people from areas of volcanic activity.

2. Leads to great loss of life

3. Leads to destruction of property.

4. Volcanic eruption causes environmental degradation

5. Occurrence of earthquakes due to the movement of magma through the lines of weakness (fault lines)

6. Some volcanic features create barriers, making construction of communication lines difficult and expensive e.g. In the Yalta Plateau.

7. The rugged nature of some volcanic landscape discourages economic activities such as agriculture and the establishment of settlement.

**4.6**

**DENUDATION AND DEPOSITION**

**Denudation** refers to all processes that involve the breaking, wearing away and lowering of the surface of the earth. Denudation involves several process such as weathering, Mass wasting, Erosion and Transport of materials.

Deposition:This is the laying down or release of the rock particles on the surface,It can be by:

1.Water producing features like flood plains.Natural Levees , alluvials fans,beaches etc.

2.By ice producing features like out wash plains ,clay plains,moraines ,eskers drumlins and kames.

3. By living organisms producing features like coral reefs.

4.By wind producing feature like loess plains and sand dunes(barchans and seifs)
5. By evaporation and precipitation producing features like salt deposits.

## I. WEATHERING

– Is the physical disintegration and chemical decomposition/decay of rocks in situ / when exposed to weather.
Weathering does not involve transport, in weathering there is no large scale movement thus weathering doesn't involve transport.
**In situ in the original or appropriate position.**

***Types of weathering***

There are two types of weathering

*i.* ***Mechanical / Physical weathering***
Is the breaking down of rocks into small particles / fragments without involving (undergoing) any chemical means / changes

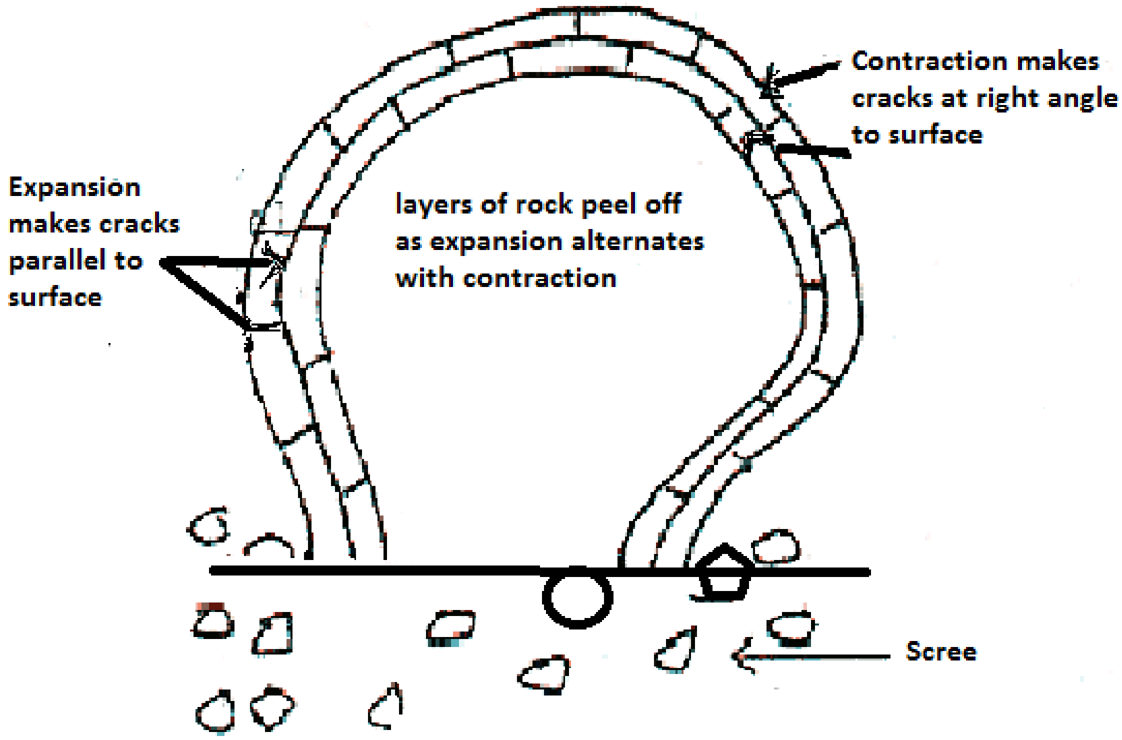
**Mechanism (How does it take place)**

i) **Temperature change**: This is best noticed / occurs mostly in hot deserts / tropical deserts. (Dominant) where there is large diurnal range of temperature during the day, temperature is very high ($45^0$c). The rock surfaces are intensively heated which causes rapid expansion which causes cracks on the surface of the rock (Parallel cracks).
During the night, temperature falls rapidly ($2^0C$). Range is $43^0C$. Rapid contraction on the rock surface which will increase cracks which are vertical / perpendicular to the surface.

- This process takes a long time (100years) and results to the peeling of rocks on the surface "Onion Peeling"
  The process is called ***EXFOLIATION.***
- A smooth mould which is called exfoliation dome remains after exfoliation has taken place
- Exfoliation particles are called Screes. These are particles which collect on the foot of a hill / rock mass This happens on daily bases.

**Why do we have diurnal range of temperature?**

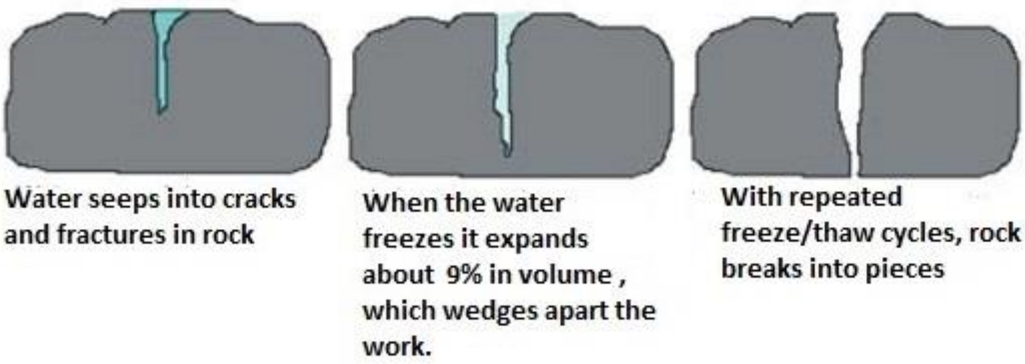
Because of absence of cloud cover. The incoming solar radiations reach at maximum and causes high temperature. And there is rapid cooling because the heat is not retained hence it removes.




THIS PROCESS IS CALLED EXFOLIATION

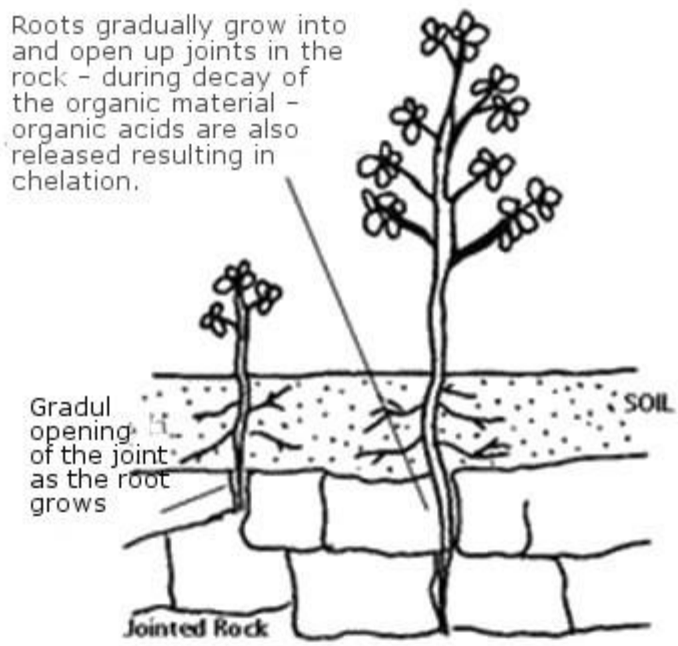
ii. ***Frost Action*** : - This is a process which is dominant in temperate regions and in high mountains (mountainous regions)

- The process occurs during summer where there melting and during winter there is freezing. It is a process which occurs seasonally.
- When $H_2O$ freezes it expands by 9% of its original volume this develops a crack. When the $H_2O$ melts it will fill the crack and when the next winter reaches the water will freeze and will expand the crack. This is continuous action which happens seasonally and eventually will lead to the disintegration of the rock.




*iii.* ***Action of living organisms: (biotic / biological).***

a) **Plants action** – Root Penetration. As the plant grows the roots grow also and penetrate in the surface which causes cracks on the ground.




b. **Animal action**.

a) Micro-organism (barrowing animals i.e. roddents,rats):
These animals make some holes on the soil whereby their activities in the soil allow weathering to reach the bedrock. This makes the soil loose hence the rocks break down.

b) Macro-organism (trampling animals and man i.e. cows, elephants) :
These animals encourage soil erosion also poor agricultural methods used by man and deforestation expose bed rock to weather.

iv. ***Alternating / alternate wetting and drying: -***

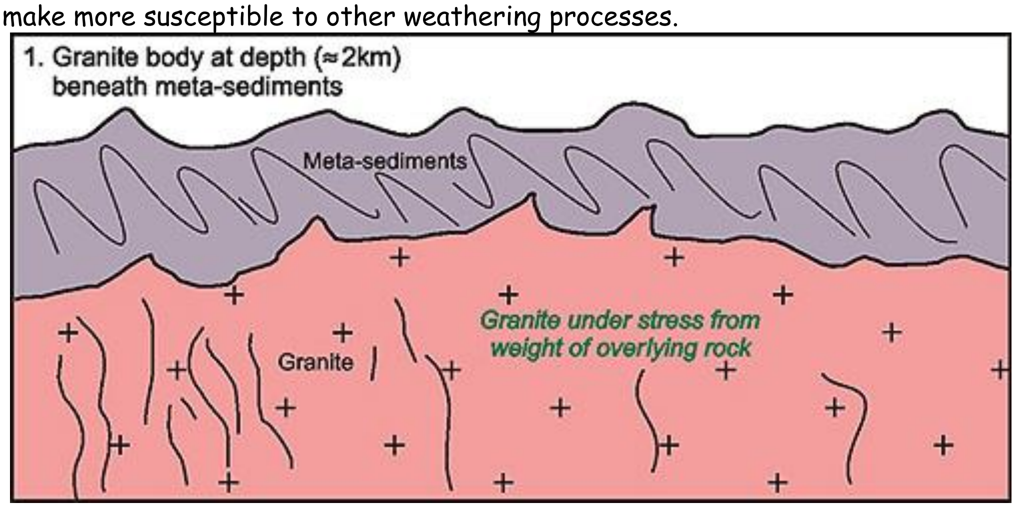
This can be dominant in coastal areas. During high tides the rock is exposed to water which causes contraction to the rock and during low tides the rock expands because it is not exposed to water. This happens daily as a result it weakens the rock and hence it breaks (it is exposed to weathering).

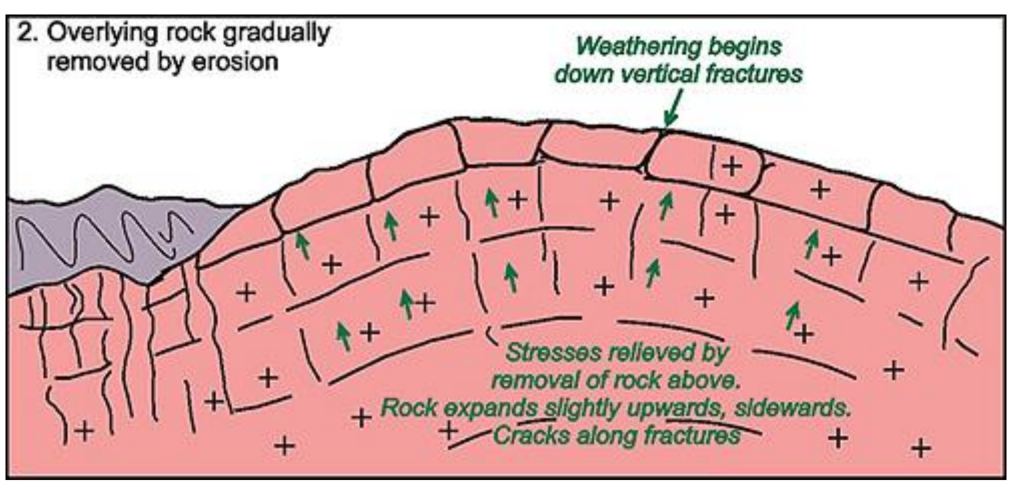
v. ***Salt Crystallization:***

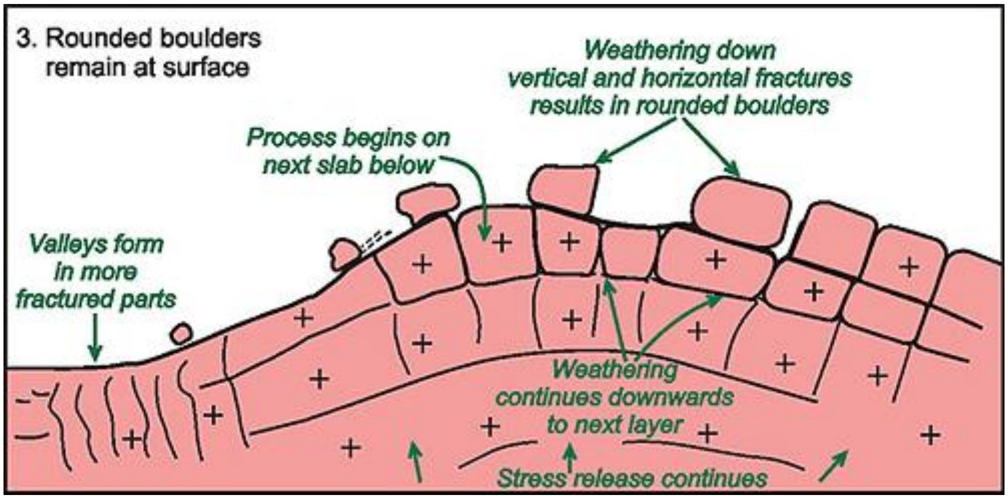
When salt water is in the rock, during dry time the water will evaporate and salt crystals will remain, these crystals are solid they will occupy space by expanding the rock and when the salt water returns the rock will contract. This continues and will hence develop a crack.

***vi.*** ***Pressure release or unloading***

It always occurs in large scale than other processes discussed it resulted from the unloading rocks during exhumation. As the overlying materials are removed the consolidating pressure are released and the rock tends to rebound. The stresses created open up joints and bedding planes. Rarely the process result to direct disintegration but is seems to be a wide spread means by which rocks are weakened and make more susceptible to other weathering processes.






ii) **Chemical weathering**

This is a process of decaying or decomposition of the rock when exposed to weather. In such process there is chemical change which weakens the rock, and makes it easily to break down by other forces / weathering agents.

Chemical weathering occurs under the following processes:

- **i. Oxidation**
- **ii. Carbonation**
- **iii. Hydration**
- **iv. Hydrolysis**
- v. **Solution**

**i.** **<u>OXIDATION:</u>**

Is the addition of Oxygen to the rock mineral. A process whereby certain mineral compounds takes additional oxygen. In that process it becomes weak and easily broken down. This is common in clay which contains iron compound when iron rusts it is oxidation.

Iron II Ferrous $\xrightarrow{\text{Decaying}}$ Iron III Ferric (unstable) Easily broken down **OR** $Fe^{2} + O_2 \longrightarrow Fe_2O_3$

ii. <u>**CARBONATION**</u> – This process takes place where there is plenty of carbon dioxide and moisture.

Is a chemical process where weak carbonic acid reacts with calcium carbonate to form calcium bi carbonate which is soluble compound which is readily removed in solution by ground water.

$$CO_2 + H_2O \longrightarrow H_2CO_3 \text{ (carbonic acid)}$$

Carbon Dioxide Water

$$CaCO_3 + H_2O_3 \longrightarrow C\,O_3Ca\,(HCO_3)$$

Calcium Carbonate Carbonic Acid Calcium Bicarbonate

Soluble: Removed from rock (leaches out)

Carbon dioxide will dissolve in rain $H_2O$ which will form weak carbonic acid, when reaches on the ground will react with lime stone in the rock to form calcium bicarbonate. The solution will come out of the rock and make the rock weak.

iii. **HYDRATION**

Some rocks take in additional water molecules which causes stress to the rock / expansion and that expansion causes internal stress and fracture. In this case the rock becomes weak and easily broken down by other processes.

E.g. Haematite combines with water to give limonite

Haematite + water $\longrightarrow$ limonite

$$2Fe_2O_3 + 2HOH \longrightarrow 2Fe_2O_3.3H_2O$$

(Red) (Yellowish) Hydrated feroxide (weaker)

iv. **HYDROLYSIS:**

This process involves hydrogen (in the water) combining with certain metal ions (in a mineral) that is the water and the mineral react chemically which gives rise to the formation of different chemical compounds.

$H_2O$ reacts with minerals rocks and carbon dioxide to form clay minerals, silica and potassium carbonate which is soluble and leaches out leaving the rock weak.

$$\underbrace{2KALSi_3O_8}_{\text{Feldspar}} + \underbrace{2H_2O}_{\text{Water}} + \underbrace{CO_2}_{\text{Carbindioxide}} \rightarrow \underbrace{AL_2Si_2O_3(OH)_4}_{\text{Clay minerals}} + \underbrace{K_2CO_3}_{\text{Potassium}} + \underbrace{4Si\,O_2}_{\text{Silica Carbonate}}$$

v. **SOLUTION** – Nacl + $H_2O$ = salt solution.

Where rock comes into contact with water and salt it disintegrates.

**vi. BIOTIC WEATHERING** –Associated by plant roots, where by root tips are secretes acid which react with rocks and they disintegrate

Decaying organs produce organic acids which when come into contact with rocks it disintegrates.

Organic acid of decaying vegetation – weathering of rock

**FACTORS WHICH INFLUENCE THE RATE OF WEATHERING**

1. **1.THE NATURE OF THE ROCK** – soft or hard
   a) Mineral composition. - This varies from one rock to another and hence affects its resistance some rocks tend to be stable, while others are unstable depending on their mineral composition. For example, rocks **like granite with quartz are stable** and very resistant to weathering hence weathering process will be slow which rocks which are unstable like basalt which have lower silica undergo weathering very fast. Iron minerals undergo oxidation very fast; rocky salt (sodium chloride) rocks dissolve quickly in water.
   b) **Plane of weakness or rock structure** – Through joints, weathering takes place very fast, since acids can penetrate easily into the rock and cause the rock to decay during chemical weathering. And frost action tends to be fast in the areas where the rocks have some cracks.
   c) **Color-** rocks with dark minerals (olivine) heat faster than rocks with light minerals. Thus, the rate of weathering by temperature change is higher to rocks with dark minerals.

2. **2. CLIMATE**

Variation of climate cause differences in the rate and type of weathering. The main climatic controls are of temperature and humidity. However the role of climate in weathering is extremely varied region to regions depending in temperature and rainfall patterns. Hence type of climate determines the rate and type of weathering.

a) Equatorial regions – These are characterized by high temperature and rainfall throughout the year. Chemical composition of rocks is very active in these latitudes due to high temperature and high rainfalls totals.

b) Tropical (Savannah) regions – These are characterized by the seasonal variation of rainfall and temperature i.e. there is dry and wet seasons. Due to the presence of both seasons, both chemical weathering and mechanical weathering takes place. Chemical weathering during wet seasons and mechanical weathering during dry seasons.

c) Hot Deserts – These are characterized by large diurnal temperature range i.e. day temperatures are extremely high while night temperature fall more rapidly. There is low amount of rainfall and excessive evaporation. Both mechanical and chemical weathering take place mechanical by the process of exfoliation and (frost action) and chemical by salt crystallization due to excessive evaporation.

d) Mountain regions – These are characterized by high humidity and low temperature. Hence, frost action is active in tropical regions where there is an existence of mountains with height above 430m like Elgon and Ruwenzori, frost action is also common.

3. **3. RELIEF (Slopes)**.

At steep slopes the rate of physical weathering will be fast but chemical weathering is retarded because $H_2O$ moves (no penetration of water).

On lowland, physical weathering will be slow because weathering is protected by weathered materials and chemical weathering will be faster because water is there and will influence weathering.
Under relief there is aspect -is the position of a place in relation to sun rays. North facing slopes do not face sunlight hence it is less developed and weathering takes place slowly but in the south facing slope, weathering takes place fast and well developed soil and good vegetation.

- In the tropical regions there is no aspects
- In mountainous regions frost action takes place actively.

4. **4. ROCK AGE**.

Old rocks are more susceptible to weathering as they had enough time been much subjected to different weather forces compared to young rocks. It is thus, the rate of weathering is higher to old rocks compared to young rocks.

5. **5. BIOTIC ACTIVITIES**

Biotic activities contribute a lot to weathering in varied ways and include;

- Penetration of plant roots causes physical destruction of rocks.
- Some plants and animals secrets acid from their bodies leading to decomposition of rocks.
- Burrowing of animals also cause mechanical weathering

- When the living organisms in the soil respire, give out carbon dioxide gas. The gas dissolves in water to form carbonic acid, which cause decomposition of rocks.
- In other way round, thick vegetation cover, such as tropical forests acts as a protection against physical weathering and also helps to slow down the removal of weathered materials.
- Human activities, poor methods of agriculture expose the bed rock to weathering.

***Study Questions***

1. ***1. Discuss exhaustively the role of water in the weathering process.***

2. ***2. Where and for what reasons mechanical weathering is a dominant process.***

3. ***3. "Mechanical weathering and chemical weathering processes are interdependent and complementary" Discuss.***

***4. Weathering is not influenced by force of gravity but mass movement is influenced by force of gravity.justify***

**II. MASS WASTING (Mass Movement)**

Is the down slope movement of weathered materials under the influence of gravity. In this movement, there is no transporting agent.$H_2O$ is involved as a lubricant and not a transporting agent. Water helps to reduce friction of particles within weathered materials. And also water adds to bulkiness, this will facilitate the process of mass wasting.

**Types of mass wasting**

**Two types according to the speed of movement**

a) Slow mass movement

1. Soil creep
2. Solifluction
3. Talus creep
4. Mudflow

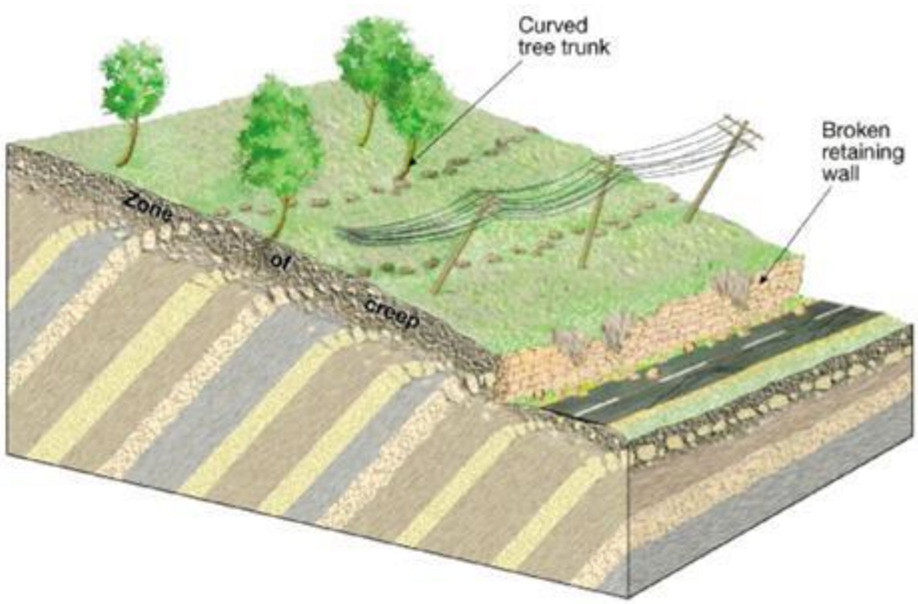
b) Rapid movement

1. Slump
2. Rock slide or sometimes both slump and rock slide are called "land slide".
3. Rock fall

## 1. SOIL CREEP

Is a steady downward movement of soil on all sloping land. Rain water lubricates soil particles and enables them to slide over each other.

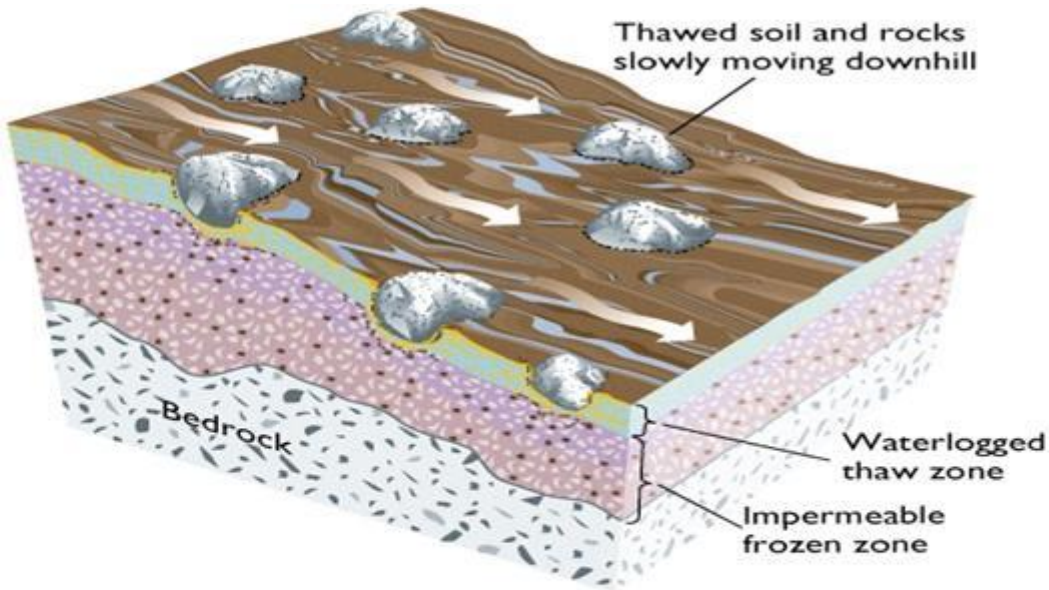
- Ø Is the slowest and imperceptible movement of weathered material, mainly fine soil down a gentle slope.
- Ø Soil creep can be manifested through mounds of soil behind the walls, tilting and cracking of walls, bending of trees, fences and telegraph poles as well as cracking of the road.




In equatorial regions creep is often disguised by dense vegetation cover.

## 2. SOLIFLUCTION

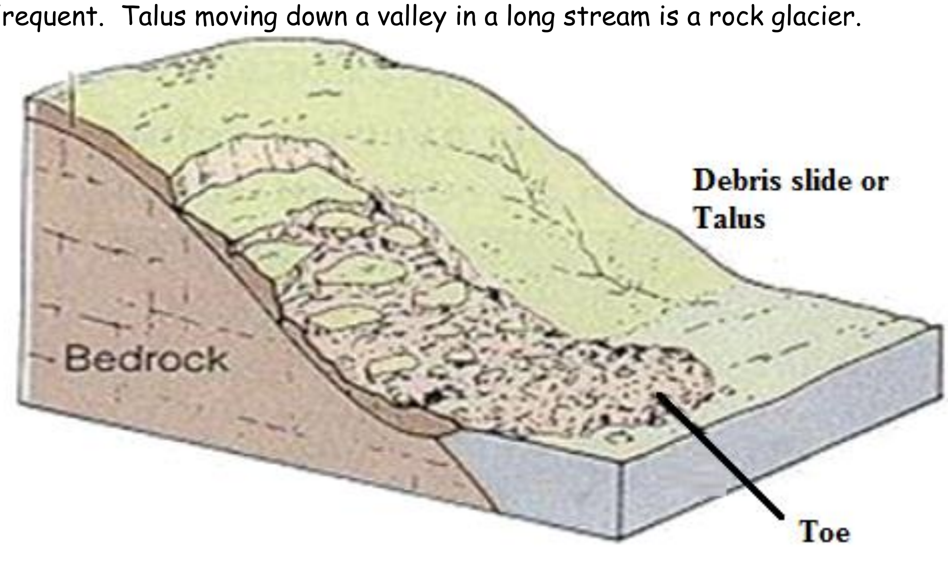
Movement of weathered materials under frost areas. It is limited to mountain and cold climate areas where thawing causes a saturated surface layer to creep as a mass over underlying frozen ground. (Saturated soil, gravels and weathered rock).




## 3. TALUS CREEP

This is also a very slow movement of angular waste rock of all sizes (talus or scree) down a slope. It is common on the sides of the mountains, hills and scraps. It takes place where free- thaw action is common especially in the highlands and high latitude regions.

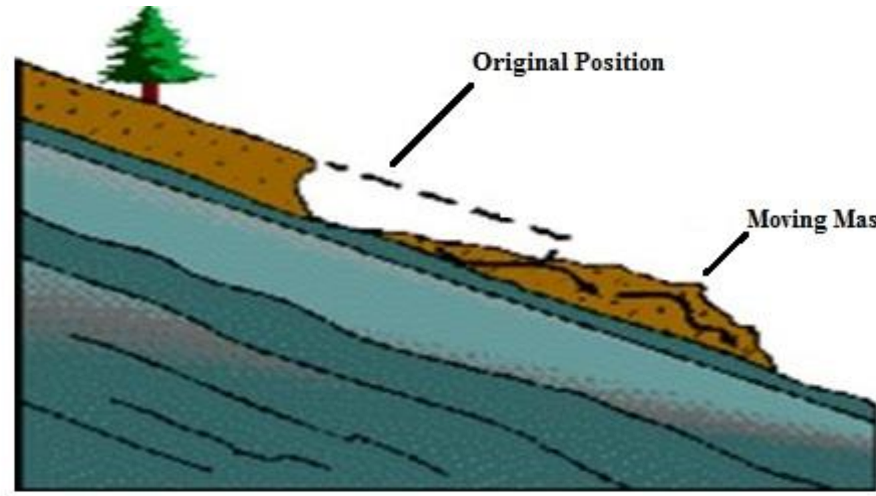
Large talus sheets move mass especially in mountains where freeze – thaw is frequent. Talus moving down a valley in a long stream is a rock glacier.




## 4. MUD FLOW.

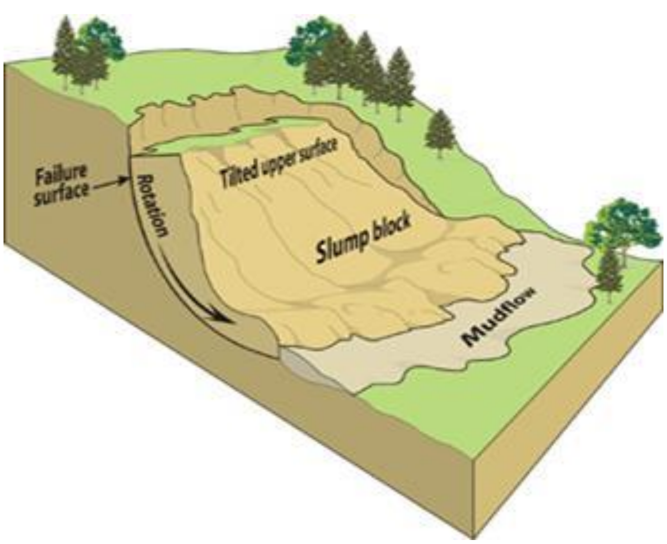
Movement of large volumes of unconsolidated materials which are super-saturated with water, the materials flow as semi-liquid mud (as slurry) with boulders and gravel embedded in mud.

Large volumes of unconsolidated material, super-saturated after heavy rain, become plastic and flow common in acid and semi arid region.




5. **SLUMP.**

Massive rocks overlying weak rocks saturated by heavy rain common on over steepened slopes. Large masses of rock and debris.




6. **ROCK SLIDE.**

Is sliding movement of the slab of rock down the steep slope, no rotation is involved. It can be triggered off by earth quake or human activities like mining or cultivation.

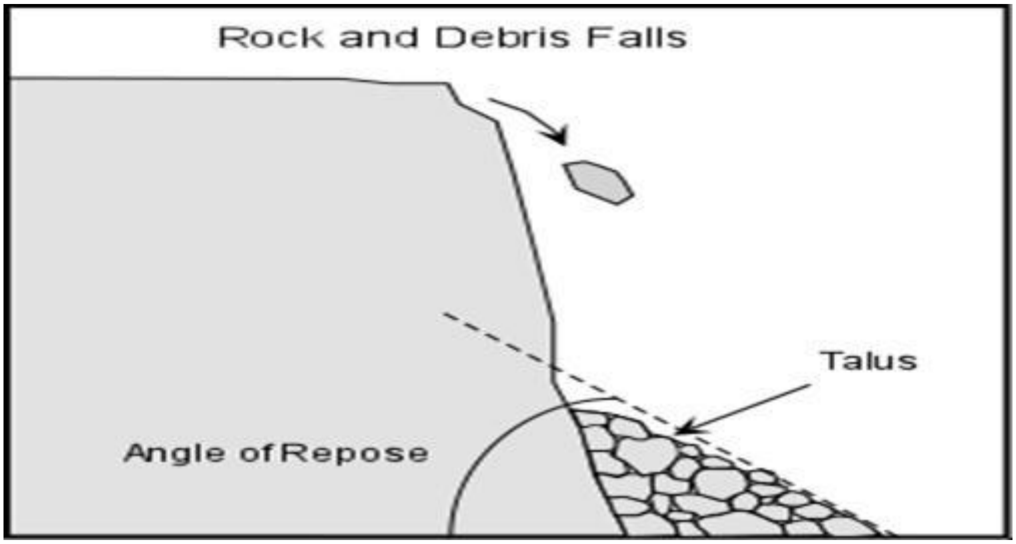
Surface rocks sliding over a slip surface formed by bedding or fault planes dipping sharply down slope.

## 7. ROCK FALL

Is a falling movement of individual rock blocks with boulders along a precipitous (steep) slope of a mountain or along road cuttings or cliffs.

Precipitous slopes in mountains where well jointed rocks may be loosened by freeze – thaw.

Rocks accumulate as a talus slope along valley sides.




**FACTORS WHICH AFFECT THE NATURE AND SPEED OF MASS WASTING**

1. **a). The degree of saturation and nature of weathered material**

The more saturated the weathered material is the faster the rate of movement. Because there is more friction between particles.

Depth of weathered materials, weakly bedded and steep dipping the faster the rate of movement.

2. **b). Gradient.**

Steeper the slope, the faster the rate of movement and vice versa.

3. **c). Climate.**

Amount of rainfall, nature of rainfall , the annual and day temperature ranges. Heavy rain or alternative freezing and thawing encourage movement.

Heating and cooling.

4. **d). Vegetation cover.**

Absence of vegetation cover to hold the materials will increase the speed of mass wasting.

5. **e). Human activities.**

Mining, overgrazing and keeping of animals are among the ways in which man has affected the stability of the surface and facilitates the rate of move.

6. **f). Earth movement**

Especially earth quake which can disturb the rocks and encourage mass wasting.

**Effect of mass wasting**

i. **1. Loss of life.**

Example, for those who build their settlement down the hills, rock fall many occur for mountain climbers the avalanche may fall.

ii. **2. Destruction of property.**

Example, those farms which are on the foot of the hill or on a slope may be destructed by mass wasting (soil creep, land slide, rock fall) buildings, roads, railway lines, river all these become blocked by mass wasting and land slide.

iii. **3. Attract tourism.**

The resulting feature after mass wasting has occurred can arrange the rocks in such a way that is attractive to the human eye. Also human beings like to see the effects of a disaster first hand.

iv. **4. Land degradation.**

Removal of fertile soil from the land. It leaves scars which is less value than the before land.

v. **5. Formation of fertile soil on the foot of the hill where weathered materials have accumulated.**

vi. **6. Can dam a river to form temporary lakes.** But the weathered materials are loose hence water will remove the weathered materials and the river will continue to flow.

**PRECAUTIONS:**

ü - Afforestation and reforestation on slope lands. This will help to the stability of weathered material, will reduce rate of move.

ü - Control human activities. Especially poor methods of agriculture (contour cultivation will stabilize the farm).

ü - Avoid establishing settlement in areas which are prone to mass wasting.

ü - Making of terraces across of slopes.

**Study questions.**
**Carefully distinguish mass wasting from weathering.**

| **Mass wasting** | **weathering** |
|---|---|
| 1. Influenced by gravity | 1. Disintegration and decomposition of rock. |
| 2. Movement of weathered materials | 2. Types include physical and chemical |
| 3. Types include slow mass movement and rapid. | 3.Generally restricted to material breakdown in place |
| 4. Processes range considerably in rate | 4. Is a surface phenomenon |

**EROSION**

Is the detachment and removal of weathered materials from the surface of the earth surface by agents of erosion.

OR Is the process of breaking up and wearing away of exposed rocks by moving water,wind and moving ice.

**Agent of erosion;-**

There are four agents of erosion

i. Running water
ii. Wind
iii. Glaciers (moving ice)
iv. Waves and tidal currents.

## EROSION BY RUNNING WATER

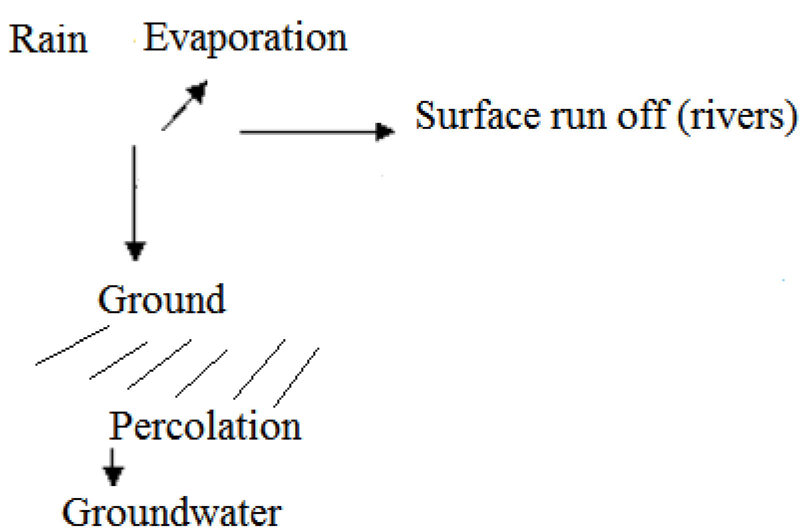
**What is running water?**

· Is any water which falls on the ground and flows down slope under the influence of gravity.

When water in running on the surface performs three functions ,that is Erosion,Transportation and Deposition.

***What happens when water fall on the surface of the earth?***

- Percolation – When $H_2O$ is absorbed in the ground.
- Evaporation-Rain
- Surface run off- Is most effective agent of erosion over the earth surface




**Surface run off cause's soil erosion**

**Types of erosion**

1. ***Sheet erosion.***

Uniformly removal of upper soil without well defined channels.

Removal over a large area of a top layer of soil and other fine materials by a thin sheet of $H_2O$ flowing over a fairly smooth surface.

2. ***Rills erosion***

Removal of upper soil from surface with well defined channels called rills. The impact of rills is more effective than sheet erosion.

3. ***Gully erosion.***

If rills are not checked they will collide and come larger and to form big channels called gullies. Removal of soil by these gullies is what is called gully erosion. Gullies are also grooves or depression of v-shaped.

4. ***Splash erosion***.

Is the rain drop impact on the surface. Particles are displaced by rain drops (loose dry materials).

**Impact (result).**

i. Formation of small channels which will leads to formation of badlands. ( smooth land – bad land which is less useful)

a) Bad land

b) Gullies

c) Rills.

## EROSION RIVER, WIND, GLACIER AND WAVES

**RIVER**

Mass of water flowing in a natural channel over the earth surface from the high land to low land under the influence of gravity.

**TYPES OF RIVER**

**1. Perennial River**:-These are rivers which flow throughout the year .The source of these rivers is the region with a abundant and well distributed rainfall throughout the year. E.g Nile River(Africa),The Congo river(Africa) and the Amazon in South America.

**2.Intermittent Rivers**:-These are the rivers which flow only during the wet season in the regions which receive seasonal rainfall.

**3. Ephemeral Rivers:**-These are the rivers which appear during the rainy season in the areas which experience very little rainfall especially the desert.They tend to disappear immediately after the rain season has stopped.

**River vs stream**

- River and stream are used interchangeably.(used the same way)

**Terminologies associated with rivers.**

1. **Rivers head. (River source).**

Is a point where the river or stream begins. It makes its first appearance on the surface / it is the highest point on a river system.

***Possible river sources***

a) Lakes - R. Nile in Lake Victoria.

b) Mountains with plenty rainfall e.g. Rockies and Appalachian ( Mississippi river ) R. Ganges, Indus (Himalayas)

c) Springs.i.e. Thames River in England.

d) Melting ice i.e. Rhine river in France.

2. **River mouth**.

Is a point where the river ends. The lowest point / base level of the river.

***Possible river mouth***

a. Oceans - River Rufiji - Indian ocean.

- River Nile - Mediterranean Sea.

b. Lakes - River Kagera - Lake Victoria

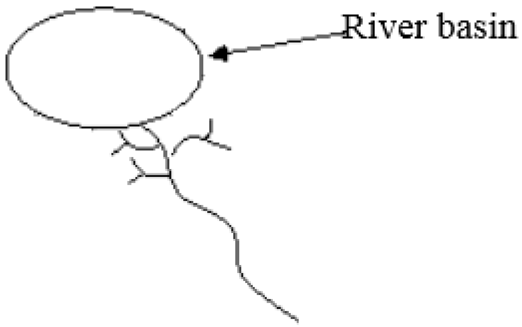
-River Malagarasy – Lake Tanganyika.

c. Swamps

d. Others rivers - (Blue Nile meets with White Nile)

3. **Water shed/ catchment area/River basin**.

Is a collecting ground of single river system. Where a river collects its water.




**Tributary**:Is a branch of river pouring its water into a main river.

**Distributary**: Is a branch of a river which collect its water from the main river.This is more prominent in the lower stage as is associated to delta formation.

4. **Divide:**

Is a highland separating two adjacent river systems.

5. **River system**:

The main river and its tributaries ( distributes)

6. **River valley**:

Lowland between two hills of drainage basin where at the bottom the river flows. (At the lowest point a river flows)

7. **River bed:**

Is the actual part of the river which is covered by water (flowing water).

8. **River load**:

Is the materials carried by running water.

**WORK OF RIVERS**

Works of a river includes three processes.

a) **Erosion**

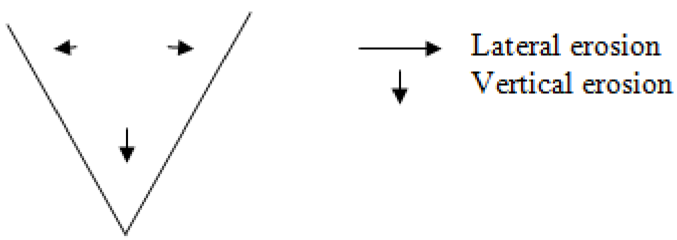
b) **Transport**

**c) Deposition**

1. **RIVER EROSION.**

Is the progressive removal of materials from the floor and side of the river / progressive removal of materials from the river bed.

Vertical erosion. - Deepens the river channel.




Section across a river channel.

Lateral erosion – Widens the stream.

Head ward erosion - Takes place on the upper course which lengthens the stream.

**The process of river erosion is accomplished through four interaction process.**

i. **Hydraulic action**

Refers to the force of moving water which is able to remove loose materials such as gravel, sand and silt and which is able to weaken solid rock by surging into cracks in the rock [from the sides and the floor of the river]

ii. **Corrosion**

Is solvent action of water (solution). Process of removing soluble materials by moving water e.g. Limestone or Calcium carbonate.

iii. **Corrasion**

Wearing away of the river bed by the load of the river.

iv. **Attrition**

Impact of the load of the river upon itself, this takes place because the rock fragment which made up the load are in constant collision with each other.

2. **RIVER TRANSPORTATION**

Movement of materials from one place to another by the river.

Mechanisms:

i. **Suspension.**

A lite material whose specific gravity is less than one is carried above the floor as suspended load.

ii. **Saltation**

Those particles which are large are transported in series of hops (bounces from one point to another, touches the floor at given interval).

iii. **Traction.**

Transportation of the load by dragging on the floor. Continuously touches the floor.

iv. **Solution.**

If river passes through soluble rocks, the materials dissolve in water and become soluble and cannot be seen.

- Transportation of the load depends on the **energy** and **power** of the river.

**Powe**r – ability to do work but power depends on energy to be able to perform a certain work.

**Energy of the river**

Depends on

i Volume

ii Velocity.

Volume + Velocity = Discharge.

i.The volume of the river is how large the river is (size)

ii.The velocity - How fast the river flows.

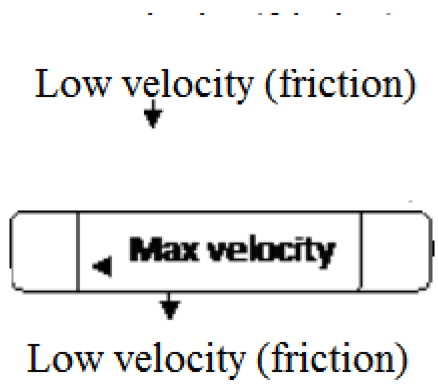
- Large volume will have more energy than a slow flowing river also the larger the velocity the greater the energy.

- Volume and velocity of a river is what is called river discharge ( is the number of cubic meters per second passing through a particular section river ) ($m^3$/sec)

- This discharge is measured by a current meter which is placed in the river which has a dialogue (current meter) which automatically records the energy of the river at any point.

-The velocity of a river varies from one place to another across the channel, Due to ;

i.The middle part of the river has maximum velocity.(maximum energy ) because the friction is less.

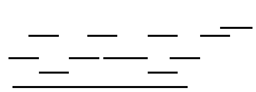



ii.Velocity of the river varies with gradient. A river with steep gradient has high energy compared to a river.

iii.The shape of the channel also has great influence on the energy of the river.

- A shallow and wide channel has less energy because friction is less compared to a wide channel.

A.Channel B losses more energy through friction than channel A but channel C has the greatest available energy due to the channel.



B. Due to the large size of the channel.

C. It is important to note the difference between the river channel and the river valley.

**THE HEIGHT OF A RIVER ABOVE THE BASE LEVEL OF THE RIVER.**

**Base level of the river.**

Is the lowest level of a river can erode. When a river ends on the lakes or oceans is the base the river.

-The height of a river above its base level gives it what called potential energy (P.E). (Energy due to position.)

-When water flows, potential energy is converted into kinetic energy which does the work of the river.

***A river uses its potential energy to.***

*i.* To overcome friction in the river bed.

*ii.* To erode

*iii.* To transport the materials /load.

- The rate of erosion along the river channel depends on;

*i.* *Volume of the river.*

The larger the volume of the river the higher the rate of erosion.

*ii.* *Velocity.*

The higher the velocity the greater the rate of erosion (greater the rate of distraction) *iii The type of rocks over which a river flows:*

A river can flow over soft rocks, erosion will be more and rate of distraction will be high but if flows over hard rocks, erosion will be low.

*iv Type of cutting tools (type of load the river carries).*

To do corrosion if it takes large load the rate of erosion will be high compared to a river which carries small load the rate of erosion will be low.

**RIVER COMPETENCE AND RIVER CAPACITY**

**RIVER COMPETENCE**

Is the ability of a river to carry large load in term of size individual particles.

- At particular places and particular velocity.
- A river competence is high where a river is narrow because the energy is higher compared to large slow moving water because energy is slow.

**River capacity**

Is the ability of a river to carry a large load in terms of the volume.

- A large slow moving river has high capacity but low competence and vice versa.
- A fast flowing moving river has high competence but low capacity.
- The ultimate goals of a river are to being the land above the sea level to its base level. But this cannot be achieved because there is adjustment.

3. **RIVER DEPOSITION.**

**What is river deposition?**

Lay down /dropping of the load transported by a river.

Why deposition.

- It deposits its load when the energy of the river is insufficient to carry the load further.

**When does this occur?**

*i. When the volume of the river decreases.*

When the does the volume of the river decrease and force deposition?. When it enters arid and semi-arid regions (dry land /hot desert) because evaporation increases and percolation increases (more reduction of water in the channel as it Wets the ground) or when it enters regions of porous rock and limestone regions or in the dry seasons (droughts) because no addition of water from rainfall.

ii. *When its velocity decreases (speed).*

*When does the speed decrease? When the gradient falls velocity decreases and energy decreases*

iii. *When a river enters a lake or swamps the speed decrease because it meets with another force.*

iv. *When a river enter ocean/sea. Because it encounters some waves and tidal currents (encounter forces).*

*The stronger the encounter force.*

v. *When the river channel widens. Friction increase where by the energy decrease and leads to deposition.*

**DEVELOPMENT OF THE RIVER VALLEY**

**Long profile and cross profile of a river.**

**Long profile of a river:**

Is the whole length of a river from its source to its mouths.

**Cross profile of a river:**

Is the width across the river from bank to bank.

- River erosion leads to development of varies features along the valley as erodes from sources to mouth. These features are studies acquired to stages of the river.

**THREE STAGES OF A RIVER**

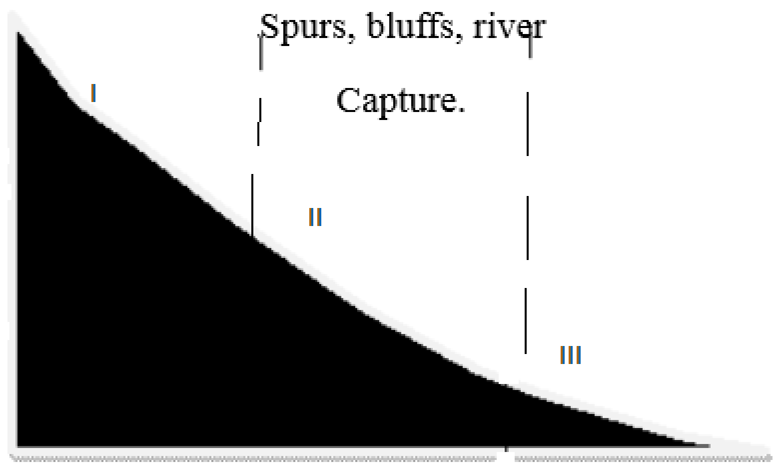
Upper / torrential / youthful stage

Middle / mature

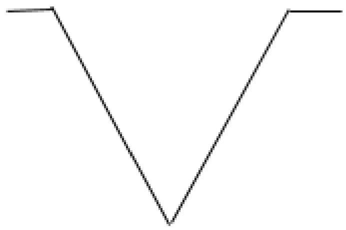
Lower / old /plain

## LONG PROFILE OF A RIVER FROM ITS SOURCE TO ITS MOUTH

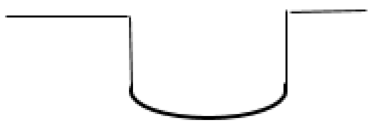
| I | II | III |
|---|---|---|
| **Upper course;** | **middle course:** | **lower course;** |
| Vertical erosion | vertical & lateral | depositions |
| Are dominant gorges, | erosion both | dominant |
| water fall, rapids | important | flood plains, |
| | Meanders River | Ox - bows lakes, |
| | Cliff, interlocking | levees, delta. |
| | Spurs, bluffs, river | |
| | Capture. | |



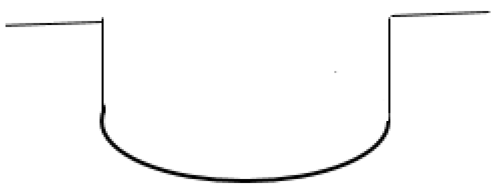

## CROSS SECTIONS



Upper Course



Middle Course



Lower Course

**CHARACTERISTIC FEATURE OF YOUTHFUL STAGE /UPPER**

1) Deep, narrow valley (v-shape) because vertical erosion is dominant. Therefore it deepens the valley.

2) Valley has step gradient –The speed of the river is very high

3) Presence of pot-hole

4) Presence of interlocking spurs

5) Presence of water fall and rapids.

**POT –HOLES**

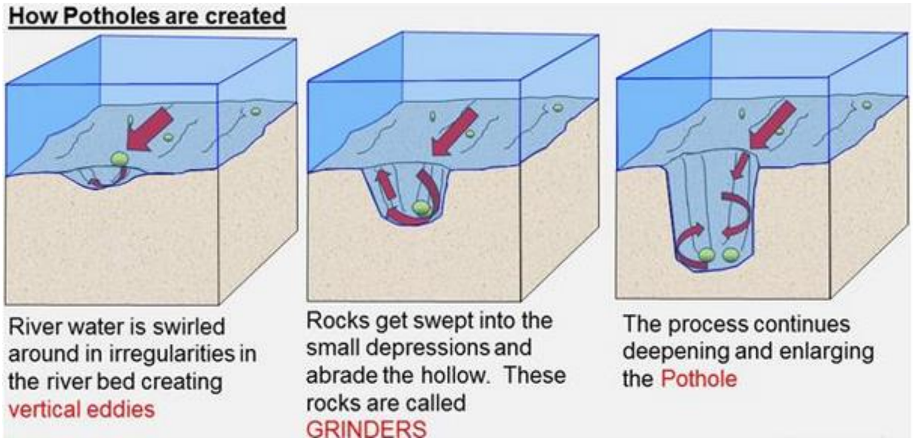
–These are circular depression on the river bed.

-$H_2O$ swirl when it passing on that depression

- Formed where the rock is softer than the surrounding rocks due to uneven river bed. Erosion of fast flowing water swirls in the depression deepening and widening it.

-A. pothole can be much wider and deeper depression

Form at the base of a water fall and form a plunge pools.




**Presence of inter locking spurs**.

What are spurs?-is a high land projecting into a lower land. A river at the upper course cannot overcome obstacle it will swirl around the obstacles.

-Spurs alternating on either side of the river interlock/overlap

**Waterfalls** -A sharp breaks on the river channel where the water falls from higher level to a lower level.

**Causes of water falls**

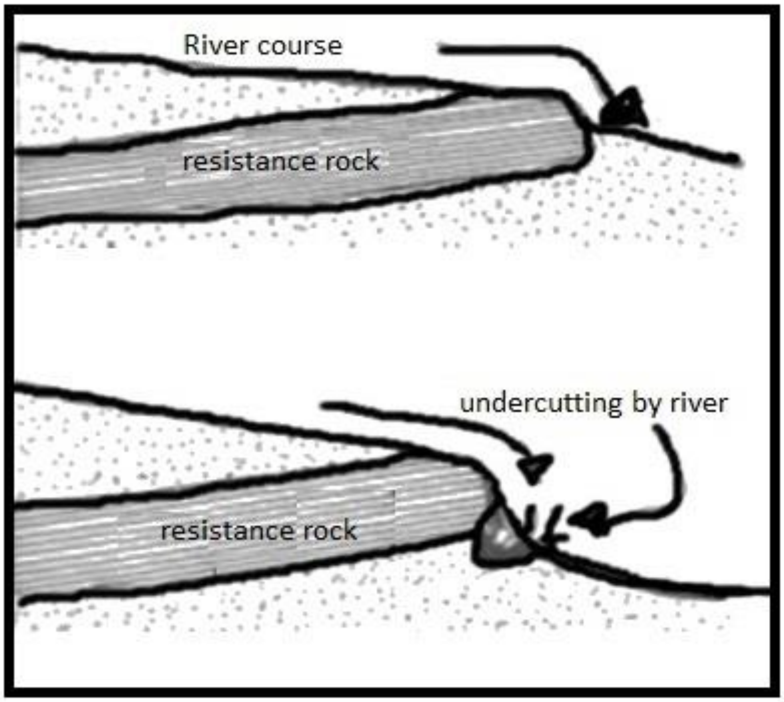
1. Difference in rock hardness
2. Uplift of land (tectonic forces ) (earth movement)
3. Glaciated valleys.
4. At a cliff.
5. River rejuvenation.

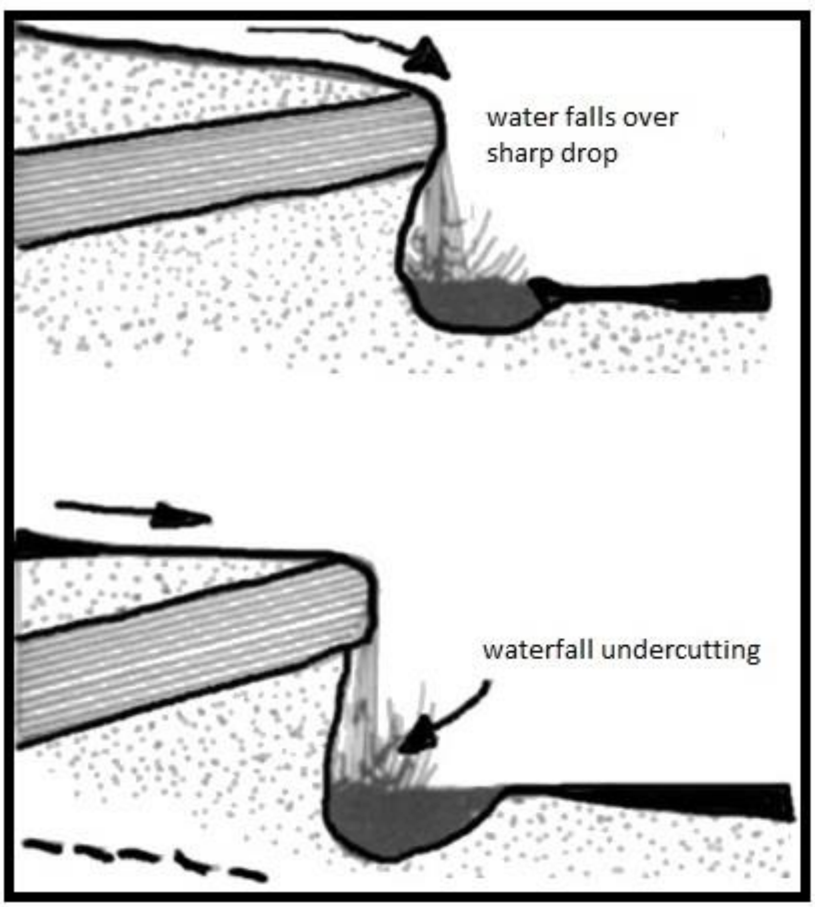
Waterfalls formed by difference in rock hardness

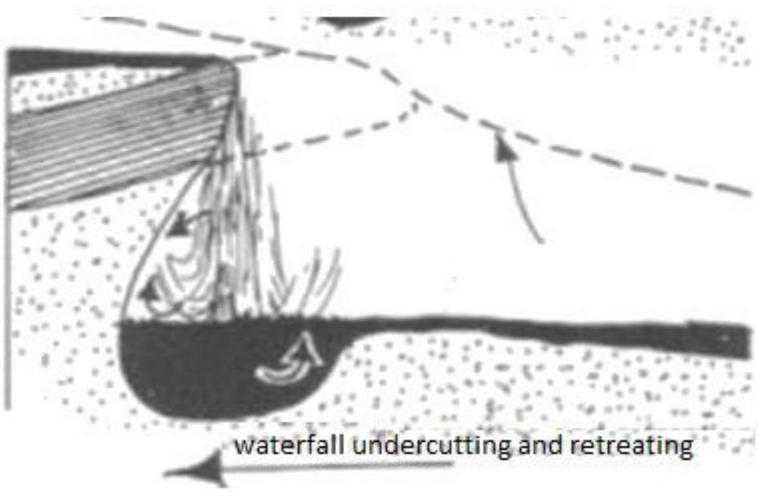
a) Inclination of the hard rock. Rock layer is horizontal

b) Rock layer dips up stream

c) Rock layer is vertical. (vertical dyke


River course
resistance rock
undercutting by river
resistance rock


water falls over
sharp drop
waterfall undercutting




Example of water falls

1) Gersoppa falls India

2) Victoria falls Zambia

3) Niagara falls between lake Erie and Ontario

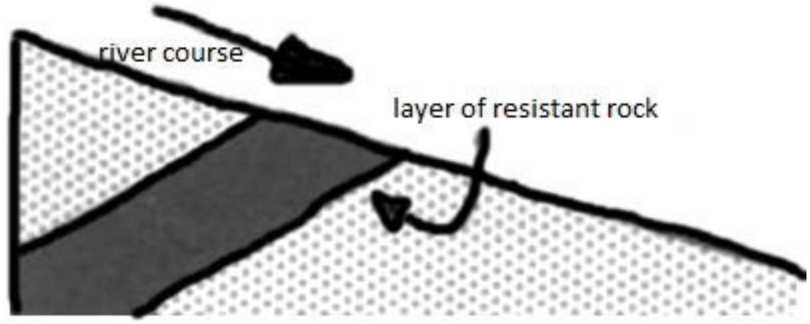
4) Living stone falls Zaire river

**Rapid** -: Is a part of stream where there is sudden increase of speed/velocity of water in a stream/river.

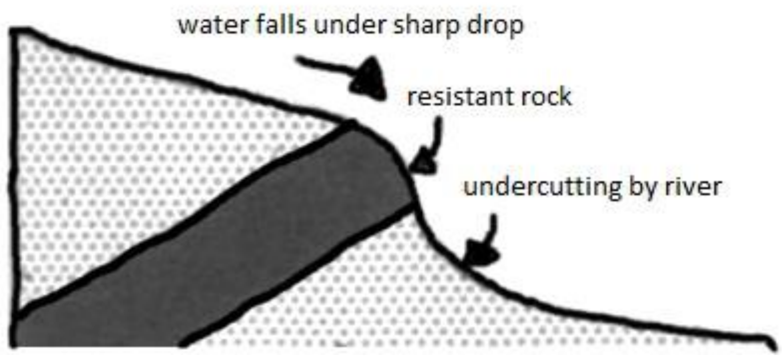
**Causes of Rapids/when do they occur**

i. When the hard rock dips gently down stream

Rapid.

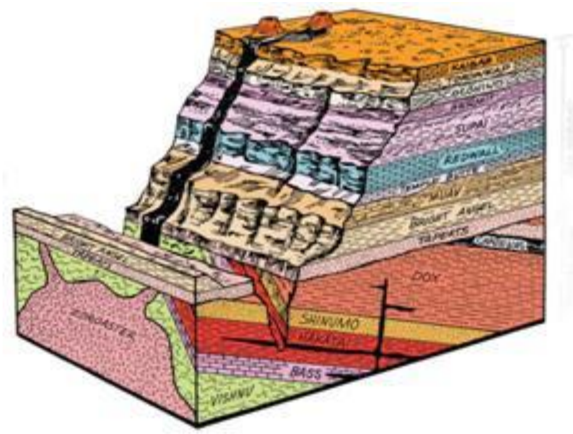



ii. <u>During recession of water fall (Retreats)</u>




***Gorges*** - An elongated steep sided trough/hollow (deep) always occur where waterfall retreats. (Waterfall migrate up to river)

***Canyons*** - Formed by $H_2O$ recession or uplift of the land (areas of up lifting) e.g. the grand canyon.




**CHARACTERISTIC FEATURE OF MIDDLE/MATURE STAGE**

1) Valley has open V – shaped valley ->because lateral erosion is dominant.

2) The speed of the river has decreased because slope decreased volume/ has increased because more tributaries join it and this in turn means that the river load increases.

3) River beds are pronounce because of maximum erosion on the concave side and even undercutting of the outside of the curve, the concave banks stand up as river cliff ;because there little erosion or even deposition on the inside of the bend ,the convex bend slope gentle as clip – off slopes (smoothed ends of spurs ). The river starts to meander and river plains are formed.

4) Bluffs – As spurs are removed, their remains form a line of bluff on each side of the valley floor.

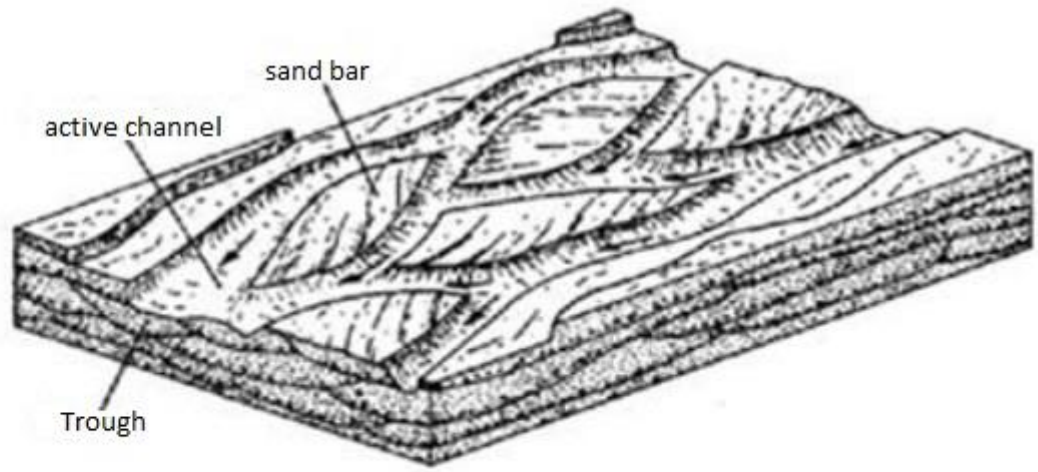
5) Deposition start to take place on a fully mature valley

**CHARACTERISTIC FEATURE OF OLD/PLAIN STAGE**

1-The gradient is very low and a river develops meander aimlessly along a wide flood plain. Its energy has decreased hence cannot overcome obstacles it then create banks

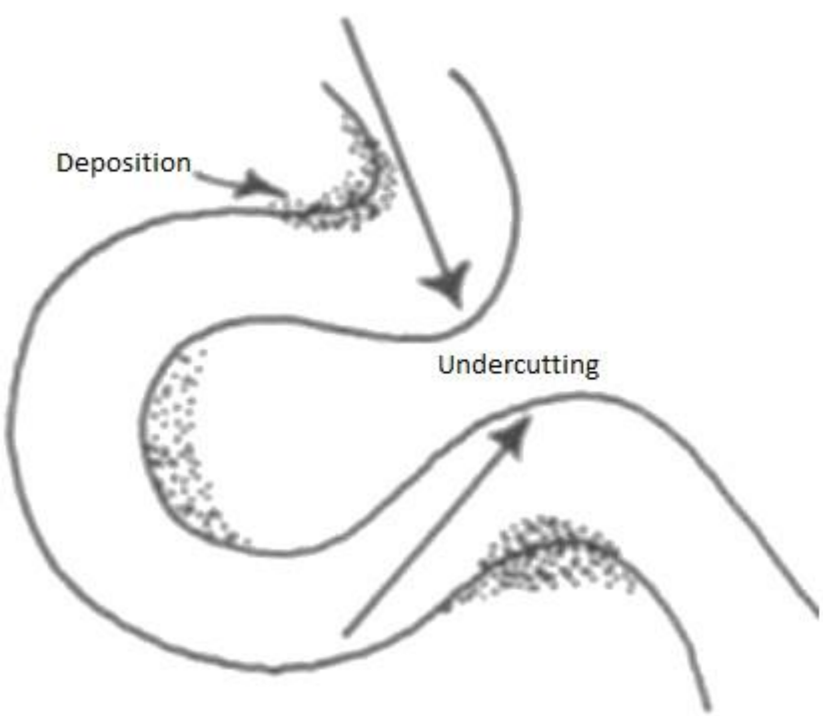
2-The main work of the river is deposition and deposition it forms some features on the river bed e.g.Braided stream,Ox-bow lakes,natural leaves ,delta etc.

**Braided stream** -Due to deposition on the river bed will build some mould and causes the river to split into several channels which rejoin and split again.

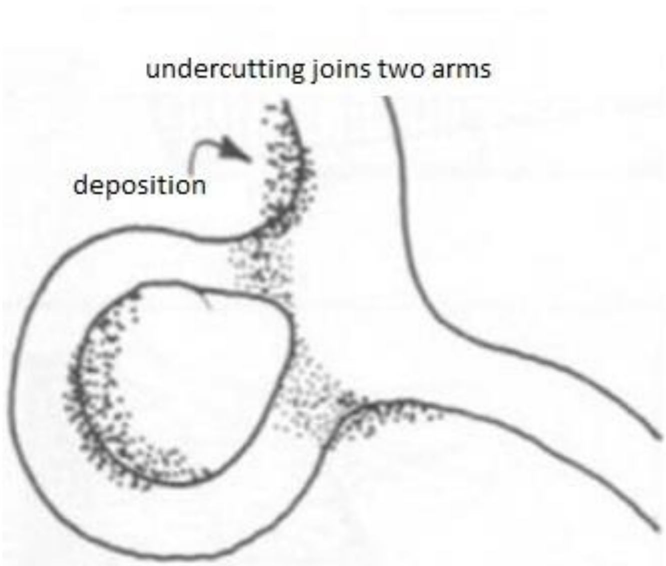



**Formation of oxbow lakes** -: Forms when meander is so acute that only a narrow neck of land separate the two ends of the meander.

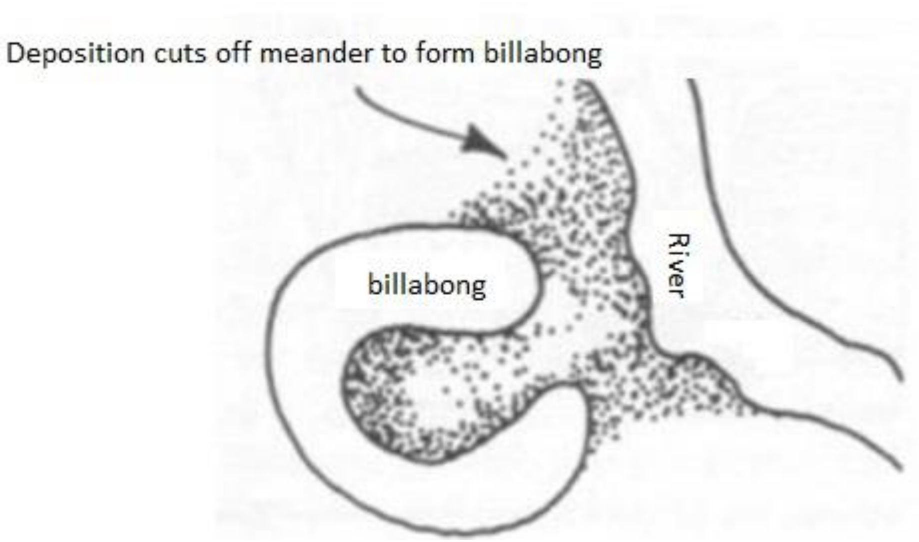
a) Neck of the land separate 2 concave banks where erosion is active.



b) The neck is ultimately out through; this may be accelerated/often during river flooding.




c) Deposition seals the cute –off which become an ox –bow deposition take place along the two ends of the cut off and eventually seal off to form Ox-bow Lake.



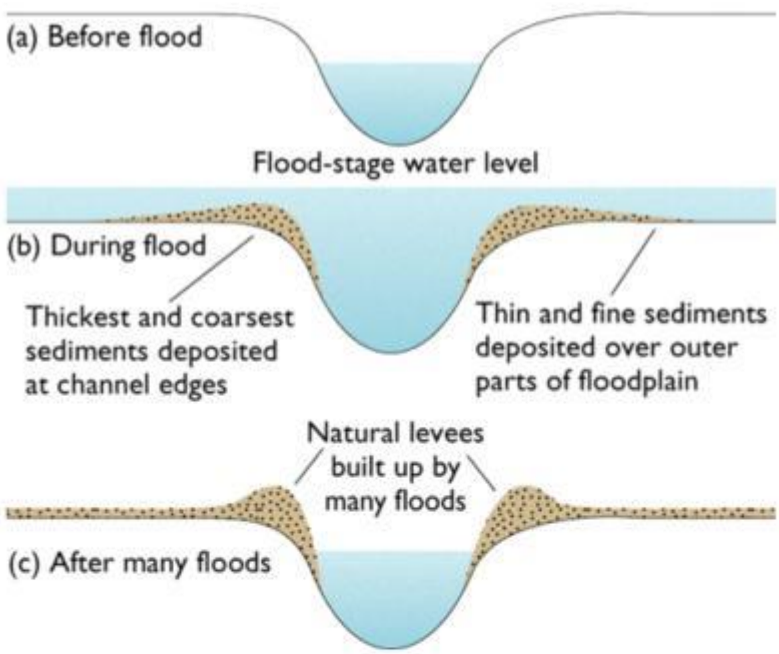
**Production of the natural levees**:-Formed through successive flooding near the river because as the water flood out of the main channel its speed is immediately checked by friction with the banks and the heavier sediments are drooped first.

-Ridge/embankment on the sides of the river formed caused by river deposition especially after flooding.

-Deferred tributary –Is a tributary which flow parallel to the main river which tries to enter it but the main river is high above the flood plain.

-Deferred junction –Is the point at which the tributary enters the main river.

Example; Ya-zoo streams flows for 200km without managing to join the river Mississippi.




**<u>Formation of delta-</u>**

What is delta: Is a large, flat low lying plain on the river mouth where deposition takes place.

è Deposition continues to takes place on the river mouth which causes the river to divide into various channels called **<u>Distributaries</u>**

## Types of delta

There are many types of delta. But the main types are;

i. Arcuate delta.

ii. Estuarine delta.

iii. Bird foot delta

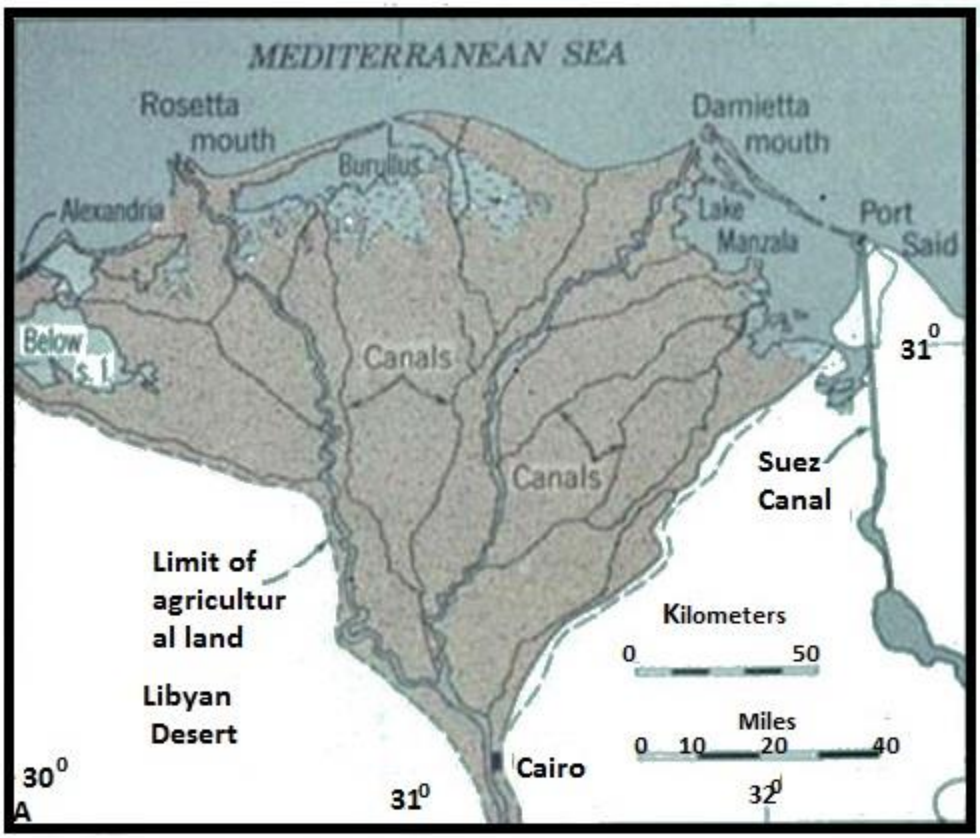
i. **Arcuate delta**

- It is made up of many distributaries.

-The load is composed of coarse and fine materials.

-It is triangular in shape.

**Examples**; Nile, Ganges, Niger, Indus and Hwan Ho.

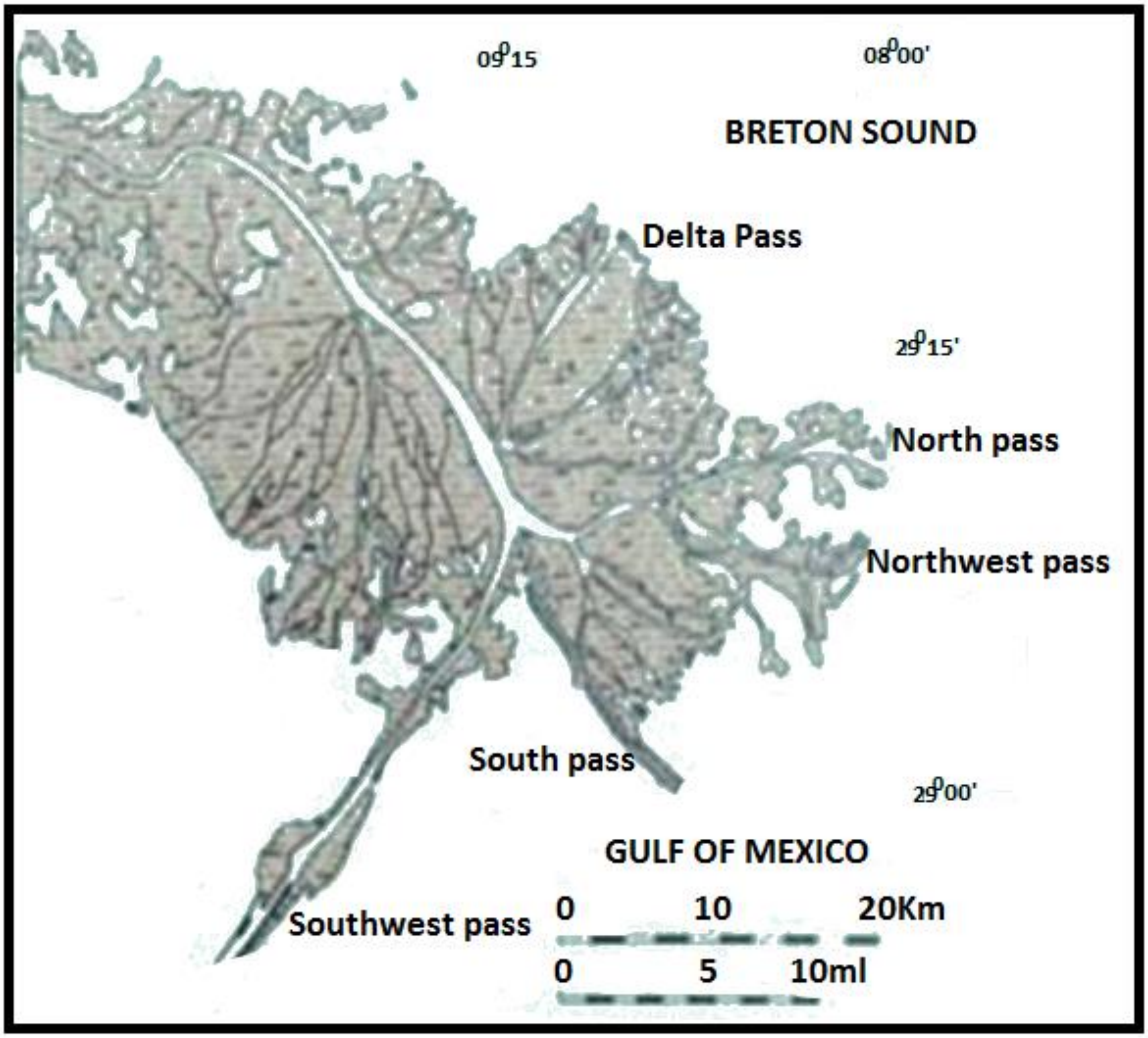



ii. **Birds foot (digital)Delta** -Has few and long distributaries

-Triangular in shape -Fine and very fine sediments.

-This will occur where the river energy is very low.

**Examples**; Mississippi, Omo River in Ethiopia. And also the wave energy is low:-deposition takes place comfortably.

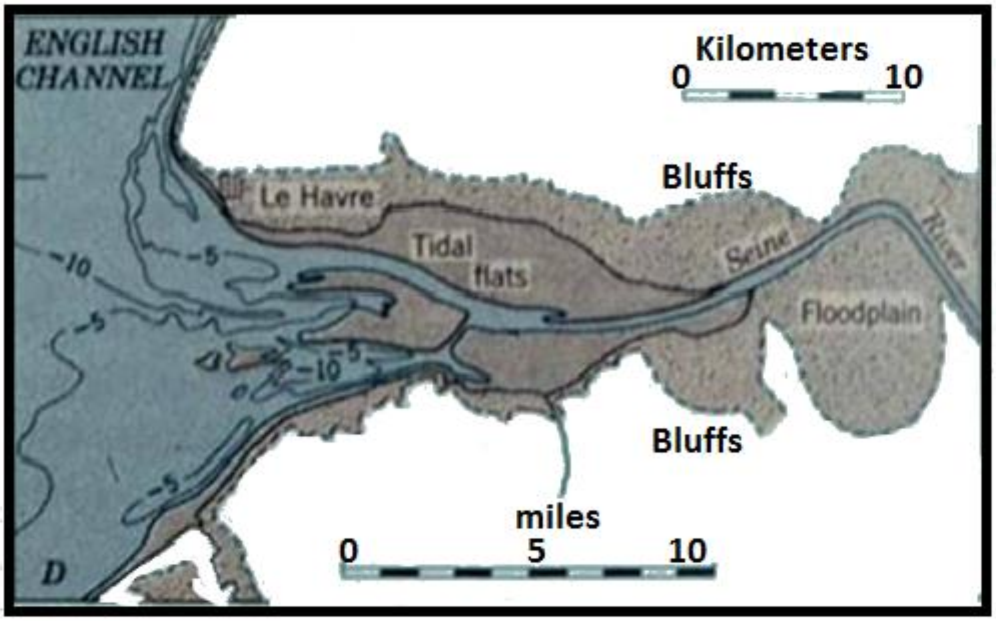



iii> **Estuarine delta**

– Has a shape of estuary (sub merged river mouth) deposition takes place on the sub merged part of the river (estuary). It is also triangular shaped.

It has no distributaries.

**Examples**; Elbe delta (Germany), Vistula delta (Poland).




Formation of flood

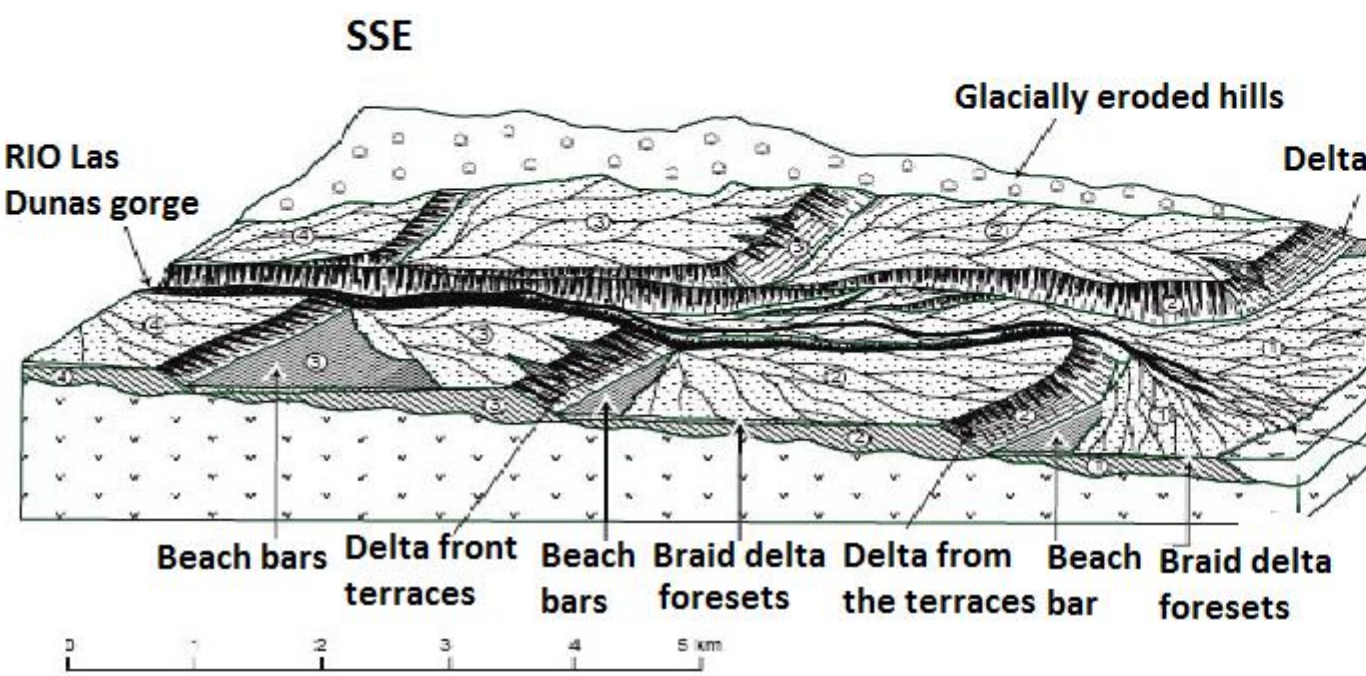



FIG: 3, Block diagram of lacustrine deltas of the Las Dunal River based on aerial photographs taken i

Formation o floodplains

– Is a broad gently sloping surface of alluvium deposits immediately after the river channel.

- Produced by the deposition of alluvial and other materials on the floor of the river valley through which river meanders

**Stages in the formation of delta**.

The stages in the formation of a delta in an ocean or sea are:-

a) **STAGE 1 :** Deposition divides the river mouth into several distributaries. Spits and bars arise and lagoons are formed. Depositions on the banks of the distributaries produce levees which extend into the river or sea.

b) **STAGE 2:** Some lagoons have already begun to fill with sediments which cause further division of distributaries into smaller distributaries. The delta has a more solid appearance though it is still very swampy and is usually well covered with water loving shrubs and threes.

c) **STAGE 3:** further in filling of lagoons plus the growth of a complete covering of vegetation results in the older parts of the delta coming to stand a above water level and to form dry land.

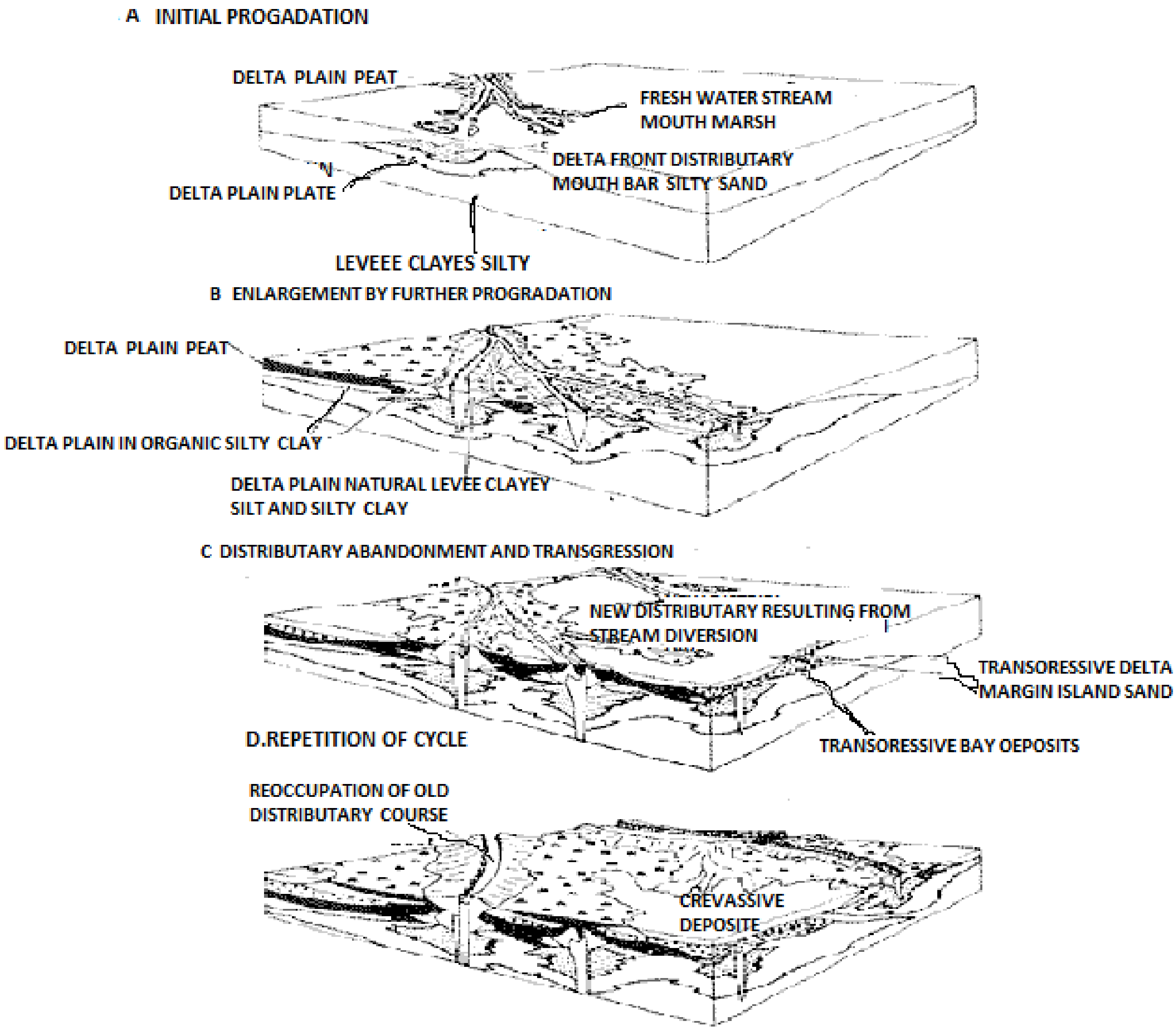
**Conditions necessary for the formation of delta**

1) The river must have a large load and this will happen if there is active erosion in the upper erosion of its valley.

2) The velocity of the river must be sufficient low to allow deposition

3) The rate of deposition must be higher than the rate of removal by tidal currents.

4) There shouldn't be any obstacles in the upper levels of the long profile.




## Why a large river like Congo not have delta?

The river Congo has a large load but a high velocity near its mouth which enables most of its load to be carried far out to sea, there by preventing the formation of delta.

River Niger also has a large load but its velocity near its mouth is low. Much of its load is deposited in its mouth where an extensive delta has formed

## Value of Rivers / Economic importance of Rivers

**1)** Water supply for both domestic use, industrial uses, industrial uses and for irrigation purposes example;

**2)** Rivers are used for local transport (Navigation) they provide inland ports on their courses E.g. St Louis on River Mississippi in U.S.A.

**3)** Provide sites for hydro-electric power generation. Harnessing of hydro-electric power is common all over the world. E.g. Mtera dam in Tanzania, Seven forks dams on river Tana in Kenya.

**4)** Rivers are sources of building materials. Sand for building is scooped from the river beds and valleys like in Machakos in Kenya.

**5)** Rivers also form sources of various alluvial minerals like gold and diamonds e.g. alluvial diamonds are mineral along the course of R. Orange in S.A and Namibia.

**6)** River deposit alluvial soils a long their valleys during floods and at their deltas. These alluvial soils are fertile and hence for agriculture e.g. along the Nile valley and its delta in Egypt.

**7)** Rivers have features, which provide tourist attractions such features are like waterfalls and gorges e.g. Victoria falls.

**8)** Rivers provide rich fishing grounds e.g. R Nile, R Tanah, River Nguruka.

**9)** Rivers form natural boundaries between communities, districts, provinces and countries e.g. Kagera river between Tanzania, Uganda, Rwanda.

## DRAINAGE PATTERNS

-Removal of water from the surface

-Drainage pattern is the actual arrangement or layout of its tributaries over the surface.

### Factors which influence drainage patterns

**1)** **Slope –:**

This will determine the direction and speed of flow the steeper the flow the higher the speed and vice versa.

**2)** **The function of structure-** :

Uniformity whether the rocks have the joints or uniform rock e.g. granite will be different from limestone which has joints.(rock with joints will cause the drainage pattern to follow the lines of weakness but uniformity rocks, the slope is the one which will determine the drainage system.).

3) **Nature of rock-** :

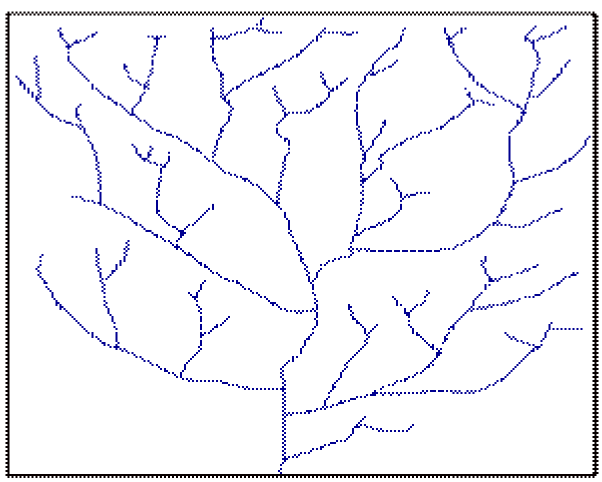
hard and soft rock .Drainage pattern develop of the soft rock because it is easy for water to penetrate unlike on hard rock, drainage pattern becomes diff to develop Alternating layers, having soft sand hard rock, the drainage pattern will develop on the soft rocks only.

**Types of Drainage Patterns**

1. **Dendrites-** This pattern has a shape like the trunk and branches of a tree without leaves. The tributaries join one another at a low angle (less than 90) from many directions.

-Develops where there is no structural control because such pattern develops in a uniform rock, the slope is the only factor which in thence's the drainage pattern. Example Granite.

**DENDRITIC PATTERN**



2. **Trellis –Pattern** develops in a region which is made up of alternate belts of hard and soft rock.

-Shape is rectilinear or almost rectangular in shape

-Tributaries join one another and eventually join the main river at a right angle ($90^0$)

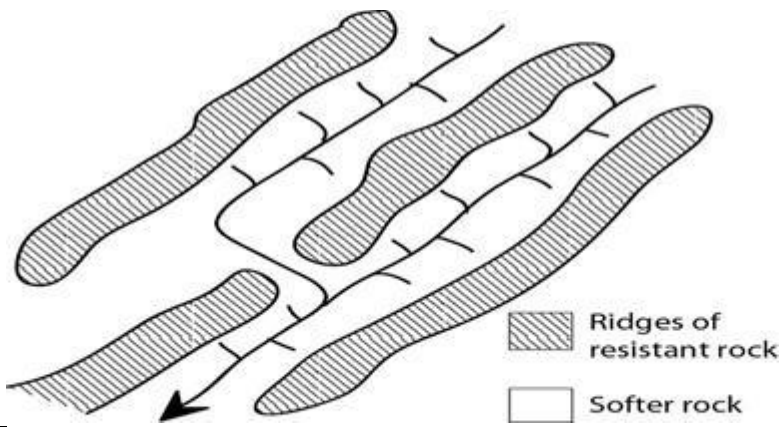
-Major control is the rock structure and nature of rock with joints or alternating layers of rocks.

-This drainage pattern gives rise to various types of rivers (stream)

(s) **Sub Sequent River** – Is any tributary which joins the consequent stream at a right angle.

(c) **Consequent river -** This is the main river which flows down slope.

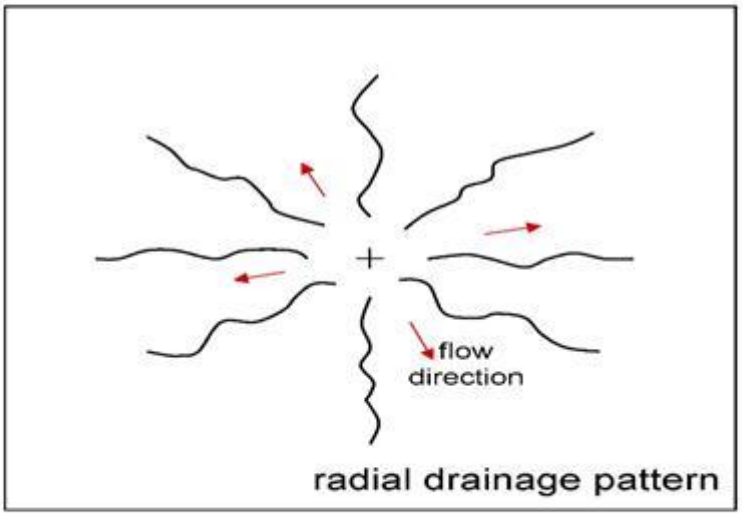
**TRELLIS**:




(o) **Consequent stream -** Any stream which flows in the opposite direction to the consequent stream and join the subsequent stream. Almost right angle.

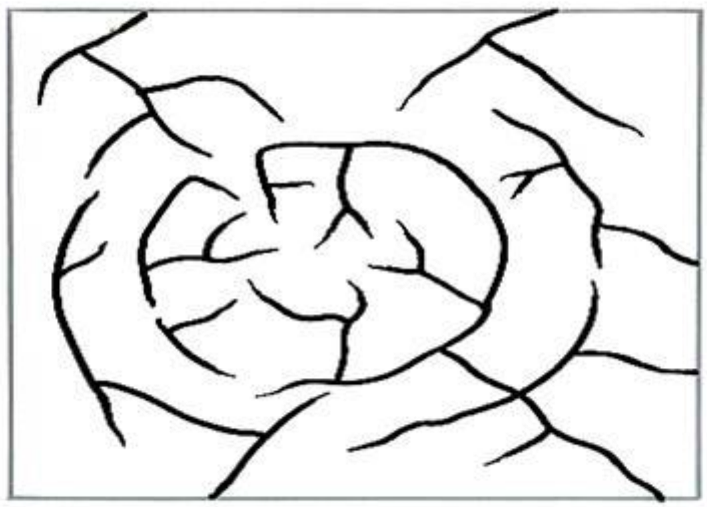
(MC) **Minor Consequent river**- A stream which flows parallel to the consequent stream and joins the subsequent stream.

3. Radial – Shape is like a spokes of a wheel. (Bicycle wheel) that radiates from the centre which can be a conical hill (volcano) ->Develops on a volcano. The major control is the slope. E.g. Granite, volcanic rocks, basalts.




4. **Centripetal-** Streams from various directions converge to the center. Common in inter – mountain basins or basins between highlands .Major control is slope.

5. **Annular** – A pattern with streams often joining at sharp angles, but arranged in a series of curves about a dissected dome, basin or crater area. Major control is the nature of the rock.



6. **Accordant and discordant**

1. **Accordant** -This is a normal drainage system of the river. In this drainage system, the river flows in accordance with the rock structure and slope. It follows the line of weakness hence hence revealing the relationship with rock structure and slope. This is described as being **accordant**.

2. **Discordant** – Drainage systems that are opposed to the dominant structure.(rock structure, slope and land forming processes.

7. **Superimposed** – Some rivers have developed a drainage pattern which is in no way related to the structure of the region in which it occurs. The drainage pattern discordant to the structure of the land surface in which it occurs.

-Doesn't have any relationship with geological structure. It has forced itself to be in a place

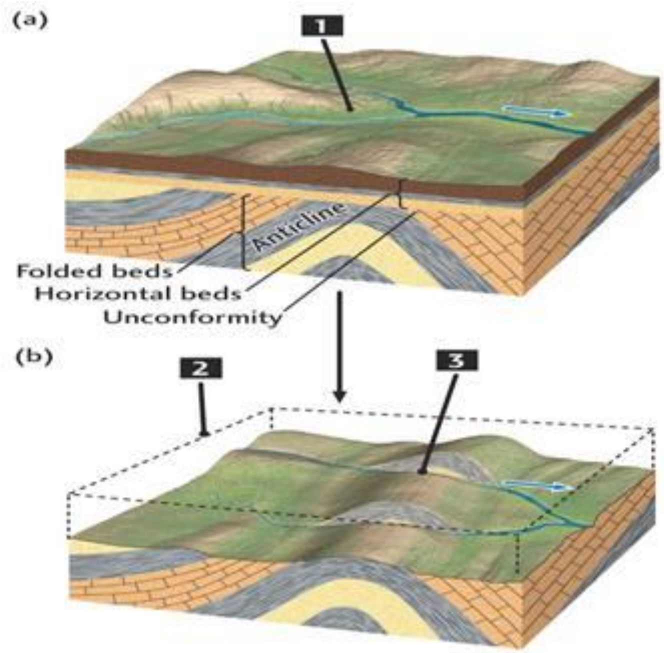
**STAGES IN THE FORMATION OF A SUPERIMPOSED DRAINAGE PATTERN**

a) Original folded surface.

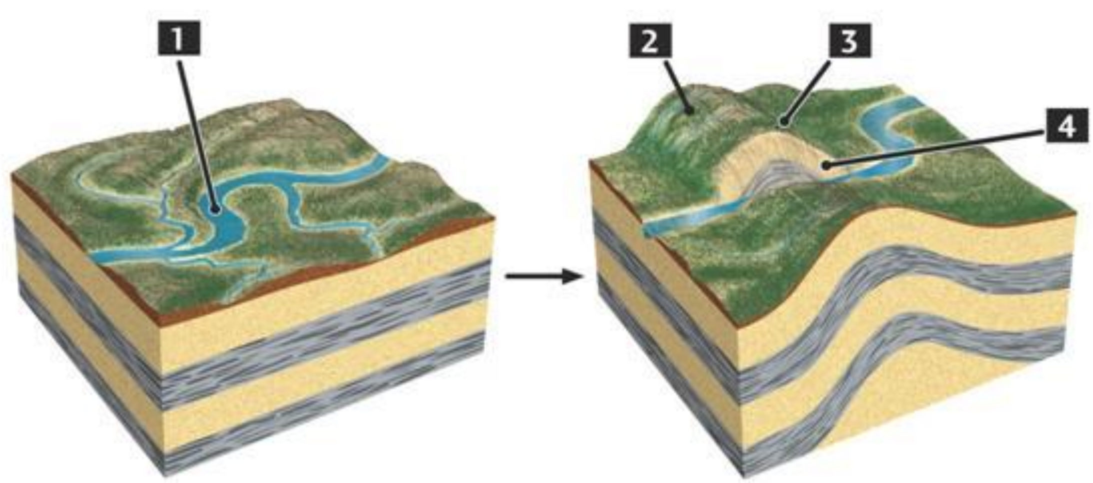
b) Region is reduced to a plain due to erosion

c) Subsidence results in region being buried by new rocks but subsequent uplift sees the formation of a drainage pattern. The main river is draining at right angles to the axis of the original structure.

d) Tributaries to the main river develop wide valleys in the weaker rocks as the main river erodes vertically it cuts across the ridges of strong rock and form gorges. The stronger rock forms ridges because the weak rocks are worn away and not because the region has been uplifted.




e) Antecedent drainage – A river pattern disturbed by earth movement (uplift or folding). A river which is capable of maintaining its course after up lift and erosion is called Antecedent. E.g. Ganges River, Snake River and River Colorado.



## RIVER CAPTURE (piracy)

It is process where one river diverse the head water of the neighboring river in its own course/valley (upper course)

### Condition necessary for river capture to occur

i. The capturing stream should flow at a lower level than its victim stream (capture stream)

ii. The capturing stream must be stronger and must be flowing at a steeper slope than its victim.

iii. The capturing must be flowing over easily eroded rocks that are weaker rocks.

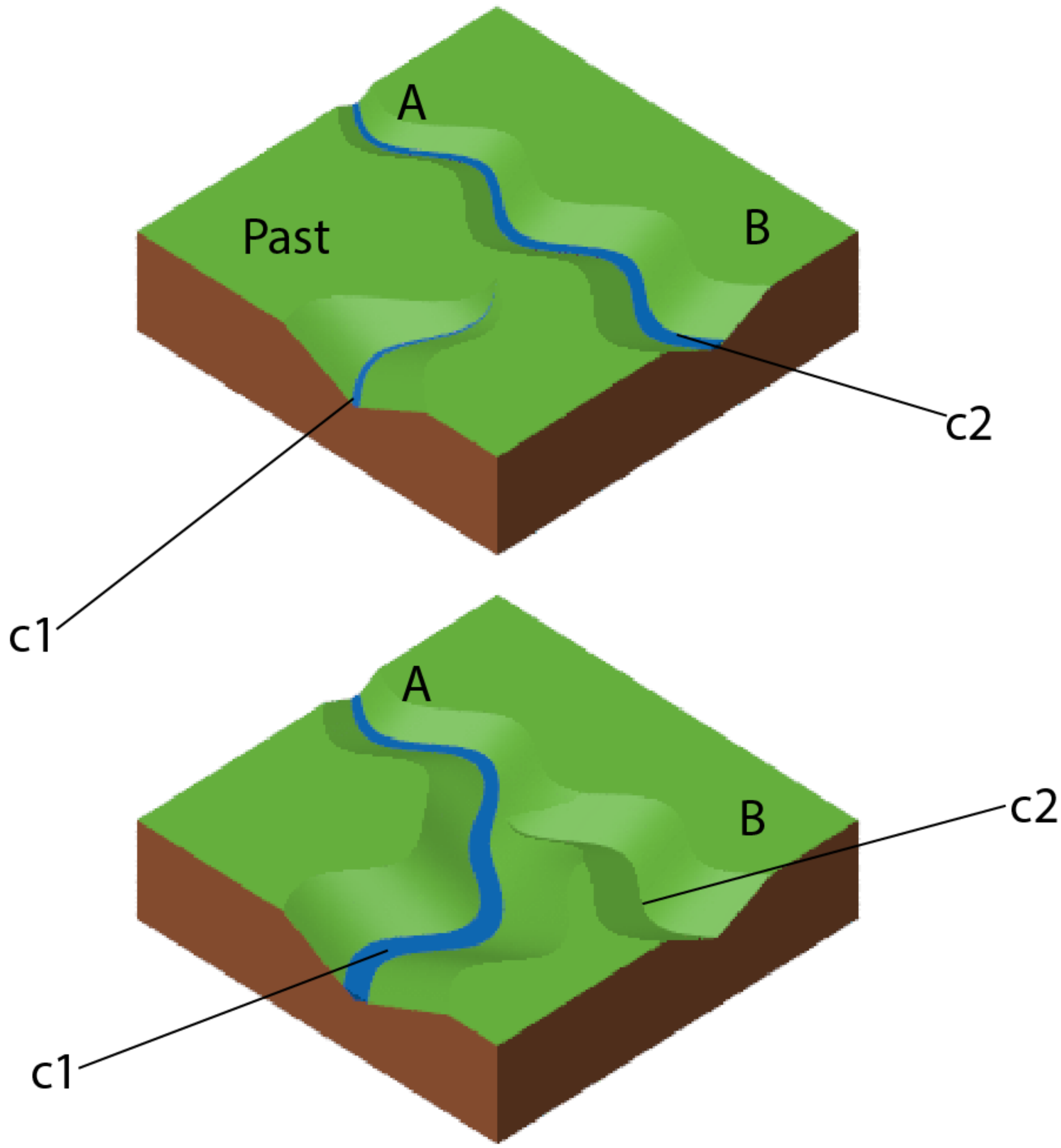
iv. River rejuvenation.

### Processes:

a) Two stream which are adjacent

There is head ward erosion which makes S extend head ward to $C_2$

b) After years of erosion $C_2$ is diverse to $C_1$ where all its water enters $C_1$.




**Evidence /feature related to river capture.**

i. **Elbow of capture.**

Is a point where there is a sharp turn of the river. Is the sharp change in the direction of the river course at the point of capture.

ii. **Wind gap (dry valley).**

This is a gap between elbow of capture and beheaded stream which is dry. The beheaded stream will not dry because it receives water from other sources.

iii. **Misfit stream (beheaded river).**

A stream carries less water than the valley depth (less water and becomes too small for its valley). A river which is flowing on a valley which is wider than the size of the river.

iv. **Rejuvenation.**

Feature of river rejuvenation can be seen in the capturing stream.

Examples:

Great berg River capture in S.A, River Volta capture in Ghana, River Niger capture in Nigeria.

**RIVER REGIME**

Is the seasonal variation of the volume of the water in its channel.

**FACTOR INFLUENCING RIVER REGIME.**

**CLIMATE**

a. Precipitation is responsible for the variation of rainfall, snow melt.

- High amount of rainfall and snow melting will increase the volume of the river.
- River regime follows the rainfall regime.
- During winter, volume decreases and early summer volume increases

b. High temperature, melting increase and volume increase also during high temperature, evaporation increases and reduces volume.

- Low temperature freezing increase and volume decreases, this leads to the fluctuation of water volume.

**NATURE OF THE ROCK.**

Porous rocks and previous rock allow water percolation; hence much of the water sinks in the ground and reduces volume of water.

- Impermeable rock does not allow water to sink hence, increase volume.

**SLOPE.**

The steeper the slope less the percolation and evaporation, hence volume is maintained. In gentle slope, more loss of water because water stays for a long time hence percolation increases and evaporation increases.

**VEGETATION.**

Variation matter with the area/surface the rivers flowing, the dry/bare land will have less water during dry season because of the increase in evaporation compared to the river passing throughout the forest.

- During rainy season, the bare land will have more volume because there is nothing which will retain the water but the river which passes through the forest, the vegetation retains the water.

**NUMBER OF TRIBUTARIES JOINING THE RIVER.**

The larger the number of tributaries, the larger the volume and vice versa.

**HUMAN ACTIVITIES.**

Taking place along the river or the river basin e.g. Irrigation, scheme, during dry seasons tends to reduce the water volume.

- Agriculture on the river basin clears the forest whereby they reduces the water volume.(farming activities)

- Clearing the land leads to increase in evaporation which reduce water volume.

**TYPES OF RIVER REGIME.**

**There are three types of river regime as follows;**

**i. Simple River Regime.**

Is a type of River regime where there is seasonal variation of water volume such that there is one high water volume period and one period of low water volume.

- These occur where there is one dry season and one wet season most common in the tropical regions. Example, Ruvu, Wami, Ruvuma Rivers.

ii. **Double River Regime** (Regime of first degree of complexity).

This is a type where there are two distinct of high water periods which maybe because of snow melt or double rainfall maxima.

- This occurs on equatorial regions where they are two peaks of high rainfall e.g. River Congo and River Amazon in S. America.

- The volume of the river varies according to those rainfall peaks.

iii. **Complex river regime** (Regime of second degree of complexity).

It's a type of river regime which evidenced the longest river in world with wider basins and numerous tributaries of different regimes.

- They cut across different climates. Example River Mississippi, the river volume isn't much affected because it across different climates in different regions.

–

**IMPORTANCE OF STUDYING RIVER REGIME.**

All development schemes planned on the river and its valley should have proper knowledge on river regime.

Example, RUBADA – Rufiji Basin Development Project /Authority.

TVA - Tennessee Valley Authority

Kagera River Development Authority

1. **NAVIGATION:**

Navigation should be planned and the vehicle also should be planned according to the depth of the water.

- During high water level can use a certain vehicle and during low water level certain vehicle can be used (type and size of vehicle)

2. **CONSTRUCTION OF HYDRO-ELECTRIC POWER STATION**.

Plan for the machines to be placed considering the level of water which keeps on varying. Because during low water level and the machines are placed at a upper position, the water won't be able to reach and the machines won't work.

3. **CONSTRUCTION OF BRIDGES.**

The engineer has to plan before building sometimes water level increase and sometimes decrease. When water level increases, energy increases hence leads to destruction of bridges. To have effective bridges must study river regime so as to make strong bridges which can overcome high energy of the river.

4. **FLOOD CONTROL.**

Must know the time that flood may occur and the level of water which will increase.

- Construction of dams will control floods but also constructing dams should consider the variation in the level of water so as to be able to prevent floods to continue taking place Eg. In U.S.A TVA builder dams to control floods.

5. **AGRICULTURE ACTIVITIES ON THE FLOOD PLAIN.**

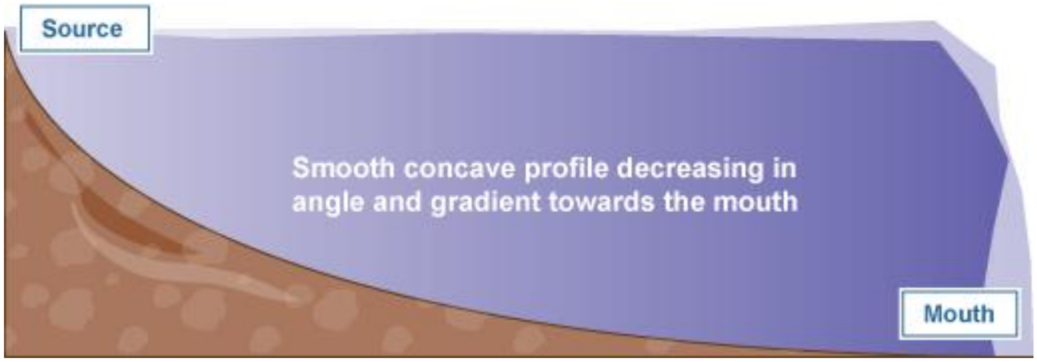
Example River Nile the consider/depend when the water level is high, irrigation is not important but during dry season, canals are constructed at the level of low water so that irrigation can take place, hence important to know the river variation.

6. **SETTLEMENT.**

To establish settlement on the river basin must know the river regime, the settlement must be above the area of floods so that during high water level the settlement should not be flooded. (Areas free from floods)

**Concept of graded profile**

- Consider the river long profile from source to mouth.
- Refers to the profile of the river, which has attained a state of dynamic equilibrium, where is there is balance between the rate of erosion and the rate of deposition.
- In its simplest interpretation, a graded river has gentle slope and long profile with the gradient decreasing towards its mouth.
- It's concave in shape and smooth due to higher erosion in the middle profile of the river and less erosion at the source (great amount of materials) at the lower course, erosion is less because smaller volume of both of heavy loads and very low speed water and load.




**CRITICISMS OF THE CONCEPT OF THE GRADED RIVER PROFILE:**

There are several obstacles that normally prevail along the river course, which in term distort the equilibrium that river attempts to attain includes;

- The variation in the nature of the rock on the river bed and banks of the river. Hard and soft rock that offer cliff resistance to erosion.
- Climatic variation, for which passes cliff climatic region cannot attain the stage. Variation rainfall and areas.
- The presences of water bodies like lakes in the river course. The lakes become the center of deposition of sediments.
- River rejuvenation. Either sea level changes, river capture interfere with the attempt to attain equilibrium
- Continuous erosion along the river channel can be an obstacle to the attainment of balance.
- Vegetation that occupies certain part of a river channel.

**RIVER REJUVENATION:**

- Juvenile - young/youth
- Juvenation – process
- Repeat /do again

**River rejuvenation;**

Is the process of renewal of the erosive activity of the river valley after it has reached its old stage.

After reaching its old stage instead of deposition it starts eroding.

**Causes of river rejuvenation:**

**A.** i. Eustatic change (fall in the sea level)

ii. Isostatic change (land uplift and subsidence)

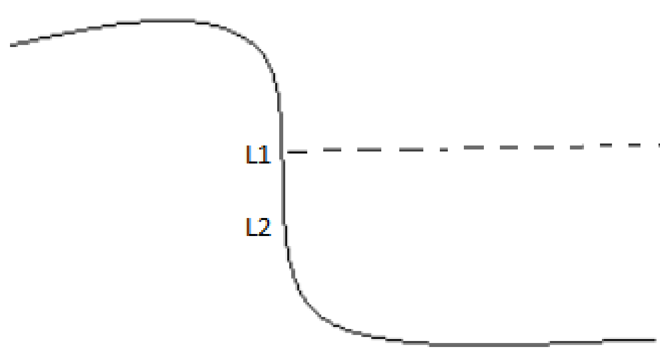
iii. Discharge (increase in the river volume)

## I. EUSTATIC CHANGE

Caused by the fall of the sea level (negative movement of base level)

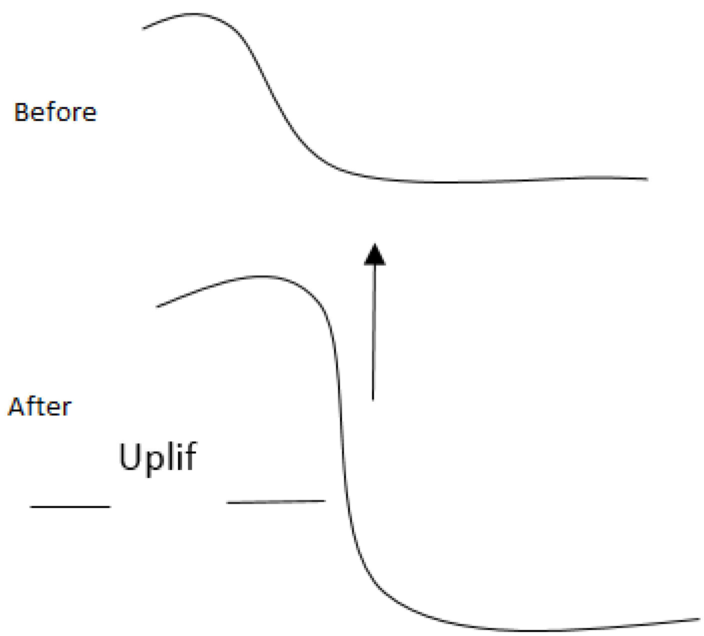
The river profile will have to adjust so as to reach the new sea level.

- The sea level has changed from $L_1$ to $L_2$
- Withdraw of water from the ocean by glacial/during glacial period – fall in sea level.




## II. DIASTROPHIC CHANGE. (Isostatic).

Fall of the sea level floor relative to the land or rise of the land relative to the sea floor – this will make the river start erosion again from the upstream.




B **STATIC REJUVENATION.**

i. **Discharge.**

Increase in the river discharge by increase in the volume of the river and can be caused by;

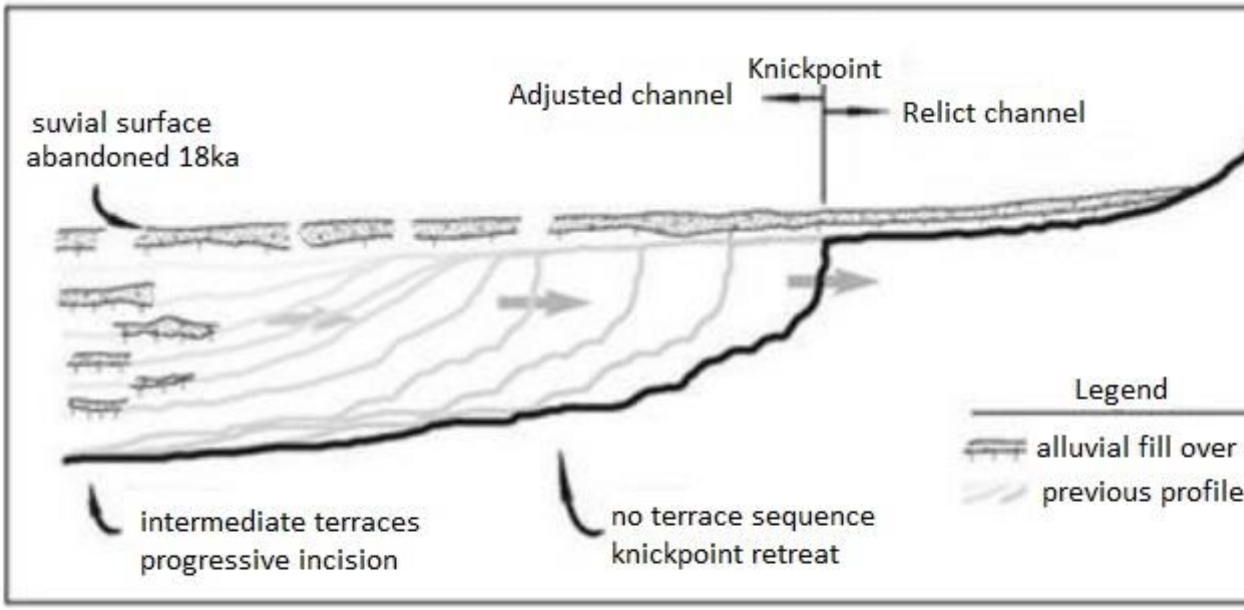
a. Increase in precipitation either melting of ice or rainfall

b. By river capture, when a weaker river is captured by the strong river the volume of the strong river will increase. This will make the river to start erosion again and will leave some marks /feature in the river valley.

**FEATURES/LANDFORMS RESULTING FROM RIVER REJUVENATION**

i. ***Knick point.***

This is a point of a river valley where there is a sharp break of a slope as a old base level joins the new base level after river rejuvenation has occurred.

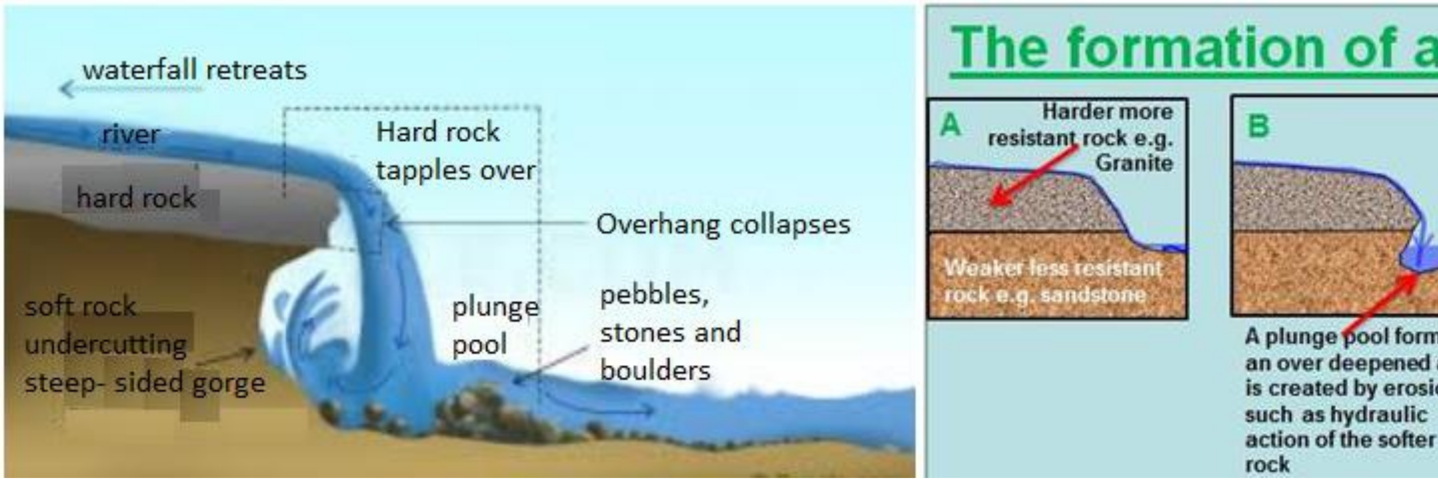



Note.

- If a gradual fall – gentle slope will cause rapid.

***ii.*** ***Waterfall /rapid.***

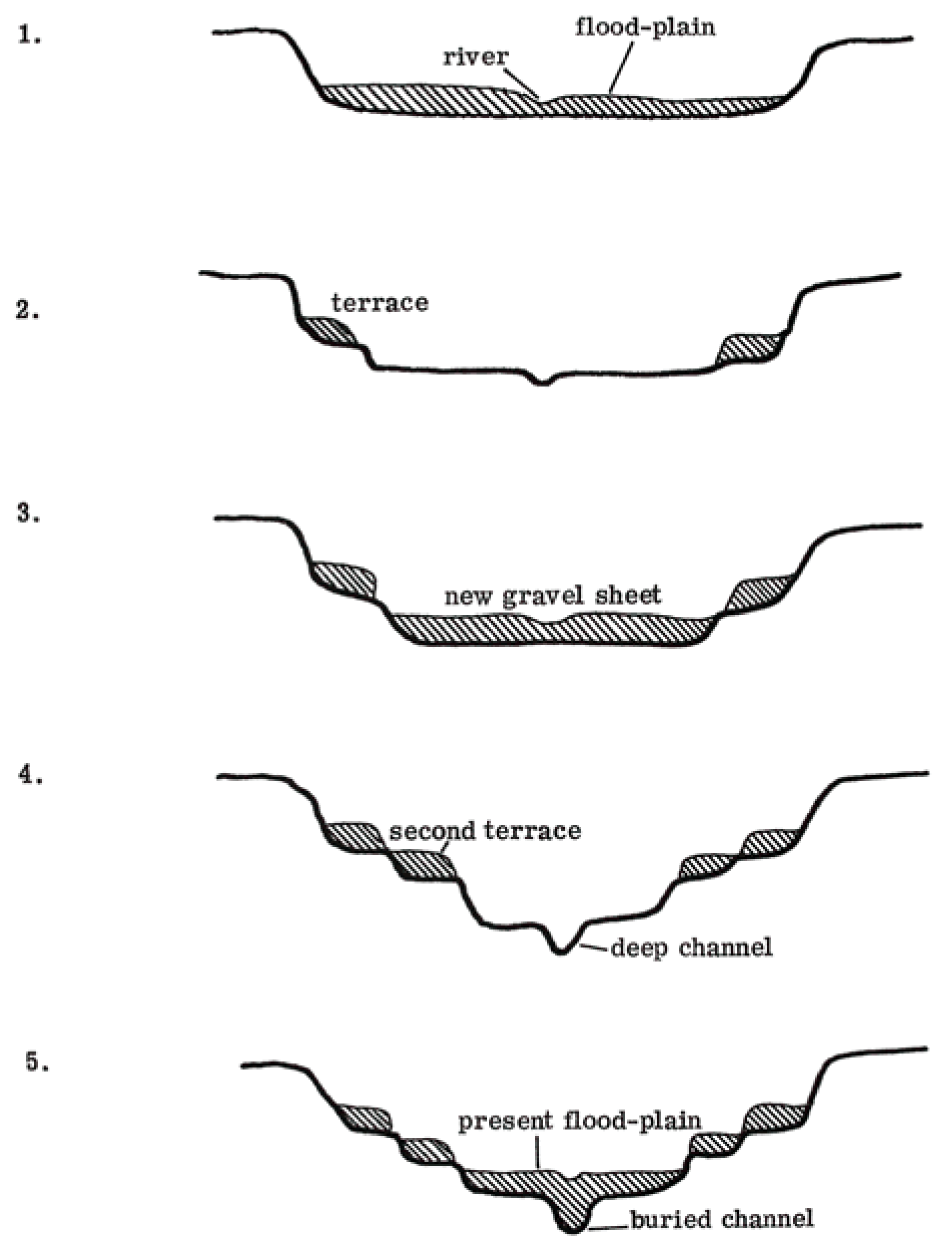
Where there is a knick point with a sharp break forms a water fall for the river to join the new base level e.g. Along the river Congo there is a knick point at old base level Bathurst fall.




***iii.*** ***River terraces.(Paired)***

Occur on the flooded area. There are the steps or benches on either side of the river valley formed as a result of undercutting of the river due to renewed erosion.

- If a river on a flood plain is rejuvenated, the down cutting of the river will produce terraces with equal size.
- - If the process of river occurs several times a series of terrace will occur.
- -Down cutting is vertical erosion, the volume of the river is the same. This will deepen the river.
- -Leaves deposition on the terraces.
- -The knick point keeps migrating up stream.



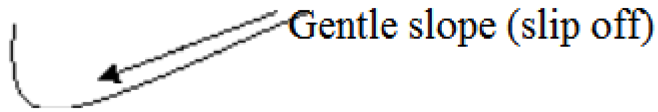

*iv.* ***Incised meanders (incise – cut down).***

These are the curved bend of the river valley that has been incised into the land's surface so that the rivers now wind between steep valley walls.

**Two types of meanders**

**Ingrown meanders -** Asymmetrical (the valley is not uniform; one part of the valley is much undercut.)

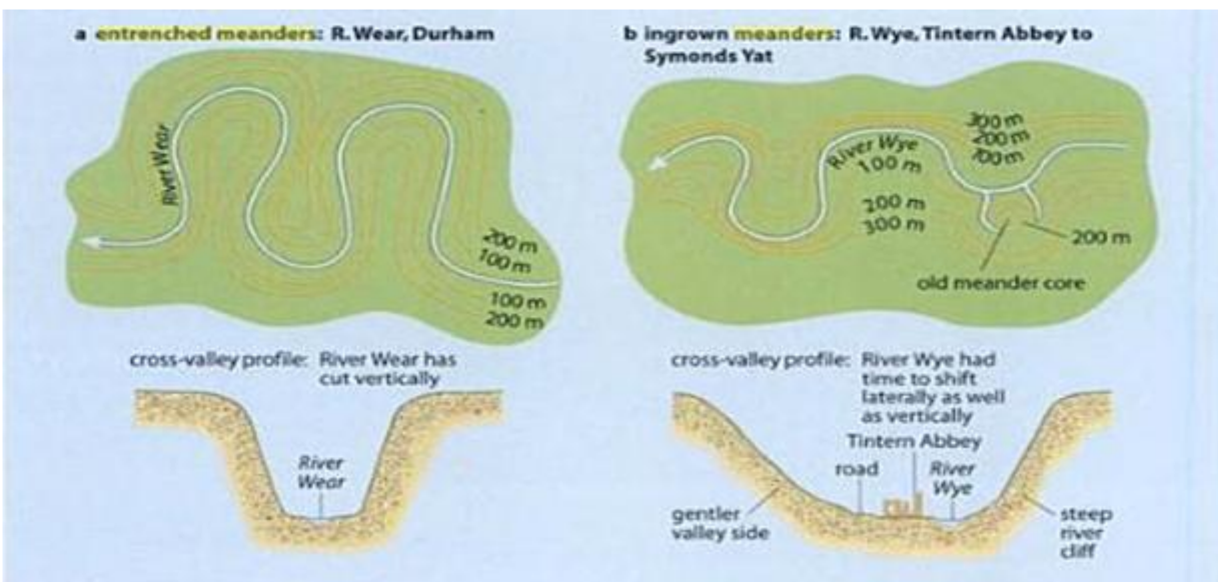
- Occur due to resistant rocks which do not erode fast compared to the other side (concave side) which erosion takes place at a high rate.




**Entrenched meander.**

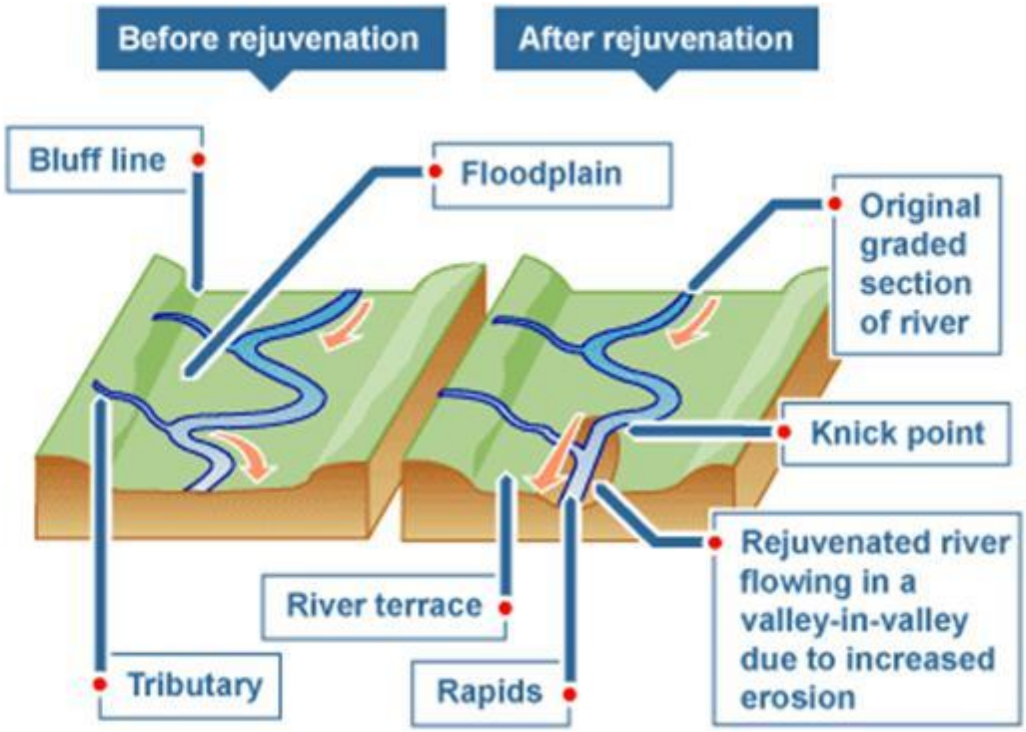
Is a steep sided symmetrical meander with side standing vertically and parallel to each other. This is produced by vertical erosion on rocks with almost uniform resistance.

- There is fast erosion.




***v. <u>Valley within a valley</u>***

- It is a deep step sided valley within the former valley of river. When the rejuvenation is fairly rapid to cause large fall of the base level producing steep sided valley.




**WIND**

Is air in motion or is the movement of air from the region of high pressure to region of low pressure

ACTION OF WIND

This is more affected in the arid region especially desert than in humidity areas. Even in desert is found that wind action is more effective in hot desert than in cold desert. This is because of the following reasons (**wind is in air motion**)

1. A lot of loose and unconsolidated dry masses of sand and gravel that can be easily acted upon by wind. Mechanical weathering can take place hence exfoliation

2. There is absence of vegetation cover in most areas

3. There are very strong tropical storms within the desert

In hot desert because the air molecules expand so wind increase.

- **ARIDITY :**

This refers to the state of the land being deficient in moisture leading to scarcity vegetation

These areas that receive less than 250mm of rainfall
A **desert** is therefore an arid area with sparse vegetation the rainfall in such area is very low and unreliable

- **Depression is the area where pressure is low.**

## THREE TYPES OF DESERT

- ***Sand desert***
- ***Rock desert***
- ***Stony desert***

### 1. SAND DESERT

Known as erg in the Sahara desert the surface of this desert is covered by mostly in large quantity of sand that are product of wind deposition.

### 1. STONY DESERT.

Known as reg in Algeria and Serir in Libya and Egypt.

- The stone desert surface is covered by angular boulders, gravel and pebbles.

### 2. ROCK DESERT.

Known as Hamada in the Sahara desert. Its surface is made up of barely rocks.

Scarcity in vegetation results in exposure of the desert surface to the agent of some process like;

- **Erosion**
- **Transportation**
- **Deposition**

–

**WIND EROSION.**

Wind erosion in desert involves three processes namely.

a. **Abrasion**.

It is the mechanical/frictional erosion that is caused by the materials such as course particles that are carried down by wind.

- It is done by hitting, grinding, scraping and polishing of the rock surface.

b. **Deflation**.

Is the blowing away of any unconsolidated materials like dust and fine particles. This is influenced by the nature of desert landscape, velocity and energy of the ocean currents.

c. **Attrition.**

Is wearing down of the wind borne materials as they collide against each other. They also rub or hit against rock forces in their path.

**WIND TRANSPORTATION**

This refers to the moving of material from one place to another by blowing wind.The movement of particles is determined by several factor like: Strongness of wind-usually over 20km/hr,turbulent from a constant direction,blow steadily for a length period of time.Wind transportation involve three processes namely.

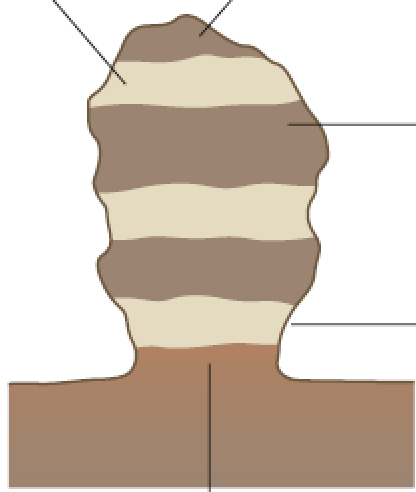
**Traction:** This involves dragging or rolling of large pieces of materials such as pebble
**Saltation**:Is process in which smaller pieces are carried while bouncing on the ground or on the surface.
**Suspension:** The process whereby very fine and light particles like silt or dust are transported while carried in suspension.

**EROSIONAL FEATURES:**

1. **ROCK PEDASTALS.**

These are tower like structure composed of alternate layers of soft and hard rock produced due to wind abrasion. Examples, found in Saudi Arabia, Tibet Mountain of the central Sahara.

- It is made up of heterogeneous rocks of different resistances.




2. **ZEUGEN**

These are ridges consisted of layer of hard and soft rocks overlying vertically downwards.

They are formed in areas where the rock layer i.e. horizontally and are characterized by joints.

Weathering opens the joints and wind abrasion then continues the work of weathering leading to the formation of furrows and zeugen.

**Illustration:**

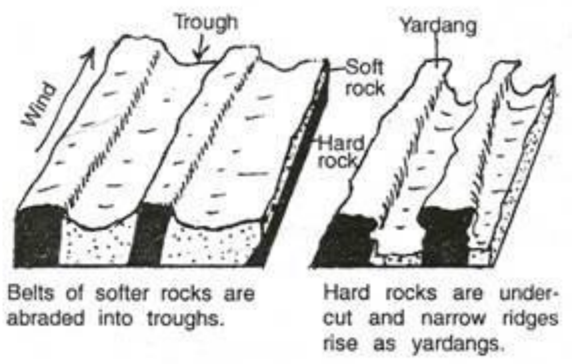
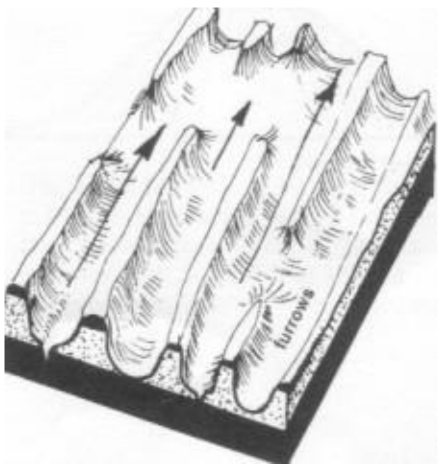



Fig. 1.78




3.**<u>YARDANG</u>**

Are the ridges consisted of hard and resistant rock standing either vertically at an angle and vary in height from 15m but having length up to 100m.

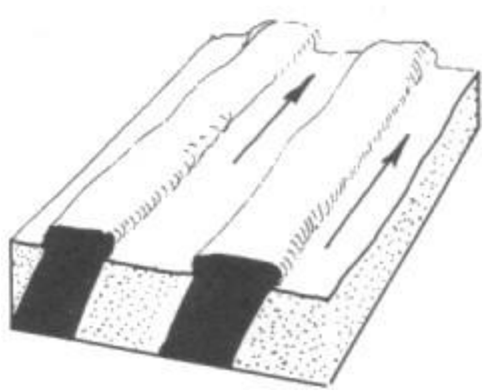
Or

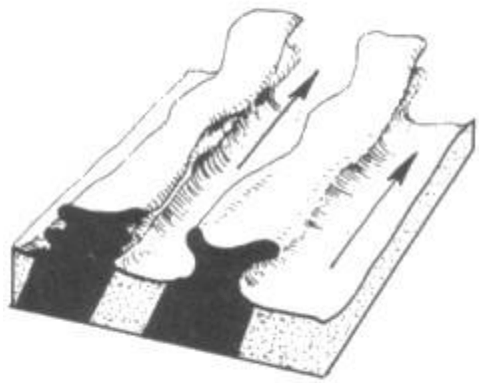
They are elongated rock ridges of vertically or nearly vertical layer of resistant rock separated by soft layers.

They run parallel to the direction of prevailing wind of abrasion.

The softer rock layers are easily worn out than the hard rock layers to form furrows and ridges. Example: Atacama Desert – South America.

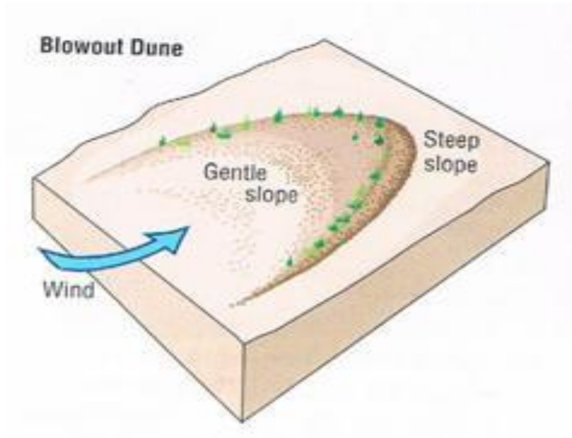
Example: Salah-central Algeria,East of the Nile-The silsila gap.





4. **BLOW OUT (DEFLATION HOLLOW, PANS)**

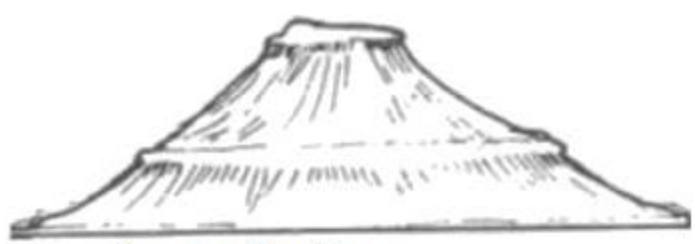
These are hallows produced by wind deflation. Shallow depressions in outcrop of the weak rocks. They are deepening by wind deflation and some originated in faulted rocks. When those hollows are filled with water they are called oases or swamp.
Example:Kalahari,Near Tsane in Botswana,NW at Upington in South Africa etc.




**5.<u>INSELBERGS</u>**

They are residual hills consisted of land and resistant rock left standing on the surface often the rest part of the earth has been eroded.

- When inselbergs are smooth they are called boarnads.

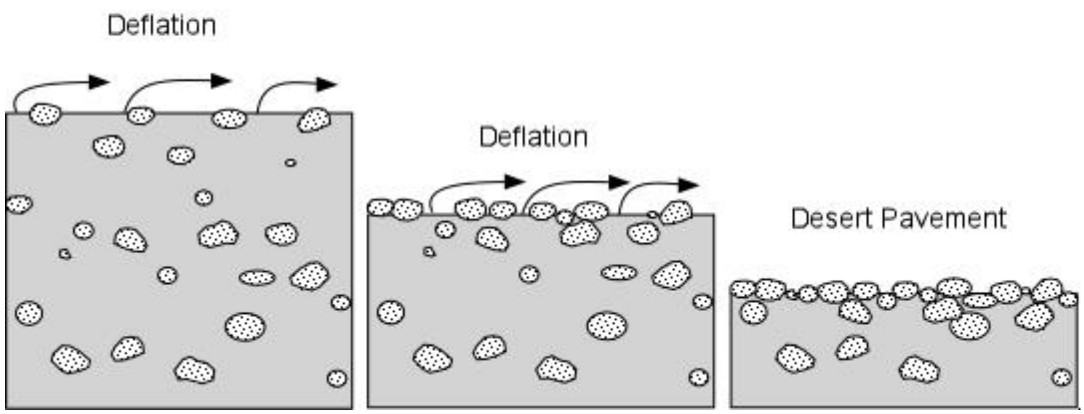

flat-topped inselberg

- They are characterized by a lot of joints.


rounded inselberg

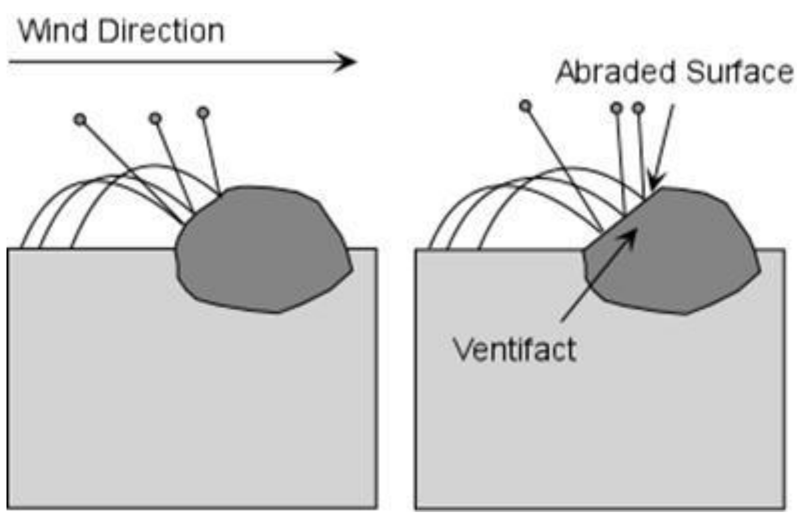
6.**DESERT PAVEMENTS.**

These are the horizontal areas of bare, polished rock formed by the scoring action of grains of quarts. – Flatter in shape (escarpment)




7.**VENTIFACT (DRAIKANTER).**

These are heavier rock blocks pebbles left behind after wind has sorted and carried away all materials.



## FEATURES DUE TO WIND (AEOLIAN) DEPOSITION.

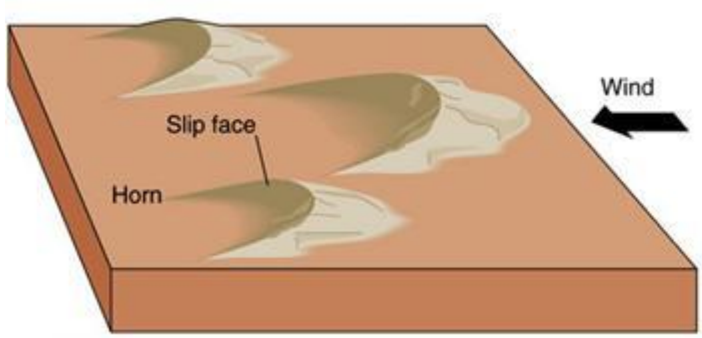
The materials transported by the wind form different feature after deposition.

- Features formed are like dunes (bar khans and seifs), loess and ripples.

### 1. SAND DUNES.

Hills of sand deposited by wind in the desert. Influenced by the extent of vegetation cover, the size of sand particles, amount of the materials and the velocity of the cover

#### a. ***Barchans/bar khans.***




A Barchans

Crescent – shaped and lying at right angle to the prevailing wind horns pointing downwards

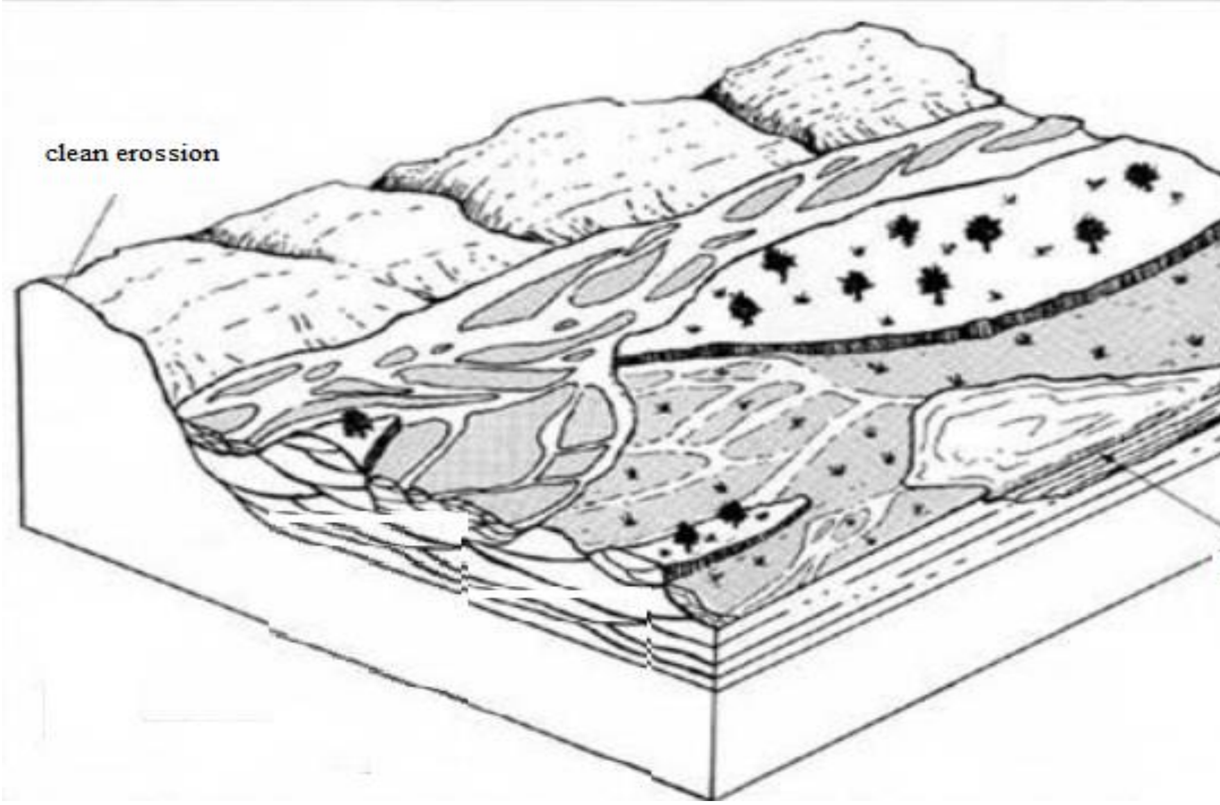
→ Eddies (an abrasion process) type of wind.

#### b. ***Seif dunes.***

(Seif dunes) they are sometimes called longitudinal dunes. They are long narrow ridges of sand which lie parallel to the direction of the wind. They occur in the small scale in sand areas

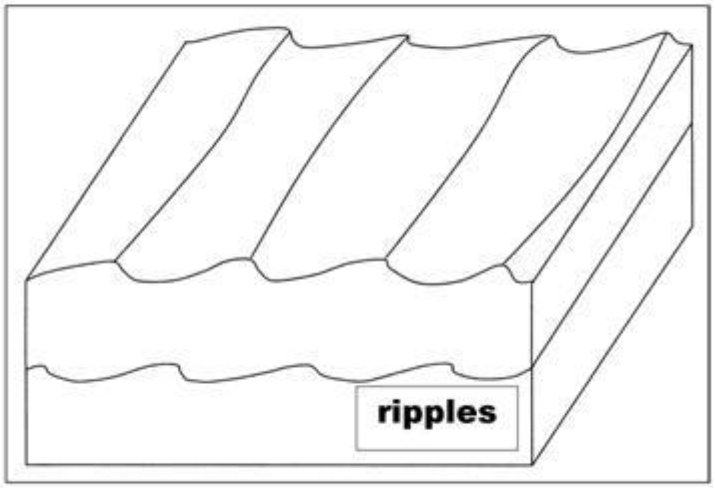
### 2. LOESS.

Is an accumulation of sand that has been carried and deposited beyond the desert limits. Loess leads to the formation of fertile soil. Example can be found in China.




3. **RIPPLES.**

They are the smallest wave structure, sometimes less than centimeter high. They are commonly found between dunes.




1. ***Why are desert found in the western part of the continents?***
2. ***Desert on the western side of continents are there because cold currents exist off the western side continents. Winds blowing over these currents lose their moisture over the sea and are dry by the time they get to land.***
3. ***Due to prevailing winds. And that both continents have high mountain ranges on the west side. Air coming from the mountains (causing the moisture to condense out) and that leaves a rain shadow on the eastern side.***
4. ***Due to their location, first being in the sub tropics places them in an area prone to lots of high pressure year round. High pressure discourages cloud development and precipitation being on the western of the continent, blocks humid air masses from reaching them.***

**GLACIATIONS**

It appears that roughly every 200 – 250 million years in the earth's history, there have been major periods of ice activity. Of these the most common (recent) and significant occurred during the Pleistocene period of the quaternary area.
In the two million years since the onset of the quaternary, there have been fluctuation in goods temperature of between 50C which have led to cold phases (glaciers) and warm phases (inter glaciers)

**CAUSES OF ICE AGE/ THEORIES**

-Variation in support activity may increase or decrease the radiation coming on earth.

-Injection of volcanic dust into the atmosphere can reflect and absorb radiation from the sun changes in atmospheric carbon dioxide gas could concentrate the green house effects (absence of carbon dioxide.
-The movements of Planets either into colder latitudes or at constructive margins where there is an increase in altitude could lead to an overall drop in world land temperature (high latitude low isolation.
-Changes in ocean currents or jet streams.
-Changes in atmospheric carbon dioxide gas could concentrate the green house effect

**SNOW ACCUMULATION AND ICE FORMATION:**

-As the climate gets colder more precipitation is likely to be in the form of snow in the winter and there is less time for that snow to melt in the shorter summer.
-If the climate continuous to deteriorate, snow will be falling throughout the year forming a permanent snowline. (The level above which snow will lie throughout the year).
-In the northern hemisphere the snow line is at a lower altitude on north facing slope and these receive less isolation (sun rays) than south facing slopes.
-Where snow collect in hollows it becomes compressed by weight of subsequent falls and gradually developed into more compact, dense form called firm or nerve.
.Firm is compacted snow which has experienced one winter freezing and survived for summer's melting.
-It is composed of randomly oriented ice crystals separated by air passed.
-In the temperature latitudes such as in the Alps, summer melt water percolates into the firn only to freeze either at night or during the following winter forming an increasing dense mass.
-Air is progressively squeezed out and after 20-40 years the firm will have turned into solid ice.
-This same process may take several hundreds of years in Antarctica and Greenland where there is no summer melting.
-Once has formed it may begin to flow downhill under the force of gravity as glacier.

**GLACIER AN ICE MASSES:**

-Glaciers may be classified according to size and shape characteristic which are relatively easily to identify by field observation. These are,

**LANDFORMS PRODUCED BY GLACIAL EROSION.**

***1.Niche glaciers.***

-Very small and occupy hollows and gulley on north facing slopes in the northern hemisphere
**2. *Corrie or cirque.(highland glacial erosion features.***
-Although larger than niche glaciers are smaller masses of ice occupying arm – chair shaped hollows in mountains. They often over pill from their hollows to feed valley glaciers.
-These are armchair – shaped hollows with a steep back wall and a rock basin. They are known as corries in Scotland.

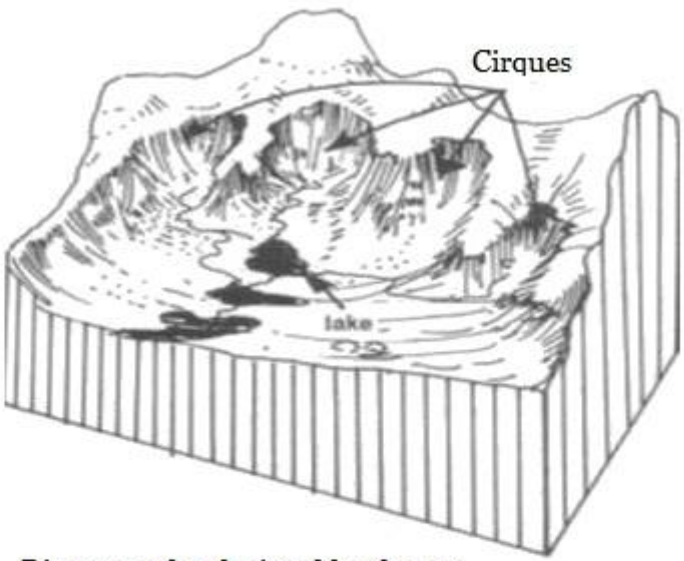
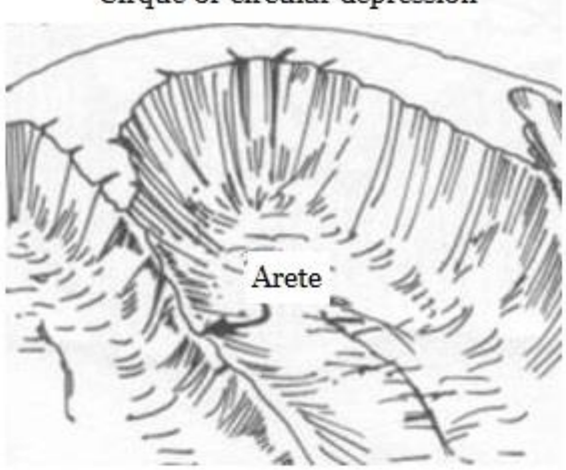



Diagram of a glaciated landscape

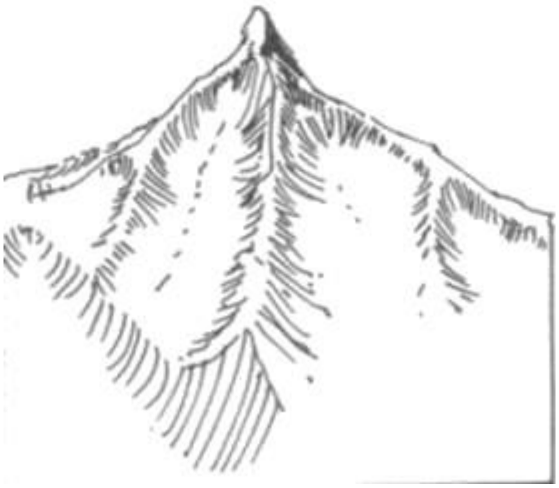
***3.Arêtes.(highland glacial erosion features)***

-When two adjacent cirque erode backward or sideways toward each other the previously rounded landscape is Transformed into a narrow, rock steep side ridges called an arête, example Alps in Switzerland.




***4.Pyramidal peak.***

-If there are three or more cirques all side of a mountain a pyramidal peak or horn may be formed.
-This feature has steep side and several arête radiating from the central peaks.
-When either cirque is combined together can form pyramidal peak.



**5. Truncated spurs**

-Formed by meanders in the low lands, where by the rate of erosion has decreased and the rocks are hard and at the end form alluvial fans.

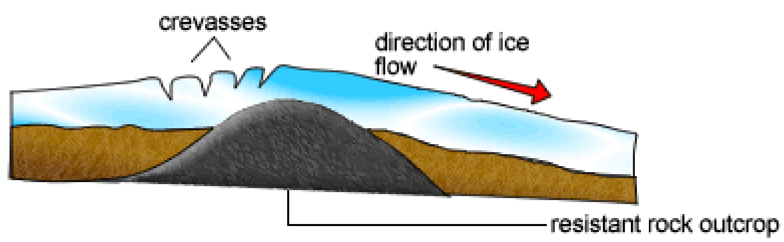
-Spurs whose ends have planed off due to erosion on the process of straightening the valley as it moves down the valley (highland glacial erosion feature).

**6. Crag and tail (lowland glacier erosion features)**

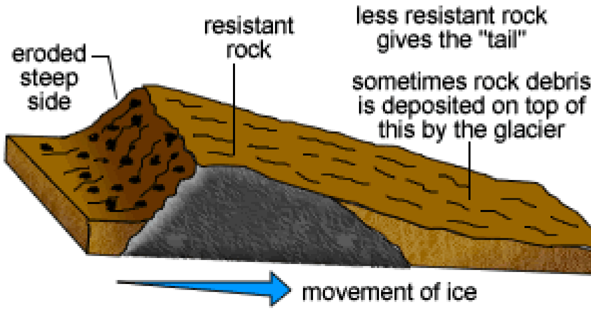
-This consists of a larger mass of resistant rock or crag (e.g. Basaltic rock crag upon which Eden burgh has been built).

-High pressure where is small area and low pressure is large area.

Crag and tail during glaciation



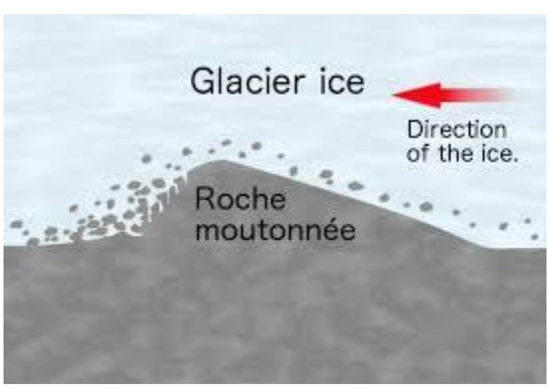

After glaciation

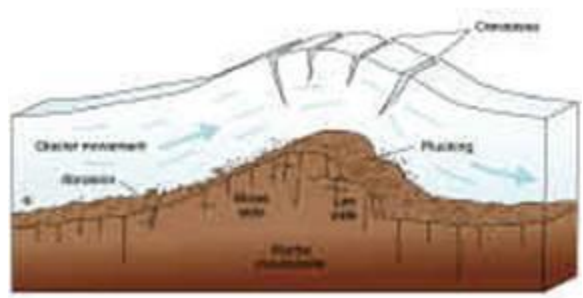



7. **Roche mountaineer. (Lowland glacier erosion feature)**-

-An outcrop of resistant rock which rise above the plain smoothed by ice on the upstream by abrasion and plucking processes. This feature also occurs in glaciated highlands. An outcrop of resistant rock smoothed by a glacier on the upstream side into a gentle slope. On the downstream side the glacier erodes by plucking to give steep and jagged (rugged) slope (lee).

**Example**: Mobuku Valley in the Ruwenzori mountains,Yosemite National Park in California,on the slope south of Mawaza along Mt.Kilimanjaro.

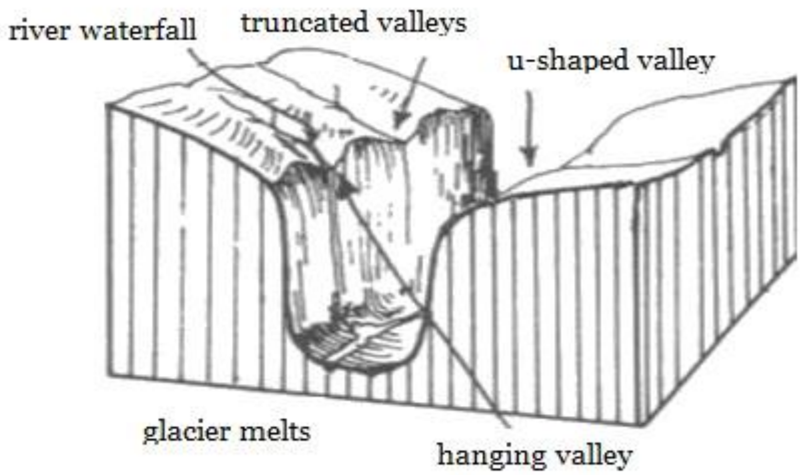


**8. U-shaped valley/glacial trough. (**Highland erosion features)

-It is a steeply sided flat-bottomed wide glacial valley. Develop from a river valley in which glacier had covered. Some contain features formed by both glacial erosion and deposition.

- At initial stage the valley occupied the V- shaped valley but because of continuous glacier erosive activities. The valley was more enlarged by being more deepened and widened becoming more opened and known as U-shaped valley.

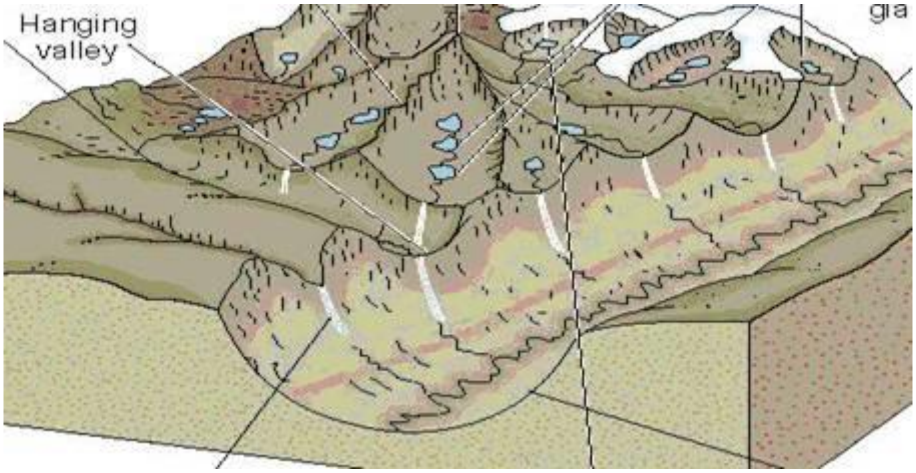



**9. Hanging valley**.

-It is a tributary valley that ends abruptly above the floor of a U-shaped valley and separated from it by almost a vertical slope.

-The rate of erosion is much greater at the main glacier valley than on the tributary valley, after glacier have retreated the floor of the main glacier valley lies far below than the floor of a tributary valley making the tributary valley to hang by ending a abruptly above the valley.

-A river occupying a hanging valley will fall more abruptly into the main valley to form waterfalls and produce alluvial fans.




**10**. **Rock basin** (highland erosion features)

- It is an irregular depression of the floor of glacial valley formed by unequal glacier upon the bedrock.

- This develops when weight and thickness of glaciers increase after two glacial have joined together.

- After glacier melts, rock basin becomes the site of lake. These are known as rock basin lakes.

**11**. **Ribbon lake** (Finger Lake or Trough Lake).

- Is a lake that occupies an elongated trough or hollow excavated by ice on the floor of a u-shaped valley E.g. lake Michelson near Mt. Kenya (Highland erosion features)

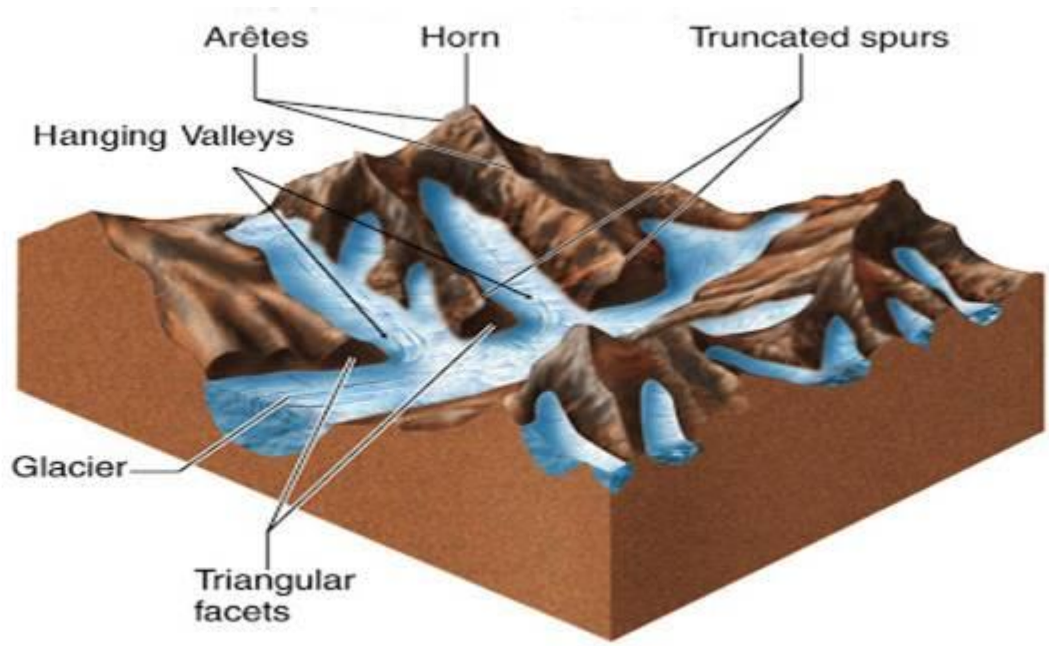
**12**. **Fiord**. (Highland erosion feature)

- It is a long, narrow, deep in let depression steeply sided into the sea. Fiords were formed when glaciers make the way to the sea.

- Most of the fiords occupied by deep sea water after the coastal land submerge due to ice melting forming natural harbours e.g. the also fiord of Norway.

**13**. **Ice eroded plain**. (Lowland glacier erosion)

- It is an extensive and almost level lowland area of bare rocks .It was once covered by an ice sheet which smoothed the topography and produced large area of bare rocks.




**GLACIER TRANSPORTATION AND DEPOSITION**

Glacier movement can also result into the formation of depositional features such as;

1) **Moraines**. (Highland (alpine) deposition features) unsorted materials.

Are the unsorted fragments of different size and shape that have been eroded, transported by glacier and then deposited in ridges within the glacial valley.

**Types of moraines** based on area within the glacier valleys where materials have been deposited;

a) **a) Ground moraines** – Formed at the bottom of glacier valley.

b) **b) Medial moraines**- Formed at the point where two glacial valleys meet

Adjacent lateral moraines joined and are carried as a single long ridge of till.

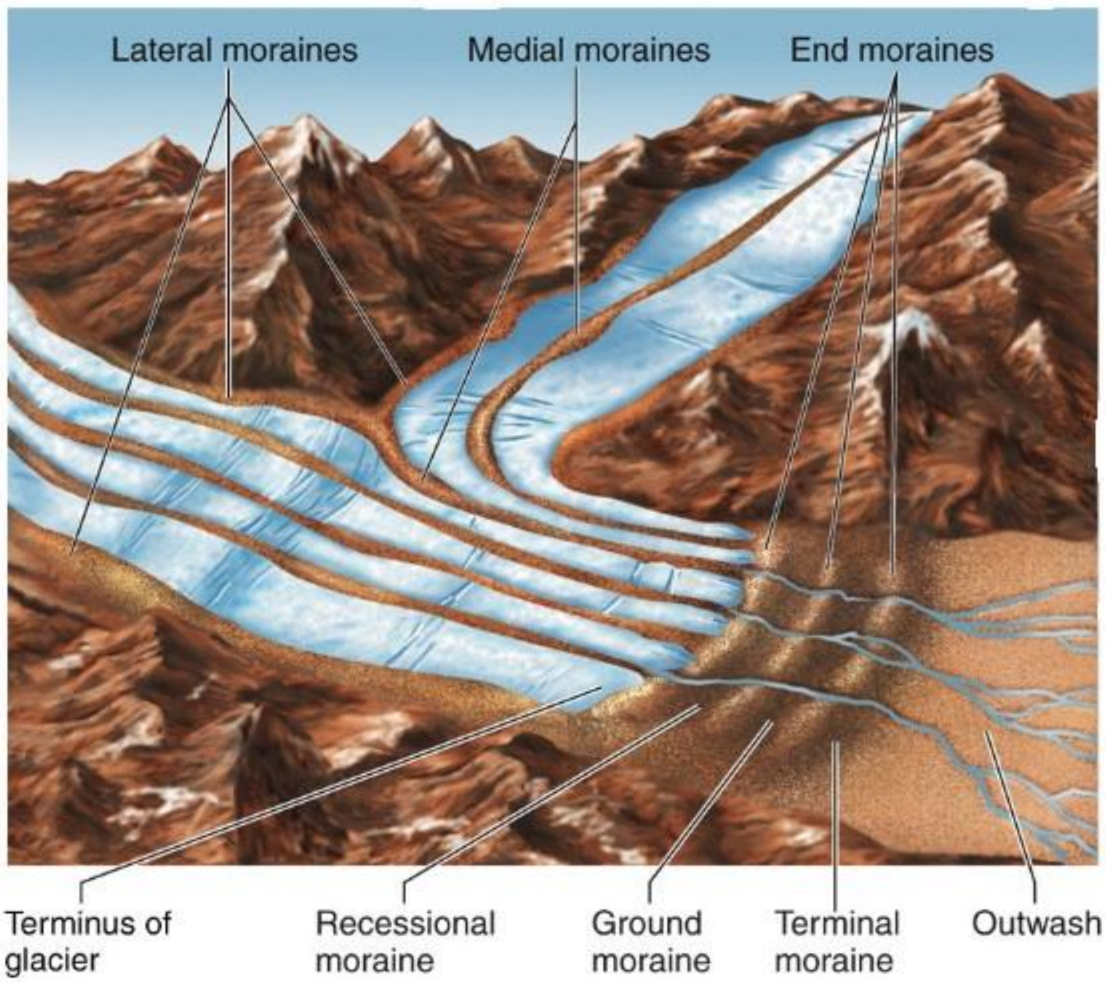
c) **c) Lateral moraine** – Formed along side of the glacial valley. (Ridge like piles of till along the sides of glacier).

d) **d) Terminal moraine**- Occurs at the end of glacial valley as the materials had been accumulated.

- Terminal moraines are built up when glacier is stationary.

- Materials of terminal moraines can be carried down the valley by melt water and deposited to form a feature known as outwash plain.

e) **e) Recessional moraines** – The end moraines built while the glacier is retreating. (A series of roughly parallel terminal moraines that make the step by step retreat of the glacier).



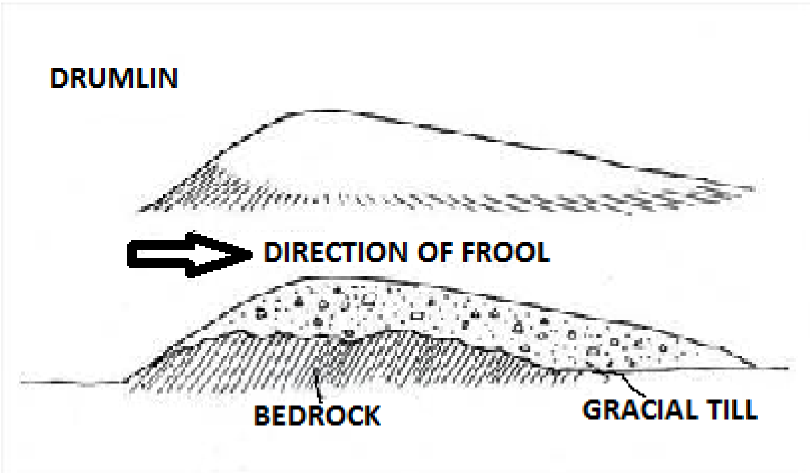

2) **Boulder clay plain**. (Lowland glacial deposition)

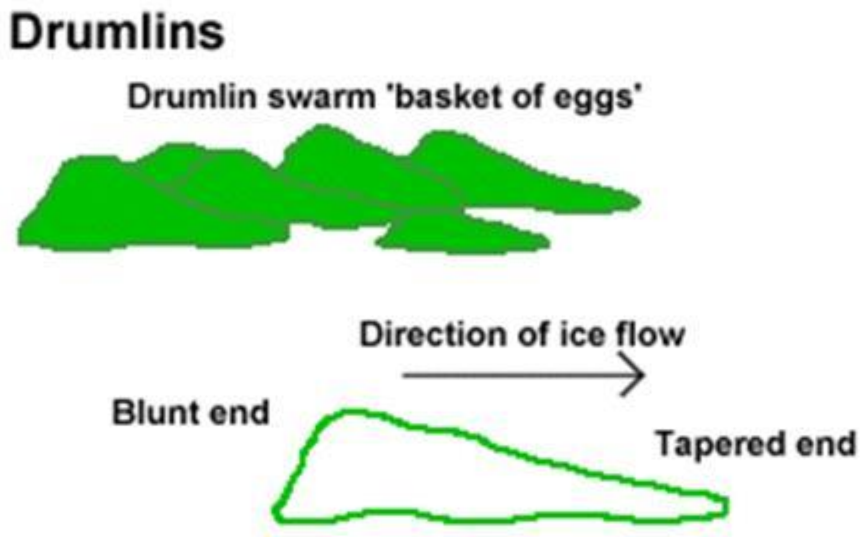
(Till plain)- Is an extensive lowland (plain) area consisting of clays and boulders deposited randomly by ice sheet and burying vast area of land.

3) **Erratics** are large boulders made of rock, different from that of the region where they are deposited

4) **Drumlins** (unsorted materials) (lowland glacier)

They are elongated oval shaped hill that are made of clay and boulders as they were deposited irregular on a till plain (boulder plain). They occur in groups and aligned in one another.

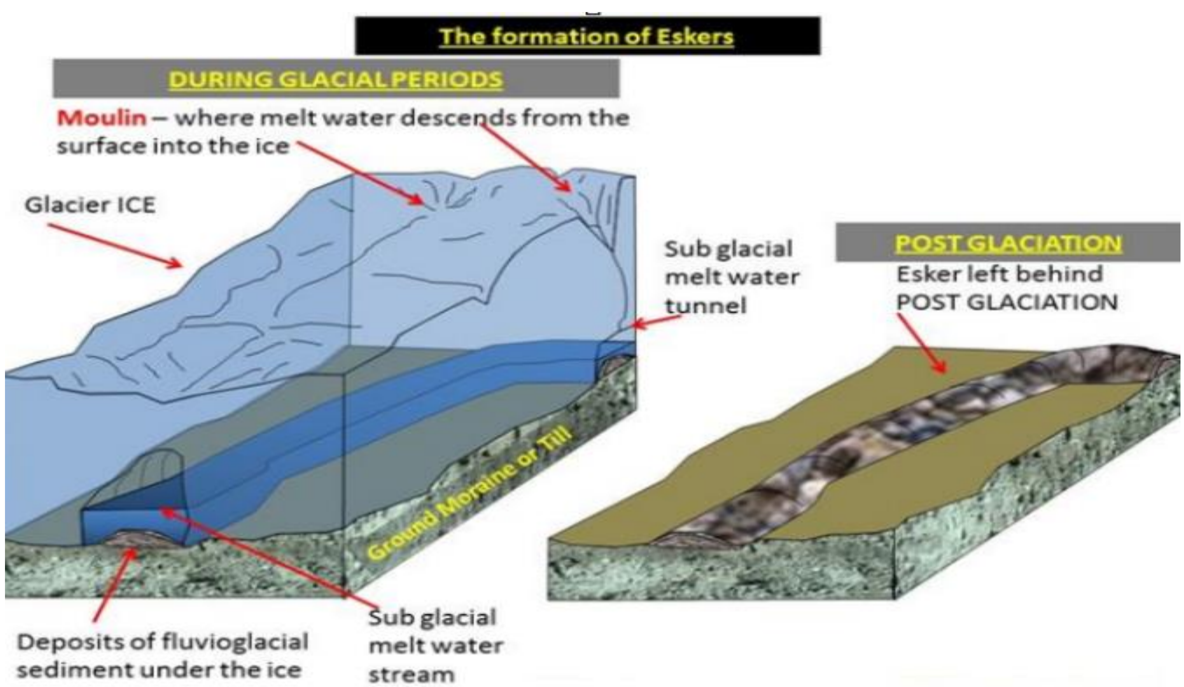





5) **Eskers** (lowland) (sorted fluvial – glacial material)

- Long, steep sided ridge of course sands and gravels.

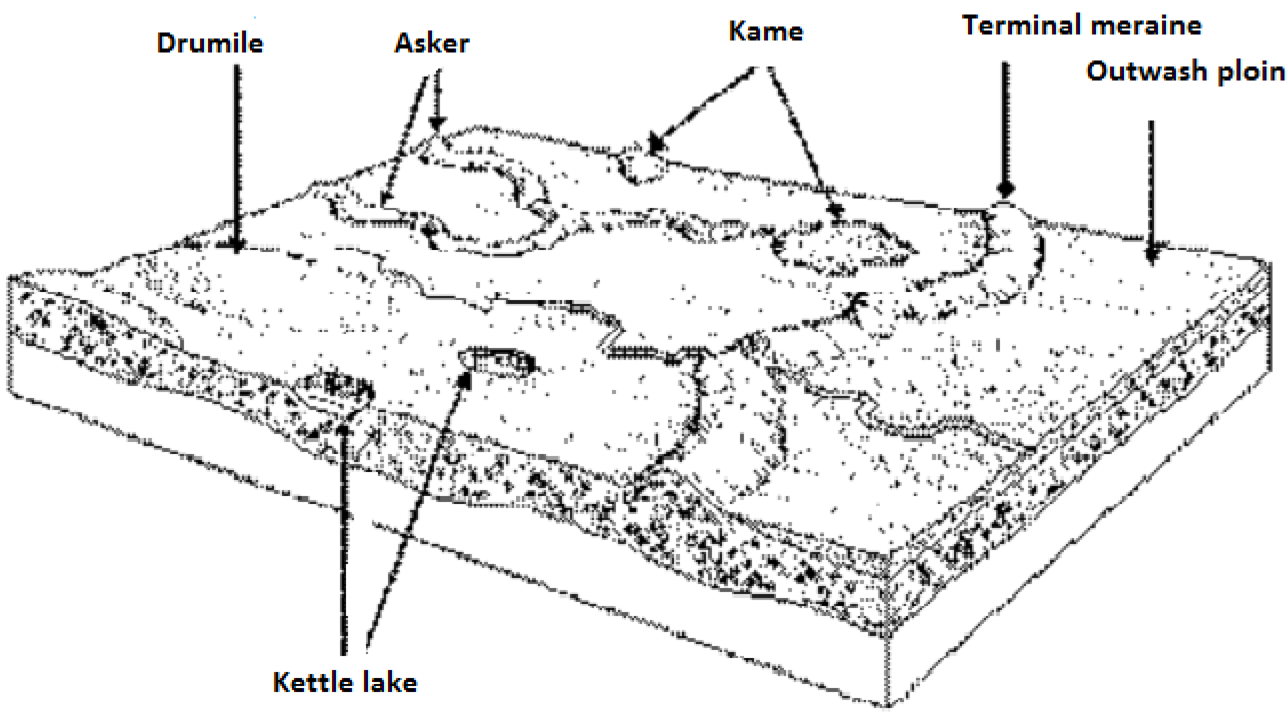
- Formed when ice remain stationary for long time. Streams form permanent sub glacial in which materials consolidate and compact if ice melts the materials are left as ridges which referred to eskers.



6) **Kames** (lowland)

- Is an irregular mound or hill (mass) of stratified materials (sand and gravel)

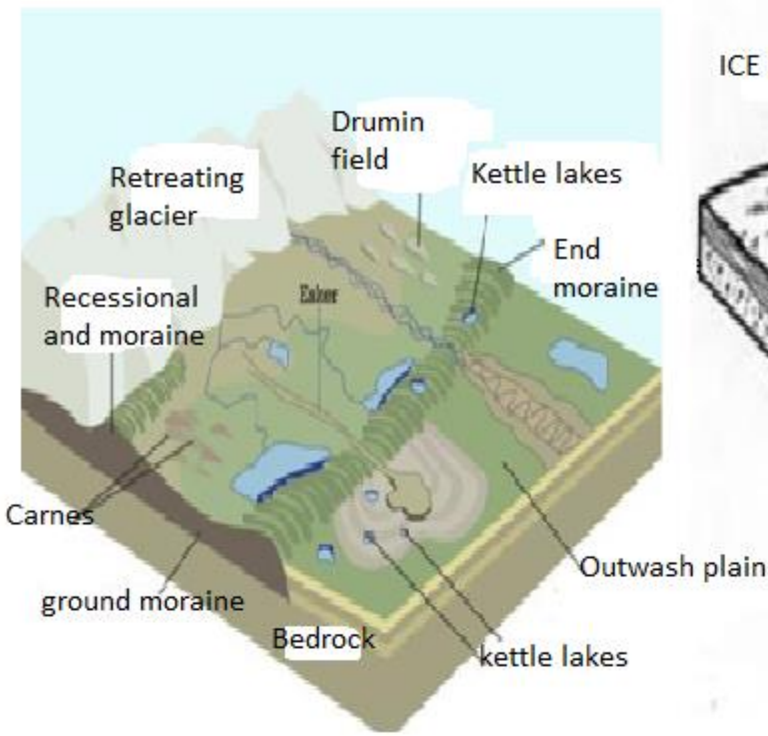
- Kames vary greatly in shape and size and occur in isolation or large groups. They form as ice deposited materials randomly.

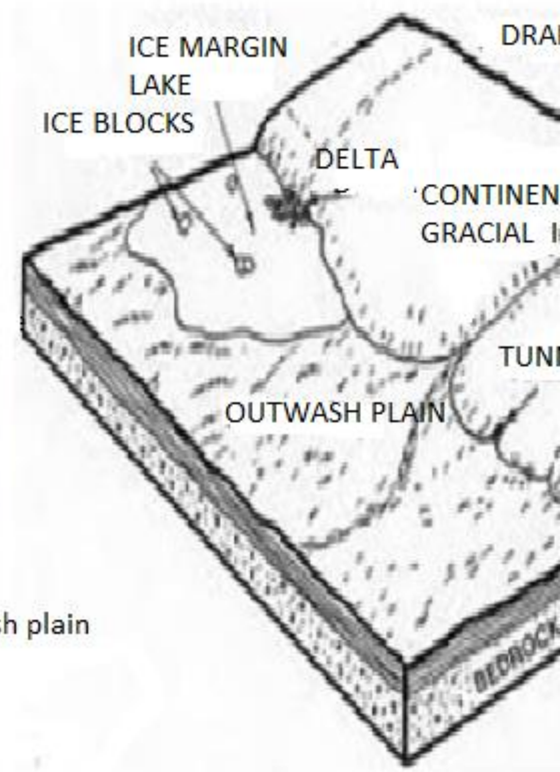



7) **Out wash plain** (lowland)

- It is a wide gently sloping low lying land of gravel and sand at the end of an ice-sheet.

- Out wash plain is usually found after boulder clay plain.




**Value/importance/significance of glaciated land escapes to human being**.

1. Some glaciated landscape like that of boulder clay plain and others are good for agriculture.(fertile)e.g. Dairy belt in U.S.A also crop cultivation in old glacier lakes e.g. wheat cultivation in Canadian prairies.
2. Hanging valleys are suitable for HEP generation. E.g. Norway, Sweden and Switzerland produce great proportional of hydro electricity by utilizing waterfalls of hanging valleys.
3. Glaciated landscapes provide attractive scenery also the glaciated highlands and peaks e.g. Mt Kenya and Kilimanjaro attract tourists.
4. Many glaciated valleys are used as grazing land as they contain good pastures. They are used for animal grazing main in summer season .e.g. In the Alps in Europe.
5. Fiords form natural harbors e.g. Oslo ford in Norway and also fishing-grounds.
6. Glaciated landscape contains a number of lakes which are used for navigation e.g. great lakes in N. America.
7. Melting of glaciers give rise to rivers. The rivers can be utilized for domestic and industrial purposes.

**Disadvantages of glaciated landscape**
1.The boulder clay plain in some regions, have produced a mainly landscape which have little or no value to agriculture e.g. central Ireland.
2.Many out wash plains contain infertile sands which give rise to extensive areas of waste land.

–

**WAVE**

WAVE ACTION AND THE FEATURES IT PRODUCES.

-Is the horizontal movement of ocean water, in the movement process it does the following three main works: These are:-**erosion**, **transportation** and **deposition**

-Waves should not be confused with tides which are the vertical movement of sea water.

**MOVEMENT ASSOCIATED WITH WAVES**.

1> **Swash**:

-The movement of sea water towards the beach is known as swash.

2> **Back wash**:

-The movement of water from the beach back to the ocean after the breaking waves.

3> **Wave break**

-Is the split of the wave when it releases its energy on the coast.

4> **Wave erosion**

– This takes place along shore (coast). It is determined by the nature of the rock and strength of the waves.

**WAVE EROSION PROCESSES CAN BE DIVIDED AS FOLLOWS:**

i. **Corrosive action**:

   -These kinds of erosion taking place when the rock fragments (particles) carried the waves are used as tools of erosion. They usually bang and cut the bare of the cliffs

ii. **Hydraulic action**:

-This occurs when water is thrown against the cliff. The air pressure expands the cracks and so the rocks are broken into smaller pieces.

iii. **Attrition**:

-This is the breaking down of the materials carried by waves when they crash among themselves to form smaller particles.

iv. **Chemical Solvent Action**:

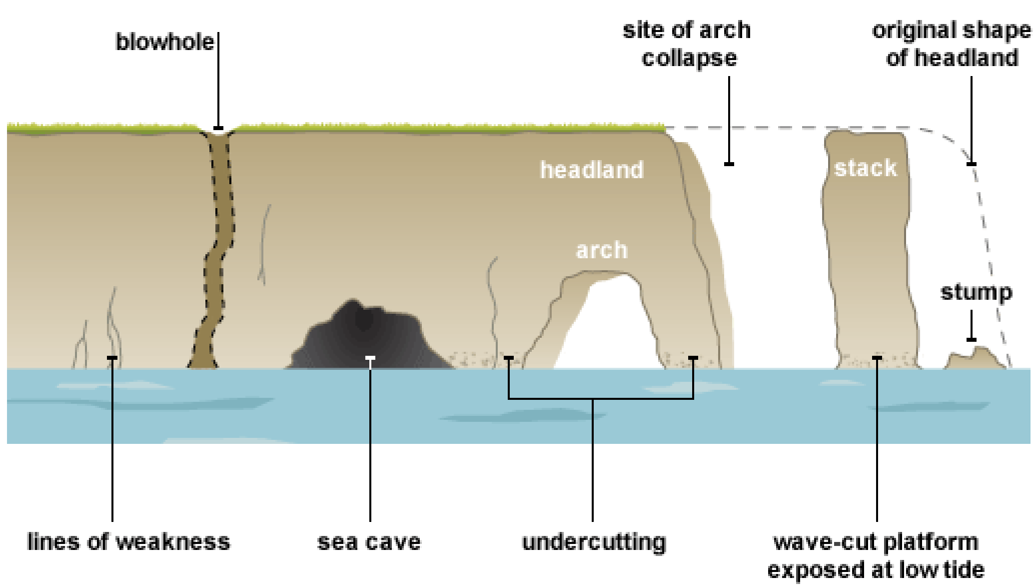
-This occurs in the coast consisting of limestone rocks. The carbon dioxide in the water will change the insoluble calcium carbonate ($caco_3$) (in limestone) to calcium Hydrogen Carbonate $C_a(HCO_3)_2$ which is easily removed.

***Cliff**: Raised land facing the sea going in land (into the land). **It is vertical**.

**Wave Erosion leads to the formation of the following features**

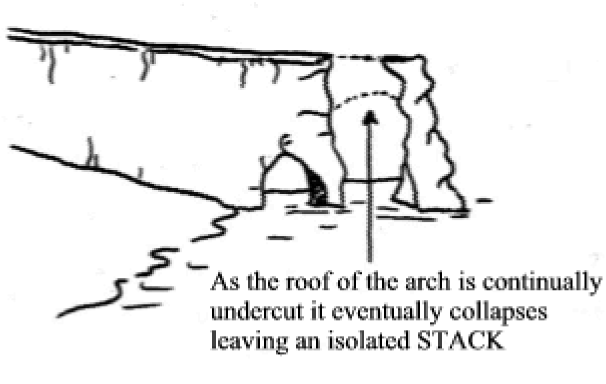
a) **a) Cave**:

-This is a chamber of a big hole formed by water when soft rock is removed by the waves usually soft rock materials are washed away by strong waves and taken to the ocean in the same way – **is a natural chamber extending into the head land or the cliff along the coastline. The weakness as opened up by wave abrasion and hydraulic action.**




b) **b) Stack:**

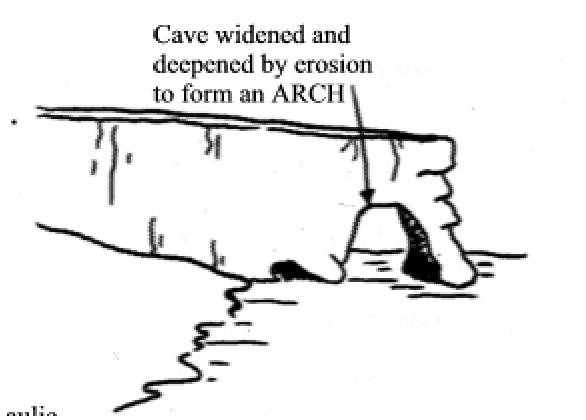
-This is a pillar which remains when the roof of arch collapses. It is a pillar which is separated by water from the rest of the dry land.




c) **c) Arch**;

-This is a feature which is formed when two waves in opposite are joined usually the top of this hole is roofed by a hard rock.

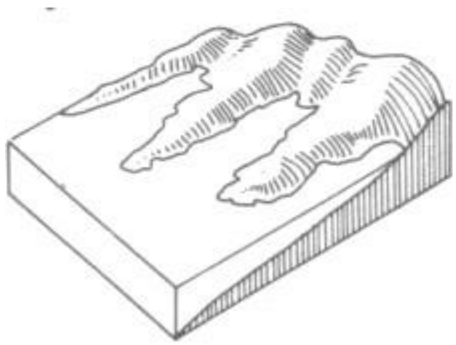
->Is a curved opening through the head land resulting from a head land eroded right through from one side cave to the other side of the head land.




d) **d) Headland**:

Refers to a high promontory with a steep faces, projecting into the sea or a lake and which is mostly formed as less resistant rocks have under gone erosion.

->Is a piece of land that grows sea wards. Hard rock bands less eroded.

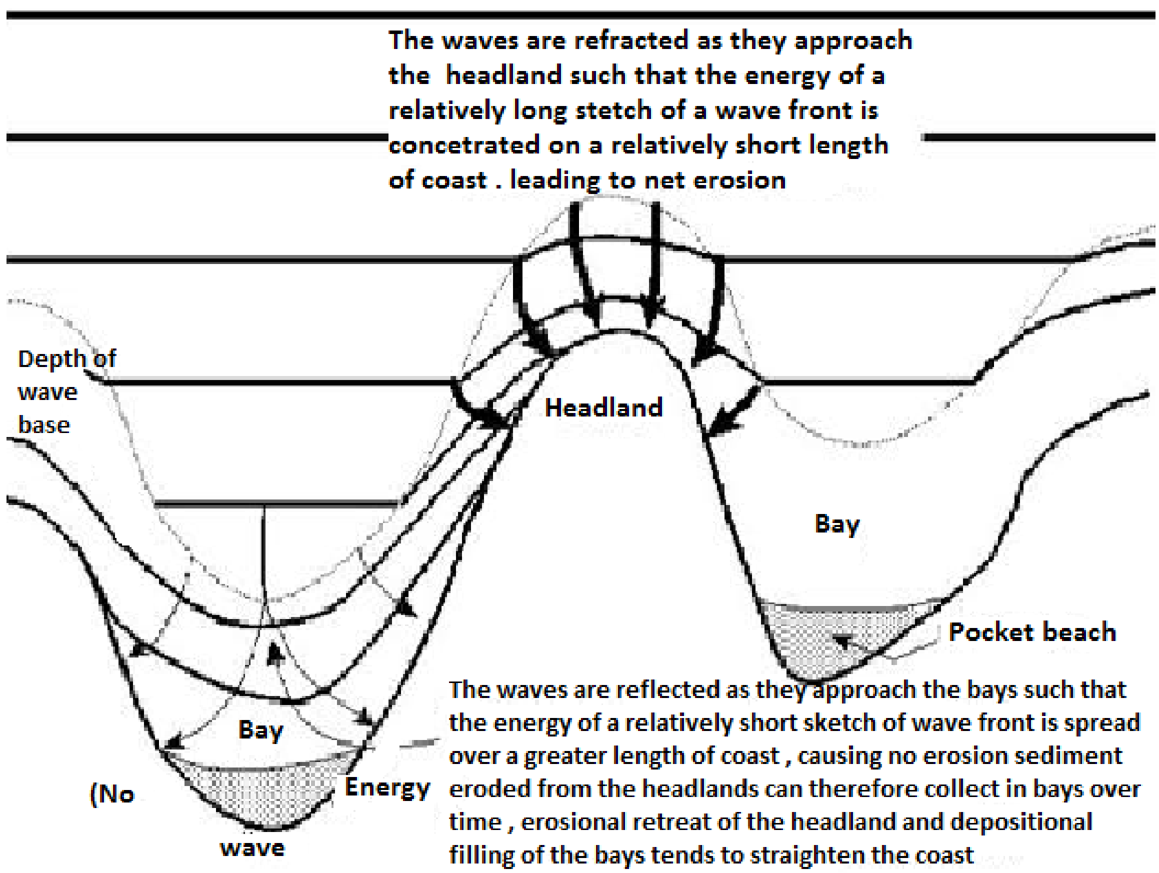


Head land

e) **e) Bay**:-

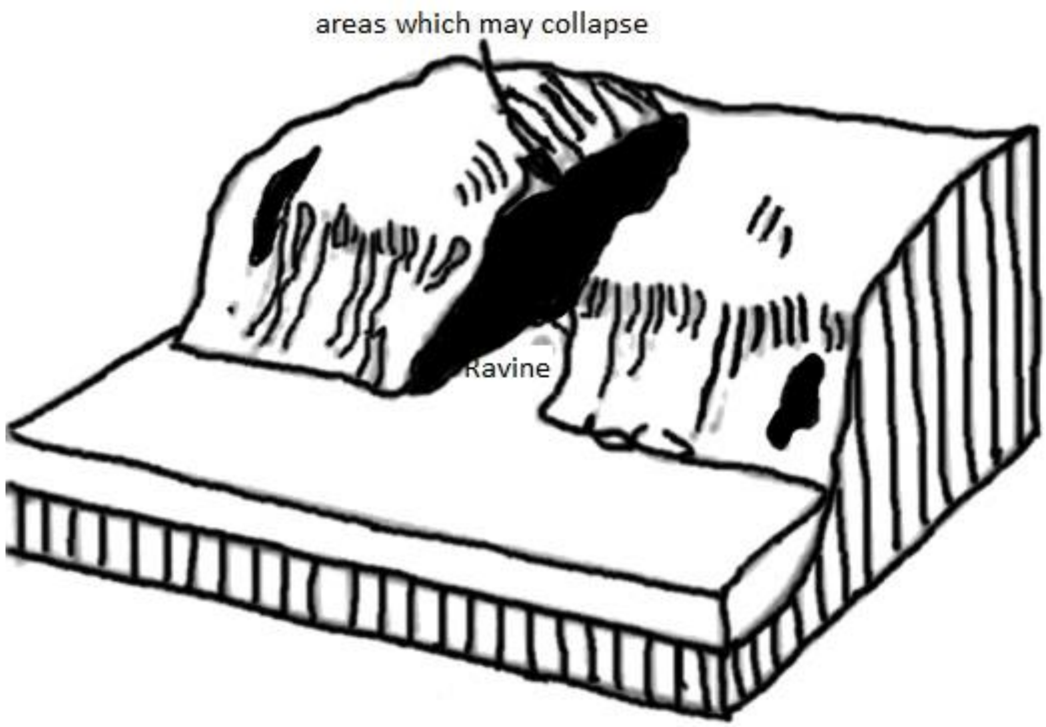
-Refer to curved indentation of the sea into the land which is formed as a result of the removal of less resistant rock.

-Is a narrow sea in let formed along the coast of alternative rock hardness, the soft rock band easily eroded and produce sea inlet.

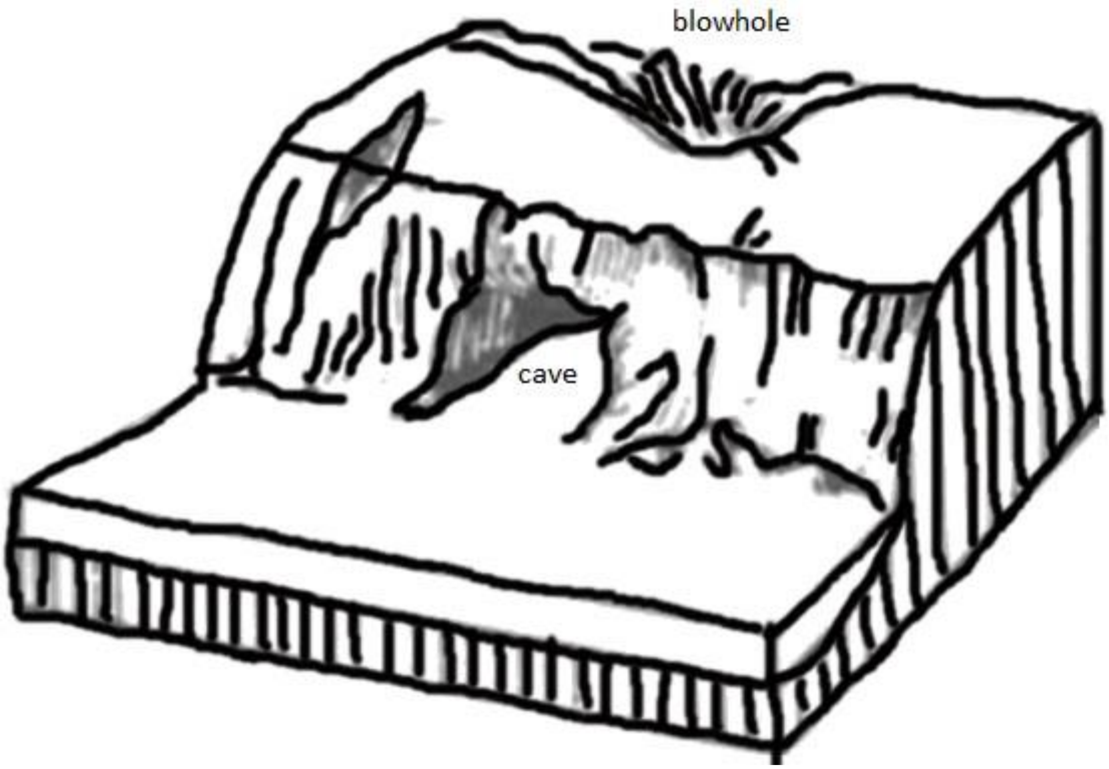



f) ***f) Geo***;

- Is a long narrow sea inlet which penetrates the cliff formed when the roof of a blow hole collapses.



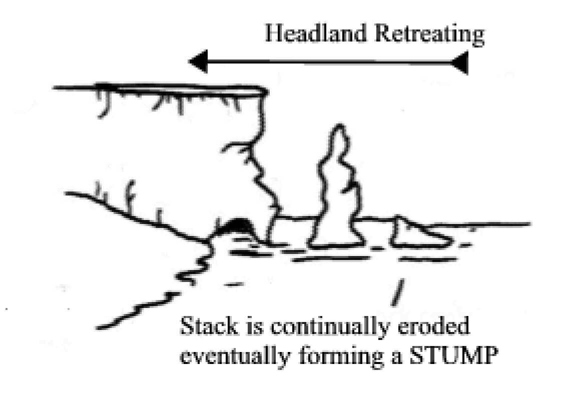

g) **g) Blow hole**; - Is a hole which extended from the cave to the surface of the upper part of cliff formed due to abrasion and hydraulic action against the cliff with a cave, makes the hole of the cave to be more enlarged and reach the top.




h) **h) Stump**;

- Is a reduced stack in height under water, usually visible at low tides.

-Continuous wave action can make the stack get lowered in height and completely immerses in water.




**i) i) Cliff.**

- Is a high more or less vertical walled rock surface which borders the sea.

- Formation of a cliff starts with the development of a notch along the coastline. (Notch is a hole formed on the rock face of the coastline due to continuous beating of waves).

- Due to continuous beating the notch is expanded and finally results to the occurrence of the outgrowth rock known as cliff.

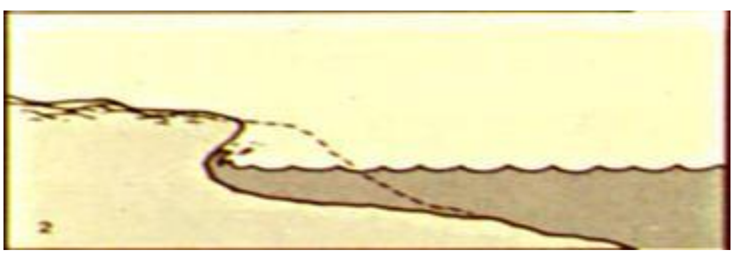
- Formation of cliff depends on nature of the rock, stratification and presence of joints.

**a)**

Waves attack a steep slope/coast.

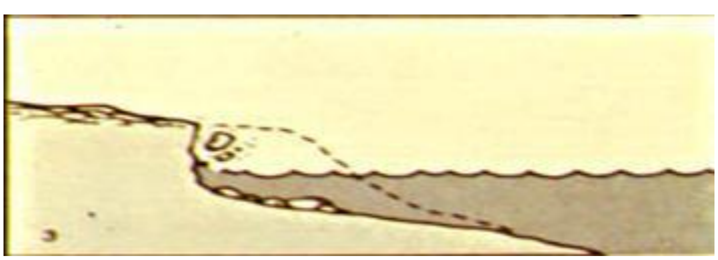
b)

-A notch forms at the high tide level mark

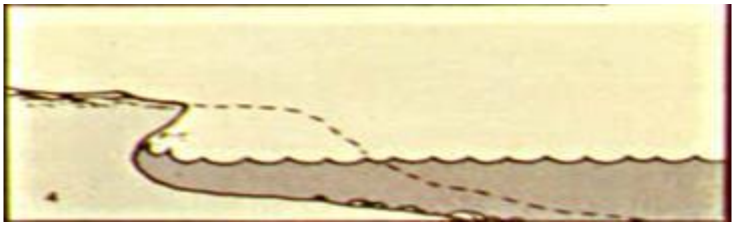


c)

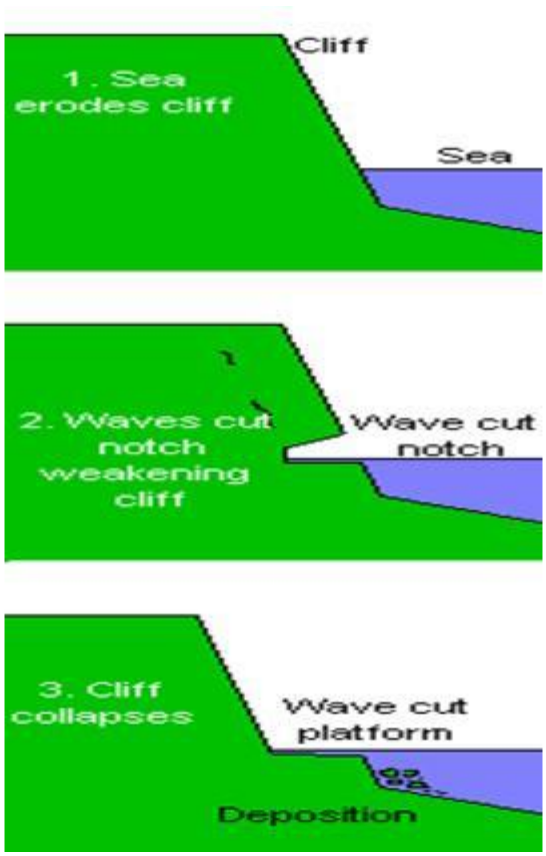
-Over hanging block collapses and cliff forms.



d) -Waves attack new cliff base to form an overhanging cliff.



**j) Wave cut platform**- Is a fairly that part of the shore which is formed by wave erosion as the cliff line retreats inland. Cliff being more steep or vertical may collapse seawards due to denudation thus mass of the collapsed cliff accumulate over a wider area in the ocean to produce wave cut plat form e.g. found in the west coast of Norway.




**WAVE DEPOSITION**

-The eroded material are transported and deposited on the shore along the coast. The deposited materials is those that have been eroded from the coast its self or from the rivers.

**The following are the wave deposited features**;

**1. Beach**;-This is the accumulation of sand, pebbles, shingle and mud on shore along the coast. The material decrease seaward (from the coast to the sea). The arrangement follows this pattern. Boulders, Shingles, pebbles, sand and mud. (Smooth surface).

- Formed by constructive waves on the gentle sloping surface between high and low water level.

- (Transportation of materials consist of swash and back swash (long shore drift))

**Example** Mombasa in Kenya,Tunza Beach in Mwanza,In Dar-es-salaam Kawe , Kigamboni and Coco beach.

**2. Bar** – A bar is a ridge of material, usually sand which lies parallel to the coast.
-This is a narrow ridge of sand and shingle formed in the sea. It is parallel to the coast line.

-Unlike a spit, a bar is not attached to the land.

**TYPES OF BARS**

a) a) Tombolo

b) b) Bay Bar

c) c) Off-shore bars.

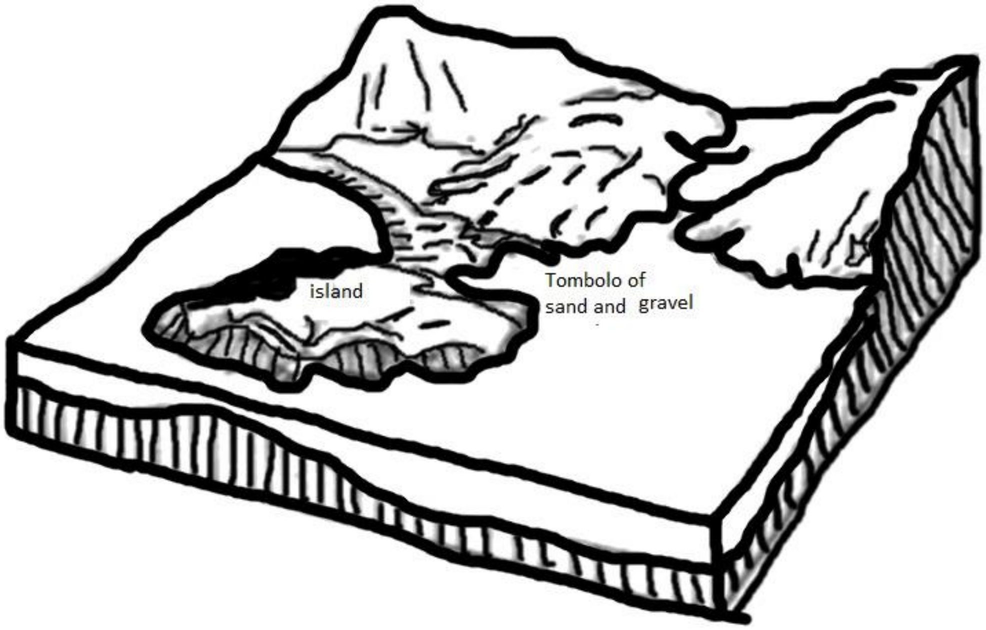
a) **a) Tombolo**
- Tombolo is a type of bar which connects the land and an island.

Occurs when a bar joins an island to the main land.

- Accumulation of sand where one end attaches coastal and the other end is attached to the island.

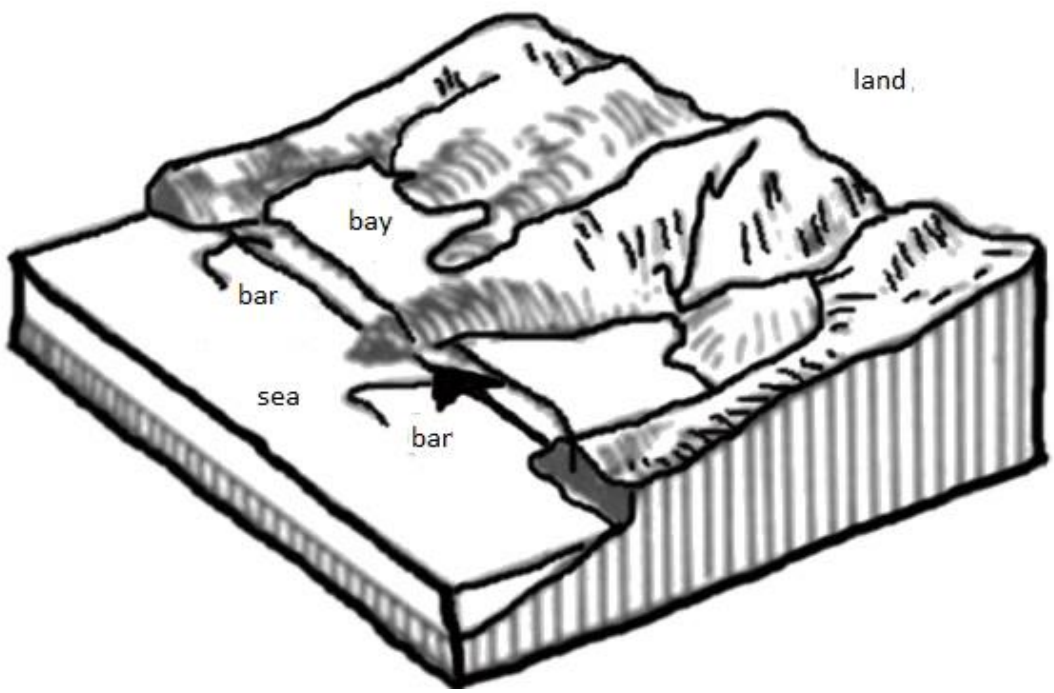
**Different between an estuary and a Tombolo.**

-Sometimes a spit can become curved/ hooked when formed on hard land and when waves meet the end obliquely.




b) **b) Bay bar**

- Is the bar that runs across the bay.



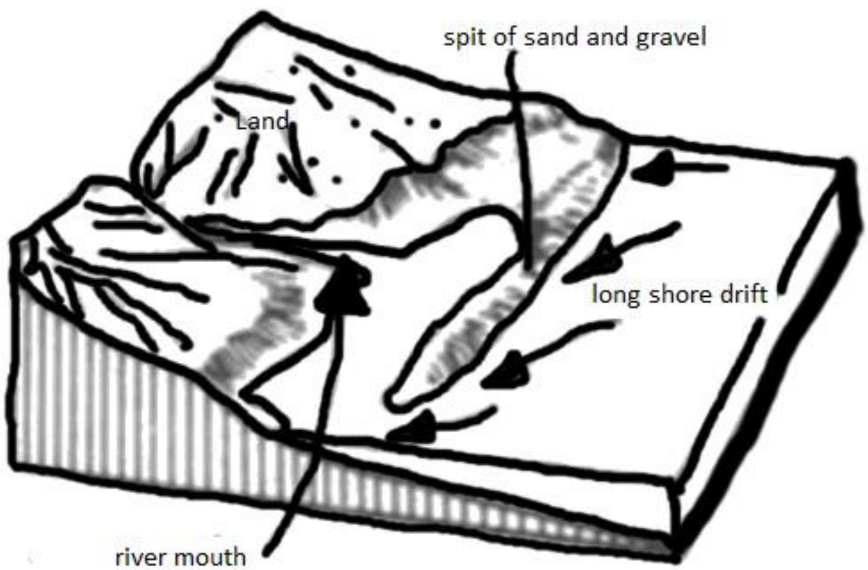

**a)**

**c) Off-shore bar**

-Accumulation of sand deposited on the gentle sloping sea bed (off shore zone) where sand is thrown up by waves breaking some distance from the coast.

**3. Spit** – This is a narrow tongue of sand and shingles joined to the land and projecting into the sea. Example; hooked spit in Namibia.
- Is a very long and narrow ridge of pebbles and sand joined to the mainland at one end and terminating into the sea on the other end.

Waves meet the end oblique.Example: Bagamoyo in Northern Dar es salaam in Tanzania,Medjerda delta in Tunisia etc.




**4.Mud-Flat**

– Deposits of mud in the base of the ocean. They can be reclaimed (modified) and become very fertile.

-Deposit of fine soil and silt in the gently sloping coast especially in the bars/estuarine. Example Lamu mud flat along East Africa Coast at the mouth of river Rufiji etc.

**5.Lagoon**

– Is a shallow enclosed amount of water which is usually caused by deposition of materials at shallow waters of the ocean.

-Is a shallow area of coastal water completely or partly separated from the open sea by sand banks (bars or spits).

E.g Benin(Dahomey, Nokone and heme to the east of Nigeria.)

**5. CUSPATE FOR ELAND**

Is a large triangular deposit of sand or shingle which is terminating sea wards.It is formed as two(2) spits which form towards each other eventually merge.

Example:Tonga around L.Albert,Cape canaveral in Florida,The Darss on the Coast of Mecklenburg,East Germany etc