- Physical factors influencing world distribution of plants & animals.
- Forms and functions of ecosystem: Forest, Grassland, marine and mountain ecosystem.
- Biodiversity and its causes of depletion through natural and man induced.
- Conservation and Managment of ecosystem.
- Enviormental Hazards and problems of Pollution
  - i) Ozone layer depletion.
  - ii) Global warming
  - iii) Drought
  - iv) flood
  - v) Earthquke
  - vi) Volcanoes
  - vii) Cyclones
  - viii) Landslides
  - ix) Tsunamies
  - x) Deforestration
  - xi) Green house effect.
  - xii) Air pollution
  - xiii) Water pollution
  - xiv) Noise Pollution
  - xv) Soil Pollution
  - xvi) Acid Rain

* world soil distribution and its type ...

1. Wild life Act - 1972
2. Project Tiger - 1973
3. Project Crocodiel - 1974
4. Project Elephant - 1992

5. Forest conservation Act - 1980
6. Enviormental Protection Act - 1986
7. National forest policy - 1988

8. The Central pollution control Board - 1974
9. The water prevention & control of pollution. - 1974
10. National water policy - 1987
11. Central Ganga Authority - 1985
12. The National River conservation plan. - 1995

13. The air prevention & control of pollution Act - 1981
14. Noise pollution. - 2000

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Books:

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Island Biogeography : MacArthur & Wilson.

Wild Bird and Protection - 1987

Biosafty Protocol - 2002

Biodiversity Bill - 2000

Protection & mentanance of ozone layer - Montreal Protocol - 1987

Reduction in the emission of CO_2 - "Toranto world conference" - 1988

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Factors Affecting on World Distribution of PLANTS and ANIMALS:

A] Physical factors influencing world distribution of PLANTS:

- Enviorment is a complex of different factors which are inter-related and which affect plant growth either singly or collectively.

for eg- The growth of plants precipitation but also by temprature, wind and evapotranspiration.

- The most significant factors on the enviorment can categorized as follows:

1) Evoluttionary factors:

- Evolution implies the succession of organism through the course of time.
- Darwin: 'Evolution as the process through which plant and animals succeeds from origin of habitat.
- It implies time, place, climate and geology plays important role in the evolution of plants.

2) Innate factors:

- Plants responce to enviormental conditions is directly dependent upon their physical & physiological ability to cope up with enviormental control.
- Adjustment and tolerence with enviormental control is related with innate factor.
- Innate factors thus affected upon the distribution of plants for e.g- Coniferous best servive specific region.

3) Geograaphical factors:

① Location -

- Reception of solar energy which is the base of life, directly depend upon location
- The solar energy decresses from equator towords polar region.

(i) 10° to 20° lat - Tall grasses mixed.

(ii) mediterian coasts - Sclerophyllous woodland.

(iii) 40° to 50° lat - rainfall distribution in pecular.

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(ii) **Area:**

- Large island have more species of plants & animals than small island, extent no. of species & area close relationship.
- Semper's : The size of area increased the size of species also inirased.

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3) **Climatic factors:**

- climatic influence on vegetations are more than any other factor.
- Climate may affect vegetation directly in terms of various variables like temprature, wind, sunlight, rainfall etc.

(i) **Temprature -**

- Temprature exerts a fundamental control on plant growth.
- Temprature overthe earth, differ according to latitudnal location, altitude, nearness to the sea & prevailing winds.
- On the basis plants are classified Tropical, Temperate & Alpine.

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(ii) **Sunlight -**

- Light is essential to plant life for providing the energy recquired by autotrophs for photosynthesis
- The amount of light is known as 'Compensation point' when respiration is just balanced by gains from photosynthesis.
- Plants having high compensation point are called 'heliophytes' while those needing less intensity of light are called 'sciophytes'.

(iii) **Moisture -**

- Water in the form of 'soil-moisture' is essential to every plant such processes as germination of seed, transport of nutrients, transpiration and photosynthesis.
- Water availablity also influences the life form & structure of plants :- Hydrophytes - submerged in water, 'Xerophytes' - dry habitats, Mesophytes - water neither excessive nor deficient

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(iv) **Winds -**

- Strong dry winds of tropical deserts increase the transpiration rate of plants.

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- These winds uproot many trees and plants; Dust storms and ice-cold winds effects on crops and natural vegetation.
- winds are transport of pollen grain and help to growing plants.

4) **Edaphic factors:**

- 'The various combination of soil factors that influence plants life are referred to as edaphic factors.'
- Such as soil texture, content, composition, properties, moisture content, aeration are important aspects and these are known as 'edaphic factor'.
- Soil texture and structure are its most significant qualities and influence vegetation by affecting drainage, aeration, moisture and nutrient availability to plants.

5) **Biotic factors:**

- These factors include the effects of one plant species on the other, together with the influence exerted by animals and men upon plants
- when one plant competes for light, soil space, nutrients, water and space for seed dispersal with other.
- Plants & animals are also closely interdependance, plants are primary producers of every food chain depend on green plants.
- Dispersal of seeds & pollen grains by birds, animals and insects.

6) **Physiographic factors:**

- These factors include Nature of land surface, Types of Relief, Altitude, slope and Drainage pattern.
- Altitude in itself induces climatic changes that give rise to vertical zonation of vegetation:
  e.g. Tropical, Temprate, subtropical, arctic or alpine vegetation etc.
- Slopes influence the sunlight, drainage and soils which, in turn affect plant life.

7) **Geological factors:**

- Wegener's idea of continental drift reflects that present landmass were originaly linked.

liana: is not a woody plant.
Carbons sink" of the globe: Equatorial rain forest.
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- chemical composition, porosity, structure and friability of the soil depend upon geological character of mother rock & soil.

8) **Anthropogenic factors:**
- These factors influence the plant communities by means of human activities.
- Distructive activities of man like felling of trees, burning of forest, forest clearenced for agriculture & settlment etc.
- Establishment of new kind of vegetation like tea and coffee plantation or growing of rubber.

Classification of Plants:
- The plants have been classified on different bases and criteria as follows:

1. **Morphological classification of plants -**
- Non-flowering plants are 'cryptogams' and flowering plants are 'phanerogams'.

① **Cryptogams** - (non-flowering)
- Cryptogams plants belong to group of non-flowering plants because these do not bear flowers and seeds.
- The whole reproductive process of non-flowering plants is hidden in their bodies.
- The non flowering plants are Bactaria, Algae, Fungi, Bryophyta, Lichens, Pteridophyta etc.

② **Phanerogams** - (flowering)
- Phanerogams categories of flowering plants include those plants which reproduce seeds, flowers and fruits.
e.g. mango, Guva, Jack fruits etc.
- These plants are sub-divided into two categories:

Gymnosperms -
include those flowering plants which carry their seeds in open form, The seeds are not closed under a cover of shell.
e.g. Pine, spruce, Juniper etc.

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Angiosperms -

include those vascular flowering plants which carry their seeds closed in protective cover or kept in body tissues.

- These are two sub types on the basis of seed structure.

(i) Dicotyledon plants - peas, grams, mango etc.

(ii) Monocotyledon plants - wheat, corn, maize, millets etc.

2. **Hierarchical classification of Plants -**

Plant kingdom : Phyla ← classes ← orders ← Families ← Genera ← species

3. **classification of plants Based on Life forms:**

a) **Raunkiaer's classification -**

- C. Raunkiaer (1934) has classification plants on the basis of their life forms which is the result of relationship betn plant life and climatic factors:

(i) Phanerophytes (ii) chamaephytes (iii) Hemicryptophytes
(iv) cryptophytes (v) Therophytes.

b) **Whittaker's classification -**

R.H. whittaker's (1975) six categories on the basis of lifeforms:

(i) Trees - Height more than 3m.
(ii) shurbs - less than 3m height.
(iii) climbers - or vines.
(iv) Epiphytes - Plants growing upon trees.
(v) Herbs - without above ground woody steams.
(vi) Thallophytes - lichens, mosses, liverworts.

4. **Classification of plants Based on climate:**

- Plants are also classified on the basis of climatic elements like, sunshine, temprature, evaporation, evapotranspiration, humidity, pricipitation & soil moisture etc. in to the following types:

e.g. Hydrophytes, mesophytes, xerophytes and cryptophytes.

* megatherms - Equatorial vegetation.
* mesotherms - Tropical and sub tropical vegetation.
* microtherms - Cool temprate region. DATE

(a) Hydrophytes - are those plants which grow and develop in permanant wet conditions & habitat such as delta and esturies, marshes, waterlogged bogy soils. 8]
e.g- Sundari of sundarban delta rich 'mangroves'.

(b) Mesophytes - mesophytes plants thrive in the regions of extream seasonal weather conditions charactrized by wet and dry, hot and cold seasons.
-mesophytes plants are divide into 2 categories:
(i) short lived, ephemeral and Annual plants.
(ii) Perennial mesophyte plants. 1]

(c) Xerophytes: are plants of extreme dry conditions of warm tropical desert climate say 'sahara type' of climate.
e.g- Cactus, acacia, date palm, Khejra trees. etc.

(d) Cryptophytes:- are those plants which are well adapted to severe cold conditions of 'Tumdra climate'. withstand extreme cold conditions, & minimum amount of Insolation & sunlight.

Biotic Succession:
'The entire natural process of replacment of one vegetation community by other vegetation comunity and sequential and directional changes and development of vegetation is called biotic succession'.

* Halophyte:
A plant that can tolerate a relatively high salt content in its enviorment.

* Tropophyte:
'Plants behave as Xerophyte at one season and hydrophyte at another is known as Tropophytes'. 2]

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B] Factors affecting on world distribution of ANIMALS:

- A particular 'species' of animals may be concentrated in particular region but a 'genus' many not be confined to a particular region rather it may be found in several faunal regions whereas a 'family' may be found over many continents.
- The distribution pattern of animals is dynamic because of speciation, extinction, dispersal and migration of animals.

* The factors distribution of animal species into 2 groups:

1) Physical factors:

- A particular animal species can live and flourish in a particular habitat because each species requires definite 'environment conditions' which favour their growth, speciation, colonization, reproduction and overall development.

(i) **Topographic features** - like distribution of land & water, mountains, plateaus, lakes and several erosional & depositional landforms.

(ii) **Climatic factors** - Temprature, Humidity, precipitation, water, sunlight, solar radiation, air pressure overall climate affects and control the distributional patterns of world fauna.

(iii) **Waterbodies** - such as lake, sea, ocean are effective barrier for the migration of land animal because most of land animal lack of swimming mechanism.

(iv) **Oceanic Properties** - like salinity, density, temp. affect the animal dispersal.
e.g. - fresh water animals can not swim in saline water.

2) Biological factors:

- Biological factors include the aspects of -
  (i) Population ecology or ecological aspects of species popln.
  (ii) Interaction betn animal & their physical enviorment.

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(iii) Interaction among the animal themselves.
(iv) Interaction betⁿ animal and plants.
(v) mobility, migration and dispersal of animals.
(vi) animal ecology - which affect & control the distribution of animals in any region.
(vii) Includes aboundance of animal popⁿ, size of population, regulation of popⁿ size.
(viii) Mutual interaction betⁿ organisms & physical environments.

classification of world Animals:

- A.R. Wallance attempt the classification of world animals into faunal regions in 1876.
- The world divided into the six major faunal regions:

1) Palaearctic faunal Region:

- Palaearctic faunal region includes Europe, middle and north Asia, N. Africa which represent 28 chordata families.
- The important animals of this great faunal region are: Russian desmans, dormice of Eurasia, Mediterranean mole rats, saiga and chiru antelope, acentors, crocodiles, lizards etc.
- Reptiles are found in lesser number

(i) Tundra Region - represents caribou, lemming, musk ox, Arctic hare, Arctic fox, wolf, polar bear etc.

(ii) Temprate coniferous forest region - moose, mule, deer, lynx are the important animals on this region.

(iii) Temprate grassland region - represents saiga, wild ass, horse, camel, jerboa, hamster, jackel etc.

(iv) Deciduous forest region - represents racoons, oppossum, red fox, black bear as important animals.

(v) Desert regions : represents lizards, snakes, hamster, hedghog, rat, jerboa, cottonail etc.

- This region includes 136 families of vertibrata animals, 100 genera of mammals and 174 genera of birds.

2) Nearctic faunal Region :

- It consits of geographical territories of North America & Greenland
- There is much similarity betⁿ palaearctic and Nearctic region. Both the regions were connected through the Bering land bridge, during 'pleistocene period.'
- some scientists have grouped these two regions into one single region as 'holarctic region'.
- Reptiles are found in large numbers.
- There are 122 families of all vertebrates, 74 genera of mammals, and 169 of birds.

(i) Tundra Region - a

Dominance of caribou, musk ox, lemming, arctic wolf, arctic fox, polar bear etc.

(ii) Temprate coniferous forest -

includes moose, mule, deer, wolverine, lynx etc.

(iii) Temprate grassland region -

is charactrized by bison, pronghorn, jack, rabbit, praire dog, gopher, fox, coynote etc.

(iv) Deciduous forest region -

includes racoons, opposum, red fox, black bear etc.

(v) Desert region -

includes lizards, snakes, kangaroo, jerboa, hamster, hedgehog, cottontail etc.

3) Oriental faunal Region -

- These geographical areas of mainly south and south east Asia. The Himalayas, Tibetan plateau and chinese mountain region
- This faunal region is tropical and most area under forest there are the region of savana and desert.

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- This region represent 164 families of all vertebrates, 118 genera of mammals & 340 genera of birds
- It is charactrized dominance of Indian elephant, rhinos, deers, antelopes, pheasants, tigers, lizards, snakes, gibbons, monkeys, sunbear, porcupine etc.
- Birds are Pigeons, parrots, peacock, crane and fowl.

4) **Ethopian faunal Region:**

- The areas of whole Africa south of sahara and SW Arabia, Madagascar.
- This faunal region also falls under tropical climatic region.
- This region is minimum diversity of animals, there is complete absence of moles, beavers, bears & camels.
- This region represented 174 families of vertibrata, 140 genera of mammals and 294 genera of birds.

① **Desert Region** -
is charactrised by the dominance of springbok, porcupine, jerboa, rock hyrax etc.

② **Savana Region** -
represents zebra, eland, gemsbok, hartbeest, gnu, giraffe, elephants, ostrich, lion, cheetah etc.

③ **Tropical forest region** -
includes important animals like okapi, gorilla, chimpanzee, monkey, forest elephant etc.

5) **Neotropical Faunal Region** -

- It includes the whole of south America which is characterized by tropical enviorment.
- This region represents the largest number of exclusive mammals
- There are 168 families of vertebrate animals, 130 genera of mammals and 683 genera of birds in this faunal region.

① **Temprate grassland region** -
is dominated by guanaco, rhea, viscacha, cavy, fox shunt etc.

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(ii) Desert Region-

is characterized by guanaco, rhea, armadillo, vulture etc.

(iii) Tropical forest region-

is represented by monkey, kinkajou, pygmy ant eater, sloth, tree snakes, parrot, humming birds etc.

6) Australian faunal Region-

- The Australian faunal region includes Australia, New Zeland and islands betn S.E. Asia and Australia.
- This region is dominated by placental animals.
- Marsupials are the typical animals of the Australian faunal region.
- There are 141 families of vertibrata, 72 genera of animals and 298 genera of birds.

(i) Desert Region-

is charactrized by marsupial, mole, jerboa, parakeet, lizard etc

(ii) Savanna Region-

is represented by emu, red kangaroo, bandicoot, wombat, cockatoo, parrot .etc.

(iii) Tropical forest region-

is dominated by tree and musk kangaroos, wallaby, koala, oppossum, cassowary etc.

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- **Mangrove:**

Mangrove is a type of swampy vegetation that grows along many tropical coastlines mainly in Asia.

- It consits of broad leaved shurb and trees that are adopted to the internal enviornment.
- These adaptation includes arching areal roots to anchor the trees and special breathing roots with 'knees' which operate at low tide.

- **Ecotone:**

- 'The transition zone betn two ecosystems is called ecotone'
- In fact it marks an overlap rather than a distinct boundry betn plant communities.

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ECOSYSTEM: A. G. Tansley (1935)

- The term ecosystem first used by A. G. Tansely in 1935.

(i) "The complex system of interaction betⁿ organisms & the physical enviorment in any unit of area is reffered to as an ecosystem".

(ii) "The functioning activities of living and non living organism in the enviorment is called as ecosystem".

- According to Tansly the ecosystem ~~the~~ is comprised of two parts:

1. Biome - the whole complex of plants & animals of spatial unit.
2. Habitat - Physical enviorment.

* Properties of Ecosystem:

1) Ecosystem represent the sum of all living organism and physical enviorment.

2) It comprised of 3 basic factor - (i) energy (ii) Biotic (Biome) (iii) Abiotic (Habitat).

3) It occupies certain well defined area on the earth.

4) It tend to be relatively stable equilibrium.

5) It is a open system charactoized by continious input and output of matter and energy.

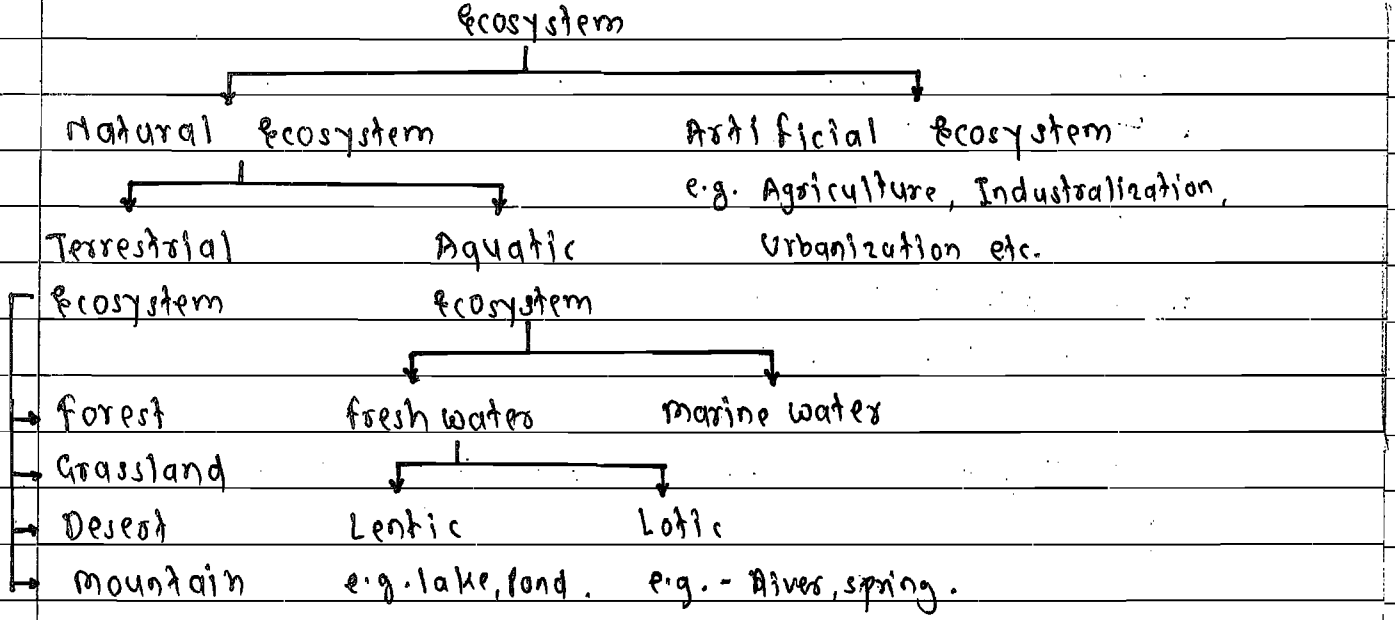
6) The ecosystem has its own productivity.

7) There are different sequence of ecosystem development.

8) Ecosystem are natural resource system.

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TYPES OF Ecosystem :



(a) Natural Ecosystem -

- Natural ecosystem classified into Terrestrial and Aquatic ecosystem as follows:

(1) Terristrial Ecosystem -

- These ecosystem are those which occur on the landmasses forming 29% on the earth surface.
- The terristrial ecosystem are the major source of food & raw materials needed by man.
- The plant & animals are more diversified on the land and are more productive than aquatic ecosystem.
- These are mainly Grassland, Desert, mountain & forest type of ecosystem.

(2) Aquatic Ecosystem -

- These system can be divided in to two categories of -

① Fresh water ecosystem -

These habitat mainly two types as follows:

Lentic - such as lake, pond, swam & bog.

Lotic - such as rivers, spring & stream.

- Ecological succession normaly leads to 'climax' DATE

(ii) Estuarine ecosystem -

- They are found in a very interesting type of habitat i.e. the tranzition zone betn the fresh waters & marine water habitat, under strong influence of tidal current.
- The plant communities of such habitats such as macrophytes as seq weeds, seq grasses, marsh grasses and some phytoplanktons.

(iii) Marine Ecosystem -

- They occur in marine waters of seas and oceans.
- The cheif components of plant communities are phytoplanktonic diatomes microflagellates and profuse growth of green brown & red algae.
- Out of these three categories, the estuarine are the most productive.

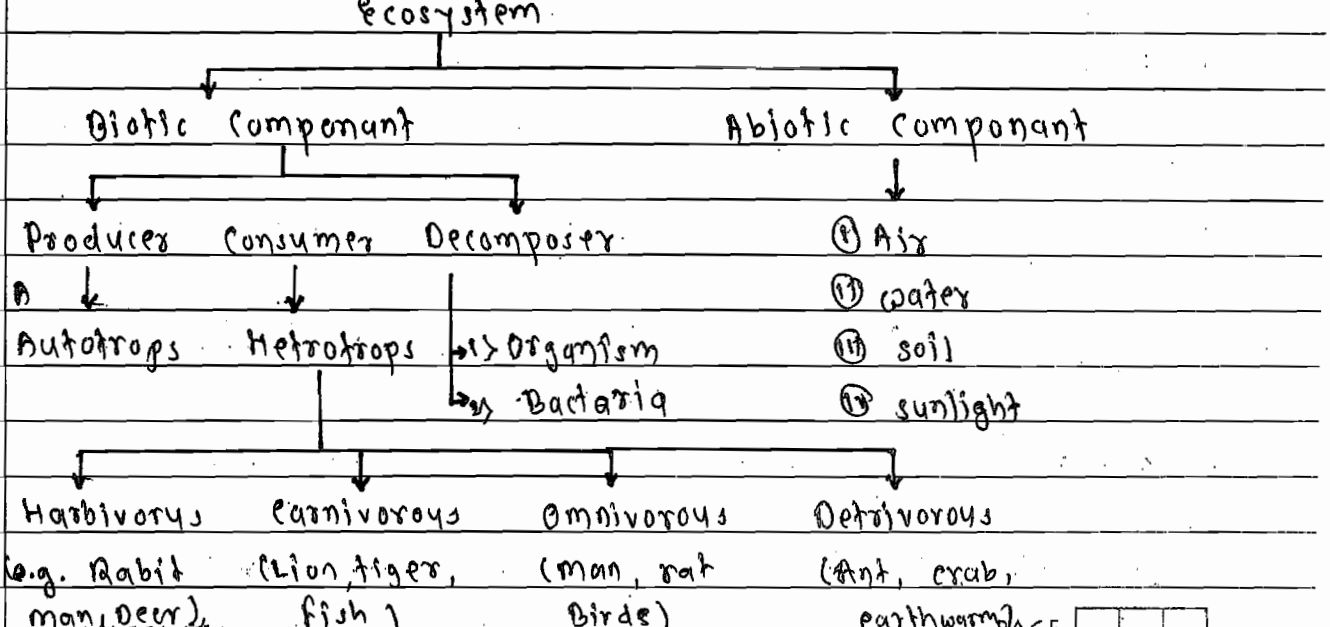
b) Artificial Ecosystem :

- 'Human activities may modify natural ecosystem in to man made ecosystem'.

e.g. Deforestration for conversion of forest land in to Agriculture.

- Besides spacecraft and aquariam may also be considerd as a man made ecosystem.

Componanet of Ecosystem - Some of the abiotic resources are renewable and some of the biotic resources non- renewable.



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* There are mainly two basic compounds from the outputs:

1) Abiotic componant -

These are also called non-living enviorment such as rock, air, water, soil, etc. But these also important help on living organism.

2) Biotic componant -

These together form of biotic denoting living organisms i.e. plants & animals.

① Autotroops -

It says produces. i.e. green plants, ~~these are the animals which obtain their food by eating plants or animals.~~

- ② Hetrotroops -

These are the animals which obtain their food by eating plants or animals.

- The Hetrotrops may be divided into :-

Herbivorous : eat only living plant materials.
Carnivorous : eat other animals.
Omnivorous : eat both plant & animal materials.
Detritivorous : eat death plant & animal materials.

③ Decomposers -

which include the bacteria and the fungi, who promotes the process of decay.

* Flow of Energy :

'The energy of sunlight fixed in food production by green plants is passed through the ecosystem by food chain or food webs from one tropic level to next. It helps in the flow energy'.

Food chain : 'The transfer of food energy from one group of organism to other group in biosphere'.

e.g. Plant → herbivorous → carnivorous → decomposers.

Food web : 'complex network of many interconnected food chain, classmate and overlaping food chain.

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Mountain Ecosystem :

Mountain

- mountain ecosystem is a type of terrestorial ecosystem.
- There are world (11%) area are covered by mountains e.g. Andjes, Rockies, Alps, African and Himalayan mountains ranges are each mountain different ecosystem.
- The mountain ecosystem affect by Height, The height increases, to temprature decreases'. The temprature are impact on a ecosystem.
  - (i) sealeved to 1500m - Tropical forest.
  - (ii) 1500m to 3000 m - Temprate forest.
  - (iii) 3000m to 4500 m - Tundra forest.

1) Abiotic componant :

Temprature - is dicresses with incresing height at rate 6.5°c / km.
Precipitation - mountains barrier helps to windward side high precipitation & leeward side rainshadow area.
Sunlight - low sunlight in upper & bottom level of mountain.
Soil - usually shallow of higher altitude & generally poor nutrient.

2) Biotic componant -

(i) Producer -

Large number of herb, shurb, climbers, lichens, grasses, and small trees.

(ii) Consumer -

Primary : spider, squirle, insects, elephant, neelgai. etc.
Secondary : snake, lizards, fox etc. Tertiary : lion, leopard, Tiger etc.

(iii) Decomposer -

micro-organisms such as fungi, bacteria & actinomycetes etc.

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Marine Ecosystem:

- Ocean occupies 72% area of earth surface; It is most largest and stable ecosystem.
- Physical factors mainly determine the life in the ocean.
- marine provide largest, thickest and most diverse ecosystem.

1) Ablotic componant -

- These are waves, tides, current, salinities, temprature, pressure, and light intensities largely determined the life in the oceans.

(i) Photic zone : upper 200 mts. photosynthesis.
(ii) Aphotic zone : 200 to 2000 mts. Penetrate for photosynthesis.
(iii) Abyssal zone : Beyond 2000mtr. complete darkness.

2) Biotic Componant -

(i) Producer -

- Continental shelf area is quite productive & seafood produced here is an important source of protiens.
- It includes large marine plants, diatoms, zooplankton, Rhizophora, Avicennia, sonnertia and maggroves.

(ii) Consumer -

- Here the food chain begins with the smallest known autotrophs and end with the largest of animals like fish, squid & whales etc.
- Heterotropic macro consumers, crustaceans, molluses fish, carnivorous fishesh - Herring shad, mackrel, cod & Haddock.

(iii) Decomposer: marine fungi and bacteria.

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Grassland Ecosystem:

- The principle grassland are the prairies of Canada & U.S.A., the Pampas of South America, the steppes of Europe & Asia, and the velds of Africa.

1) Abiotic Componant -
- The annual rainfall is betn 25 and 75 cm.

2) Biotic Componant -

(i) Producer -
- The dominant plant species comprise short and tall grasses.

(ii) Consumer -
- Animal species include larks, the burrowing owl, pronghorned anteloped, badgers, coyote, jackrabbit and bison.

(iii) Decomposer -

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- **Ecology:** E. Haeckel (1869).

'Ecology is a science that studies the interdependent, mutually reactive & interconnected relationship bet^n the organism & their physical enviorment on the one hand & among the organisms on the other hand'.

- **climax:**

'A 'sere' represents the development of a series of sequential successions starting from primary succession & culuminating the last succession in 'climax' or 'climatic climax'.

- **Sere climax:**

'One of the temporary development stages in the sequence of plant colonization is known as sereclimax'.

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Conservation and Manegement of Ecosystem

CONSERVATION:

'Our resources are meant not only for the utilization of the present generation but also for the future generation'.

- Therefore, a balance bet^n the growth of popl^n and the utilization of resources is absolutely necessary.
- The modern awarness about part of preservation and conservation of resources.

* Conservation of forest and wildlife:

a) Forest -

- The large scale utilization of forests in response to the increases demand of growing popl^n, dises of trees and forest fire.
- The major causes for the degradation of forests.

* Methods of forest conservation:

i) Afforestration
ii) Creating awarness among local people.
iii) Using insecticides and by preventing forest fire.
iv) Social forestrey.
v) Agricultural forestry.
vi) Development of national park.

b) Wildlife:

- Due to loss of forests and hunting activity of human being wild animals are at the verge of extinction.

* The main objectives of wildlife management include:

i) Establishment of national parks & wildlife sancturies.
ii) Restriction on Hunting.
iii) The maintanance of non-game species.
iv) To conduct cencus of wildlife & to provide protection.
v) To protection of wildlife from pullution & forest fire.

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Ecosystem Management :

- The disappearance of forest and its products prompted the human being to save it for their present & future generation.
- The conservation movment born in U.S.A., but currently much wider over world.

* Aspects of Ecosystem Management :

i) The preservation and protection of wild life or of natural habitants from modification & depletion by man.

ii) Wildlife refuges and sanctuaries have been set up all over world.

iii) The maintainance of sustained yield from organic resources. for breeding stock of marine animals & forestry practice.

iv) The principle of soil conservation, the aim of which is to sustain agricultural fertility.

v) The most important aspect of ecosystem management in the face of growing pressure on food resources.

vi) Modern enviormental management policies attempt to reconcile preservation and productivity.

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BIO-DIVERSITY

Term coined - W. G. Rosen (1986)
Popularised - E. O. Wilson

Definations:

Biological diversity - Thomas E. Lovejoy (1980)

① 'The term biological diversity, commonly shortend to 'biodiversity' used to describe the numbers, variety & variety of living organism'.

② 'Biodiversity refers to the variety of species in both flora & fauna withing an ecosystem'. Bio (life) & diversity (variety).

③ 'Biodiversity is the totality of genes, species and ecosystem in a region'. (UNEP).

- The term biodiversity was first coined and used by 'W.G. Rosen' in the year 1986.
- In fact, the term biodiversity is the contraction of the term 'biological diversity' which was used by 'Thomas E. Lovejoy' in 1980.
- The concept was popularized worldover by 'E.O. Wilson.'

* TYPES OF Biodiversity:

- Based on the elements of biodiversity is basically divided in to 3 types:

1) Genetic Biodiversity:

- Genetic diversity is considered as variations and differences at the levels of genes in the species of plants and animals.
- more genetic diversity within a species means greater variability to enviormental conditions.

2) Species Biodiversity -

- Species biodiversity simply means variety and variability of species of biological communities i.e plants, animals of a given ecosystem.
- Species diversity refers to the variety and number of different types of individuals popln of living organisms in an ecosystem.
e.g. Equatorial rainforest ecosystem.

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3) Ecosystem Biodiversity -

- 'The variety of habitats and niches for biological communities, biological processes operating in each natural ecosystem'.

e.g. equatorial rainforest, coral reefs, esturies, grasslands etc.

- In fact, physical enviormental conditions determine the nature and variation of habitats for different biological communities.

* Importance of Biodiversity:

1) Ecological Benifits -

i) conservation and protection of water.
ii) purification of air.
iii) creation, protection and conservation of soils.
iv) moderation and regulation of weather and climate.
v) Regulation and function of hydrological cycle.
vi) function and regulation of Biochemical cycle.
vii) Maintainance of ecosystem stability.
viii) absorbtions of CO_2 and emitted from anthropogenic sources.
ix) aesthetic values.
x) ethical value, natural wild areas are 'natural museum' for future generation etc.

2) Economic Benifits:

i) source of food
ii) clothing
iii) shelter
iv) vitamins
v) drugs and medicins
vi) fuel wood and commercial timber
vii) sports goods
viii) tourism.
ix) industrial raw material
x) genetic storehouse etc.

- Besides, biodiversity has also political & religious significant

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Biodiversity Loss:

- The rate of extinction of species has increased phenomenally after 1850 due to increased human economic activities.
- The avarage rate of extinction was 2 to 3 species per decade bet^n 1600 to 1850, but thereafter rate increased.
- The earth are 40,00,000 out of which 10,000 species are becoming extinct every year.

• Causes of Biodiversity loss:

- The emergence of new species is a natural process of evolution.
- Natural process of extinction of species slowly, but anthropogenic process of species extinction rapidly.

a) Natural Causes:

1) Climatic changes -

- The importance causes are climatic changes at global level climates cannot adapt to sudden change in climatic conditions and hence die.

2) Volcanic eruption -

- The rapid lava flow during fissure eruption of volcanoes covers larger areas and the existing species of plants and animals are burid under thick covers of lava & become extinct.

3) Colliosion earth with celestial bodies -

- colliosions of the earth with celestal bodies such as asteroids and meteroids.
- colliosion of the earth with celestal bodies in the generation of immens volume of dusts which form temp. remarkbly reduced.
- When a giant meteorite collided with the earth & the resultant dusts caused mass extinction of dinosaurs.

4) Continental drift and fragmentation:

- The permocarboneferous glaciation of the Gondwanaland about 250 million years ago resulted in the loss of 84% of families and 90% of species became extenct due to extreme cold condition.

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5) Ice ages:
- Onset of ice age & continental glaciation results in covering of ground sheet of thick ice sheet, which results in responsible for loss of several species of plants & animals.

6) Prolonged drought, flood and famine condition also affect on biodiversity extinction.

(b) Anthropogenic causes of Biodiversity Loss:

1) Habitat Distruction -
- The fragmantation of habitats of species of plants, animals and microbes due to -
  (i) Deforestration
  (ii) construction of road, railway and Dams in densly forest.
  (iii) mining and location of industries.

2) Overexploitation:
- 'The harvesting of wild animals and plants beyond a critical sustainable limit may be termed as overexploitation'.
e.g. Illigal hunting of rhinos, tigers, elephants has resulted in remarkable reduction in their number.

3) Introduction to Exotic Species:
- The alien plants great damage to native plants beyond sustainable limit ~~with~~ with the result many species become extinct.
e.g. congress grass elimination of native plants.
- where animals are transported by deliberate action or by accident, incourage rapid growth of popln of transport animals

4) Enviormental Pollution:
- Pollution of land, soils, air and waters causes immense loss to biodiversity of various natural ecosystem.
- Increasing urbanization & industrilization, mechanization of agriculture, rapid rate of human popln growth, 'use and throw classmate away culture' of western industrialized

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5) Global warming & climatic change -
- The rising temp. in Tundra region vegetation shrinking in their areas.
- melting of ice sheets upon global warming may effect submergence of small islands ecosystem would be lost.
- Rise in sea temprature causes coral bleaching.

6) Other causes:
- Biodiversity loss are -
  (i) diseases
  (ii) genetic assimilation of certain organisms
  (iii) Trade of wild species for pets i.e. cats, dogs, fishes etc.
  (iv) overharvesting of certain species.
  (v) intensive agriculture
  (vi) tourism industry.

Conservation of Biodiversity:
- The destruction of natural habitats of wildlife & biodiversity loss have assumed alarming proportion.
- The protection of natural habitats and wildlife has now drawn the attention of world communities so that there may be proper conservation of biodiversity.

- The first serious attempt to protect wildlife and biodiversity in international level in the years 1992
- 'Rio Summit' held at Rio de Janerio city of Brazil from December 3 to 14 1992 under United nation.
- These conference attendence 178 countries.
- Discussed issue forest conservation and protect^ of natural forest.

* Basically there are two ways of conservation of Biodiversity:

1) In situ Conservation:
'The conservation of plants and animals in their natural habitats i.e. wild areas called in-sity or on-site conservation'
- Such as nature reserve, biosphere reserve, national parks, sanctuaries etc.

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2) **Ex-situ conservation :**

- 'It means protection and conservation of plants and animals outside their natural native places'. such conservation as ex-situ or off-site conservation.
- Such areas are botanical garden, zoopark, arboreta, genetic resource centres, culture collections, hatcheries etc.
- In order to restore genetic diversity of plants & animals the seeds and germplasm of rare and endengered are stored in 'gene banks'.

Bio-Diversity in INDIA :

- India is one of the mega bio-diversity of the world out of 12 megabiodiversity.
- In India 10 Biogeographic zones and 25 biotic provinaces, all major ecosystem represented here.

* **Charactaristics -**

i) Global biodiversity 8.22%. out of 2.42% land area cover in India.
ii) India cover near about 7% flora & 6.5% faung of the world.
iii) India has 10th rank in floral diversity and mammals.
iv) India has 2 hot spot out of 25 hotspot of world.
v) India has 45 type of mangroves.
vi) Out of world 50% coral reef found in India.

- The Goverment of India recorded about 47000 species of plants and 81,000 species of animals.

* **Biodiversity Hotspots in India :**

- The term biodiversity hotspots coined by 'Norman Myers' in 1998.
- 'He defined biodiversity hotspots as those areas which have rich biological communities including plants, animals & microorganisms.'

* The world of 3 hot-spots are found in India:

- 2.1 land area cover & 50% biodiversity of world hotspots.

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4) Himalayan Biodiversity Hotspot Region:
- comprises rich biological communities of Uttarakhand, Sikkim, Arunachal, Nepal, Bhutan & SW China.
- The region characterized 10,000 plant species.

2) Eastern Himalayas:
- North-eastern states of India and adjoining Myanmar. Indian region include the states of Nagaland, Meghalaya, manipur, Assam and Tripura.
- Numerous species of freshwater animals, birds & endemic animals.
- This region recive highest rainfall of world.

3) Western Ghats:
- The Western Ghats spread over the western margins of the states of Maharashtra, Karnataka, Tamil Nadu and Kerala.
- Agastamalai Hills & silent valley rich biodiversity of these areas.
- In W. Ghat 48 genera of mammals, 275 of birds, & 80 of reptiles.
- several rare species of plants & animals i.e. Asian elephant are now endanger species.

* Endangered and Endemic species of India:
- 'A species is considered extinct when no member of the species remains alive anywhere in the world.'

1) Endangered Species -
- The no. of endangered species have been reduced to a critical level or their habitats have been drastically reduced that they are in immediate danger of extinction.
- Great India bustard, Pink leaded duck, Lion, Tiger, Musk deer, Kashmir stag etc.

2) Endemic species:
- 'The species are naturally found in specific region and not found anywhere else in the world are termed as a endemic species.'
- India has large no. of endemic species of W. Ghat & NE Himalayas.
- In India 7000 plant species out of 47000. & 62% endemic species classmate in W. Ghat & NE Himalayas.

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2 February: World Wetland Day

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* Biodiversity conservation in India:

- Most of Indian wild animals have now become endangered species because rapid dicrese their popln.
- The unscrupulous & reckless hunting of game animals for recreation, food, hide, tusk, musk, horn, fur, wool etc.
- Rapid deforestration due to ggriculture expantion and industrial and urban growth.

• **Management Wildlife -**

- The Wild Birds and Animals Protection act was passed in the year 1887, But unfortunetly it was repealed in 1912.
- Forest Act passed in the year 1927 aimed at the protection of game animals.
- The Indian Board of Wildlife was established in 1952, for the protection of wild animal. (IBOW-1952)

- India joined Convention on Biological Diversity (CBD) in the year 1994.
- The Biodiversity Bill was passed in the year 2002 by Loksabha.
- The Biosafety protocol was ratified by Indian goverment on September 5, 2002.

* Biosphere Reserves in India:

- The framework of UNESCO man & Biosphere programme with the goals of:
  - (i) conservation of Biodiversity.
  - (ii) Pramoting reaserch & training.
  - (iii) monitoring & providing models for sustainable development.

Goverment Biodiversity Management Plans:

1) Wetlands, Mangroves and corals:

- The goverment launched a scheme of conservation and management of these frangile ecosystem in 1987.

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- In all 24 wetlands, 33 mangroves, and 4 coral ecosystem have been identified for their conservation and management.

2) **National Parks:**

- Any natural ecosystem of rich biodiversity and almost pristine habitats, may be declared national parks.
- At present there are 94 national parks in India, accounts for 85 in states and 9 in union territories.

3) **Wildlife Sanctuaries:**

- There are 500 wildlife sancturies in the country where animals and habitats are protected and direct human use of any kind of strictly prohibited.

4) **Tiger Reserves:** (1973) G.O.I.

- A national scheme known as 'Project Tiger' has been launched in the country since 1973 by the Goverment of India.
- At present there are '27 tiger reserves' in India.
- It may be mentioned that initially total tiger popln was about 2000 in the year 1973.

5) **Proje Elephant:** (1992)

- The Govt. of India launched 'Project Elephant' in the year 1992. By the year 2002, 14 'elephant reserves'.
- The scheme has been implemented in 12 states of the country.

6) **Marine Protected Area (MPA):**

- In India, marine protected areas under the Wildlife Protection Act, 1972.
- Ecologically important marine flora and fauna like fishing, if not totally prohabited, coastal & marine habitats are protected and conserved.
- There are 31 marine protected areas & about 100 protected areas having partial marine enviorment in India along west coast and east coast.

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BIOMES

- **Defn**: ① 'The most extensive ecosystem with unit which it is convinent to designate is called Biome'.

② 'Biomes refers to the whole complex of plant and animal in spatial unit'.

- In the biome includes all plants, animals and soils are studied collectivelly. Those areas of the world where all the biota have minimum common charactaristics.
- All the areas of a biome are charactrized by more or less uniform enviormental conditions.

1) Tropical Evergreen Rainforest Biome :

Location & Extent -

- The evergreen rainforest biome extends betⁿ 10°N and 10°S latitudes.
- The maximum development of this biome has taken place in - Amazon Basin (S. America), Congo Basin (Africa) and Indo-Malaysian Region (mainly in Java, Sumatra, Borneo, Malaysia, Guinea).
- This biome has developed true equatorial climate, but some areas extend beyond the equator e.g. Veracruz in Mexico (19°N).
- This cover 8% area of earth surface & half of flora & fauna.

Climate -

- The avarage annual rainfall above 2000mm, every month 200mm.
- mean annual temp. 20°C, annual range of temp 1°C.
- Rainfall recived convectional mechanism, which yields heavy downpour through cumulonimbous clouds daily 2 p.m and 4 p.m.
- Upper cannopy of the tallest trees recives maximum sunlight whereas its amount decreases downward.

Species Composition -

- These biome accounts for largest number of plant species.
- The tallest trees are found in the equatorial biome due to high rain & high temprature.

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- Flowering plant species 6000 to 7000 Cango Basin, 40,000 malaysia, 40,000 in Brazil.
- Tree species account for 70% of the total plant on these biome areas.
- The climbers are greatly bind several trees and plants; for example. Lianas and Epiphytes.

Vertical Startification:

(i) 1st layer - height 30m to 60m 'dominant layer'
(ii) IInd layer - height 25m to 30m 'codominant layer'.
(iii) IIIrd layer - height 15m to 20m - leaves are larger than first two layers.
(iv) IVth layer - height less than 5m - herbaceous or shurb layer.
(v) 5th layer - height more than one or two meters - herbaceous plants & fern.

Animal Life:

- Rainforest biome are least mobile & these animals activate 24 hours.
(i) Upper air animal - birds are Asian falconet, swifts, sevifflet etc.
(ii) Canopy animals - squirrles, herbivorous monkey, bill birds etc.
(iii) middle zone - includes flying birds & insectivorous bats.
(iv) Ground animal - African elephant, occapi, pigs & fowl etc.

2) Monsoon Deciduous Forest Biome:

Location & Extent -

(i) The neotropical mainly west Indies.
(ii) Indo-Malaysian zone, mainly south & SE Asia.
(iii) Eastern Africa & northern Australia.
(iv) mionar region - S. Africa, S. Brazil, SE USA & S. China & Japan.

climate -

- Tropical deciduous forest biome two season (i) moist & (ii) dry season.
- India & surrounded monsoonal areas summer, winter & Rainy season.
- Average annual temp. 20° to 32° C, summer ranges bet^n 38°C to 48°C & winter 10°C to 27°C.
- On an avarage annual rainfall is 1500 mm., 80% rainfall receive in July Aug & sept.

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Plant Community and structure:

- The height of the most trees ranges betn 12 m and 30 mm.
- The trees are characterized by thick girth of stems, thick, rough and coarse bark and large hydromorphic leaves and small xeromorphic leaves.
- There are four strata of vertical layers upper most two strata are trees, third shrubs & lowermost herbaceous plants.
- Species in India mainly sal, teak, bamboo etc.
- Sal & Teak are commonly found in monsoon forest.

Animal life:

- The seasonal character of monsoon decidious forests has been responcible for the seasonal breeding, reproduction & migration of animals.
- Decidious forest biome ranges small to very large bodies animals like elephant, horses, hippopotamus, camel, rhinos, lions, forest Baffelow together large popln of birds.

3) **Savanna Biome:**

Location and Extent -

- The savanna biome extends in both the hemisphere betn 10°-20° lat.
- Includes Lanoes of Coloumbia & venezuela, South central Brazil, Guaiana, Paraguay (S. America), Hilly areas of central America, central and East Africa, Northern Australia & some area of India.
- Lanoes, campose & Savana (Africa)

Climate:

- The savanna climate is distinct dry and wet seasons, mean high temp. throughout year; mean
- mean annual rainfall ranges betn 250-500 mm on the desert fringe of the savanna & 1300-2000 mm on its equatorial climate.
- Temp. does not fall below 20°c in any month of the year.
  (i) cold dry season - 26°c - 32°c (ii) warm dry season - 32°c - 38°c.

Vegetational Community:

Ground layer - Grasses & herbaceous plants 80 cm to 350 cm is height.
middle layer - consits of shurbs & very stunted woody plants.
Top layer - is formed by trees usually 6-12 m in height.
- Type: (i) Woodland Savanna (ii) Tree savanna (iii) shurb savanna (iv) Grass savanna.

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Animal community -

African savanna - African baffelo, zebra, giraffe, elephant etc.

S. American savanna - Guanaco, nightjars, kingfisher, doves, finches, parrots, parakeets, wood peakers etc.

Australian savanna - marsupials, kangaroo.

- The greatest variety of herbivorus species.

4) MEDITERRANIAN BIOME :

Location & Extent - It is also known as the 'Chapparal'.

- The mediterranian biome is also called as sclerophyll ecosystem or biome.
- The mediterian biome developed bet^n 30° - 40° lattitudes in both the hemisphere.
- The biome includes the european land bordering on mediterian sea, central & southern California (U.S.A.), central chile, NW coast of Africa, & western coast of Australia.

Climate :

(i) winters are cool ~~and~~ wet whereas summer are dry.
(ii) summers are dry and warm whereas winter moderetly cool.
(iii) sufficent sunlight throughout year.

- The avarage annual temp 15° to 17°C., in winter 5°C to 10°C and summer 20°C to 27°C.
- mean annual rainfall ranges bet^n 370 mm to 650 mm.

Vegetation community -

- The leaves have developed sclerophyllous characteristics from medetarranean mixed evergreen forests to woodlands, dwarf and scrubs.
- The vegetation community dominated by trees and shrubs.
- These plants studies is 'xeromorphic' such as thickened, susticles, gradual hairs, sunken stomata etc.

Types: (i) European Mediterranean Biome.
(ii) North American or Californian Biome.
(iii) South African mediteranean biome.
(iv) Australian mediteranean biome.

- Important species : Pine, cedar, fir etc.

classmate
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Animal community :

- Like vegetation, there is a also regional variation in these animals.
- The mammals are - squirrels, wood rats, & mule deers, wolf and mountain lion, rabbits, chilian fox, lizards, snakes.
- Birds are - kites, falcons, hawks, robins, whistlers, wrens, honeyeaters etc.

6) **Temprate Grassland Biome :**

Location and Extent -

- Temprate grassland are located in the interior of the ~~grassland~~ continant.
- They do not get sufficient raintall & grassland practically treeless.
  - (i) Steppes - Eurasia extends for more than 3200 km.
  - (ii) Prairies - N. America extend from the foot hills of Rockies.
  - (iii) Pampas - Argentina and Uruguay.
  - (iv) Veld - South Africa bush veld or the high veld.
  - (v) Downs - SE Australia marray - Darling river basin
  - (vi) Canterbury - New zeland.

Climate :

- The avarage winter temp. ranges betn 1°c and 12°c.
- The steppe climate is chractrized by high annual range of temp. for eg. winnepeg record avarage annual temp. 40°c.
- Mean annual temp. southern hemi. lower than northern hemisphere.
- The mean annual priciptation ranges betn 250 mm to 750 mm in different location of temprate grassland.

Vegetation Community -

- Grasses are most dominant members of the different regions. Besides some harbivorus plants are found but shrub & trees absence.

(i) Eurasian steppe - oak, limes, elms & maple.
(ii) Prairie - oak & hickory, bluestem, needle grass, june grass, blue gramma.
(iii) Pampas - Grasses are Brizal, Bromus, Panicum, Paspalum, Lolium etc.
(iv) Veld - Red grass, Aristida, Eragrostits, Hyparrhenia.
(v) Australian Downs - mixture of grasses with eucalyptus trees.
(vi) Canterbury - Festuca & Poa grass, tussock grass.

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Animal community -

(i) Steppes - antelopes, gazellers, wild horses, rodents burrowing, Predator animals - wolves, eagles, large hawks etc.
(ii) Prairies - gophers, dogs, hawks, eagles, rattle snakes etc.
(iii) Pampas - Deer, Rhea, herons, geese, ducks etc.
(iv) Velds - antelopes, hyaenna, jackals, lions, leopards etc.
(v) Downs - Kangaroos, wallroos, emu etc.
- Animal rearing on a commercial scale has developed well in Praire & Steppe Regions.

6) **TUNDRA BIOME:**

Location and Extent -

- Tundra is finnish word means barren land.
- Tundra region having least vegetation & polar or arctic climates is found N. America and Eurasia, Alaska, Canada, Greenland and northern Saiberia.
- Three zones from south to north (i) low arctic tundra (ii) middle arctic tundra (iii) high arctic tundra.
- The tundra biome with the shortest growing season.

Climate -

- Generally absence of insolation & sunlight and very low temp. through out year.
- Most of the tundra barren land, total lack of trees.
- Ground surface covered snow at least 7 to 8 months.
- mean annual precipitation mostly in the form of snowfall, is below 400 mm.
- winters are long & very severe whereas summers are short.

Vegetation community -

- The tundra biome support only lichens and mosses, arctic gray soils favour dwarf herbaceous plants.
- The vegetations of the tundra biome are 'cryptophyte'.
- The plants are tufted and height bet^n 5cm to 8cm.
- Plants features of fleshy leaves, thick cuticle & external covers of hairs, around stems & branches.
- Growth of tundra plants is of only 50 days during cool summer season.
- The biome virtually treeless.

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Animal community -

- Arctic tundra grouped into two categories:
  - (i) Resident animals - musk ox, arctic fox, Ptarmigan (bird) wolves, caribou, rodents, lemmings, shrews.
  - (ii) Migrant animals - waterfowl, ducks, swans, geese (kind of birds). Raindeer & caribou important animals of the category of large migratory animals.

7) **DESERT BIOME :**

Location & Extent -

- The great hot deasert Sahara (N. Africa), Kalhari (SW Africa), Australian, Thar, Atacama (Chile) & desert of mexico.
- It extend from 10° to 30° lattitude in both the hemisphere.

Climate -

- The avarage annual temp. above 32°c and ranges bet^n 28°c to 38°c through out year.
- The amount of precipitation is less than 25 cm per year., Geographical position is rain shadow area.

Vegetation community -

- In desert region lack of vegetation,
- The vegetation charactrized by small leaves, thick steams, deep roots & waxing cover of trees.

Animal community -

- Harbivorous are camel, antelope and mountain sheep. rodents are - kangarous, rat & pucket mouse.
- The desert animals cheif consumers are snakes, birds and various insects.

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8) **MARINE BIOME :**

- 'The total geographical area of the earth surface is covered with water which makes the marine biome'.
- No physical barriers exists in sea & ocean water.
- Most of neutrient in solution form which are easily consumed.
- food chain & web depends on the sunlight avaiblity of water.
- Distribution of marine plants & animals are widespread.

* **Types of marine Biome :**

1) **Pelagic Biome -**

- The formers extend up to depth 200m by sea level.
- The biome include the total water mass of the seas & oceans, from sea surface to sea bottom.

2) **Benthic Biome :**

- This biome includes the bottom seas & oceans right from the bottom below 200m to ocean bottom.
- Abysal plain; deep trenches, & ranges are found Benthic Biome.

Animal community :-

(i) **zooplanktons -**

- These are range from a fraction of m.m. to several mtr.
- These are also Harbivorous, carnivorous & Detrivorous.
- Harbivorous conversion vegetable into animal protiens and carnivorous animals feed on zooplanktons.

(ii) **Nektons -**

- The nekton groups are vertibrates primiarly, these animals consists of swimming animals of verious depth.
- These are formed verious species of fishes.

(iii) **Benthos -**

- The important species are mussels, oysters & cockles.
- The neigh of benthic animal 1000 to 4000 mts. deep.

e.g. shark, sablefish, hagfish and octopus.

correct :
forest, savanna, grassland, desert & tundra.

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9> **Taiga Biome :**

- The Taiga biome streches across large parts of Canada, Europe and Asia.
- A lot of coniferous trees grow in the Taiga.
- These coniferous have to with stant extremely low tempratare and lengthy period of snowfall.

Climate -

- In the northern coniferous forest or taiga, the growing period of plants is only about 150 days.

Vegetation community -

- Pine, fir, cedar, hemlock, and spruce, constitute the dominant vegetation.
- In some areas the trees are so dense that little light reaches the floor of the forest.

Animal community -

- This biome is a good habitat for elks, deer, grouse, rabbits, squirrels, pumas, lynx and many species of insects

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ENVIORMENTAL HAZARDS AND PROBLEMS OF POLLUTION

a] **OZONE LAYER DEPLECTION:**

- The statospheric ozone layer mostly concentrated 20 km to 25 km (12 Km to 35 Km) is consider 'earth umbrela'.
- It prevent ultraviolet solar radiation from reaching the earth surface.

- The problem of ozone depletion was first identified in 1970's to the advent of supersonic aircraft. M. Molina & S. Rowland (1974-75).
- The first significant data about the depletion of ozone layer was presented by J. Farman (1985) (British Antartic survey team)
- About 90% of the Antarctica since 1987 is covered by the ozone hole which has expanded.
- The concentration of ozone has decreased by 40% subsequently Kerr in 1988 also reported the decline of ozone layer over Arctic.
- Recently ozone hole discovered Arctic, Scandinavia and N. America.

* **Creation of ozone layer -**

- A three atom of oxygen isotope (O_3) or mearly triatomic oxygen.
- It is faintly blue irritating gas with 'pungent odur'.
- The creation and distruction of ozone gas in natural process,
- The O_2 molecule are broken up and seprated in the atmosphere layer betn the altitude of 80 to 100 km, by U.V.R.

$$O_2 \longrightarrow O + O$$

- These separated oxygen atom combined with O_2.

$$O_2 + O + m \longrightarrow O_3 + m \quad OR$$

$$O_2 + O \longrightarrow O_3 \text{ (ozone)}$$

\# **Factors affecting of ozone layer depletion:**

① **Clorofluorocarbon (CFC's):** carbon, chlorine & fluorine.

- Compounds of elements are widely used as airconditioners (A.C.) Refrigerators, Insulation forms & Deodrants, Hair spray, shaving cream, coolants, cleaning agents, and plastic foam are main paters of ozone present in the ozonosphere.

Hydrocarbons: Trichlorofluro methan CFC's-11
Dichlorofluro methan CFC's-12

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(ii) **Chlorine** - '1 chlorin atom eat = 1,00,000 ozone molecule.'
- Nitrogen oxide and chlorine reported that chlorin atom could deplete the ozone in the same manner as nitrogen oxide.
- The oxygen atom from the new chlorine monoxide molecule is pulled away by free oxygen atoms freeing the chlorine atom progresively more ozone molecules are decomposed.

(iii) **Nitrous oxide** -
- The nitrogen oxides then deplection the ozone layer through 'Photochemical reaction'.

(iii) **Dynamic Mechanism** :
- The upper air atmospheric circulation transport ozone from over south pole & accumulates it in belt betn 60° to 70°S.
- This transport of ozone from over south pole results in the thinning of ozone layer and thus the formation of 'ozone hole'.

(iv) **Natural Process** :
- The conversion of atmospheric nitrogen in to nitrogen oxide due to solar activity because of maximum sunspot at the end of every 11-year cycle.

* **Effect of ozone Depletion:**

(1) **Climate** -
- The weaking of ozone layer there will be less absorption of solar radiation & hence more U.V.R. will reach the earth. surface, and
- Consequently (i) The temprature increased of earth surface (ii) melting of polar ice (iii) Acid rain (iv) smog incressed.

(2) **Human Being** -
- skin cancer among the white persons, Retarded physiological growth of Human bodies, respiratory system of human bodies. function & reduce the body strength, Bacteria infection, and eyes diseses.

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③ **Biotic communities :**

- The increses of uvr would adversely affect plant, crops and animal communities and is a varities ways
- The heavy fertillzer crops would be more adversly affected due to their exposure to uvr.

④ **Ecological depletion -**

- The global radiation balance may adversly affect the ecosystem productivity.
- Ecological stability and overall enviormental pollution.

* **Protection & Mentanance of ozone layer :**

- The signing of 'montreal protocol in 1987' to reduce the production and consumption of CFC's and the organization of International conference of 'London'.

1. Reduction in the production and consumption of CFC's and halones.
2. Search for Alternative Technology and substitute chemicals.

• **Carbon sequestration :**

'The process of removing carbon from the atmosphere and depositing it in a reservior.'

- It is geoengeneering technique for long-term storage of CO_2 or other forms of carbon to either mitigate or defer global warming.
- It has been proposed as a way to slow the atmospheric & marine accumulation of Green House gases, which are relased by burning fossile fuels.

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GREEN HOUSE EFFECT:

- Define- "The Green House effect means 'surface due to progressive warming-up of the blanketing effect of man-made carbondioxide in the atmosphere". - oxford Dictionary

* **Process:**

- Greenhouse is that body which allows the shortwave incoming solar radiation to come in but does not alow the longwave outgoing terristarial infrared radiatn escape.
- CO_2 & water vapour act as a green house in that these allow visible light of the sun to reach the surface of the earth.
- But absorb and reflect back the longwave outgoing terrestarial radiation mainly infrared & thus help in keeping the earth's surface warmer.

* **Green House Gases:**

cfc's (i) Halogenetic Gases (CFC's) absorb longwave radiatn 8-13 micron.

CO_2 (ii) carbondioxide (CO_2), Carbonmonoxide (CO), methane (CH_4).

CH_4 (iii) water vapour - are absorb S.W.R. but reflected back L.W.R. are not transper they increases atmospheric temprature.

HFC (iv) Hydro-flurocarbon (HFC).

W.V.

- **Sources of Green House Gases:-**

- CO_2 is released to the atmosphere by burning fossile & fuels for different purpose:
  - (i) Electric power station - coal & mineral oil.
  - (ii) factories - coal, oil & natural gas.
  - (iii) Transport sector - vehical runs petroleum, gas, coal.
  - (iv) Deforestration - burning of fire woods.

Carbondioxide (CO_2):

- The pattern of emission of CO_2 by burning fossile & fuels i.e. coal, Petroleum, and natural gas.
- emission of CO_2 U.S.A - Ist, U.S.S.R - IInd, China - 3rd, classmate Japan - 4th and India 5th position.

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* Green House Effect & climatic change:

① Temprature Incress -
- The change in the global mean temprature by a few degree celsious caused by green house effect greatly human society & agriculture.

② Pricipitation Decress -
- The increased temp. due to increased greenhouse effect would cause decreases in soil molsture & pricipitation adversly ecosystem damaged.

③ marine ecosystem damaged -
- concentrat^n of CO_2 increases to also increased oceanic acidity would decrease biological productivity of marine ecosystem.

④ Sealevel rise-up -
- The increased surface temp. would cause melting continental glacier mountain & polar ice caps.
- The resultant melt water and rise the sea level, cause floding lowlands. e.g. mediterranean sea, Bangladesh etc.

⑤ Air pressure incress -
- The concentrat^n of CO_2 may increase to such an extent that the total atmospheric pressure would be increase.

⑥ ozone layer depletion -
- CO_2 is also intensify the depletion of ozone layer which would causes further rise in the temp. of the earth's surface.

⑦ Positive relat^n of CO_2 & plants -
- The increased concentration of CO_2 in the atmosphere would increase plant production may be pointed out positive response.

* Measures to decrease the increasing Greenhouse effect:

1) control on consumption of fossil & fuel -
- There should be drastic cut in the consumption of fossils fuel mainly in the developed & highly industrized countries like USA, USSR, UK, Japan etc.
- 'The Toranto world conference' held at Toranto' (TWC) Canada in June 1988 - for 20% reduction in the emission of CO_2 by year 2005.

classmate Toranto conference — cfc's consumption PAGE
montelol protocall — CO_2 consumptions.

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2) **Alternative source -**

-To reduce the emission of CO_2 must develop alternative source of energy and power improved better technologies. for example- "methanon" may be expected to be substitute for petroleum.

3) **Advanced Technology -**

- more advanced and efficent technologies should be developed so maximum energy derived & emmision of CO_2 is minimised.

4) **Alternative Energy source -**

- Solar energy may be developed as alternative to the convectional fossil fuel energy.
- Biogas may be alternative source of convectional energy.

5) **Afforestration -**

- Afforestration or reforestration on a large scale will certainly reduce the green house effect.

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SOIL EROSION:

"Thus, soil erosion is an extreme form of soil degradation in which natural geomorphological processes are accelerated so that soil ~~degradation in which natural geomorphological~~ removed at rates ten ~~&~~ sometimes several thousand times faster than is the case under the condition of natural vegetation and much faster than rates at which new soil forms".

- The removal of fertile upper soil horizons at the rates faster than the can be formed.
- Decline the organic content of soil and several changes of physical & chemical properties of soil.
- soil erosion is mostly operative in the humid climatic region.

* Forms of soil erosion-

Soil erosion involves mainly two process:

① Transport limited -
- loosening and detachment of soil particles from the soil mass.

② Detachment limited -
- removal and transport of the detached soil particles downslope.

- Different forms of soil erosion: Splash erosion, sheet erosion, Rain wash, Interrill erosion, Rill erosion, Gully erosion etc.

* Factors and Causes of soil erosion:

1) Climatic factor -
- The Influencing runoff and soil erosion include Precipitation mainly rainfall, Temprature and Wind
- The intensity, quantity, duration and distribution of raintall are the most important component the nature & magnitude of soil erosion.

2) Topographic factor -
- Includes relative reliefs, gradient, slope segment, length, slope profiles, slope aspects etc.

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3) Lithological factor :

- Includes rock types and their chemical and physical characteristics.
- These factors are related to geological erosion, of all types of geomaterials & are not related to soil erosion.

4) Vegetation factor -

- The rainfall through protect ground surface from direct raindrop impact. Rainwater reaches the ground surface very slowly through leaves, branches & steams..
- Decreass surface runoff, & reduce the rate of detachment of soil particles.
- its roots effects increase soil strength & reduce speed of wind.

5) Soil factor -

- soil characteristics such as physical and chemical properties e.g. partical size, porosity, permability, structure, organic matter etc.
- management practices i.e. crop management & land management.

6) Human factor -

(i) Land use - Agriculture, Industralization, urbanization, construction purpose - road, dam, rails, roads etc..

(ii) farm practice change - farm machin used e.g. tractor, nature of farming, chemical fertilizers, grazing by sheep.

Conservation measures of soil erosion :

- The soil conservation measures and techniques are broadly divided into two groups : (i) measurment of crop manegement.
(ii) mechanical protection device.

1) Measure of crop management :

(i) Such crops should be grown which cover maximum surface area & bind the soil particles.

(ii) Alternetively, the sowing of crops.

(iii) Practice for intercroping & mixed croping.

(iv) The application of sufficent amount of chemical fertilizers.

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(v) Stubble mulching - protection of soil surface against raindrops, because the leaves, steams & roots of crops after harvest.

(vi) crop rotation must be practiced to increase the fertility of soils.

(vii) Deforestration and Afforestration.

2) Mechanical protection devices:

- These include several techniques of ploughing, hoeing, cultivation etc. to check soil erosion mainly over slopy ground.
- The following techniques are used for this purpose -

(i) Contour farming -

is a general term for ploughing, planting, cultivating and furrowing along the natural contour lines of sloping ground.

(ii) Terrecing or contour Bunding -

involves the construction of level-floored benches across the general slope gradient of hillslope.

(iii) Control of gully erosion -

- Soil erosion caused by rainwash, sheetwash, & rainsplash erosion by rill and gully erosion.
- To reduce the flow of water in the gullies by constructing dams.

* **Rally for valley** :- programme was operated by 'Arundhati Roy' for enviormental degradation.

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ENVIORNMENTAL HAZARDS AND DISASTER:

a] Enviormental Disaster :

* Define : 'Those events or accidents, wheather caused by natural processes or human factors, are called extreme events which occurs very rarely and agravate natural environmental processes to cause disaster for human society'.
- such as tectonic movments leading to earthquake and voleanic eruption, drought, floods, atmospheric disturbance etc.

• **Characteristics -**

i) Disaster occurs rapidly, instantaneously & indiscriminantly.

ii) Disaster is sudden adverse or unfortunate extreme event which causes great damage to human beings as well as plants and animals.

iii) enviormental disasters are the results or responses of enviormental Hazards.

iv) The intensity of enviormental disasters is weighted in terms of the quantum of damages done to the human society.

v) Disasters only when they adversily affect human society e.g. very strong tropical cyclone.

b] Enviormental Hazards :

• **Def^n** - 'Those extreme events either natural or man-induced, which exceed tolerable magnitude within or beyond certain time limits, make adjustment difficult, results in catastrophic losses of property, income & lives & become the headlines of different news media at world level.'

* **Characteristics :**

i) 'Hazards are generally taken to be the processes both natural and anthropogenic.

ii) Enviormental Hazards are processes.

Example : Earthquake more than 10 Richter scale occurs in totally unhabited area it is not hazards, But an earthquake lower intensity say below 7 Rf. occurs in heavily populated area it becomes hazards of disaster.

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Classification of Environmental Hazards and Disasters :

- **Natural Hazards**
  - **Planetary Hazards**
    - **Terrestrial / endogenetic**
      1. Volcanoes
      2. Earthquake
      3. Landslide
    - **Atmospheric / exogenetic**
      1. Cyclones
      2. Flood
      3. Drought
  - **Extra-Planetary or Extra Terrestrial**
- **Man-induced Hazards**
  - **Physical Hazards**
    1. Earthquake
    2. Landslide
    3. Soil erosion
  - **Chemical Hazards**
    1. Release of toxic chem.
    2. Nuclear explosion
    - Popⁿ explosion 1)
    - Eutrophication 2)
  - **Biological Hazards**

a] EARTHQUAKE :

'An earthquake is a motion of the ground surface ranging from a faint tremor to a wild motion capable of shaking buildings apart and causing gaping to fissures open in ground'.

- The 'intensity of energy released by an earthquake measured by the 'Richter scale' devised by charles F. Richter in (1935)
- The number indicating Richter scale ranges betⁿ 0 and 9.
- It is estimated that total annual energy released by earthquake is about 10^{25} ergs.
- Good friday earthquake of march 27, 1964 in Alaska measuring 8.4 to 8.6 Rt. among greatest earthquake of world.

Focus : The place of the origin of an earthquake is called 'focus' which is always hidden inside the earth but the depth of which varies from place to place' e.g. - deepest earthquake 700km.

Epicentre : The place on the ground surface, which is perpendicular to the buried 'focus' or 'hypocentre' recoding seismic waves first time is called 'epicentre'.

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Seismic waves :

1) Primary or Pressure waves (P waves)
2) Secondary, shear or Transverse waves (S-waves)
3) Long waves or surface waves (L-waves)

- These seismic waves are recorded with the help of an instrument called 'seismograph' or 'seismometer' at the epicentre.

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- **Causes of earthquake:**
  - 1) Volcanic eruption.
  - 2) Faulting and folding.
  - 3) Upwarping and Downwarping.
  - 4) Plate movments.
  - 5) Hydrostatic pressure of man made water bodies like reservions and lakes.

- **Effects of earthquake:**
  1) Deformation of Ground surfaces - slope instability, failures and Landslides.
  2) Damage and Distruction of Human structure - such as buildings, rails, roads, bridges, dams, factories,
  3) Distruction to the Town and cities.
  4) Loss of Human lives and animal lives and property.
  5) Violent fires
  6) Landslides
  7) Floods
  8) Distarbance of ground water conditions
  9) Tsunamis.

- **Distribution of earthquake:**

-world distribution of earthquake:

i) Circum Pacific Belt or ring of fire - surrounding the Pacific Ocean.

ii) Mid-continental Belt - representing epicentre located along the Alpine-Himalayan chains of Eurasia and Northern Africa.

iii) Mid-Atlantic Belt - representing the earthquake located along the mid-Atlantic Ridge.

India: Indian earthquake along the Himalayas and foothill zones in terms of plate techtonics.

- Asiatic plate moves southward & Indian plate moves northward consequent folding & faulting and gradual rise of Himalayas at the rate of 50 mm per year and cause earthquake in N. India, Nepal & Tibet.

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b] **Volcanic Erruption:**

'explosive central eruption and spread of hot and liquid lavas coming out of fissure flows as well as they provide rich soils for agriculture purpose'.

* on the basis of nature of eruption volcanoes are divided into two broad categories:

1) **Explosive type** -

'volcanic erruption occurs through a central pipe by breaking & blowing of crustal surface due to violent and explosive gaseous accumulated deep within the earth'.

- Five types:

(i) Hawaiin (ii) Strombolian (iii) Vulcanian (iv) Pelean (v) Visuvian type of volcanoes.

2) **Fissure erruption type:**

Such volcanoes occurs along a long fracture, fault and fissure and there is slow upwelling of magma from below and resultant lavas spread over the ground surface'.

- The speed of lava movment depends on the nature of magma, slope of ground surface & temprature condition.

* **Distribution of Volcanoes:**

- Like earthquake belts, there are also three major belts:

i) **Circum Pacific Belt** -

convergent plate boundries

- accounts for about **80%** of the total active volcanoes of the world.
- Volcanoes are caused due to collision of convergent plate along the 'Benioff zones.

ii) **Mid Continental Belt** -

- Alpine mountain chains, mediterania sea & eastern Africa.
- famous volcanoes of mediterian sea such as stramboli, Etana and Visuvius.
- This belt also represents collision of eurasian plate and indian & African plate.

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iii) mid oceanic Belt -

divergent plate boundaries

- includes volcanoes mainly along the 'mid Atlantic Ridge' which represents the spliting zones of plates.
- Plates diverge in opposite directions from the mid oceanic ridge.
- These volcanoes mainly fissure type.

* Case Histories of Volcanoes:

1) Laki fissure eruption of 1783 - located on the mid Atlantic Ridge.
2) Krakatoa Eruption of 1883 - located in the sunda strait betⁿ Java & Sumatra in the pacific ocean.
3) Mount Pelee Eruption of 1902 :- St. Pierre facing Mount Pelee on the Martinique island in the west Indies in the caribbean sea.
4) Kilauea Eruption of 1959-60 : The Mauna Loa and Kilauea shield volcanoes of southern Hawaii.
5) Mt. Helgafell Eruption of 1973
6) mt. Helens Eruption of 1980 - state of washington.

* Hazardous Effect of Volcanic Eruption:

i) Lava burried human structure, kill people and animals, distroy agriculture farms pastures, plug river and lakes, burn and destroy forest.

ii) Volcanic matarials, dusts, ash & smoke covers ground surface and destroy crops, vegetation & buildings, creates health hazards due to poisonous gases.

iii) Earthquke like volcanic eruptions generate distructive tsunamis which create disastrous deaths of human beings in coastal areas.

Enviormental impacts of Volcanic Eruption:

① formation of Jokullhlaups -

- Jokullhlaups refers to the existance of enormous volume of water beneath the ice caps due to melting of ice caused PAGE the rise in temp. during the mechanism of vulcanicity.

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(ii) Volcanic dust and climatic change -

- Enormous quantities of dust & ashesh emitted into the sky during a volcanic eruption have been associated with weather & climatic changes at regional & global level.

(iii) Volcanic eruption & Ecological changes.

- A group of scientist believe that volcanic eruptions and fallout of dusts & ash causes mass extinction & fallout of dusts & ash cause mass extinction of a few species of animals.

- Volcanic activities are found mainly in weak zone of the earth.
- The pacific ocean contains techtonic plates, where these plates converging & diverging to each other.

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c) **FLOODS:**

Meaning: ⓐ Flood simply means inundation of extensive land area with water for several days in continuation.

ⓑ Floods are considered to be as associated with rivers and people conective floods as the outcome of accumulation of huge volume of water coming out of the rivers through overtopping of river banks during peak discharge period.

- About 3.5 % of the total geographical area of the world are covered by flood plains.
- which house about 16.5% of the total popln of the world.

* **Causes of floods:**

1) **Natural causes:**
i) High intensity of Rainfall.
ii) Meandering course of rivers.
iii) Extensive flood plains.
iv) Break in slope in the long profile of the river
v) Blocking of free flow of the rivers because of enormous debris provided by landslides.

2) **Anthropogenic causes -**
i) Building activity and evantual urbanization.
ii) Channel manipulation through diversion of its course.
iii) construction of bridge, Baarage and reserviore.
iv) Agricultural practices.
v) Deforestration.
vi) Land use changes etc.

* **Floods in India:**
- most of the flood-prone areas of country located in the northern parts mainly in the **Ganga plains** the states of U.P., Bihar & W. Bengal.
- Bihar (23.8 %), U.P (23.8 %), Andhra (15.4 %) combined

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Flood control measures:

1) To delay the return of runoff resulting form torrential rainfall to the rivers -
- reforestration & afforestration in hilly source areas

2) To hasten the discharge of water -
- meandering loops are performing artificial cutoff of bends and flood discharge..

3) To reduce the volume of water -
- Through a series of engineering devices such as construction of flood control storage reserviore.

4) To divert flow of river water -
- in lowlying areas, depression or artificialy constructed channels bordered by artificial dykes so flood are reduce.

5) To reduce the impact of floods & above -
- embakments, dikes and flood walls are used to confine the flood water within the valley or or say narrow channel.

6) To forewarn occurance of flood -
- The flood control organisation the constituation of central flood control Board in 1954. the established level flood control measure.
- The flood forecasting & warning system was started in India in 1959.

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DROUGHTS:

① C.G. Bates:

'Annual pricipitation is 75% or less of normal precipitation and monthly pricipitation is 60% or less of normal monthly precipitation'

② BRO (British Rainfall organisation) -

- **Absolute Drought**: when there are atleast 15 consecutive days with less than 0.01 inch rainfall per day.
- **Partial Drought**: when there are at least 29 days having mean rainfall of 0.01 inch or less.
- **Dry Spell**: when 15 consecutive days recive less than 0.04 inch of rainfall per day.

③ IMD (Indian Meteorological Department) -

- Severe Drought: when the deficency of rainfall exceeds 50% of normal rainfall.
- Moderate Drought: when the deficency of rainfall is betn 25% & 50% of normal rainfall.

* Impact of Drought:

1) Ecological impact -

- Species of plant & animals perish, animals migrate to other places, popln decreses of certain animals & animal die.
- Competition of food for animals which results elimination of weaker animals.

2) Economical impact -

- Drought includes economic losses due mainly to marked decreases in agricultural production, livestock yield & even industrial production because of short supply of water.

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3) Demographic impact -

- Drought includes depopulation of areas & temporary migratn of affected people & animals.

e.g. frequent migratn of drought affected areas Rajsthan.

4) Political impact -

- Drought conditions includes the change of political power due to acute shortage of foodgrains caused by crop failure due to droughts.

Drought control Measures:

i) Afforestration to increase the content of air moisture, to increase the amount of precipitation.

ii) Introduction of dryfarming techniques to reduce the dependance of farming on rainwater

iii) checking of desertification or desert spread.

iv) Introduction of water conservation scheme.

v) Development of horticulture and pastures.

vi) Revitalisation of Drought-Prone Area Programmes (DPAP)

vii) Construction of reservoirs.

viii) Digging of wells.

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Enviormental Hazards:

'is a generic terms for any situation or state of events which poses a threat to the surrounding enviorment'.

Example: volcanoes, earthquake, cyclone etc.

Enviormental Disasters:

'is a disaster to the natural enviorment due to human activity'.

- Enviormental disaster affect on agriculture, biodiversity, the economy & human health.

Example: pollution, depletion of natural resources etc.

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ENVIRONMENTAL POLLUTION:

Def^n: ① "unfavourable alteration of our surroundings wholly or largely as a by product of changes in energy patterns, radiation levels, chemical & physical constituents and the abundance of organisms".

② Pollution is viewed as "the release of substance and energy as waste products of human activities which result in changes, usually harmful, within the natural enviornment".

* **Pollutants:**
- 'A pollutant is defined as any form of energy or matter that cause degradation and pollution in the existing natural balance of ecosystem'.

* Pollutant classified on the basis of nature & state:

1) **Solid:**
- aerosols, industrial wastes such as lead, mercury, tailings, asbestos etc.

2) **Gaseous:**
- CFC's, CO_2, sulphar dioxide, nitrogen oxide etc.

3) **Liquid:**
- leaked oil slicks in sea water, dissolved solids, ammonia, urea, nitrate, chloride, floride, carbonate, insecticide & pesticides etc.

* **Sources of pollution:**

1) **Natural-**
volcanic eruption, undesirable substances, flood water, forest fire etc.

2) **Anthropogenic-**
- industrial, urban, agricultural, population source etc.

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9] **AIR POLLUTION :**

*Defin: "air pollution may be defined as the disequilibrium condition of the air caused due to introduction of foreign elements from natural as well as anthropogenic sources to the air so that air becomes injurious of biological communities e.g. human".

* **Sources of Air Pollution :**

1) **Natural Sources -**

(i) Volcanoes - dust, ashes, smoke, CO_2 & other gases.

(ii) extraterristrial bodies - cosmic dust, dust produced due to collision of astroids, meteros, cosmets etc.

(iii) Green plants - evapotranspiration, pollen grains, casbon dioxide from bacteria etc.

(iv) fungi - fungal spores, viruses.

(v) land surface - salts from oceans, dust & soil partical from ground surface.

2) **Man-made sources -**

(i) Gases from kitchen & domestic heating, industries, incineration of municiple & domestic garbage, automobiles, railways, aircrafts etc.

(ii) solid particular matter from industries, mines and urban centres etc.

(iii) Radioactive substance from nuclear plants, nuclear fuel releases, nuclear explosions etc.

(iv) Heat from industries & domestic kitchens etc.

Effect of Air Pollution :

1) **Effect on weather or climate -**

i) Depletion of ozone layer.

ii) Green house effect.

iii) SMOG

iv) Acid Rain etc.

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2) **Effect on Human Health:**

i) Carbon monoxide combines with himoglobin molecules of human blood much faster than O_2 causes suffocation inspite.

ii) ozone depletion due to CFC's is expected to cause skin cancer.

iii) SO_2 combines with water & forms poisonous smogs & these impact block the respiratory system of human body & his death.

iv) SO_2 causes of diseases of eyes, throat & lungs, irritatation of nose etc.

v) Nitric oxide (NO) - respiratory problem, oxygen deficency, pneumonia & lung cancer.

3) **Effects on plants -**

i) The increased U.V.R. would adversly affect plant & animals.

ii) Photosynthesis yields of plants would be subsequently reduced.

iii) soil moisture would be significantly reduced & resulting into marked decreases in food production.

iv) Phytoplanktons in the marine ecosystem would be greatly reduced. adversly affect on zooplanktons.

Control of Air Pollution:

1) To create awarness among all walks of people in society and goverment bodies & offices.

2) To conduct extensive survey and regular monitoring of the existing level of air pollution.

3) To reduce the total pollution load of atmosphere.

4) To make efforts to search alternative less harmful products - such as solar-powered cars.

5) To improve existing device of air pollution control.

6) To eridicate extremely hazardous forms of air pollution.

7) To make efforts to disperse and dilute the pollutants in the upper air to reduce their concentrat^n in ground level.

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b] **WATER POLLUTION :**

Def^n-① "water pollution may be defined as 'alteration in physical, chemical & Biological charactaristics of water which may cause harmful effects on human & aquatic life'.

② 'foreign materials either form natural or other sources are contaiminated with water supplies and may be harmful to life'. -WHO

* **Sources of Water Pollution :**

1) **Natural sources -**
- i) soil erosion
- ii) Landslide
- iii) Coastal and cliff erosion.
- iv) Volcanic eruption
- v) Decay & Decomposition of plants & animals.

2) **Anthropogenic sources :**

i) **Industrial source** - stream, river, lakes & coastal waters through industrial influents solid & liquid.

ii) **Agricultural source -**
- chemicals used in chemical fertilizers, pesticides & herbicides etc.

iii) **Urban sources -**
- such as sewage, domestic garbage, industrial infflumts, automobile exusts etc.

iv) **cultural source -**
- congregation of large no. of people from all over India i.e. Piligramage, religious fair etc.

\# **Effect of Water Pollution :**

1) **Human beings -**
- Polluted water is the major causes for the spread of epidemics & several dengerous diseases. Such as cholera, tuberculosis, jaundice, dysentry, typhoid, paratyphoid

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- Polluted water with solid material causes 'fatal diseases'.
- Polluted water with fiber asbestos causes 'Lung cancer.
- Polluted water with 'mercury' causes 'minimata diseases'.

2) **Aquatic organisms -**
- water pollution mainly caused by toxic chemicals causes deaths of aquatic organisms including both plant & animals.

3) **Agriculture -**
- The use of polluted water of river, lakes, ponds & groundwater for irrigating agricultural field several damage of crops and decreases agricultural production.

4) **microgenisms -**
- Heavily polluted water also pollutes soils, decreases theis fertility and kills soil micro-organism such as usefull bacteria.

5) **soil -**
- The polluted water use of agriculture reduce soil fertility & raises the water requirment of the soils; salts increases alkalanity of soils.

Control of Water Pollution :

1) The individuals must be educated enough to understand the nature of water pollution.

2) There must be mass awarness and right perception at community level about various aspects of water pollution.

3) The industrial units must be obliged to treat industrial effluents before discharging them in to water bodies.

4) The munciple carporation must errange for sewage treatment plants.

5) Goverment should provide funds for water pollution control programmies. and govt. must bring in force effective laws for pollution control.

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C) Noise Pollution :

Def^n : "Noise pollution may be defined as the state of discomfort and restlessness caused to humans by unwanted high intensity sound known as noise".

- The common measurment unit of sound in decibel (dB).

* Noise level :

No.	Sound source	Decebel (dB)
1.	Thresold of hearing	0
2.	Normal breathing & Tree leaves	10
3.	Whispering e.g. Liberary	30
4.	Living room & quiet office	40
5.	Restaurant & noise traffic light	50
6.	Noise during normal conversatn	60
7.	Noise of automobiles	70-80
8.	Noise of waterfalls e.g. Nigara	90
9.	Jet aircraft upto 300 m height	100-110
10.	Jet aircraft at take off point	150.
11.	Rocket engine.	180-195

Sources of Noise Pollution :

1) **Natural sources -**
- such as cloud thunder, hurricanes, gales, thunderstorm, high intensity rainfall, hailstorms, waterfalls etc.

2) **Biological sources -**
- wild animals, street dogs, jackals, man - laughing, crying, singing, weaping, quarrelling etc.

3) **Artificial sources -**
- musical instruments, automobiles, aircrafts, factories etc.

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Effects of Noise Pollution:

1) General effects -
- Noise pollution of humans includes speech interferance, annoyance, sleep interference & related after effects and problems.

2) Auditory Effects -
- temporary & mild damage to hearing mechanism.
- Permanant hearing loss.

3) Psychological effects -
- High level noise causes many behavioural changes among human as well as animals.
- Human being long period of noise may cause tension in muscles, nervous irritability and strain & mental disorder.

4) Physiological effects -
- High blood pressure, heart diseases, dialation of pupils of the eyes, tensing of the voluntary & involuntary muscles, dimention of gastric secretion.
- Neromuscular tension, nervousness, stomach and intential diseases such as ulcer etc.

Control of Noise Pollution:

1) Noise may be controlled at source by providing silencers to the machines by reducing amplitude.
2) Noise generated by record players & loudspeakers may be convencing the people.
3) The intensity of noise at recivers sound absorbing materials in the community hall, dance halls, cinema halls, temples, churches etc.
4) Individual level reciver by using ear plugs, ear muffs or noise halmet or small booth in the machin room.
5) Road side plantation has proved to be effective measure of control of noise pollution.
6) Traffic rules particularly about sollancers rules.

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Soil Pollution:

Defⁿ - "Decrease in the quality of soils either due to anthropogenic sources or natural sources or by both is called soil pollution or soil degradation".

* Factors of soil pollution:

i) accelarated rate of soil erosion.
ii) Major landuse changes e.g. deforestration.
iii) Excessive use of chemical fertilizers & Pesticides, insecticide and herbicides.
iv) Polluted waste water from industrial and urban area.
v) a few micro-organisms.
vi) forest fires.
vii) dumping of urban & industrial solid wastes.
viii) water logging and related capillary processes.
ix) Leaching process
x) Drought.

\# Effects of soil pollution:

i) effects on human being, animals and plants are far reaching.
ii) Pollution degrades the quality of soils.
iii) Decrease in agricultural production.
iv) soil pollution even render the land unusable for crop farming.
v) soil erosion converts land into wasteland.
vi) Chemical fertilizers reaching with soils reach the human and animal bodies through food chains and cause various diseases & several deaths.

\# Control soil Pollution:

i) To implements various control measures of soil erosion.
ii) Use of organic fertilizers, immediates restrictions on the use of D.D.T.
iii) Proper disposal of industrial & urban wastes.
iv) proper landuse & crop managment.
v) Proper reserches regarding the adverce effect of soil pollutants.

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Acid Rain

- Acid rains pH is betn 11 and 13.
- In a polluted enviorment, where the rain & snow become contaminated by either sulpher oxides or by a combination of sulpher dioxide and nitrogen oxide emitted motor vehicle exhaust the acid rain takes place.

- 'It is the precipitation charged with an excessive amount of acid droplets formed with oxides of sulphur & nitrogen, released by the burning of hydrocarbons are converted to acids in the atmosphere'.

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- Fundamental Principle of climatology.
- Composition and structure of atmosphere.
- Heat budget of the earth; Distribution of temprature. (latitudnal & seasonal)
- Atmospheric pressure and general circulation of winds.
- monsoon and jet streams.
- Humidity, stability and instability of the atmosphere.
- Air masses; fronts, Temprate and Tropical cyclones, & ENSO.
- Cloud formation, Types and distribution of precipitation, water balance.
- Classification of climate : Koppen's and Thornethwaite scheme.
- Hydrological cycle.
- climatic change.
- Global warming.

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concepts :-

- Anticyclone - Galton

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COMPOSITION OF THE ATMOSPHERE:

"The atmosphere is a thick gaseous envelope which surrounds the earth from all sides and is attached to the earth's surface by gravitational force".

- The height of the atmosphere is estimated betⁿ 16 to 29 thousand kilometers from the sea level.
- It is estimated that 97% of the effective atmosphere is upto the height 29 km, and 99% within 32 km.

* The atmosphere is composed of Gases, Vapours and Particulates:

1) **Gases:** $N_2 + O_2 + Ar + CO_2 = 99\%$. (128 km.)

(i) **Nitrogen** - (78.08%) It has no colour, odor or taste, it helps to controlling fire. Nitrogen acts as dilutents & is generally chemically inactive, It add protiens to vegetation.

(ii) **Oxygen** - (20.94%)
accounts 21% upto height 68 km: helps to photosynthesis process. O_2 is essential of burning matter. importance of heat energy budget.

(iii) **CO_2** - (0.03%)
It accounts 0.03% up to 32 km, helps to photosynthesis process, It absorb radient energy, CO_2 is a greenhouse gas increases the temp. of lower atmosphere.

(iv) **Ozone** - (0.00006%)
It account 0.00006% upto 20-25 km. O3 absorb by ultra-violet rays & prevent to earth becoming to hot.

(v) **Other** -
Argon (0.93%), Neon (0.0018%), Helium (0.0005%), methane (0.0001%), Krypton (0.00005%), Hydrogen (0.00005%)

2) **Water vapour:**

- The vapour content in the atmosphere ranges betⁿ 0 and 5 % by volume.
- The atmospheric vapour are recived through the evaporation of classmate moisture & water from the water bodies.

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- Water vapour almost absent above 10-12 km. DATE

- Vapours depends on temprature & therefore decreases from the equator to poleword in responce to temprature.
  i.e tropical areas - 2.6%, 50° - 0.9% & 70° - 0.2% respectively
- more than 90% vapour is found upto the height of 5 km.
- Water vapour responcible to atmospheric phenomena, weather related pricipitation & condensation.
- Water vapour is almost transperant for incoming shortwaves without obstacles but vapour is less transperent for outgoing longwave radiations.

3) Particulate Matter:

- The solid particles present in the atmosphere include dust particles, pollen grains, salt particles, smoke & soot & volcanic ash etc.
- This particulates helps in the scattering of solar radiation, which add varied charming colour of red & orange at sunrise & sunset.
- The sky appears blue in colour due to 'selective scattering.'
- Salt particles becomes hygroscopic nuclei to helps in the formatn of water drops, clouds & verious condensation & pricipitatn forms.

Hygroscopic Particles: "The particles of atmosphere which readily absorb & retain moisture from the atmosphere is called Hygroscopic particles."
e.g: Sea salt.

Composition of the Atmosphere

Component	Perrent by volume.
Nitrogen (N_2)	78.08%
Oxygen (O_2)	20.94
Argon (A_r)	0.93
Carbon dioxide (CO_2)	0.03
Neon (Ne)	0.0018
Helium (He)	0.0005
ozone (O_3)	0.00006
Hydrogen (H_2)	0.00005
methane (CH_4)	0.00001
Kypton (Kr)	0.000005
Xenon (Xe)	0.000005

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STRUCTURE OF THE ATMOSPHERE:

- The modern knowledge about the atmosphere is based on the informat" through rockets, radar and satellites.
- The effective height of atmosphere is 16 and 29 thousand km from sea level but the height of the atmosphere up to 800 km most important.

56 km - 50%
29 km - 97%
32 km - 99%

- About 50% atmosphere up to 5.6 km and 97% to the height only 29 km.

- The earth's atmosphere consits of few zones like spherical shells. on the basis of the characteristics of temprature & pressure.

(a) **HOMOSPHERE:** (height upto 90 km) –

1) **Trophosphere:**

- The lowermost layer of atmosphere is known as 'trophosphere' and is the most important layer because almost all of the weather phenomena e.g. fog, cloud, rainfall occur in this layer.
- Temprature decreases with increasing height at the rate 6.5°c / 1 km. thise is also called 'normal lapse rate'.
- The height of troposphere changes from equator towards the poles (decreases) and during summer increases while winter decreases.
- The avarage height of equator '16 km' and pole' 8 km'.
- Troposphere means 'zone or region of mixing' & tropopause – 'where the stop of mixing'

Tropopause –

- The upper limit of the troposphere is called 'tropopause' which is about 1.5 km thick.
- The height of tropopaus is 17 km over the equator & 9 to 10 km over the poles.
- The height is 17 km temprature at this height -70°c.

2) **Stratosphere:**

middle latitude height 35-30 km.

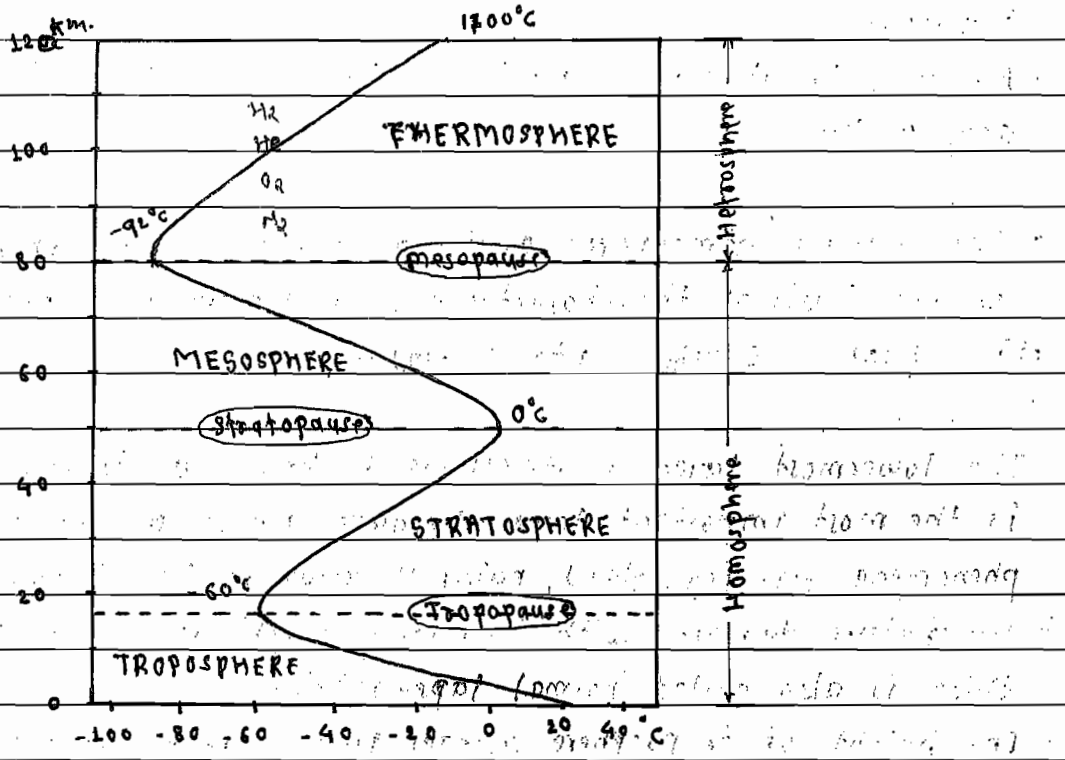
- The layer just above the troposphere is called 'stratosphere'.
- The upper limit of the stratosphere is taken to be 50 km.
- The temprature gradully rises upward as it becomes 0°c at the height 50 km.
- warming of stratosphere is mainly caused by absorption of the

- The praportion of CO_2 is rapidly incresing, but ozone gas is rapidly decreasing. DATE

- The lower portion of the stratosphere having maximum concentration ozone is called 'ozonosphere', at the hegiht 25 to 35 km.

- **Stratopause:**

- 'The upper limit of the stratosphere which is known as 'stratopause.'
- The temprature here is constant 0°c for some km.



8) **Mesosphere:**

- Mesosphere extends betn 50 km to 80 km.
- The temprature decreases with increasing height at upper limit of mesosphere -90°c.
- The avarage decreases of temprature with height increases is about 3°c per km.
- vertical mixing of air to fairly sharp decreasing temp with height some times vertical movment of air at occurance 'noctilucent clouds'.

- **Mesopause:**

'The upper limit of mesosphere (80 km) is also known as mesopause'.

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⑥ HETROSPHERE : (height above 90km)

4) Thermosphere :

- The part of atmosphere beyond mesopause is known as 'thermosphere'.
- Thermosphere temprature increases rapidly with increasing height at its upper limit temp 1700°c.

* Thermosphere is divided in to two layers :

ⓐ Ionosphere : Aurora Boreal's and Aurora Australis.

- The lower portion of the thermosphere & hetrosphere and electrically chargerd layer is known as 'Ionosphere'.
- Ionosphere extends from 80 km to 640 km.

* There are number of ionic layers in this sphere :

i) D-layer : (60 km to 99 km).

- reflects the signals of low freqyency radio waves & absorb medium & high frequency.
- This layer absent during night time, because associated with solar radiation

ii) E-Layer : (99 km - 130 km).

- It is also known as 'Kennelly - Heaviside layer'.
- This layer reflect high and medium radio freqyency back to earth.
- This layer during disappearance at night.

iii) F-layer : (150 km - 380 km) 'F1-Layer at a close relation to the sun spot'.

- consits of two sub layer f_1 & f_2 are collectively called 'appleton layer'.
- This layer reflect high & medium freqyency during day & night time.

iv) G-layer (400 km & above) : It is not detectable.

ⓑ Exosphere :

- The uppermost layer of atmosphere extending beyond 640 km height from the sea level.
- The temprature becomes 5568°c at its outer limit, and density becomes extremly low.

* there are four distinct layer -

① Molecular nitrogen layer (N_2) - 90-200 km.
② Atomic oxygen layer (O_2) - 200-1100 km.
③ Helium layer (He) - 1100-3500 km.
④ Hydrogen layer (H_2) - above 3500 km.

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- **Auroras**: are cosmic glowing light produced by a stream of electron discharged from sunsurface due to magnetic storms. Auroras are seen as unique multicoloured firework hanging in the polar sky during mid-night in the exposphere & magnetosphere.
  - Auroras borealis - northern and australis - southern.

- **Gas Law's**:
  - ① Boyel's - To relationship among gas air, pressure, volume of gas and its density.
  - ⑪ Charle's - shows relationship betn air pressure & temprature with constant gas volume.
  - ⑪ Lussac's - show relationship among pressure, volume of gas and temprature.

- **Noctilucent clouds**: formed through the process of condensation in association with meteoric dusts and some moisture transported upward by convective mechanisms, are noticed during summer season over polar areas.

- **Climate**: climate is more than a statistical avarage it is the aggrigate of atmospheric condition involving heat, moisture & air movment.

- **Weather**: Physical state of atmosphere at a given time and place.

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Structure of the Atmosphere

Broad Layers	Name of sub-layers	Altitude (Km)
	Van Allen radiation Belt magnetosphere - proton & electron	2000 - 4000 km
	(iv) Hydrogen layer (H_2)	< 3500 km
	(iii) Helium layer (He)	1100 - 3500
	(ii) Oxygen layer (O_2)	200 - 1100
	(i) Nitrogen layer (N_2)	90 - 200
	5) Exosphere	(90 - 640)
	(iv) f-layer	150 - 380
	(iii) E-layer - Kenelly Heavyside	100 - 150
	(ii) D-layer - Appleton	80 - 99
	4) Inosphere	(80 - 380)
b] Heterosphere	Thermosphere	90 +
	Mesopause	85 - 90
	3) Mesosphere	50 - 80
	Stratopause	50 - 55
	2) Stratosphere	11 - 50
	Tropopause	eq. 17 & pole 9-10
a] Homosphere	1) Troposphere	eq - 16 , pole - 6

- **Ozonosphere :**
  - The height of 15 - 30 kms, O_3 - triatomic oxygen isotopes.
  - It is faintly blue irritating gas with pungent odour.
  - Protective cover because absorb U.V.R. from becoming too hot.
  - creation : $O_2 + O \rightarrow O_3$, breaking $O_3 \rightarrow O_2 + O$.
  - Destruction gaseous : CFC's, halons & nitrogen oxides.
  - * **Causes** : (i) Global warming (ii) acid rain (iii) rise in sea level, (iv) skin cancer (v) poisonous smog (vi) ecosystem instability.

- **Heterosphere :** (90 km to 10,000 km)
  - (i) Molecular nitrogen layer (N_2) - 90 - 200 km
  - (ii) Atomic oxygen layer (O_2) - 200 - 1200 km.
  - (iii) Helium layer (He) - 1200 - 3500 km
  - (iv) Atomic Hydrogen layer (H_2) - 3500 to above.

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Lithosphere :

- Planet Earth - fifth biggest planet in solar system.
- Earth's shape - 'geoid' known as an 'oblate ellipsoid'.
- Earth's axis -
  - The axis of earth is inclined to the plane of eliptic at an angle 66 1/2°. (23 1/2°)
  - giving rise to different season and varying length of day & night.
  - (i) equinoxes : meaning 'equal night.'
    21 march & 23 sept. sun overhead equator.
  - (ii) summer solastice -
    21 june - sun verticle on Tropic of cancer.
  - (iii) winter solastice -
    22 Dec. - sun verticle on Tropic of capricorn.
- movment of Earth -
  - It rotates own axis west to east apece in 24 hours.
  - It revolving around sun 365 1/4 days; on elliptical orbit at speed '18.5 miles/second.'
- standerd time :
  - The whole world has been divided 24 standerd time zones. each zone seprated 15° longitude by one hour or 4° for 1 minute.
  - International date line in the mid-pacific curves at normal 180° meridian.
- Earth position
  1> respect to moon : (i) Apoge - farthest distance (407,000 km)
  (ii) Perigee - nearest distance (356,000 km)
  2> respect to sun : (i) Perihelon - nearest distance (147 million km)
  (ii) Aphehelon - farthest distance (152 million km)

- The blueness of the sky is mainly due to scattering of sunlight by air molecules.

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INSOLATION :

"The radient energy recived from the sun, transmitted in a form shortwaves and ~~fromat~~ traveling at the rate of 1,86,000 miles a second, is called solar radiation or insolation".

- The earth recives heat energy from three basic sources
  (i) Solar radiation (ii) Gravity (iii) Endogenetic forces.

* Charactaristics -

i) The surface temprature of sun is 6000°C (10,000°F) and centre ~~5500~~°C. (18,000000) 10,000,000°C

ii) The E.M.R travel at the speed of 3,00,000 km/second or (2,98,00,000) 1,86000/miles.

iii) E.M.R. travel sunsurface to earth at time 8' 20" to covering areas 150 million km.

iv) The density of 'earth' is 5.5 and 'sun' is 1.41 and sun dimetar 13,82,400 km. & moon 3.3

* Relation betn Wavelength and Wavefrequency -

i) Wavelength -

'The straight distance betn two successive creast or troughs is called wavelength'.

ii) Wavefrequency -

'The no. of radiation waves are passing through a certain point per unit time is called wave freqyency'.

- There is inverse relationship betn wavelength & wavefreqyency i.e. shorter the wavelength, higher the wave freqyency and lower the wavefreqyency, longer the wavelength.

Freqyency	wave length
Low	
medium	
High	
Very High	

- Longwave

- shortwave

L = wavelength
C = Cruest
T = Trough

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* The E.M.R. Spectrum:

1) The first spectrum of e.m.r waves including Gama rays, Hard X-Rays, soft X-Ray & Ultraviolet rays.
- The wavelength of this spectrum of the shortest wavelength in it unit measure 'angiostorm'.

1 angiostorm = 0.000,000,01 cm or 10^{-8} cm.

i.	Gama Rays	less than 0.03	10^{14}
ii.	Hard X-Rays	0.03 - 0.6	10^{13}
iii.	soft X-Rays	0.6 - 100	$10^{12} - 10^{11}$
iv.	ultra violet Rays	100 - 400	$10^{10} - 10^{9}$

2) Visible light:

'The second spectrum of the e.m.r. wave is also called spectrum of visible light.'
- which includes violet, blue, green, yellow, orange & red (VBGYOR).

unit 1 micron = 0.0001 cm or 10,000 angiostorm

i.	violet rays	0.4 - 0.43
ii.	Blue rays	0.43 - 0.49
iii.	Green rays	0.49 - 0.53
iv.	Yellow rays	0.53 - 0.58
v.	Red rays	0.58 - 0.70.

3) Infrared spectrum -
- The 3rd spectrum of emr is called infrared spectrum.
- Infrared waves of wavelength ranging from 0.7 to 300 microns.
- The wavefrequency 10^5 and 10^4 mz/second.

4) fourth spectrum of e.m.r waves consits of longwaves including microwaves, radar waves and radio waves.
- The unit measure of longwave is cm to meter.

i.	microwaves	0.03 cm to 1.0 cm.
ii.	Radar waves	1cm to 100 cm (1m)

- The radar system is divided into two sub system:

(i) Television system (ii) radio system.

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Factors affecting the Distribution of solar Insolation:

1) **Angle of the sun rays:**

① **Area**: vertical rays are spread over minimum area of the earth surface & energy recived per unit area increases.

- Oblique rays are spread over larger area of the earth surface and energy recived per unit area decreases.

② **Thickness of the atmosphere**-

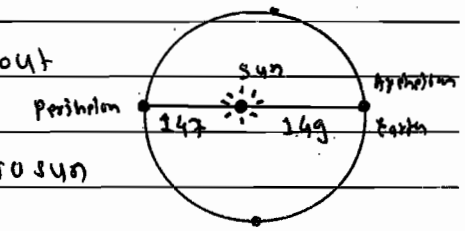
- Oblique rays have to pass through thicker portion of the atmosphere than the vertical rays.

2) **Length of the Day**-

- The longer duration of day and shortest duration of night to recive larger amount of insolation.
- The shorter duration of day & longer duration of night to receive lesser amount of insolation on the earth surface.

3) **Distance bet^n sun and earth** -

- The avarage distance bet^n sun and earth is about 93 million miles (149 million km).
- **Perihelion**: 3 January the earth is nearest to sun say 91.5 miles (147 million km).
- **Agehelion**: 4 July the earth is farthest to sun say 94.5 million miles (152 million km.)



4) **Sunspots**-

- The energy radiated from the sun increases when the number of sunspots increases & therefore amount of insolation recived at the earth's surface also increses.
- The amount of insolation recived at the earth's surface decreases when the number of sunspot decreses.

5) **Effect of the Atmosphere**-

- Clouds, water vapour, dust particles etc are variable elements of the atmosphere & they absorb, reflect and scatter the insolation comming from the sun.

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6) Nature of surface-

- Different surface insolation reflected different amount of insolatn actually recived by them also differs

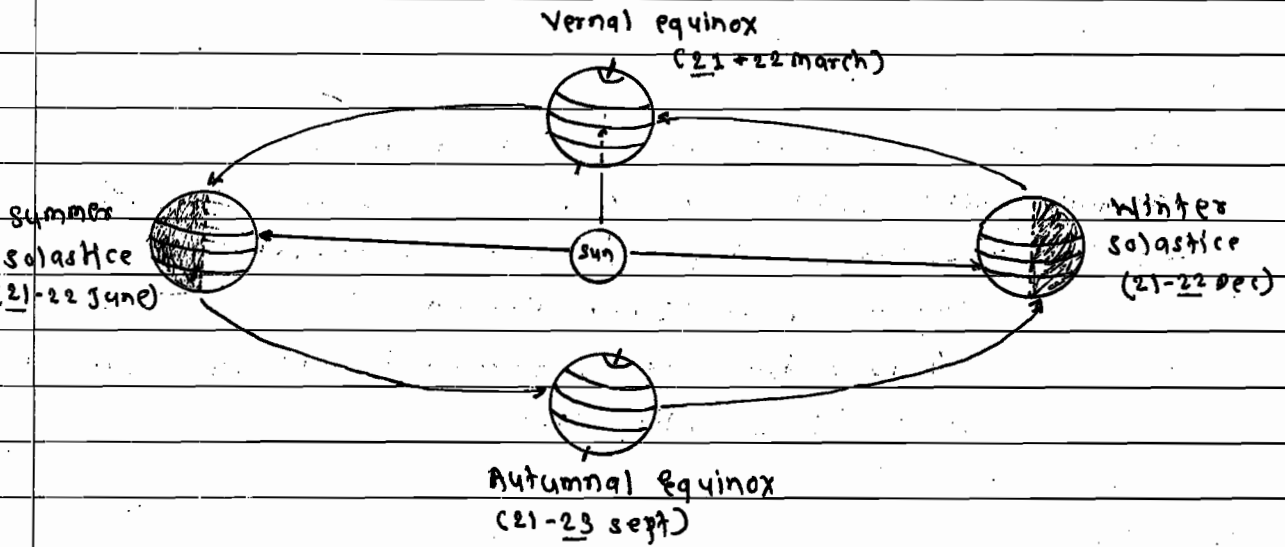
e.g: clay, soil absorb more heat than sand & snow.

7) slope of land -

- In Northern hemisphere mountain recived more energy in southern slope & less in northern slope.
- In other hand southern hemisphere mountain recived more energy in nothern slope & less in southern slope.

Distribution of Insolation:

-The amount of insolation recived at the earth surface decreases from equator towards the poles, but there is temporal variation of insolation recived different lattitude.



1) Tropical zone:

- extends betn Tropic of cancer and tropic of capricorn
- Every place recive maximum & minimum insolatn twice a year.

2) middle lattitude zone: (23.5° - 66° both hemisphere).

- within this zone every place recive maximum and minimum insolation once during the course of a year.

3) Polar zone:

- extends betn 66° to 90° lattitude both the hemisphere.
- Every place recive maximum & minimum insolation once during the course of a year, but some time insolation becomes zero.

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HEAT BUDGT OF THE EARTH AND ATMOSPHERE:

- "On an avarage, their is supposed to exist heat balance bet^n the amount of solar radiation recived by the earth's surface and its atmosphere and the amount of heat lost by the outgoing terrestrial longwave radiation from the earth surface and its ~~atmosphere~~ loss of heat from the atmosphere", is called as Heat Budget."

** The estimated data of G.T. Trewartha are being used to explain the heat budget of the earth and its atmosphere:

a) Incomming Shortwave Solar Radiation:

(i) The earth recives most of its energy from the sun through shortwave solar radiation. The solar energy radiated toward's the earth surface is 100% or 100 units.

(ii) Out of total incoming solar radiation entiering the earth atmosphere 35% cent is back to space - scattering by dust particles (6%), reflection from the clouds (27%) & ground surface (2%).

(iii) 51% is recived by the earth surface and 14% absorb by atmospheric gases, and water vapours in different vertical zones of atmosphere.

(iv) The 51% solar energy recived by the earth comprises 34% as direct solar radiation and 17% diffuse day light.

(v) The heat budget of the atmosphere comprises 48% of solar radiation wherein 14% is recived through absorption of the shortwave incoming solar radiation & 34% is recived from the outgoing longwave terrestrial radiation.

1. Incomming shortwave solar radiation = 100%.
2. Amount lost to space through scattering and reflection.

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a) refected by the clouds = 27%.
b) refected by the ground = 2%. } 35%.
c) scattered energy loss to space = 6%.
Remaining solar energy = 65%.

A) Heat budget of earth

i) Recived through direct radiation = 34%.
ii) Recived as diffuse day light = 17%.
Total = 51%.

B) Heat budget of the atmosphere

i) Absorption of incoming solar radiation = 14%.
ii) Recived from outgoing terrestrial radiat" = 34%.
Total = 48%.

b) Outgoing Longwave Terrestrial Radiation:

i) After receiving energy from the sun the earth also radiates energy out of its surface into the atmosphere through longwaves.

ii) 23% out of 51% is lost through direct longwave outgoing terrestrial radiation out of which 6% is absorbed by the atmosphere & 17% goes directly to space.

iii) About 9% terrestrial energy is spent in convection & turbulance and 19% is spent through evaporation.

iv) The total energy recived by the atmosphere from the sun (14%) and the earth (34%) becomes (48%) which is radiated to the space in one way or the other.

A) Terrestrial Heat Balance -

Energy Recived	Energy lost
51%	i) 23% through radiation.
	ii) 9% through convection & turbulance.
	iii) 19% through evaporation
Total	= 51%.

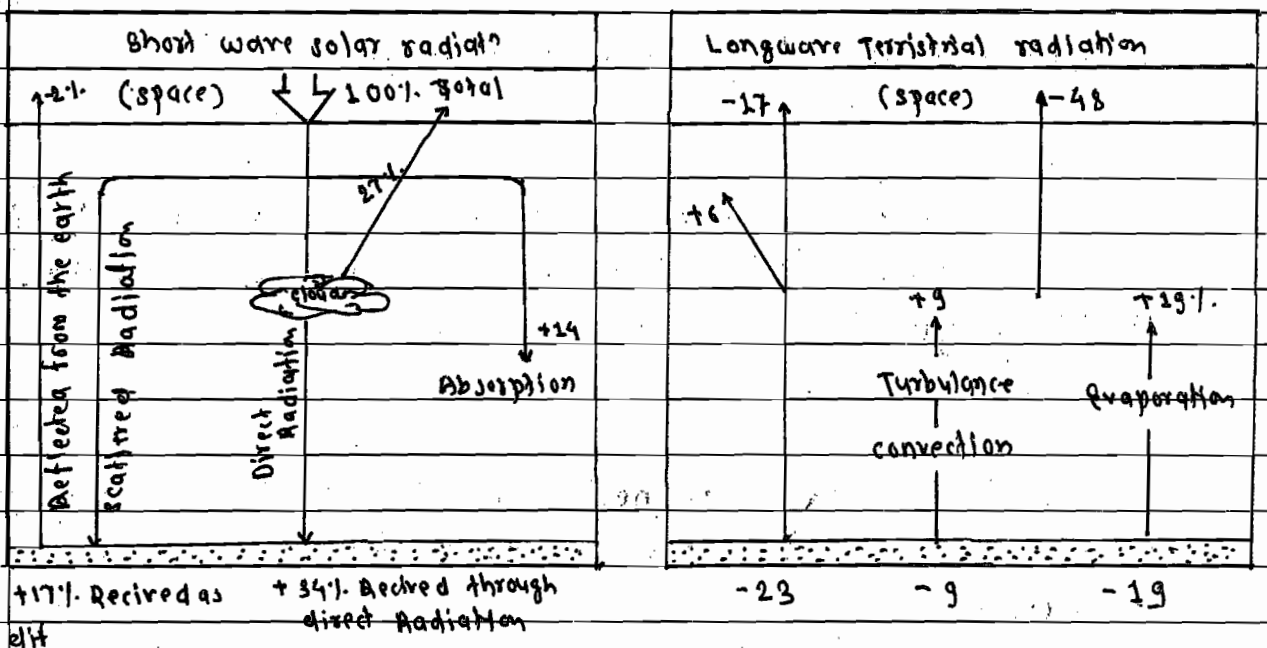
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B) Atmospheric Heat Balance-

Energy recived	Eenergy lost
i) 14% through absorption of incoming solar radiation.	
ii) 6% through effective radiation from the earth.	48% through radiation into the space.
iii) 9% through convection and turbulance from the earth.	
iv) 19% through evaporation.	
Total = 48%	

- Eenergy sent back to space = 35% + 17% (through radiation from the earth) + 48% (through radiation from the atmosphere) = 100%.



- Solar statistics:

* Distance from earth - 150 mn km²
* Diameter - 100 earth diameter.
* Core Temp. - 15 million °c
* surface temp. - 6000°c
* Age - ~~25 days~~ 5 bn yrs
* composition - H_2 (71%)
  He (26.5%)
  other (2.5%).

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TEMPRATURE

- It may be pointed out that 'heat' and 'temprature' generally appear synonym to common people but two term differ at real meaning.
- 'Heat' is a form of energy while 'temprature' denotes the intensity of hotness or coldness of any substance.

* There transfer of heat from one body to the other is accomplished through conduction, convection and radiation.

1) **Conduction:**

'The transfer of heat through the molecules of matter in any body is called conduction'.

- Transfer of heat in two ways:

(i) from one part of body to the other part of same body.
(ii) from one body to other touching body.

2) **Radiation:**

'The process of transfer of heat from one body to the other body without the aid of a material medium i.e. solid, liquid or gas is called radiation'.

3) **Convection:**

'The transfer of heat energy through the movment of a mass of substance from one place to another place is called convection'.

- The process of convection becomes effectively only in fluids and gaseous because their internal mass motion activities convection of heat energy.

Mean Temprature –

- The maximum temprature record 2pm - 4pm is called as maximum daily temprature.
- The lowest temprature recorded 4-5 Am instead of midnight is called minimum daily temprature.
- 'The avargge of maximum and minimum temprature within 24 hours is called mean daily temprature'.

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-Temprature gradients are greater in winter than in summer in the northern hemisphere. DATE

Distribution of Temprature :

- The spatial and temporal distribution of temprature is very significant because different type of weather, climates, vegetation zones, animals and human life.

* factors controlling the Distribution of Temprature -

1) Latitudes -

- The amount of insolation recived by the ground surface decreases polewood from the equator, i.e. low lattitudes towards the high lattitudes.
- It be noted maximum temp. noted 20°N lattitude, do not equator Because insolation is reflected by clouds & evaporation.

2) Altitude -

-The temp. decreases with increasing height from the earth's surface at an avarage rate of 6.5°C per km. because of the follwing reason:

① The lower layer of air contains more water vapour & dust particles than the layers above & hence it absorb larger amount of heat.

② The portion of atmosphere coming in direct contact with the earth surface gets more heat.

3) Distance from the coast -

- The marine enviorment moderates the weather conditions of the coastal areas because more mixing of land & sea breezes.
- The daily range of temp. is the coastal enviorment is minimum but it increases as the distance from the sea coast increases.

4) Nature of land and water -

- It may be pointed out that land becomes warm and cold more quickly than the water body.
- They recliving equal amount of insolation, but differential rate of heating & coolling of land & water, Because —

① The sun rays only penetrate 3 feet in land & several meters classmate in water.

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(ii) There is more evaporation of ocean as compaire land.
(iii) The reflection of oceanic water surface is far more than from the land.
(iv) Oceanic areas generally clouded & hence less recive insolation.

5) Nature of Ground surface -
- The nature of ground surface in terms of colour, vegetation, landuse practices etc. affects the distribution of temprature.
- The snow and sand covered surface reflect high amount of insolation as compair clay & Black soil.

6) Nature of Ground slope -
- The sunfacing ground surfaces record higher temp. than the leeward slopes where's sun ray's reach more obliquely.
- In Northern hemisphere east-west streching mountain more energy recive in southern slope & vice versa.
- In southern hemisphere more amount of entrgy recive in
7) northern slope & less in southern slope.

7) Prevailing Winds -
- The prevailing winds help in redistribution of temprature.
- The winds blowing from high (low) lattitude to low (high) lattitude raise the temprature of region where they reach while winds blowing from high lattitudes to low lattitudes lower the temprature.

8) Ocean Currents :
- The warm ocean currents flowing from tropical areas to temprate and cold zones raise the avarage temprature in the affected areas. e.g. Gulf stream.
- cold current lower the temprature of affected areas.

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- The study of the distribution of temprature is attempted in several ways:
  a) Temporal Distribution
  b) spatial Distribution
- The spatial Distribution is studied in to two ways -
  1) Vertical Distribution.
  2) Horizantal Distribution of temprature.

1) Vertical Distribution of Temprature:

- The temprature dicreases with increasing height in the troposphere but the rate of decrease varies according to season, duration of sunshine and location.
- The rate of decrease of temprature with increasing height at the rate 6.5°c / km is called 'normal lapse rate'.

- The follwing reason dicreases temprature with increasing altitude in the troposphere:
  (i) Heat is transferred to the atmosphere from the earth's surface through the process of conduction, radiation and convection.
  (ii) The air pressure is higher in the lower portion of the atmosphere nearly the earth surface.
  (iii) The quantity of water droplets, dust particles, water vapour, co2 etc. which absorb outgoing longwave radiation.

Troposphere -
- The decreases of temprature with increasing height is confined to troposphere.
- The height of troposphere 16 km (equator) & 6 km (poles) respectively.
- The upperlimit of troposphere is called tropopause.
- The height of tropopause is 17 km & temprature is -70°c.

Stratosphere -
- The upward of tropopause the temp. increases with increasing height where it becomes 0°c at the height 50 km.
- The upper limit of the stratosphere is called stratopause.

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Mesosphere -

- Temprature again decreases with increasing height in the mesosphere.
- This upper limit of mesosphere called mesopause at the height 80km at the rate of temp. -80°c.

Thermosphere -

- Beyond mesopause temprature again increases with increasing height in the the thermosphere.
- The upper limit of ~~the~~ thermosphere temp. 1700°c.
- This temp. can not be measured by ordinary thermometer, because the gases becomes very light due to very low air density.

Inversion of Temperature:

Some times, temprature increases with increasing height in the troposphere, In other words some time warm air lies over cold air, this phenomenon is called inversion of temprature.

- Temprature increases upward up to a few km from the earth's surface is called 'negative lapse rate'.

* Factors controlling The Inversion of Temprature:

1) Long Nights -

- Insolation is recived during day & is radiated during night. Radiation at night results in cooling the earth surface & upper air still warm.

2) Clear sky -

clear sky helps in loss of heat energy by radiation from the earth and results in its cooling. Clouds abstract this process. Thererefore clear sky is essential for temprature inversion.

3) Stable Weather -

Continious radiation of heat is possible only in a stable weather. This condition leads to temp. inversion, change in weather hinders the temp. inversion.

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4) Dry Air -

Water vapour absorb the radiation of earth surface and incoming solar radiation. The dry air permits free movment of heat radiation & helps in temp. inversion.

5) Ice cover -

Areas covered with ice cause cooling of air touching it while the upper air remains comparitively warm.

6) Incoming cool air masses - The incomming air mass is cold it throws the warm air upword and creates temprature inversion.

TYPES Of Temprature Inversion:

1) Ground surface inversion -

- There is a rapid radiation of heat from the surface of the earth, it causes cooling of the lower layer of atmosphere.
- while the upper air still pomparatively warm, this result is temprature inversion.

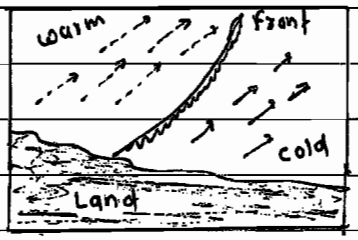


Figure 05. 2) Advection inversion -

- This inversion occurs as a result of meeting of warm and cold air masses in a cyclone.
- The heavyour cold air mass life the warm air mass above it and causes temprature inversion,
- The negative laps rate of temprature operate.

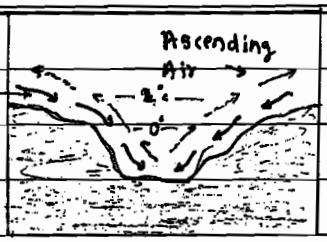
3) Upper layer Inversion -

- when air from upper layers of the atmosphere descends in large quantity, it makes contact with the turbulent lower layers.
- The upper air is pressed down by still upper layers & gets heated by the pressure but lower air remains unaffected.
- Thus a layer of warm air settles over the lower cool air and inversion of temp. takes place.

Significance:

(i) formation of fogs.
(ii) Discourages rainfall & favours dry conditions.
(iii) Greatly damaged agricultural crops. DATE

4) Valley's inversion Temprature:



- In areas of uneven relief, the air at the slopes and hill tops becomes colder and heavier as compared to the air in the valleys.
- This heavy and cold air descends down the hill slopes and accumulates at the valley bottom.
- In this process the pre-existing warm air is uplifted and it's place is taken by the descending cold & heavy air is called temprature inversion.

Horizontal Distribution of Temprature:

- On an avarage, temp. decreases from the equator towards the poles, and thus low lattitude are highest temp. whereas high lattitude record lowest temp.

- Highest temp. is never recorded at the equator insted it record near the tropics of Capricorn and cancer, because equator region radiatn reflected by clouds & evaporation.

- The temp. decreases from equator towards the poles, this change of temp. rather decreases of temp. poleword is called temprature gradient.

* Isotherm: 'The lines drawn on maps joining the places of equal temp. reduced to sea level are called isotherms'.
i) isotherms run east-west and are generally parallel to latitudes.
ii) isotherms are straight but they bend at the junction of continents and oceans due to differential heating & cooling of land & water.
iii) isotherm more irregular in N. hemisphere because large extent of continents, but more regular in the southern hemisphere due to over dominance of oceans.
iv) isotherm trending from land towards the ocean bend equatorward during summer & poleward during winter.
v) isotherm trending from the oceans to the continents bend poleword during summer & equatorword during winter. PAGE

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* Avarage Annual Temp. Distribution:

- The highest avarage temp. are in the tropics or subtropics where largest amount of solar energy recived.
- lowest avarage temp. are found near the poles, which recive less amount of solar energy.

i.e. means dicrease of temp. equator towords poles.

Mean surface Temp(°C) at selected latitudes-

Lattitude	Junvary	Julty
30°	15	38
40°	5	24
50°	-7	18
60°	-16	14
70°	-26	7
80°	-32	2
90°	-41	-1

a) In Junvary Temprature:

- At this time, when the sunshine vertically overhead near the Tropic of capricorn.,
- It is winter in northern hemisphere and summer in the southern hemisphere.
- Temp. high overland mass in southern hemisphere NW Argentina, East central Africa, Borneo & central Australia.
- In northern hemisphere landmasses cooler than oceans, as a result lowest temp. occurs in N.E Asia
- 'Verkhoyansk' (-50°c) temp. consider coldest place in the world.

b) In Julty Temprature:

- During this period the sunshine vertically overhead near the 'Tropic of cancer.'
- It is summer in the N. hemisphere & winter for S. hemisphere.
- maximum temp. of over 30° occurs in N. hemisphere betn 10° to 40° N lattitude.
- The areas SE USA, sahara, Arabia, Iran, Iraq, Afganistan & S-India.

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- The lowest temp. i.e. below 0°c recorded in N. hemisphere in the central part of Greenland.
- most of the world highest temp. recorded at 'sahara'.

Regional Distribution of Temprature:

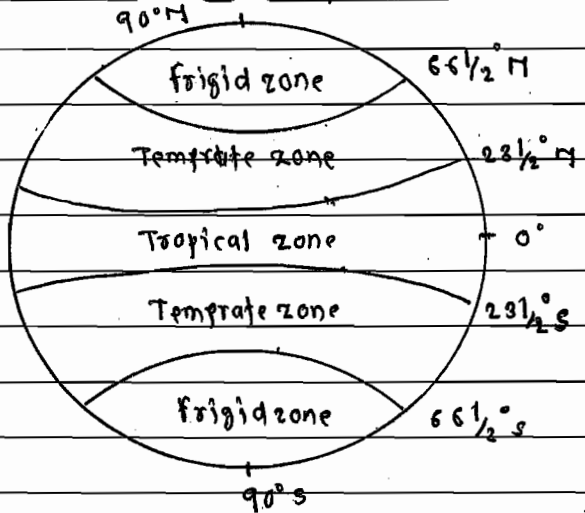


Fig: Temp. views of zones according to anecient 'Greek' thinker.

(1) Tropical zone:
- extends betⁿ the tropics of cancer 23½° N and Tropic of capricorn 23½° S.
- The sun ray's verticle on the equator through out year.
- There is no winter in equator but one approch Tropic of cancer and capricorn summer & winter are clearly observed.

(2) Temprate zone:
- extends betⁿ 23½° & 66½° in both the hemisphere.
- Though duration of day & night are longer.
- The seasonal contrast with the northword & southword migration of sun.
- The range of temp. betⁿ summer & winter very high.

(3) frigid zone:
- extending betⁿ 66½° lattitude & the pole both the hemisphere.

characteristics: (i) more obligue sun ray's through out year.
(ii) exceptionaly very low temprature.
(iii) Length of day & night more than 24 hrs.
(iv) Days & night are of months duration of the pole.

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- **Albedo -**

'The portion of incident radiation (energy) reflected back from a surface of a body is called albedo or reflection coefficient or simply reflectivity'.

- **Atmospheric window:** Atmospheric window refers to any of the wavelengths at which electromagnetic solar radiation can pass through the atmosphere and reach the earth's surface.

- **Corona:** 'The outermost zone of the sun's atmosphere characterized by the ~~atmos~~ very hot (temp. 1° to 2° million) and rarefied gases is called corona'.

- **Isonomalous temprature :**

'The differances of observed temp. of a place and the mean temp. of the lattitude passing through that place is called anomaly'.

Example: If the avarage temp. 30°N lattitude is 20°c and the temp. of 'A' place located on that lattitude is 30°c then the thermal anomaly is of 10°c.

" The equal thermal anomaly of several places is called isonamalous temprature ".

- **Greenhouse :**

An expression referring to the ability of glass to allow incoming short wave radiation to pass easily into a greenhouse but which blocks some of the radiated outgoing long-wave terrestrial radiation.

- The process has been same s.w.R. passes easily through the atmosphere to reach the earth's surface where l.w.R. is absorbed and reradiated by water vapour, dropets & co2.

- **Ozone Hole -**

- A hole ~~of~~ in the layer of ozone due to high altitude ozone depletion. Ozone is deplated by CFC's.
- 1987, 40 countries adopted as CFC reduction protocol known as Montreal Protocol.

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- Hadley Cell:

  Hadley cell comprise an extensive circulatory system of winds whereby air rises at the ITCZ near the equator.

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ATMOSPHERIC PRESSURE:

'Air pressure is thus defined as total weight of a mass of coloumn of air above per unit area at sea level'.
The atmospheric pressure maximum at sea level.

* characteristics:

1) The atmospheric pressure decreases with increasing altitude 3.4 mb/ 100ft
2) The standerd air pressure at sea level is 1013.25 mb.
3) The lines joining the places of equal pressure at seal level are called 'isobars'.
4) The highest sea level pressure of 1075.2 mb was recorded at 'Irkutsk' in siberia on 14 jane. 1893.
5) The lowest sea level pressure of 877 mb was recorded in 'Mariana Island'.
6) 'The rate of change of pressure per unit horizantal distance is called 'pressure gradient'.
7) Air pressure decreases with increasing altitude at the rate 0.1 inch or 3.4 mb/ 60 feet

\# Horizantal Distribution of Air Pressure; and Pressure Belts:

- The horizantal distribution of air pressure on the globe is studied on the basis of isobars'.
- Air pressure is generally divided in two types:
  (i) High pressure also called as 'high' or anticyclone.
  (ii) Low pressure, also called as 'low' or cyclone.

- The pressure belt are discontinued in the northern hemisphere and regular pattern in southern hemisphere.
- There are seven pressure belts on the globe, are divided mainly two categories:
  1) Thermaly induced pressure belt:
     e.g- Equatorial low pressure belt & Polar High pressure belt.
  2) Dynamically induced pressure belts:
     e.g- subtropical high pressure belt and
     subpolar low pressure belt.

A man suffers from nose & ear bleed at higher altitudes
Because the atmospheric pressure decreases with increasing altitude,
the balance of outward pressure exerted by air of human body
& inward pressure exerted by atmosphere

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1) **Equatorial Low Pressure Belt:**

- It is extending betⁿ 5° N and 5° S latitudes
- These belt are seasonal shifting with the northword (summer solastice) and southword (winter solastice) migratⁿ of the sun.
- The equatorial low pressure belt thermally induced because ground surface intensly heated during the day due to almost vertical sun ray's.
- The lowermost layer air warm and expand, becomes light & consequently rises upword causing low pressure.
- The equatorial low pressure belt represents the zone of convergence of NE and SE trade winds.
- These belt of frequent calm condition is also called "doldrum".

2) **Sub-Tropical High Pressure Belt:**

- It is extending betⁿ the latitude 25°-35° in both hemisphere.
- It's origin to rotation of the earth and sinking & settling down the winds, it's dynamically induced.
- This zone is charactrized anticyclonic condition which causes atmospheric stability and aridity.
- This is reason of presence of hot deasrart in world.
- This zone of high pressure is called "horse latitude"

3) **Sub-Polar Low Pressure Belt:**

- This belt is located betⁿ 60°-50° latitude in both the hemisphere.
- This L.P. belt is dynamically produced.
- These belt is more developed & regular in the southern hemisphere while broken in northern hemisphere.

4) **Polar High Pressure Belt:**

- High pressure at the poles throughout the years because very low temp. all the year around.
- In fact, both the factors, thermal & dynamic operate at the poles.
- The high pressure produced due to very low temprature.

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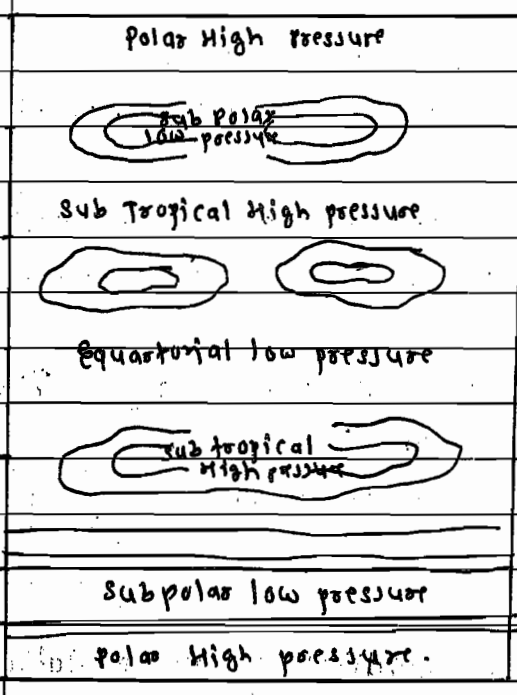


Fig: Distribut° of Air pressure

* Shifting of Pressure Belt:

- The lowest pressure belt developed during 2 to 4 p.m during day & highest pressure belt recording during 4-6 Am duetonight.
- All the pressure belts move northward during 'summer' solastice sun vertical on tropic of cancer.
- All the pressure belts move southward during 'winter' solastice sun verticle on Tropic of capricorn.
- The pressure belt normal position at the time vernal equinox (21 march) & autumnal equinox (23 sept.) sun vertical at the equator.

- પૃથ્વિઓળાયા પૃથ્વિકાંદી ઉપરના વિવુતમાવકોએ કોણ $66\frac{1}{2}°$ જેવા હોય છે.

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Pressure Gradient and Air Circulation:

a) **Pressure Gradient:**

"The differances of pressure bet" any two places is called pressure gradient".

- steep pressure gradient is represented by closely spaced isobars while widely spaced isobars reveal low pressure gradient.
- The direction of pressure gradient is considered from high pressure direction is always perpandicular to isobars. H.P → L.P.
- Pressure Gradient is also called "barometric slope".

b) **Air circulation:**

- The close relationship bet" pressure gradient & air circulation.
- The air moves to high pressure to low pressure.
- The direction of air movment should be perpandicular to the isobars.

* Horizantal pressure gradient, corolis force, frictional force, centrifugal action of wind etc. affect & control air motion.

(i) **The pressure gradient force:**

- The pressure differences caused by wind are blow.
- The pressure gradient expressed as the distance bet" isobars. closely spaced isobars indicating steep pressure gradient & widely spaced weak pressure gradient.
- The magnitude is determined from spacing of isobars and the direction of force.

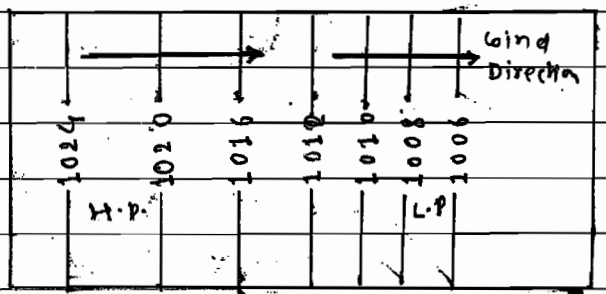


fig: Pressure Gradient & wind Direction

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(vi) **Coriolis Force:**

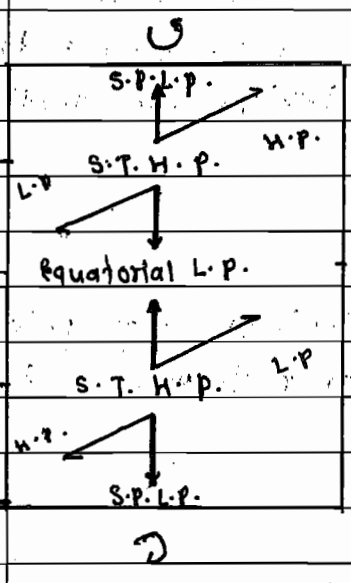
"is the force which deflects the direction of surface winds. Coriolis force or effects is not a force in itself in real sense rather it is an effect of the rotational movement of the earth, along its axis the winds are deflected, This force called coriolis force".

- Coriolis force of all the winds are deflected to the 'right' in the - northern hemisphere while they are deflected to the 'left' in the - southern hemisphere, with respect to the rotating earth.
- This winds blow 'counter clockwise' in - northern hemisphere and 'clockwise' in - southern hemisphere.

"It may be mentioned that coriolis force is not in itself a force in real sense rather it is an effect of the rotational movment of the earth is called 'coriolis effect'."

* Characteristics:

i) Coriolis force an effect on rotational movment of the earth.
ii) Coriolis force becomes effective on any object which is in motion i.e. winds, flying birds, aircrafts etc.
iii) Coriolis force affect the wind direction and not the wind speed.
iv) It become maximum at the poles & minimum at the equator.
v) The magnitude of coriolis force is determined by wind speed.



L.P. - left hand
H.P. - right hand

June 05, 06

* Ferrel's Law: Ferrel cell known as Direct cell.

'If one stands with one's back towards the direction from where winds are comming they are deflected to the right in the northern hemisphere and to the left in the southern hemisphere'. clockwise ocean current - N. Hemisphere
Anticlockwise " - S. Hemisphere.

* Buys Ballot law -

'In the northern hemisphere if you stand with your back to the wind there will be low pressure to your right. In the S. hemisphere the coriolis deflection being to the left

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(iii) Frictional force :

'The force generated by the resistance of the surface of an object against a moving object is called frictional force'.

- frictional force is generated by the resistance of ground or water surfaces over which blows the wind.

° characteristics -

① The magnitude of frictional force depends upon the roughness of the surface over which winds blow.

② The frictional force work in opposition to the pressure gradient force.

③ The zone of lower atmosphere where frictional force becomes effectiveness is called friction layer.

④ The ground & water surface having contrasting behaviours due to varying degree of roughness reduce the coriolis effect differently.

AIR CIRCULATION :

- The pressure gradient force, corolis force, frictional force etc. control the speed and direction of air circulation at the surface & above the surface.

* Pattern of air circulation :

1) Geostrophic wind -

'The air blowing above the ground or water surfaces, generally bet^n the altitudes of 500 - 1000 mtrs. parallel to the isobars and at the right angle to the pressure gradient is called geostrophic wind'.

2) Gradient wind -

'Gradient wind is, in fact a 'varient of geostrophic wind & blows along a curved or circular path parallel to the curved or circular isobars'.

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CLASSIFICATON OF WINDS

A) Planetory or Permanant winds - e.g. trade winds, westerlines and polar winds.

B) Seasonal winds - e.g. monsoon winds.

C) Local winds - e.g. chinook, sirocco, harmattan, mistral, bora, blizzard, loo etc.

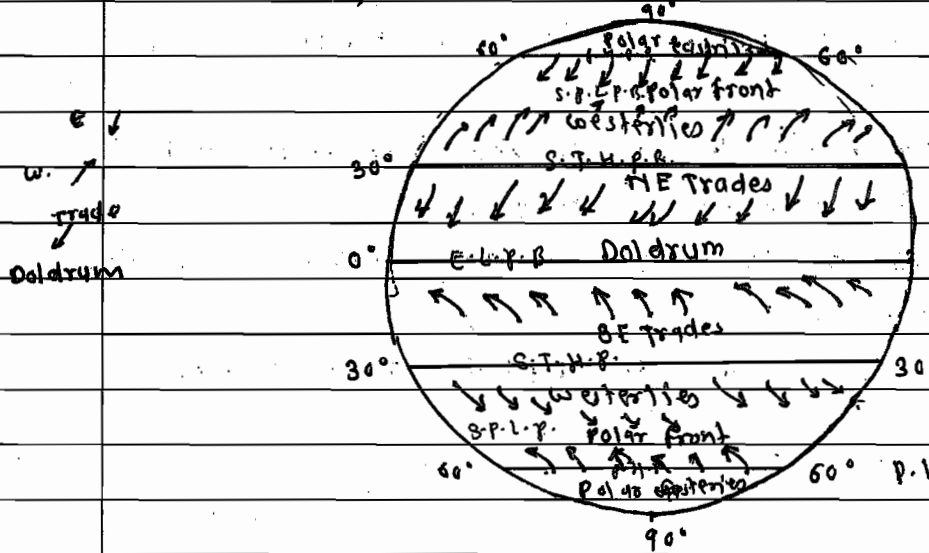
A] Permanant / Planetory winds:

'The winds blowing almost in the same direction throughout the year is called permanent winds'.

- Since these winds are distributed all over the globe and these are related to thermally & dynamically induced pressure belts & rotation of the earth are also called as 'Planetory winds'.

* These winds including Trade winds, westerlies and Polar winds:

Doldrum: A belt of low pressure popularly known as equatorial trough extends along the equator within a zone of 5°N & 5°S latitudes, this belt is called 'belt of calm & Doldrum'.



1) Trade Winds:

'There is more or regular inflow of winds from subtropical high pressure belts to equatorial low pressure belt. These tropical winds have NE direction in the N. hemisphere while they are SE direction in the southern hemisphere. These winds

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NE
SE
- These winds called trade winds because they help sea merchant in sailing their ships.
- Trade winds are deflected to the right in the N. hemisphere & to the left in the S. hemisphere.
- Trade winds have two layers : e.g.
  (i) surface layer of moist and unstable air.
  (ii) upper layer of dry & stable air.

2) **Westerlies :**

S.T.H.P → S.P.L.P.
SW
NW
"The permanent winds blowing from the subtropical high pressure belts (30°-35°) to the sub polar low pressure belts (60°-65°) in both the hemisphere is called as westerlies".
- The general direction of the westerlies is S.W to N.E. in the northern hemisphere and N.W. to S.E in the S. hemisphere.
- The velocities of westerlies :
  (i) roaring fourties - 40°-50°S.
  (ii) furious fifties - at 50°S latitude
  (iii) shricking sixties - at 60°S latitude.
- westerlies are stronger in S. hemi. because vast extension of ocean.

3) **Polar Winds :**

P.H.P → S.P.L.P.
NE
SE
"These winds blow from the polar high pressure to subpolar low pressure cells, These are called polar winds".
- Which are northeasterly in the northern hemisphere and southeasterly in the southern hemisphere.
- Polar easterly winds are weak become stronger & more effective during northern summer.
- The polar easterly wind system is complicated in the southern hemisphere.

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B) **Local Winds :**

'The winds confined to a limited spatial locality and caused by local conditions are called local winds'.

* The local winds may be classified into two broad categories :
  - 1) Periodical local winds -
    - (i) Land and sea breezes.
    - (ii) Mountain and valley breezes.
  - 2) Non - Periodical local winds
    - (i) Chinook, (ii) Foehn (iii) Harmatten (iv) Sircco (v) Norwester
    - (vi) Brickfielder (vii) Shamal (viii) Loo. (ix) Santaanna.
    - (x) Mistral (xi) Bora (xii) Blizard (xiii) Laventer (xiv) Pimperio.

1) **Periodic Local Winds :**

'The winds originating from diurnal temprature & pressure are called periodic or diurnal local winds'.

- The daily change in temprature and pressure during day light and night time.

(i) **Land and Sea Breeze :**

- Land and sea breezes are found in a coastal areas.
- Where in sea breeze blows from sea to land during day time and land breeze moves from land to sea during night due to differential heating and cooling of land & water.

- The daily local winds in lake shore areas are called 'land and lake breezes'.

(a) **Sea Breeze :**

- Land is heated more quickly than adjacent sea during daytime.
- Which result warm air expand and developed low pressure, while high pressure is adjecent sea.
- The pressure gradient from sea surface to land surface cause air moves H.P to L.P. areas.

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* Charactaristics :

(i) Sea breezes being flow 10-11 a.m. & most active 1 to 2 p.m.

(ii) maximum velocity 10 to 20 km / hour and are terminated by 8 p.m at night.

(iii) The avarage depth of sea breeze 1000 - 2000 mts.

(iv) The sea breezes cooling effects on the coastal land the temp. drops 5°c to 10°c.

(v) Sea breezes are most active during summer season.

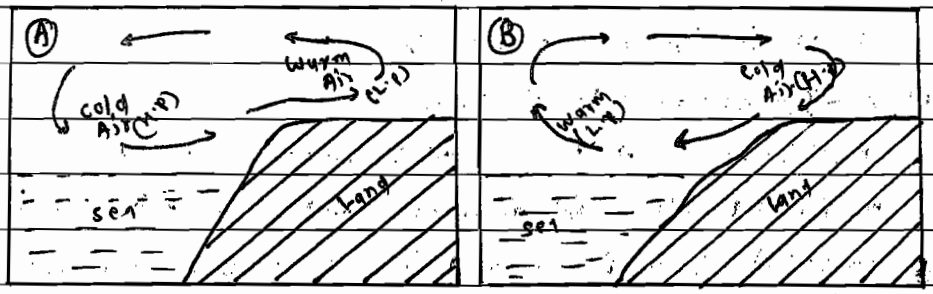


Fig : A - Sea breeze B - Land Breeze.

(b) Land Breezes :

* After sunset high pressure is developed on land against low pressure on the adjacent sea with the result air start moving from land to sea during night.

- Land breezes are compantively weaker than sea breezes.

- The high pressure over land surface caused due to radiation loss of heat while sea surface remains warm.

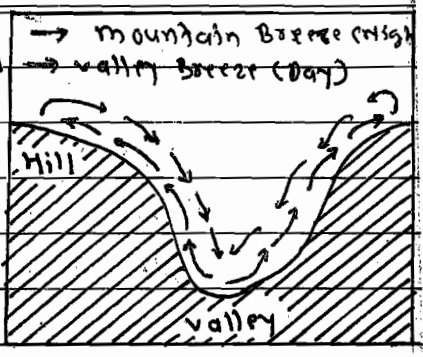
(ii) Mountain and Valley Breezes :

mountain and valley breezes also known as upvalley (during day time) and downvalley (during night) breezes infact local as well as diurnal.

Valley Breezes : (Anabatic wind)

The slopes and valley floors in the mountainious regions are more heated through the insolation during day time than the free atmosphere at the same elevation. This upslope moving breeze during daytime is called 'valley breeze' or anabatic wind

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Mountain Breeze: (Katabatic wind)/Gravity wind

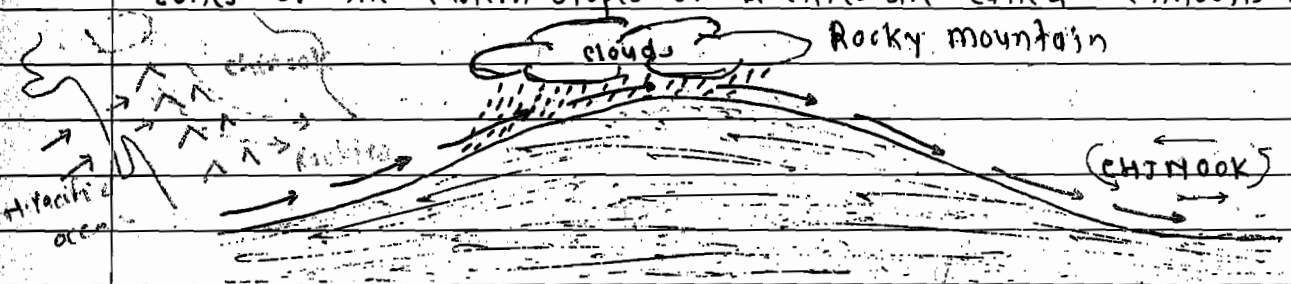
The valley slopes and upper part cooled during night time due to loss of heat through outgoing longwave radiation and thus cool air descends through the valley slopes. Such wind is called downvalley or 'mountainous breeze' or 'katabatic wind'.

2) **Non-Periodic Local Winds**:

'The local winds, other than diurnal system of air circulation having complete reversal in direction within every 24 hours, are called non-periodic local winds'.
- which are both thermaly & dyanamically originated.

i] **Chinook and Fohen**:

Chinook - (Rockies)
- The winds associated with the cyclones after descending through the eastern slopes of Rockies becomes warm and dry and thus give birth to chinook.
- The winds ascending through the western slope of Rockies & thus cooled 'dry adibatic rate' of 10°c / 1000m.
- These winds after reaching higher height become saturated and yield precipitation.
- The ascending winds decreases at the moist adiabatic rate 6°c/km.
- The westerly winds after crossing over the Rockies descend through eastern slope & dry adibatic rate 10°c / km.
- These warm and dry winds after ~~crossing~~ reaching the foothill zones of the eastern slopes of Rockies are called 'chinooks'.



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Foehn: (European Alps) / Climatic Oasis

'A warm and dry wind similar to chinook is called 'foehn' along the northern slopes of Alps mountains'.

- These are more common during spring & autum in Swizerland.
- valley of swizerland are called 'climatic oasis' during winter season.
- These winds help sowing of spring wheat, ripening of grapes & check autumn frost.

Zonda: (Argentina)

'A similar warm and dry downslope compressional wind in Argentina is locally called Zonda'.

- which blow leeward slope of the Andes.
- It attain velocity of 120 km / hour during winter season.

iii] Santa Ana: (California)

'A downslope compressional but channelled warm and dry air drainage in the santa Ana valley of the southern california is locally called Santa Ana.'

- Santa Ana are similar to 'chinook & foehn'.
- His winds are gusty & dusty becomes dust devial.
- winds are ~~or~~ very much injurious to farming mainly to orchards.
- Similar downvalley warm and dry winds is called -
  Yamo - in Japan. &
  Tramontane - in central Europe.

iii] Harmattan: (Sahara)

'The warm and dry winds blowing from north-east to west in the eastern parts of sahara deseart are called Harmattan'.

- These winds become extremly dry because of their journey over 'sahara Desert'.
- These winds pick up more sands mainly red sands.

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MONSOONS:

- A wind operating at a level of 20km from the earth surface.
- The word 'monsoon' is used to indicate the winds in the areas where they change their direction twice each year.
- The word 'monsoon' which has been derived 'Arabic' word 'mausim' or 'Malayan' word 'monsin' means 'season'.
- It refers to such an atmospheric circulation which reverse its direction completly every 6 months or say during summer and winter season.
- monsoon like wind reversal takes place called 'pseudo monsoon area'.

Defination - 'monsoon are large scale seasonal wind system blowing over vast areas of the globe persistently in the same direction only to be reserved with change of season'.

TYPES and DISTRIBUTION OF MONSOON:

1) True and Traditional monsoon areas -
include India, Pakistan, Bangladesh, Myanmar, Thiland, Laos, Cambodia, N & S Vietnam, S. China, Philipines and northern coastal areas of Australia.

2) Areas of monsoonal tendancies or Pseudo monsoons:
are found along SW coast of Africa including the coasts of Guinea, Sierra, Leone, Liberia and Iovary coast.
- Eastern Africa & Western Madagascar.

3) Areas of monsoonal effects -
including NE coast of Latin America e.g. east Venezuela, Guyana, Surinam, french Guyana and NE Brazil. and Dominanie Rebublica in the Carribean Island.

4) Areas of Modified Monsoons -
are found in part of Central America and south-east U.S.A.

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Concepts of the Origin of Monsoons:

- The concept of the origin of monsoon is related to thermal and dynamic factors:

1) Thermal concept - Sir Edmund Halley (1686)

- The thermal concept of the origin of monsoon was first propounded by Halley in 1686.
- The monsoons are the result of heterogeneous character of the globe and differential seasonal heating & cooling of the continental and oceanic areas.

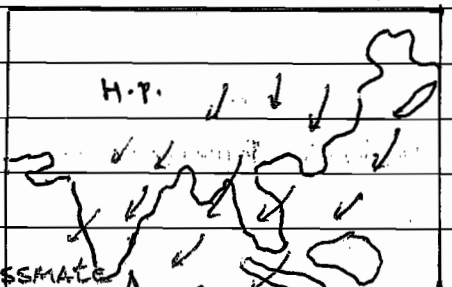
a) Winter Monsoon -

- During northern winter when the sun becomes verticle over the tropic of capricorn.
- High pressure areas are developed over Asia due to very low temprature and low pressure in the Indian Ocean due to high temprature.
- Winds start blowing from the high pressure land areas to the low pressure oceanic areas.
  These are called NE monsoon or winter monsoon.

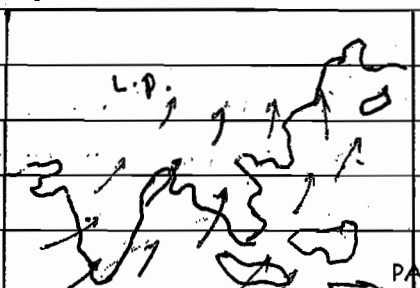
b) Summer Monsoon:

- At the time summer solastice that the sun becomes verticle over the 'Tropic of cancer' in N. hemisphere.
- Because of high temp. low pressure centres are developed at two places Baykal lake and Multan.
- Conversly high pressure centres are developed in the southern Indian ocean.
- Consequently winds blow from Indian ocean to Asian continents, these winds yield heavy rainfall. These are called SW monsoons or summer monsoons.

A) Winter Monsoon -



B) Summer Monsoon -



Edmond Halley model

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2) **Dynamic Monsoon** - H. Flohn

- 'Flohn' rejected the thermal concept of monsoon origin and propounded his new concept Dynamic monsoon (1951).
- Monsoons are originited due to shifting of pressure and wind belts.
- ITC : Tropical convergence is formed due to convergence of NE and SE trade winds near the equator is called 'inter tropical convergence'.
- The northern & southern boundries of ITC are called NITC and SITC respectively.

① At that time of summer solostice sun vertical on Tropic of cancer NITC is extended up to 30°N latitude
- South and SE Asia & thus equatorial westerlies are established over the areas.
- These equatorial westerlies become SW or summer monsoons.

② The NE monsoons are NE trade winds which are reestablished over south and SE Asia during winter solastice, Due to southward shifting of pressure and wind belts and NITC
- These north-east trades, thus becomes winter monsoons.

I. **S.W. Monsoon** -
- India, Bangaladesh, Sri Lanka, Mynmar, Pakistan, Thiland.

II. **S.E. Monsoon** -
- China, Korea, Vietnam.

III. **Westerlies Monsoon** -
- Pacific coast of Canada, Spain, Portugal, France, Germany.

IV. **Doldrum - Monsoon** -
- Indonesia, Brazil, Cango.

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JET STREAM:

1. Def^{n} - "The strong and rapidly moving circumpolar upper westerly air circulation in a narrow belt of a few hundred kilometers in the upper limit of troposphere is called jet stream".

2. WHO - 'a strong narrow current concentrated a qusi-horizontal axis in the upper troposphere or in the stratosphere characterized by strong verticle and lateral wind share and featuring one or more velocity maximamis called jet stream'.

* **Properties -**

(i) The circulation of jet stream is form 'west to east' in a narrow belt of a few handred km width at the height 7.5 - 14 km.

(ii) Their circulation is observed betⁿ 'poles' and '20° latitudes' in both the hemispheres, also called circum-polar whirl).

(iii) The vertical wind share of jet stream is 5-10 m/second (18-36 km/hr). & the lateral wind shear is 5 m/second (18-36 km/hr.).

(iv) The minimum velocity of jet stream is 208 km/hour and maximum wind velocity is 480 km/hour.

(v) Their circulation path is wavy and meandering.

(vi) Their seasonal change of wind velocity in jet streams 'strong' during winter season & wind velocity becomes twice during summer season.

(vii) The extent of 'jet streams narrow down during summer season- while extend up to 20° latitude during winter season.

(viii) On an average 1000's km of length and 200 km of width in a 2-4 km depth.

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Types of Jet stream :

- on the basis of locational aspect -

1) **Polar front jet stream -**

- They are formed above the convergence zone i.e 40°-60° lattitudes
- The surface polar cold air mass & tropical warm air mass, convergense of two contrasting air masses.
- These move in easterly direction but are irregular.

2) **Subtropical westerly jet stream -**

- They are move in above 30°-35° lattitude both hemisphere.
- This circulation is form west to east in more regular manner than the polar front jet streams.

3) **Tropical easterly jet stream -**

- These easterly trade wind develope over India and Africa during summer season.
- Due to intense heating of Tibeatean plateau and play important role in the mechanism of Indian monsoon.

4) **Polar night jet stream -**

- It is also know as stratospheric subpolar jet stream, develop in winter season.
- Due to steep temprature gradient in the stratosphere around the poles at the height of 30 km.

5) **Local jet stream -**

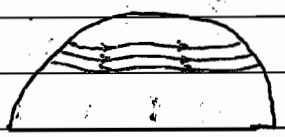
are formed locally due to local thermal & dynamic conditions and have limited local importance.

Index cycle of Jet streams :

- The wavy jet stream is called 'Rossby waves'.
- The period of transformation of straigh path of jet stream to wavy or meandering path is called 'index cycle'.

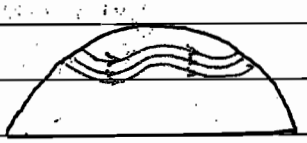
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a) **First Stage –**



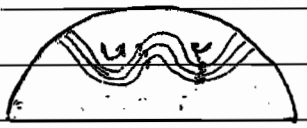
- The position of jet stream near the poles.
- The circulation of jet stream almost in straight path from west to east.
- Rossby waves are not developed these time.

b) **Second stage:**



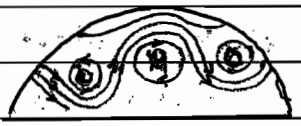
- The straight path of jet stream is transformed into wavy path.
- This process initiated beginig of Rossby waves.
- The pressure gradient in north-south.

c) **Third stage –**



- is charactrized by fully developed meandering course of jet streams.
- They posited near the equator i.e. 20° lattitud.
- The pressure gradient first two stages from north to south but in this stage it becomes east-west.

d) **Fourth stage –**



- is charactrized by cutting off meandering of jet stream from north to south.
- In the form of cyclonic and anticyclonic circulation.

Significance of Jet stream;

i. There is close relationship betn the intensity of temprate cyclones and jet streams.

ii. There are fluctuations in the local weather conditions.

iii. Jet streams cause horizantal convergence and divergence in the upper troposphere.

iv. The transport of anthropogenic pollutant from troposphere to stratosphere.

v. The monsoon of south Asia is largelly affected & controlled by jet streams.

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ORIGIN OF INDIAN MONSOON :

- M.T. Yin

* Mechanism are related to the following facts :

i] The role of the position of the 'Himalayas' and 'Tibetan plateau' as mechanical barrier or as high level heat source.

ii] The existance of 'upper air circum-polar whirls' over north & south poles in the troposphere.

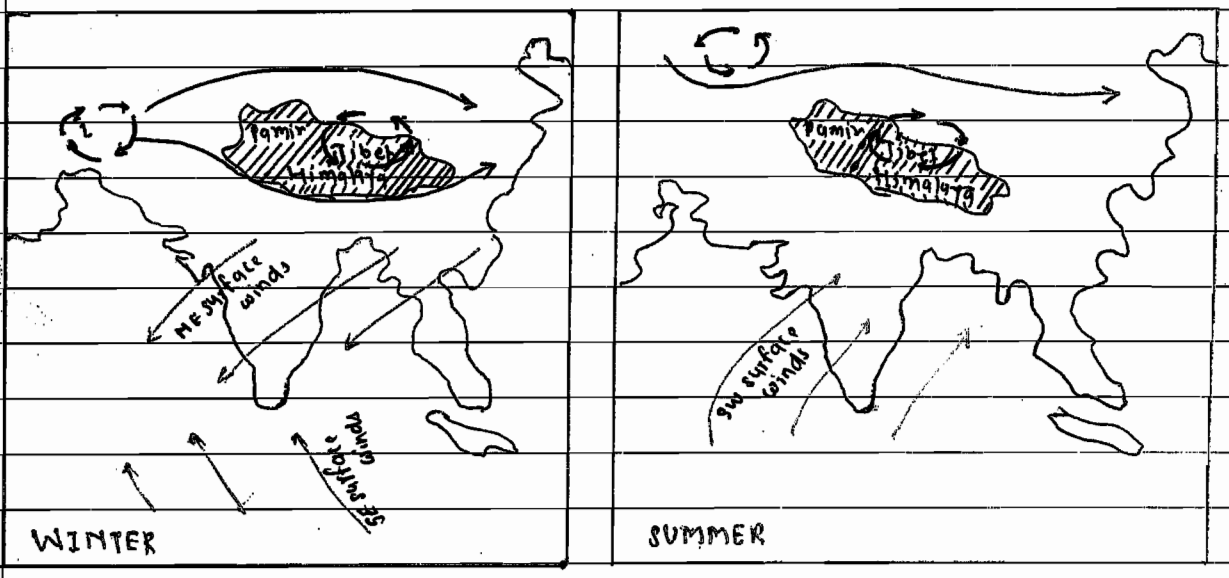
iii] The circulation of 'upper air jet streams' in the troposphere.

iv] Differential heating and cooling of huge landmass of Asia and Indian ocean.

v] The 'EL-Nino - Southern Oscillation' (ENSO) event.

a) Winter seasons :

- The upper air westerly jet streams are extended upto 20°-35° N latitude due to equatoword shift of upper air north polar whirl during northern winter.
- The upper air westerly jet streams are bifurcated into two branches due to obstruction Himalayas & Tibeatan Plateau.
  - (i) one branch located south of Himalayas.
  - (ii) second branch is positioned north of Tibetan Plateau.
- Upper air high pressure & anticyclonic conditions are developed over Afganistan & Pakistan.
- On an avarage most parts of India remains dry during winter season, except Tamilnady recive much rainfall during oct-nov.



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1) વસંત : ચૈત્ર - વૈશાખ (માર્ચ - એપ્રિલ) 5) કારતક : આસોજ - કારતક (સપ્ટે - ઓક્ટો)

2) ગ્રીષ્મ : જેષ્ઠ - અષાઢ (મે - જુન) 6) હેમંત : માગશર - પોષ (નોવે - ડિસે)

3) વર્ષા : શ્રાવણ - ભાદરવ (જુલે - ઓગસ્ટ) 7) શિશિર : માઘ - ફાગણ (જાન્યુ - ફેબ્રુ)

b) Summer Season :

- At that time summer solstice' 21 June' sun vertical over the tropic of cancer. with the result winter season shift northward also jet stream shift northward.
- The upper air circum-polar whirl unable southern branch of Himalayas & thus they shift to the north of Himalayas & Tibetan Plateau.
- This upper air low pressure is also extended over Pakistan & NW India are thermaly induced.
- The warm winds rise upward, the upper air low pressure sucks the air form the ground surface.
- This mechanism causes sudden burst of SW monsoon.

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EL NINO:

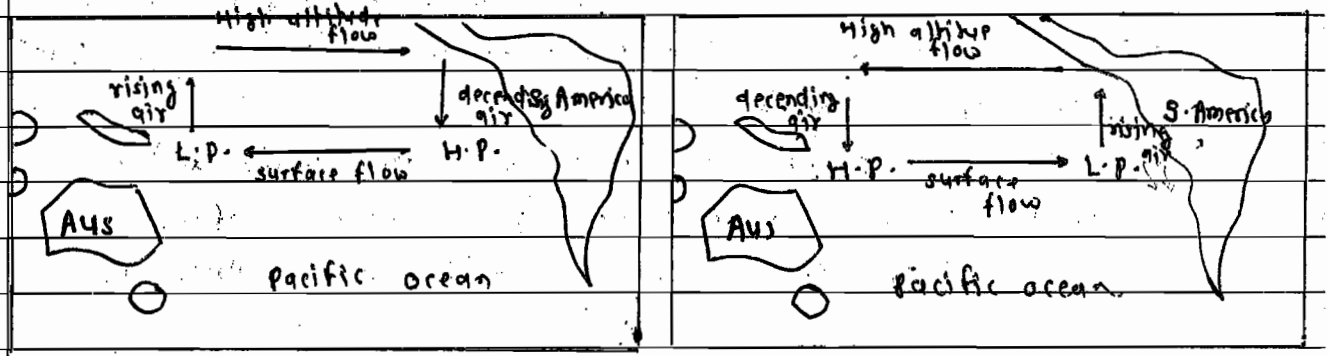
- A subsurface warm current, known as EL Nino current, flows from 'north to south' bet^n '3°s and 96°s' latitudes, at a distance bet^n '180 km' from the Peruvian coast.
- The EL-Nino event was first noticed in the year 1541.

a) **Normal -**

Walker Circulation: A typical east-west convective cell of circulat^n of tropical winds is called 'walker circulation'.

- Walker also discovered low pressue near to Indonesia & high pressure of eastern side of S. America.
- The trade winds drive equatorial current that flows from east to west, carrying warm surface water towards Indonesia.
- The warm water accumulates around Indonesia in a 'warmpool'.

Fig: Southern Oscillation, Walker circulation and EL-Nino -



La-Nina / Walker Circulation EL-Nino

b) **EL-Nino:**

- Pressure rises over the western pacific & weakness in the east, The trade wind slacken.
- They may blow to west to east direction, The causes equatorial current to riverse direction.
- The warm pool moving eastward and the depth of warm water increases of the south America coast.
- A reversal of pressure distribution allows warm water to flow eastward.

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* **Effects of EL Nino Events :**

- EL Nino events impact on weather phenomena, in the N. hemisphere, marine life, vegetation, agriculture and human health & wealth.
  - i) Severe drought conditions & failure of monsoon in S.E. and south Asia mainly Indonesia and India.
  - ii) The western coastal region of S. America driest climate of world, But EL Nino brings heavy rainfall.
  - iii) Coral Bleaching in the Pacific ocean, and mass distruction of corals.
  - iv) Fishesh die due to disappearance of planktons & occurance of guano diseases.
  - v) Drought in mexico, SE Africa, Australia and Newzeland.

LA-NINA :

- La-Nina is a counter part of EL-Nino.
- The low pressure of in the west & high pressure in the east.
- The occurance of La-Nina event strengthen southern oscillation & Walker Circulation
- The eastern pacific cool water & western warm water.

* affects: ① The south & SE Asia recive more rainfall.
  ② The dry condition along the south America.

	EL-Nino	La-Nina
①	EL Nino considered as christ child	La Nina as a younger sister of EL-Nino.
②	EL Nino is related increase temp. of east Pacific coast.	La Nina is related to increase temp. western pacific ocean.
③	EL Nino condition failure monsoon	

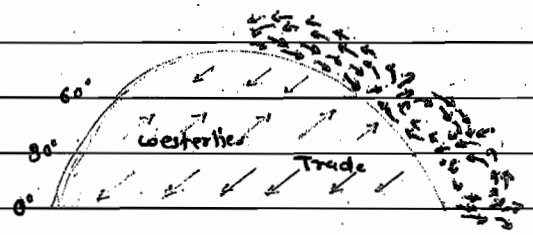
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TRICELLULAR MERIDIONAL CIRCULATION OF THE ATMOSPHERE:

- 'The modern school envisages a three-cell model of meridional circulation of the atmosphere, popularly known as tricellular meridional circulation of the atmosphere'.



a) Tropical Cell -

- It is also called as Hadley cell; G. Hadley first identified.
  (i) The equatorial high temprature wind heating and they being arend upward, and they diverging southward & north poleward.
  (ii) The surface winds in the in the name of trade winds blow from S.T.H.P belt to E.L.P. belt in order to replace the acending air at the equator.
  (iii) The upper air moving in opposite direction to surface winds (trade winds) is called 'antitrade'.
  (iv) These antitrades after decending near 30°-35° latitudes to STHP, after decending again blow towards the equator and where they again heated and aacend.
- Thus, one complete meridional cell of air circulation is formed are called 'Tropical meridional cell'.
- which is located betⁿ equator to 30° latitudes.

b) Mid-latitude or Polar front cell:

(i) The surface wind blows from S.T.H.P belts to S.P.L.P belts.
(ii) The winds acending near 60°-65° latitudes because of the rotation of earth and after reaching the upper toposphere diverge in opposite direction poleward & equatorwards.
(iii) These winds decending again near horse latitudes (30°-35°) to reforce S.T.H.P. belts.
(iv) After decending these winds again blows poleward as surface westerlies and thus a complete cell is formed.

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c) Polar Cell :

- involves atmospheric circulation pervelling betⁿ 60° and poles.
  - ① Polar easterlies blow from polar high pressure areas to sub-polar or mid-latitude low pressure belt.
  - ⑪ The winds ascend upward due to the rotation of the earth at the sub P.L.P.B. and after reaching middle troposphere they turn poleward & equatoward.
  - ⑪ The poleward upper air descends at the poles and reinforce the polar high pressure. Thus, a complete polar cell is formed.

* Criticism :

1. Upper air anti-trades are not uniformly found over all the meridians.
2. At the hieght of 500 to 1000 m winds blow parallel to isobars, so cell circulation not possible.
3. The pressure and winds are found in cellular form rather than in zonal pattern.
4. Cellular meridonial circulation has not been fully validated.

- The mechanism of the monsoon is influenced by the circulation of air over ;-
  - North - south : Hadley cell and
  - east - west : Walker cells.

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Local Winds :

NO.	NAMES	NATURE	REGION
1.	Fohn	warm	Alps
2.	Chinook (snow eater)	warm	Rockies
3.	Kalbaishakhi	warm	North India
4.	Berg	warm	South Africa
5.	Zonda	warm	Andes (Argentina)
6.	Loo	warm	Indian subcontinent
7.	Santa-Ana	warm	Coastal southern California.
8.	Kashmin	warm	Egypt
9.	Harmattan (Doctor)	warm	Guinea Coast.
10.	Samun	warm	Iran.
11.	Norwester	Warm dry	Newzeland
12.	Harmattan	warm dry	Eastern part of sahara.
13.	Southerly	cold	New south wales Burster
14.	mistral	cold	SE France.
15.	Purga	cold	Russian Tundra
16.	Leventer	cold	France / southern spain
17.	Pampero	cold	south America. (pampas).
18.	Yamo	warm	Japan.
19.	Tramantone	warm	central Europe.
20.	Brickfielder	warm	victoria province of Australia
21.	Brickroller	warm	Great plain of U.S.A.
22.	Shamal	warm	mesopotemia & persian Gulf.
23.	Sircco	warm	medetarian sea.
24.	Gibli	warm	Libiya
25.	Chili	warm	Tunesia
26.	Karabyran	cold	Gobi, N. China, Tarim basin
27.	Katabatic	cold	Antarctic & Greenland.
28.	Bora	cold	Adreatic sea.
29	Blizzard	cold	Northern' - USA., Burran - Saiberia.
30.			

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• ATMOSPHERIC HUMIDITY :

"Atmospheric humidity refers to the content of water in gaseous form in a parcel of air having definite volume and temprature at a particular time and place."

- Vapour depends on temprature and therefore it dicreases from the equator to polewards.
- The atmospheric vapour also decreases upward, q.v. total atmospheric vapour (Humidity) is found up to 5km.

* Importance of Humidity -

① It is responcible for various types of 'weather phenomena'.
② The moisture content in the atmosphere creates several forms : e.g. dew, fog, rainfall, frost, ice etc.
③ water also help in 'intensify green house effect' of the atmosphere.

* Humidity Capacity -

The moisture retaining capacity or simply humidity capacity refers to the capacity of air having certain volume at certain temprature and point of time to retain or hold maximum amount of moisture content.
- It is directly proportional to air temprature.

TYPES of Humidity :-

1] Absolute Humidity -

'The total weight of moisture content (water vapour) per volume of air at definate temprature and point of time is called absolute humidity'
- Generally expressed as gram per cubic meters volume.
- Absolute humidity does not change with increase or dicrease of temprature, if no additional vapour added, through additional evaporation.
- It changes with contraction (descent) & expantion (on ascent) of air.
- The absolute humidity dicreases from equator towards the poles.

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2] **Specific Humidity:**

"Specific humidity is defined as the mass of water vapour in grams contained in one kilogram of moisture air."

- In fact, specific humidity is a ratio of water vapour to the weight of moisture air.

- Specific humidity decreases from equator to poleward.
- specific humidity changes affected by air pressure and air temprature.

3] **Relative Humidity:**

"Relative Humidity defined as a ratio of the amount of water vapour actually present in the air having definite volume & temprature (absolute humidity) to the maximum amount the air can hold (humidity capacity) at that volume and temprature."

$$\text{Relative Humidity} = \frac{\text{Absolute Humidity}}{\text{Humidity capacity}} \times 100$$

- Relative humidity generally expressed as percentage.
- Relative humidity increases with decreasing temprature while decresses with increasing temprature.
- It measure by a 'Hygrometer'.

(i) **Absolute Humidity** - The weight of water vapour per volume of air is called absolute Humidity.

(ii) **Relative Humidity** - It is the ratio of the airs water vapour content to its water vapour capacity.

(iii) **Specific Humidity** - The weight of water vapour per weight of air including the water vapour is specific humidity.

(iv) **Vapour pressure** - is the total atmospheric pressure of its water vapour capacity.

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STABILITY AND INSTABILITY OF THE ATMOSPHERE:

- Different forms of precipitation i.e. dew, fog, rainfall, frost, snowfall, hailstorm etc. depends on stability & instability of the atmosphere.
- The air without verticle movments is called 'stable air' while 'unstable air' undergoes verticle movment (both upward & downward).

* **Normal lapse rate** - 'Temprature dicreases with increasing altitude at the rate of 6.5°c / km or 3°f / 1000 ft. The rate of vertical decrease of temprature is called normal lapse rate.'
- The N.L.R. of temp. in the troposphere 1°c for every 166 m.

* **Adibatic change of temprature** -
'There is change of temprature of air due to ascent or descent but without addition or substraction of heat. Such type of change of temp. of air due to contraction or expantion is called adibatic change of temprature.'

* Adibatic change of temprature of two types:

i) **Dry adibatic change** -
'The temprature of unsaturated air decreases with increasing altitude at the rate 10°c / 1000 mtr. This type of change of temp. of unsaturated ascending or descending air is called dry adibatic rate.' 5.5°f / 1000 feet.

ii) **Moist / wet adibatic rate** -
The temprature of an ascending air beyond condensation level decreses at the rate 6°c / 1000 mtr. due to addition of latent heat of condensation to the surrounding atmosphere. This is also called 'moist adibatic rate.' 3°f / 1000 feet.
- The moist adibatic rate also called 'retarded adibatic rate'

- The stability & Instability depends on normal lapse rate and adibatic change of temprature.

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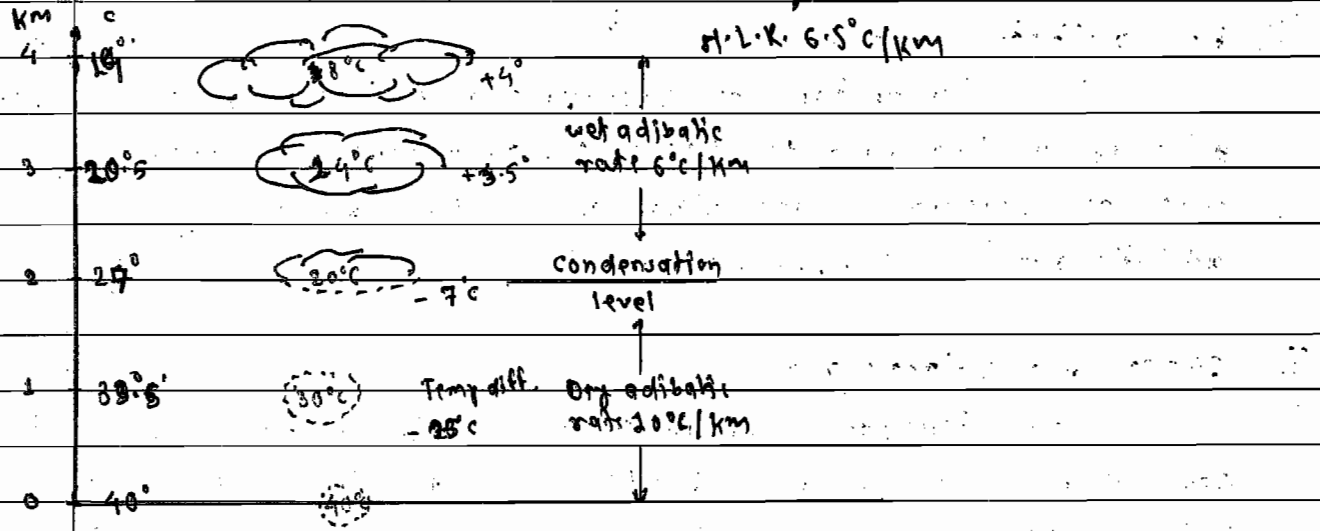
9] **STABILITY :**

"When dry adibatic lapse rate of an ascending dry air is higher than the normal lapse rate. If it is not saturated and does not attain dew point it becomes colder than surrounding air at certain height results it becomes heaviour ~~and~~ descends it is also called stability."

- This process causes stability of atmospheric circulation due to vertical movment circulation of air is resisted.

For example -

- At the ground surface temp. of parcel air is 40°c, the dry adibatic rate 10°c / 1000 mtrs & normal lapse rate 6.5°c / 1000 mtrs.
- from the ground surface then the height of 1 km. temp. of ascending air 30°c & surrounding temp. 33.5°c.
- The ascending air colder than surrounding air is called as 'stable equilibrium'.
- The 'normal lapse rate' is less than 'wet adibatic rate' even at condensation point, further vertical motion air stopped & thus air is called 'absolute stability'.



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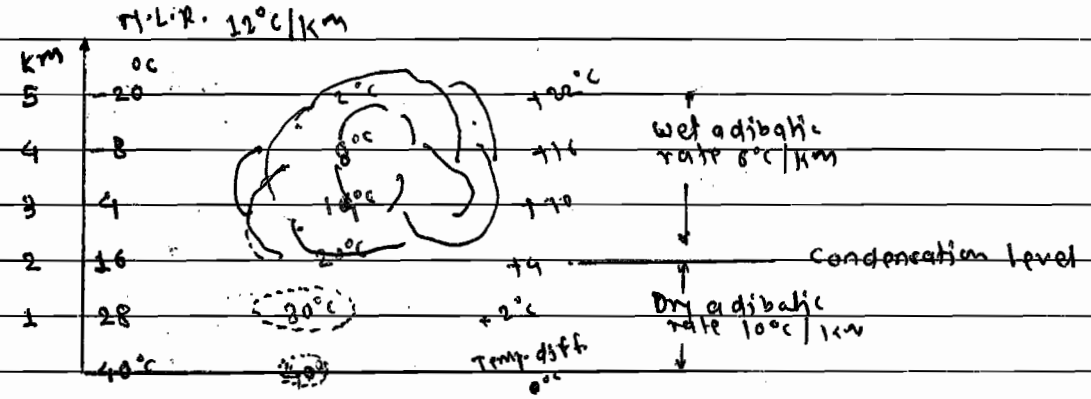
b] **INSTABILITY :**

"when the normal lapse rate is greater than dry adibatic lapse rate of ascending parcel of air, the rising air continious to rise upward and expand & thus becomes unstable is called as unstable equilibrium".

- The atmospheric instability is caused normal lapse rate is higher than dry adibatic lapse rate.

for example -

- The surface temp. 40°c, and dry adibatic lapse rate and normal lapse rate 10°c/km & 12°c/km respectively.
- The height of 1km. temp. of ascending air 30°c and temp. of enviorment 28°c continious to rise & expand to cause atmospheric instability.
- If wet adibatic lapse rate less than normal lapse rate is called absolute instability'.



1) **Mechanical Instability -**

- Some times, there are normal conditions when normal lapse rate is exceptionaly very high 15° to 35°c/1000 mtr.
- 'In such conditions the upper layers of the atmosphere cold & denser than the underlying layers automatically descend, such situation called mechanical instability'.
- It helps in the formation of 'tornadoes'.

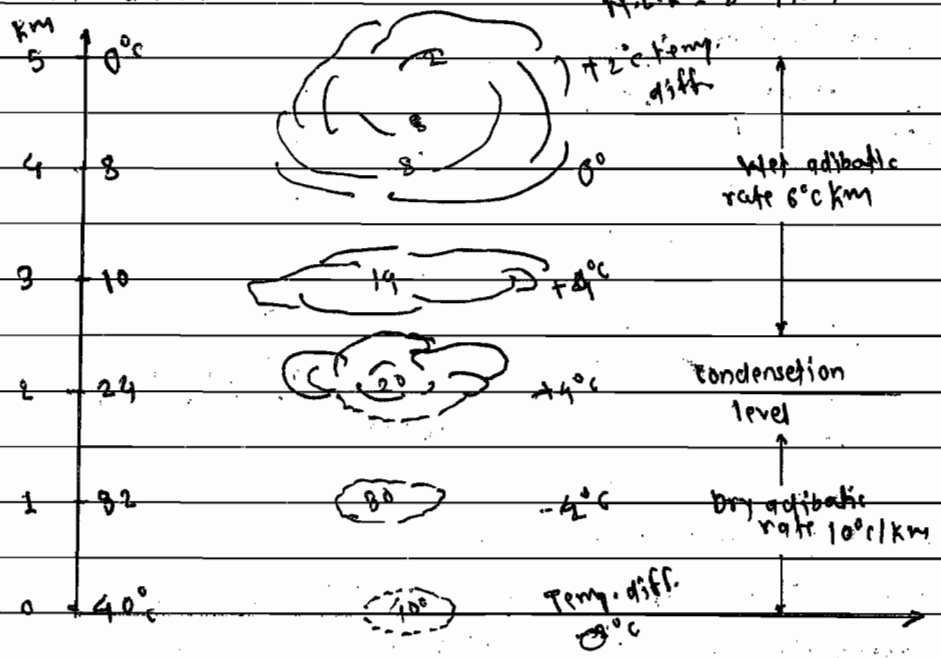
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2) Conditional Instability -

- conditional instability may occur only when the normal laps rate ranges betⁿ dry & wet adibatic lapse rate.
- 'conditional instability occurs when normal lapse rate is ~~greater~~ lesser than dry adibatic lapse rate but ~~less~~ greater than wet adibatic rate'.

for example -

- If's dry adibatic lapse rate 10°c/km, wet adibatic rate 6°c/km and normal lapse rate 8°c/km.
- If the surface temprature 40°c after 1km height 32°c normal lapse rate & ascending air temp. 30°c., it becomes ascending air colder than surrounding air at condensation level.
- After condensation level parcel air warm than surrounding air and unstable.



3) Potential Instability -

'some times extensive & thick air mass undergoes differential rate of adibatic changes of it's temp. because of variation in moisture condition of its upper & lower parts'.

- The stable condition of air mass into unstable condition which is called potential instability or convective instability.

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Summary -

1. The column air is in stable equilibrium condition - i.e. when - el < dra.

2. The column of the air is in **absolute stable** condition - i.e. when el < ma.

3. The column air is in unstable equilibrium condition - i.e. when el > dra.

4. The column of the air is in neutral equilibrium condition - i.e. when el = dra.

5. The column of the air is in **conditional** unstable - i.e when el > ma.

where, el = environmental lapse rate 6.5°c / km.
dra = dry adibatic lapse rate 10°c / km.
ma = moist adibatic lapse rate 5°c / km.

- **Evapotranspiration -**

"The process of loss of water from soils through evaporation, loss of water from the surface of plant leaves through ~~evaporation~~ transpiration are collectively called as 'evapotranspiration".

Evaporation (soil) + Transpiration (plant) = Evapotranspiration.

- **Latent heat -**

"Energy in the form of heat required (to be absorbed) for the conversion of water into vapour, ice into water, and ice into vapour is called latent heat".

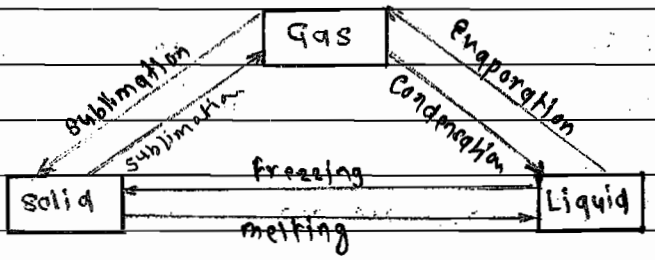
- **Potential Evapotranspiration -**

"Potential evapotranspiration is an index of thermal efficency and water loss because it represents the amount of transfer of both moisture and heat to the atmosphere from soils & vegetation and thus, is a function of energy recived from the sun."

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- **Condensation** –

The process of conversion of water vapour into liquid (water) and solid form (ice) is called condensation.

- **Evaporation** –

The transformation of liquid into gaseous form is called evaporation.

- **Sublimation** –

The process of transformation of solid (ice) directly into gaseous form (water vapour) by the use of heat energy is called sublimation.

- Condensation of water vapour in the atmosphere on particles of dust leads to the 'cloud'.

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AIR MASSES:

① Barry and chorley - "an airmass may be defined as a large body of air whose physical properties, especialy temprature, moisture content, and lapse rate are more or less uniform horizontally for hundreds of kilometers."

⑪ "Air mass is defined as a homogeneous body of air in which the upward gradients of temprature and moisture are uniform over extensive area covering thousands to million of square kilometers."

* Source Regions:

- The extensive areas over which air masses originate or form are called source regions.
- An air mass originates when atmospheric conditions remains stable and uniform over an extensive area.
* An ideal source region of air masses posses the follwing essential conditions:
  - ① There must be extensive and homogeneous earth's surface and uniform temp. & moisture conditions.
  - ⑪ There should not be convergence of air, rathere there should be divergence of air flow.
  - ⑪⑪ Atmospheric conditions should be stable for considerable long period of time.

• The major source region:

1) Polar oceanic areas - N. Atlantic ocean bet" canada & N. europe, and N. Pacific ocean bet" siberia & canada.

2) Polar & arctic continental areas - snow covered areas of Eurasia & N. America and Arctic region during winter season.

3) Tropical oceanic areas - anticyclonic areas through out year.

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4) Tropical continental areas - N. Africa, Sahara, Asia, Mississippi valley zone of the USA developed in summer.

5) Equatorial regions - zone located bet' trade winds - active throughout the year.

6) Monsoon land - South and S.E. Asia.

Classification of Air masses

- Any classification of air masses must consider the fact that all of their weather characteristics i.e. temp., humidity and lapse rate.
- There are two approches to the classification of air masses: ① Geographical.
  ② Thermodynamic.

a) Geographical classification -

* It's classification based on source regions, basically air masses are classified into -
  ① warm air mass
  ⑪ cold air mass on the basis of temprature.

* Trewarth classified airs masses on the basis of geographical location -
  ① Polar air masses (P) - which originate polar areas.
  ⑪ e.g. - Arctic air masses.
  ⑪ Tropical air masses (T) - which originate tropical areas.
  ⑪ e.g. - Equatorial air masses.
* These two air masses further divided in to two categories:
  ⓐ Continental air masses (c) ⓑ ~~Polar~~ maritime air masses (m).

* - Following four principle type according to geographical location:
  1) Continental Polar Air mass (cP)
  2) Maritime Polar Air mass (mP)
  3) Continental Tropical Air mass (cT)

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b) Thermodynamic classification:

- Based on thermodynamic and mechanical modifications air masses are divided into
  1) cold air mass
  2) warm air mass, each of which further divided into
  (i) stable air masses (ii) unstable air masses.

(1) Cold air masses

originate in the polar and arctic regions, They are characterized by following properties in their source regions:

(i) Temp. is very low because of loss of heat through outgoing longwave terrestrial radiation.
(ii) specific humidity extremly low.
(iii) stability increases & normal lapse rate low.

(2) warm air masses -

Warm air masses generally originate in the subtropical regions characterized by anticyclonic conditions.

- They are further divided into
  (i) continental warm air mass.
  (ii) maritime warm air mass.

3) Composite classification -

Based on Thermodynamic & mechanical modifications and some other consideration into 16 types:

a) Continental Polar air masses (cP) -

(i) Continental Polar cold stable Air mass (cPKs)
(ii) Continental Polar cold unstable Air mass (cPKu)
(iii) Continental Polar warm stable Air mass (cPWs)
(iv) continental Polar warm unstable Air mass (cPWu)

b) Maritime Polar Air masses (mP) -

(i) maritime Polar cold stable Air mass (mPKs)
(ii) maritime Polar cold unstable Air mass (mPKu)
(iii) maritime Polar warm stable Air mass (mPWs)
(iv) maritime Polar warm unstable Air mass (mPWu)

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c) Continental Tropical Air masses (cT) -

(ix) Continental Tropical cold stable Air mass (cTKs)
(x) Continental Tropical cold unstable Air mass (cTKu)
(xi) Continental Tropical warm stable Air mass (cTWs)
(xii) Continental Tropical warm unstable Air mass (cTWu).

d) Maritime Tropical Air masses (mT)

(xiii) Maritime Tropical Air masses cold stable (mTKs)
(xiv) maritime Tropical cold unstable Air masses (mTKu)
(xv) maritime Tropical warm stable Air masses (mTWs)
(xvi) maritime tropical warm unstable Air masses (mTWu)

Characteristics of Major Air Masses:

- Air mass fall into categories on the basis of locational aspect of source regions:

1) Polar Continental Air mass (cP) -

- Its originate over the extensive cold surface of central Canada and Siberia.
- These air masses have different physical characteristics during summer and winter seasons.
- The polar continental air masses are generally cold & dry,
- It's formation of limited clouds mainly low stratocumulus.
- The winter time polar continental air mass after being originated over frozen land surface central canada and mississippi plain of the USA.
- In the summer, frost conditions south as New orleans, Galveston and Huston of the USA.

2) Polar Maritime Air masses (mP) -

- It may be the same source regions as those of continental polar air masses.
- The upper part is dry and cool.
- They are adiabatically warmed and become stable dry continental air masses.

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- Such situation are found along the West coast of N. America where eastern slope of Rockies recive more pricipitation & Great plains are dry.

3) Continental Tropical Air masses (cT) -

- There source region is S.T.H.P. areas of hot deserts located betn 20°-30° latitudes in both hemisphere.
- which are charactrized by High temprature, least moisture content, steep lapse rate, atmospheric stability, and dry weather.
- They are modification of maritime tropical air masses.

4) Maritime Tropical Air masses (mT) -

- There source regions over warm ocean surfaces of tropical regions betn 30°N & 30°S latitudes.
- These are warm, moist and unstable air masses
- They are associated with cumulus and cumulonibus clouds, which are give aboundant rainfall.

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FRONTS:

- 'The sloping boundry betⁿ two contrasting air masses of different characteristics in terms of temperature, velocity, humidity, density etc. is normally called **front**.'
- The concept of first introduced in the year 1918. Thus the contribution V.J. Bjerknes, H. Solberg, & T. Bergeron.

* **Define**: "It is defined as an interface or transition zone betⁿ two air masses of different densities."

• **FRONTOGENESIS** –

'The process associated with the creation of new fronts or regeneration of old and decaying fronts already in existence is called frontogenesis.'

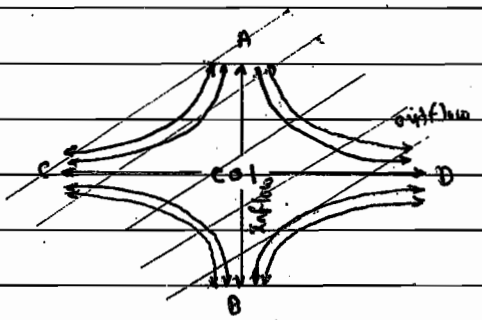
- The formation of fronts is responsible by frontogenesis.

• **Frontolysis** - 'The process of destruction or decaying of fronts is called frontolysis which is opposite to frontogenesis'.

Creation of fronts:

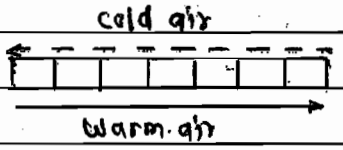
① **Frontogenesis** –

When two contrasting air masses converging deformation circulation, they spread horizantally along the axis of 'outflow' or 'dialation'



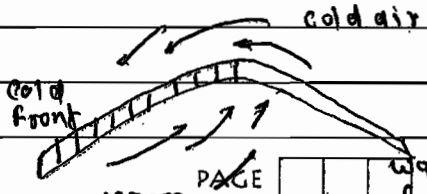
⑪ **Stationary front** –

If two contrasting air masses parallel to each other and there is no upword displacment of air stationary front is formed.



⑪ **Full developed front** –

Two contrasting air masses are generaly seprated by sloping boundry



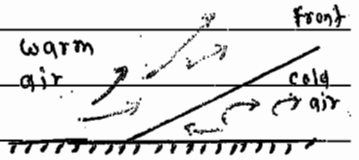
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due to deflective force (coriolice force) of the earth and cold and dense air mass push light and warm air mass upward. It may be pointed out fronts are fully developed.

Classification of fronts:

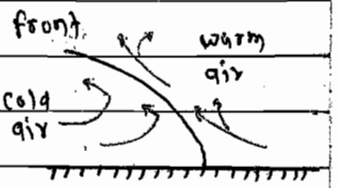
- fronts are classified on the basis of different characteristics:

1) Warm front -



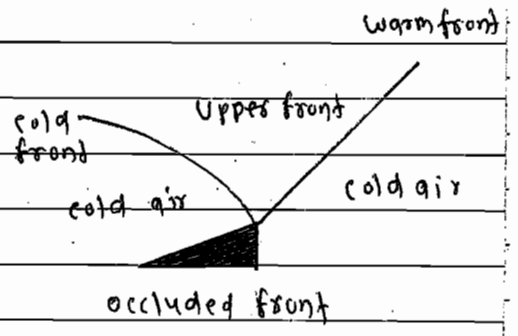
- warm front is that gently sloping frontal surface.
- When the warm air becomes active & rises over the cold air, the resultant front is called 'anafront' or 'kata front'.
- These front formed as a difference of temp. betn two converging warm & cold air masses.

2) Cold front:



- The cold front much steeper than warm front.
- The cold front varies from 1:50 to 1:100
- cold front is that sloping frontal surface along which cold air becomes active & aggressive and invades the warm air territory & being denser remains at ground but forcibly uplift the warm & light air.

3) Occluded front:



'Occluded front is formed when cold front overtakes warm front and warm air completly displaced from the ground surface'.

- The occluded fronts are two types:

① Cold front occlusion-

It occurs when the cold air behind the cold front is colder than the advancing cold air which is ahead of warm front & thus the cold front overtake warm front.

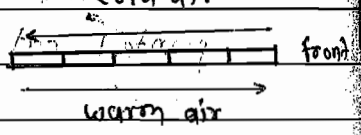
② Warm front occlusion-

The cold front is warmer than the advancing air which is ahead of warm front & thus the retreating

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4) **Stationary front:**

'It is formed when two contrasting air masses converge in such a way that they become parallel to each other & there is no ascent of air'.



FRONTAL ZONES:

- fronts are not formed everywhere, but they are formed only in those areas where two air masses converge.

June 05. 1) **Polar Frontal zone -**

- These frontal zone is also known as 'Atlantic polar front'. Because fronts are formed NW part of Atlantic ocean.
- Polar front are formed middle latitude in both the hemisphere. Because convergene of polar continental air mass (cpcam) and tropical maritime air mass. (tmam)
- These fronts more developed in the northern part of Atlantic and Pacific oceans.
- They are more active during winter season.
- The polar front associated with origin of temprate cyclones.

2) **Arctic frontal zone -**

- Arctic fronts are created in the arctic areas due to convergence of continental & maritime polar air masses.
- These fronts develop along the arctic of Eurasia and north America.
- These fronts are not always very strong & active, because less temp. contrast betn two air masses.

3) **Medeterian frontal zone -**

- These frontal zone formed due to cold continental European air mass and winter air mass of N. Africa along with Mediterranean - Caspian sea.
- These frontal weather disterbances pakistan & NW India & account winter pricipitation of India.

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4) Intertropical frontal zone -

- It is formed near the equator due to convergence of north-east and south-east trade winds.
- There is no temp. contrast betⁿ these two air masses of similar origin and same properties.

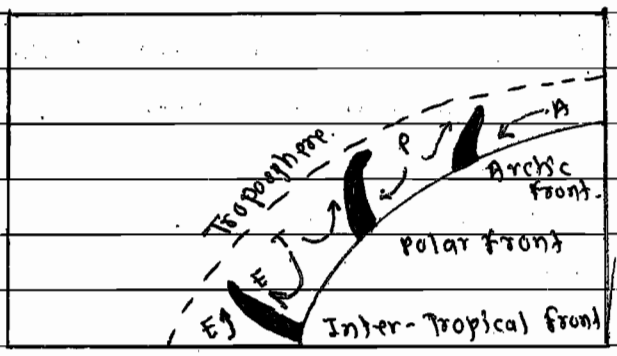


fig: Major frontal zone over the globe.

5) Pacific Arctic frontal zone -

- fronts develop along a line running from the Rocky mountains to the Great Lakes during winter season.
- The cyclones associated with this frontal zone move southward such as Texas & N. mexico.

6) Pacific Polar frontal zone -

- Two frontal zone develop during winter season over the north Pacific ocean: (i) Near NE Asian coast
  (ii) Near NW N. American coast.
- It extending from Gulf of Alaska, to southern California & W. mexico.

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CYCLONES :

"Cyclones are centres of Low pressure surrounded by closed isobars having increasing pressure outward and closed air circulation from outside towards the central low pressure".

- Such way thats winds blow in anticlockwise in northern and clockwise in southern hemisphere.

* From the location point of view cyclones are classified in to two principle types:
  - (A) Tropical cyclones
  - (B) Temprate cyclones.

A) TROPICAL CYCLONES :

- 'Tropical cyclones, representing a closed L.P. system generally having a diameter of about 650 km.
- It clockwise in southern & counterclockwise in northern hemisphere. (S) (N)

* Tropical cyclones different names of different part of the globe:
  - (i) Hurricanes - N. Atlantic ocean, carribian sea & southern USA.
  - (ii) Typhoons - North pacific, china sea, Japan, Philipines & SE Asia.
  - (iii) Cyclones - Bangladesh & East coast of India.
  - (iv) Willy-willy - in Australia.

* Charactaristics :

1) Size - of tropical cyclones on an avarage diameter range 80 km to 300 km.
2) velocity - They varying velocity of weak cyclones 32 km while hurricanes 180 km/hour or more.
3) Pressure - The centre of cyclone low pressure 650 mb. Isobars are more or less circular & few in number.
4) Temprature - Tropical cyclones are not charatrized by temprature variation, because do not have different front.

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5) Rainfall - There are no different rainfall cells, hence each part of the cyclones yield rainfall.

6) Direction - They move from east to west under the influence of trade winds. The general direction is westerly up to 15° latitude from the equator.

7) Period - Tropical cyclones are confined to a particular period of the year, mainly during summer season.

8) Hazards - It becomes disastrous natural hazards, because of their high wind speed of 180 to 400 km/hr., high tidal surges, high rainfall intensity.

TYPES of Tropical Cyclones:

1) Tropical disturbance -

'Tropical disturbance are migratory wave-like cyclones and are associated with easterly trade winds. They are also called easterly waves'.

- Winds move towards centre with low speed.
- most of the easterly waves develop bet^n 5° & 20° north latitudes in the western part of oceans.
- They are associated with cumulus or cumulonimbus clouds, which yield moderate to heavy rainfall, with thunderstorm.
- They develop Carribean sea, N. Pacific ocean during summer.

2) Tropical Dipressions -

'Tropical dipressions are centres of low pressure surrounded by more than one closed isobars & very small in size'.

- wind velocity low pressure at centre ranges bet^n 40-50 km/hr.
- They usually develop in ITC but seldom develop trade wind belt.
- They generally develop India and N. Australia during summer.

3) Tropical storms -

- They are L.P. centre surrounded by closed isobars with wind velocity bet^n 40 to 120 km/hr.
- They develop Bay of Bengal & Arabian sea, carribian sea and classmate phillipines.

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- These cyclones becomes violent & disastrous atmospheric hazards as they cause heavy rainfall.

4) **Hurricanes and Typhoons:**

* The extensive tropical cyclones surrounded by several closed isobars are called hurricanes (USA), and Typhoon (China).

- They move with origin. avarage speed more than 120 km/hr.

* **Characteristics -**

(i) Hurricans are represented by more symmetrical and circular isobars.

(ii) The rainfall occuring heavy downspour, and there is no temprature variation.

(iii) There is no change in wind direction & they associate with anticyclones.

(iv) The diameter ranges betⁿ 160 & 640 km, and pressure ranges betⁿ 900 and 950 mb.

(v) Hurricanes originate & develop only over warm ocean in the tropical zone.

Origin of Tropical cyclones:

- The necessary conditions required formation of tropical cyclones as follows:

i) Continious supply of warm and moist air.
ii) Suitable source of senseible and latent heat
iii) vertical air motion & convergence of air.
iv) In the form of intruding low pressure system at high latitude
v) warm water surface of the oceans up to depth 60-70 mts.
vi) Higher values of coriolis force.
vii) Divergent circulation in upper troposphere.
viii) Existance of small atmospheric vortices in the ITC.
ix) weak vertical wind share.

* **Weather condition -**

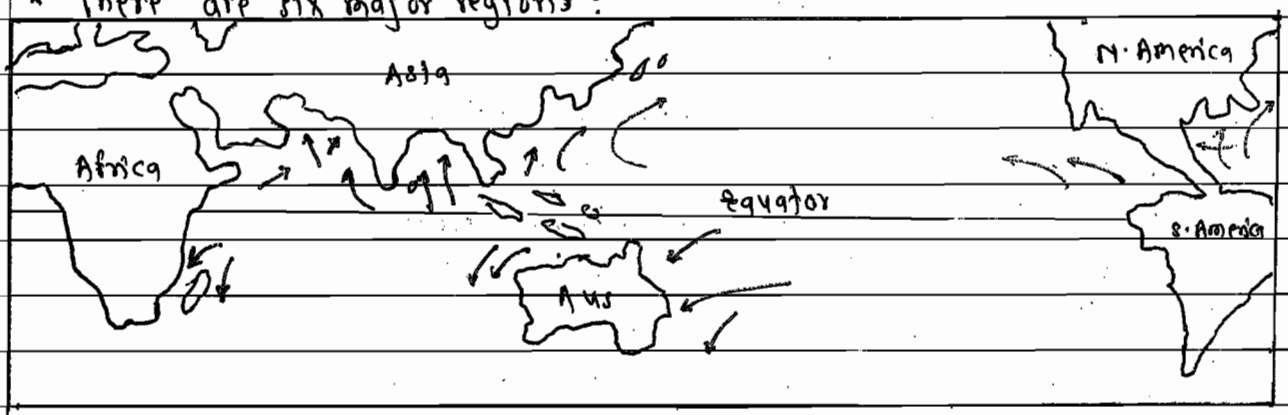
- It increases in air temp & wind velocity, marked decrease air pressure, appearance cirrus & cumulonibous clouds.
- The clouds are thickened, thunder and lightning.

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Distribution of Tropical cyclones:

- Tropical cyclones mostly develop over the ocean surface between 5°-20° latitude in both the hemisphere.

* There are six major regions:



1) **North Atlantic ocean -**

They develop - Cape Verde Island, east of west Indies, south of Atlantic coast of USA, Carribean sea, Gulf of Mexico.

2) **North Pacific ocean -**

- western coast of mexico, california and Hawai Islands.

3) **SW north Pacific ocean -**

- in china sea, coast of Phillipines, south Japan, eastern coast of china.

4) **South Pacific ocean -**

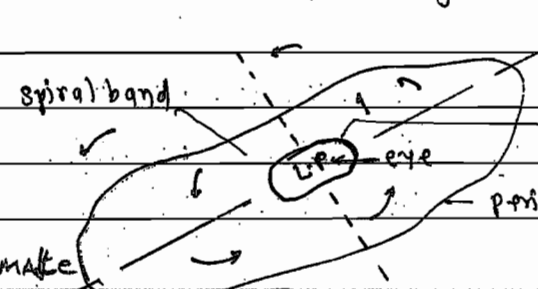
- The east of society Islands (east of 180° longitude), NE coast of Australia.

5) **North Indian ocean -**

- the Arabian sea & Bay of Bengal, influence weather conditions of India & Bangladesh bet^n in April and December.

6) **South Indian ocean:**

- The coast of Re union, madagascar, & Maritius Islands.



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Effect of Tropical cyclones:

i) Heavy loss to human lives.
ii) Distruction of buildings.
iii) Distruction of transport system.
iv) Distruction of water and power supply.
v) Distruption of communication system.
vi) Distruction of standerd agricultural crops.
vii) Distruction of domestic and wild animals.
viii) Distruction of natural vegitation.
ix) Distruption of private and public institutions.

Thunderstorms:

'A thunderstorms is an intense local storm associated with large, dense cumulonimbus clouds in which there are very strong updraft of air'.

- fundamentally the thunderstorm is thermodynamic machine with associated torrential rain, hail, gusty surface squall winds, lightning & thunder.

Tornadoes:

'Tornadoes are funnel shaped very violent rotating system of air wherein the air from the ground having lowest pressure is sucked by the upper air and is suddenly uplifted causing convective instability'.

- Tornado outbreak - 'The occurance of several tornadoes in groups is called Tornado outbreak'.
- Tornado misseles - 'The material of different nature like uprooted trees, roots of buildings, small cars etc. carried by tornadoes are called Tornado misseles'.

i) Typhoons - China seq
ii) Tropical cyclones - Indian Ocean
iii) Hyrricanes - Caribean seq.
iv) Willy-willy - N. Australia
v) Tornadoes - U.S.A.
vi) Baguio - Philipines
vii) Taifu - Japan

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B] TEMPRATE CYCLONES -

"Temprate cyclones are also called as extratropical cyclones or wave cyclones or simply depressions are atmospheric disturbances having low pressure in the centre and increasing pressure outward."

- They are formed in the regions extending betn 35°-65° lattitudes in both the hemisphere, due to convergence of two contrasting air masses.
  e.g. warm, moist and light tropical air masses and cold, and dense polar air masses.
- The polar front created two opposing air masses are responcible for the origin and development of temprate cyclones.

Types of Temprate Cyclone -

- Temprate cyclones originated due to two contrasting air masses are convergent in terms of temprature, pressure and humidity.

1) Dynamic Cyclones:

- They are formed due to convergence of cold polar air masses and and warm tropical air masses.
- These cyclones affect the weather conditions of very large areas in middle lattitude.
- Different fronts and sectors development in dynamic cyclones.
- They are called dynamic because they are dynamically produced e.g. Due to convergence of two contrasting air masses.

2) Thermal Cyclones:

- Thermal cyclones are formed due to development of L.P. centres on the continents in summers, in temprate regions & as such winds blow from all direction towards low pressure centres.
- They develop land surface in summer e.g. Iberian Penninsula, Alaska, SW USA and NW Australia. and over sea surface in winter e.g. okhotosk sea, norwegian sea, to the south of Iceland and Greenland.

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3) Secondary Cyclones -

- These are develop due to passage of cold winds over warm sea after the occlusion of main cyclone.
- They are short-lived and very weak.

* Charactarjstics :

i) Shape - Temprate cyclones are of different shapes
e.g. circular, semi-circular, elliptical, elongated or 'V'-shaped.

ii) Pressure - The pressure increases centre towards outer margin.
e.g. about 10 to 20 mb increases 35 mb.

iii) size - Their diameter ranges from 150 km to more than 3000 km. area of 1,000,000 sq. km., The vertical extent about 10-12 km.

iv) velocity - The avarage velocity of 32 km/hr. in summer and 48 km/hr. in winter.

v) Temprature - Origin due to thermally contrasting air masses Southern part high temp & Northern part low temprature.

vi) Wind Direction - becomes anticlockwise in the northern hemisphere and clock-wise in the southern hemisphere.

Source Regions :

- The areas lie betn 35°-65° middle and high lattitude in both the hemisphere.

1) Pacific ocean region -

- North east coast of Asia, Gulf of Alaska, Aluetian low lands, southern California.

2) North America -

(a) areas of east sierrea Nevada range
(b) eastern Colorado - 'colorado lows'.
(c) east of canadian Rocky - "Alberta lows"
(d) Great lake region.

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3) Atlantic ocean region -
- North east America, and north western part of europe, Gulf of mexico.

4) Continental Europe -
(a) Baltic sea
(b) mediterranian sea etc.

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* Weather Conditions Associated with Temprate Cyclones -

1) Arrival of cyclones -
- Temprature suddenly increases when the cyclones come very close to the observation point.
- Wind direction changes from easterly to south-easterly.
- The cloud cover thickness of the sky becomes dark are formed mainly nimbostratous clouds.

2) Warm frontal Precipitation -
- It is charactrized by foggy weather and poor visibility.
- Some time warm air ascend cold air becomes unstable and yield heavy rainfall.

3) Warm Sector -
- The wind direction becomes southerly and south westerly.
- The sky becomes cloudless and clear.
- There sudden rise in temprature, increases specific humidity and air pressure decreases remarkably.
- which may produce convective drizzles or showers through strato-cumulus clouds.

4) Cold front -
- The cold air pushesh the warm air upward and there is change in wind direction from southerly to sw & westerly.
- sky is again covered with clouds which soon start precipitation.

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5) Cold frontal precipitation -
- sky becomes overcast with cumulonimbous clouds which yield heavy showers.
- The warm air lifted upward & the cold frontal precipitation form heavy rainfall.

6) Cold sector -
- weather again changes remarkably with the passage of cold front and arrival cold sector.
- sky becomes cloudless and hence clear.
- There is sharp fall in air temprature & considerable rise in air pressure but decrease specific humidity.

7) Occluded Fronts -
- Occlusion of cyclonic front is defined as overtaking of warm front by cold front.
- Occlusion is of two types (i) cold front occlusion.
(ii) warm front occlusion.

Origin of Temprate cyclones -
- The chronologically elevelopment of concept of cyclogenesis in middle latitudes:

(i) Fitzroy - (1863) -
He postulated that temprate cyclones originated because of the convergence of two opposing air masses.
i.e. temprature, pressure, humidity, wind direction etc.

(ii) Abererromby - (1887)
- formulation theory of cyclogenesis in 'weather' (1887).
- physical processes responsible for origin of temprate cyclones.

(iii) Shaw and Lampfert - (1891).
- Temprate cyclone originated due to convergence of winds from all direction towards the centre.
- They elaborated 'dynamic theory' of cyclogenesis.

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(iii) Eddy theory -

- Temprate cyclones originated due to the formation of eddies caused by obstructions in the advancing air masses.

(iv) Polar front Theory - 'V. Bjerknes and J. Bjerkanes' (1918).

- These two contrasting air masses i.e polar cold air mass and tropical warm air masses converging along a line in the middle lattitudes.
- These are collide to each other which help and development of temprate cyclones.
- The two air masses straight but becomes unstable & wave-like the warm and cold ~~front~~ air masses penetrate to one another, such unstable wavy front is called 'polar front'.

(v) Baroclinic Theory -

Baroclinic theory was formulated for cyclone development in the middle lattitue.

- On the basis of recent meteorological data from middle & upper troposphere through satellites and radars.

- weather associated with cyclones bring cloudley skies, which act to minimize diurnal temprature extremes.

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ANTICYCLONES : F. Galton (1961)

"A such a wind system which has highest pressure at centre and pressure decreases in outwards in such a way that it becomes lowest at the outer margin".

- The wind blowing from centre outward in clockwise in northern hemisphere and anticlockwise in southern hemisphere.
- It is more common is sub-Tropical High pressure belt and absence in equatorial region.
- They are generally associated with rainless fair weather.
- 'F. Galton' introduced term Anticyclone for first time in 1961.

* **Characteristics -**

i) They are usually circular in shape but some time 'V' shape.
ii) They are pressure ranges bet^n 10 mb to 35 mb.
iii) The avarage velocity of anticyclones is 30-50 km/hr.
iv) They record high temprature in summer and low temprature in winter.
v) Anticyclones do not have front.
vi) They becomes larger in size diameter as 9,000 km.
vii) The weather of Canada, USA and north Eurasia is mostly affected by anticyclone.

Types of Anticyclones -

1) **Cold Anticyclone -**

- They are thermally induced because of very low insolation during winter season in the arctic regions.
- low temprature create high pressure on given region and formed by anticyclones condition.
- Region: Canada, USA, Siberia, China, Japan and Alaska.

2) **Warm Anticyclones -**

- These are originated sub tropical high pressure belt. (STHP)
- They are dynamically induced.
- They becomes stationary over a place for several days & weeks.
- They are associated with light wind, cloudless sky & clear weather.
- It influenced SE USA & western Europe.

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3) Blocking Anticyclone -

- They develop in the upper troposphere.
- They develop over N.W. Europe & adjoining Atlantic ocean, the N. Pacific ocean betn 140° - 170°W.
- They are similar warm anticyclones as regards wind system, air pressure. But are small in size and move very slowly.

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	TEMPERATE CYCLONES	TROPICAL CYCLONE
Origin (i)	It originate temprate lands & more develop both land and sea.	(i) It originate tropical zone & develope in sea mostly.
season (ii)	They are mainly born in winter season.	(ii) They are mainly born in summer season.
Characteristics (iii)	shape - elleptical size - large in 800 - 1600 km. Pressure - gradient in gentle. Wind - less 30-40 km/hr. Direction - west to east. → Rainfall - light but widespred Temprature - cold & warm sector	(iii) - circular shape - small in size & diameter 300-1000 km. - pressure gradient steep. - wind velocity more 100-200 km/hr. - move from east to west. ← - Torential rainfall small area. - Temprature more & less uniform.
form (iv)	Temprate cyclones are born due to colloision of two different air masses.	(iv) Tropical cyclones are born due to heating of a post of atmosphere.
fronts (v)	There are two seprate air fronts known as cold & warm front.	(v) There are no fronts in a tropical cyclone.
स्थान	प्रामुख्याने जलभाग	भूभाग व जलभाग
विस्तार.		
विस्तीर्ण क्षेत्र	दोन्ही 65° अक्षवृत्त	30° ते 65° अक्षवृत्त
दिशा	पश्चिमेकडून - पूर्वेकडे	पूर्वेकडून - पश्चिमेकडे
आवर्तन दिशा	Teatonin	Sotonin
पूर्वेश	anti-trade winds	Trade winds.
वायुभार	~~नीच~~ मंद	~~मंद~~ तीव्र

DATE

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CONDENSATION -

'The transformation of gaseous form of water (i.e. water vapour) into solid form (ice) and liquid form (water) is called condensation'.

- The process of change of water vapour into liquid forms is called 'condensation'.
- At dew point air gets saturated i.e. relative humidity become 100%.

* Forms of condensation -

It include dew, frost, rime, mist, and fog, clouds, snowfall, sleet, hail, drizzles, rainfall etc.

- The major forms are : fogs, clouds and rainfalls.

FOGS :

'It is defined as almost microscopically small water drops suspended in the atmosphere and reducing the horizontal visibility to less than one kilometer.'

* Characteristics -

1) Clouds are formed due to expantion and contraction (cooling) of air.
2) It's formed due to radiation, conduction & mixing of warm and cold air masses near the earth surface.
3) fog is formed due to moist air becomes saturated reches its dew point & further around dust particles, smoke etc.
4) microscopically tiny water droplets fly with the winds.
5) A light fog called as mist, is that when visibility is restricted to 2 kilometers.
6) fog generally associated with inversion of temperature occurs in morning hours but some times also continious till noon.
7) fog occur winter season in sub-tropical region, but occurs in all seasons in the regions beyond 35° latitude.

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CLOUDS:

'clouds are defined as aggregate of innumerable tiny water droplets, ice particles or mixture of both in the air generally above the ground surface'.

- clouds are formed due to condensation of water vapour around hygroscopic nuclei, caused by cooling.
- Clouds are significant because all forms of precipitation. 'not all clouds yield precipitation, but no precipitation possible without cloud'.
- Clouds play major role in the heat budget of the earth.

* Classification of Clouds -

- There is wide range of variations in clouds in terms of height, shape, colour and transmission or reflection of light.
- Clouds have been classified into Genera (10), species (26) and varibles (31).

* All clouds of troposphere are classified into 4 families. i.e. Low, middle, high and vertical development.

A] High clouds - (height 6 to 20 km).

height 3-8 km over the poles, 5-13 km in the temprate regions, 8-18 km tropical regions.

1> Cirrus clouds (Ci) -

- The high altitude having fibrous (hair like) or silky appearance are called cirrus clouds.
- They are tiny ice crystals & transperent white in colour but have brilliant colours at sunset & sunrise.
- These clouds indicative of dry weather.
- Cirrous clouds are 'mother of Pearl' found frozgaus & ice crustals.

2> Cirro - cumulus clouds (Cc) -

- These are white coloured clouds having cirriform layes or patches of small white flakes or small globules.
- which are arranged in distinct groups or wavelike forms.
- They generally appears as ripples similler to sand ripples the desert.

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3) **Cirro-stratus clouds (Cs)** -
- They are generally white in colour and spread in the sky like milky thin sheets.
- They are so transperant that the sun and moon are visible through them.
- These form halo around the moon in the night.

B] **Middle clouds** - (Height 3 to 8 km)

Height '2-4 km' over the poles, '2-7 km' in the temprate region, '2-8 km' in the tropical regions

4) **Alto-stratus clouds (As)** -
- These are thin sheets of gray or blue colour having fibrous or uniform appearance.
- They become thick sheet the sun and moon are 'obscured'.
- They yield widespread continued precipitation either in the form of drizzle or snow.

5) **Alto-cumulus clouds (Ac)** -
- Alto cumulus are some time called as 'sheep clouds' or wool pack clouds'.
- They appears white or gray in colour.
- They are charactrized globular form, regular pattern of lines, groups or waves.

6) **Nimbo-stratus clouds (Ns)** -
- Nimbo is form Latin word 'nimbus' meanig thereby 'rainstorm'.
- They are associated with rain, snow and sleet.
- They are thick and compact that there is complete darkness and there is copious precipitation.

C] **Low clouds** - (Height 2-5 km.)

Height ground surface to 2.5 km.

7) **Strato-cumulus clouds**-
- They are gray of whitish colour at height 2.5 to 3 km.
- They are composed of globular masses or rolls which are generally arranged in lines.

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8) Stratus clouds (St)-

- These are dense, lowlying fog-like clouds of dark grey colour and close to the ground surface.
- They are composed of several uniform layers.
- These clouds are associated with rains or snow.

9) Cumulus clouds (Cu)-

- These are very dense, widespread, and dome shaped and have flat bases.
- They are white woolpack cloud masses & associated with fair weather. But some times they become thunder clouds.

10) Cumulo-nimbus clouds (Cb)-

- These are thunder-storm clouds.
- They show great vertical development & produce heavy rains, snow, hail storm.
- They appears like mountains or huge towers & assume shape of anavail or vast plumes.
- Some time pricipitation occuring in summer, such rain is called 'vigra'.

Diagram:

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PRECIPITATION :

'Precipitation is also defined as deposition of atmospheric moisture either in liquid or solid forms.'.

- The adibatic cooling of moisture air caused by either mechanical lifting or by dynamic lifting causes condensation and precipitation.

* Forms of Precipitation -

1) **Rain** -
- Rain in the form of raindrops with diameter < 5 m.m.
- Rain drops contains as many as 8,000,000 cloudy droplets.
- It occurs suffient moisture in the air and condensation occurs above freezing point (above 0°C).

2) **Drizzle** -
- It is defined as the fall of numerous uniform tiny droplets of water having diameter less than 0.5 mm.
- Drizzle are combined with fog & hence reduce visibility.

3) **Snow** -
- It is formed when condensation occurs below freezing point (0°C).
- snowfalls is precipitation of white and opaque grains of ice.
- The snowfall occurs when the freezing level is so close to the ground surface.

4) **Snow pellets** -
- snow pellets having white and opaque grains of ice of spherical shape are formed when condensation takes place around freezing point.
- The diameter of snow pellets 2mm - 5 mm.
- snow pellets are so brittle that they break in pieces.

visibility -
1. Haze - > 2km
2. mist - 1 - 2km
3. fog - < 1 km
4. smog - ~~near zero visibility~~.

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5) Graupel -
- a form of precipitation in solid form is comprised of ice grains of white colour.
- The diameter less than 1mm.

6) Hail -
- It consits of larges pellets or spheres (balls) of ice
- It's diameter 5mm to 50mm fall downward known as hailstorms.
- Hail distroy agricultural crops and etaim human and animal lives.

7) Sleet -
- sleet refers to mixture of snow and rain.
- sleet means falling of small pellets of transparent or transculent.
- It's diameter of 5mm or less.

8) Rime -
- Rime is an opaque coating of tiny, white, granular ice-particles, caused by rapid freezing.
- Rime is deposited mainly on the edges and points of objects.
- Rime looks like cauliflower shaped heap.

Process of Precipitation:

i) The presence of warm, moist and unstable air and suffisent number of hygroscopic nuclei.
ii) The warm air lifted upward is cooled at the dry adibatic rates of 10°c / km. height; and becomes saturated.
iii) The process of condensation begins only when the relative humidity of ascending - air becomes 100%.
iv) condensation occurs around larger hygroscopic nuclei only, such droplets are called 'cloud droplets'.

* Cloud Instability Theory : Tor Bergeron.
* Collision Theory : Longmuir.

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v) The aggregation of large number of cloud droplets forms clouds, cloud droplets are microscopic in size & suspended air.
vi) cloud droplets fall downward they are evaporated before they reach the ground surface as 'Virga'.
vii) Rainfall occurs only when cloud droplets change to raindrops.

- There are two possibilities process of change of cloud droplets into raindrops:

(a) Warm and moist air ascends to condensation level below freezing point, then both water droplets & ice droplets formed.
- Evaporated water around ice crystals which go increasing in size.
- They can not be held in suspension by the air & consequently they begain to fall down.
- The temp. of above the ground is high they fall in the form of raindrops.

(b) The suspeded cloud droplets are different sizes.
- These cloud droplets collide among themselves and thus form large droplets.
- In the process several cloud droplets are coalesced to from raindrops, the fall down as rainfall.

Types of Precipitation -

1) Convectional Rainfall -
- The ground surface intensly heated due to enormous amount of heat recived through solar radiation during day time.
- The result the air coming in contact with warm ground surface also gets heated, and ultimetly rise upward.
- The ascending warm & moist cools according to dry adibatic rate 10°c / km. and it's increses relative humidity.
- The moist air saturated causes condensation and cloud formation and thus rainfall start.



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Characteristics -

i) It occurs daily in the afternoon in the equatorial regions at 2-3 p.m.

ii) It is of very short duration but occurs in the form of heavy showers.

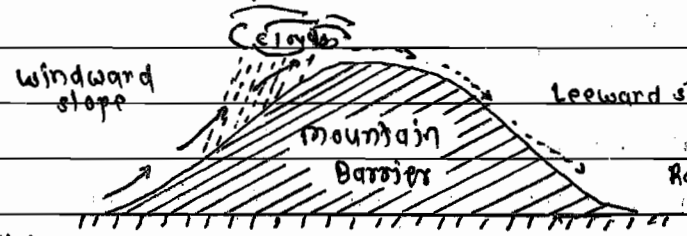
iii) It occurs through thick dark & extensive cumulo-nimbus clouds.

iv) It is accompanied by cloud thunder and lightning.

v) Convectional rainfall supports luxurious evergreen rainforest.

b) **Orographic rainfall)-**

- orographic rainfall occurs due to ascent of air forced by mountain barriers.
- The mountain barriers lying across airflow & air rises along the mountain slope & thus lifted and cools. ~~accord~~
- According to dry adiabatic rate 10°c / km with increas. Relative humidity.
- The ascending air saturated and condensation begins around hygroscopic nuclei.
- Thus ascending air continues to yield precipitation with increasing height.
- The slope of mountain facing 'windward' side recive maximum precipitation and 'leeward side' are called 'rainshadow region'.
- most of the world precipitation occurs through orographic rainfall.



* **Characteristics:**

i) There should be mountain barier across the wind direction.
e.g- Aravalis ranges running in SW & NE direction. are parallel to the Arabian sea Branch of SW Indian monsoon.

ii) If the mountains are very close & parallel to the sea coasts & they become effective barriers e.g- west ~~ghat~~ at in India.

iii) The height of mountains also affects the form of amount of orographic rainfall.

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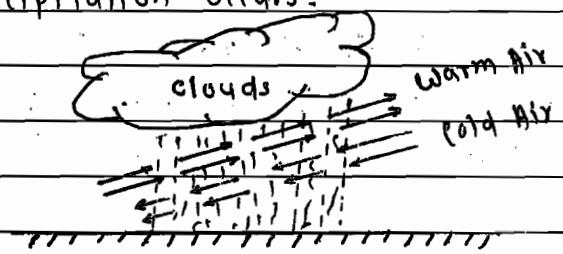
c) Cyclonic or frontal Rainfall -

- These rainfall occurs due to ascending of moist air & adibatic cooling caused by convergence of two extensive air masses.

- The cyclonic precipitation of two types: (i) temprate cyclones and (ii) tropical cyclones.

i) Temprate cyclones -

- Rainfall associated with two contrasting air masses (cold polar & warm tropical) converging along a line, a front is formed.
- The warm wind is lifted upward & cold air being heavier settles downward.
- The warm air cooled and get saturated & condensation around hygroscopic nuclei.
- The process of condensation is also slow and gradual, with the result precipitation occurs.



ii) Tropical cyclones -

- In tropical regions two extensive air masses of similar physical properties converge to form tropical cyclones.
- Where in lifting of air almost vertical which full of moisture becomes saturated and yield heavy showers.
- It characterized lightning and thunder.

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Distribution of ~~Temprature~~ Rainfall :

- There is wide range of spatial and temporal variation in the distribution of precipitation over the globe.
e.g- equatorial region recive highest rainfall and tropical & subtropical hot deserts recive lowest annual rainfall.

- Mean annual rainfall for the globe is 970 mm.
- Some places receive > 100 mm of annual rainfall for e.g- Sahara, Thar, Acatama, Kalhari, Australian deseart. etc.
- while some places recive < 10,000 mm of annual rainfall.
e.g- Cherapunji and Mawsyram of India.

* Controls of precipitation Distribution -

i) moisture content in the air -

Rate of evaporation

- The atmospheric moisture depend upon evaporation of water or ice through the input of heat energy.
- Precipitation is also indirectly related to the evaporation, higher the evaporation rate higher annual rainfall for e.g- equatorial region.

ii) The convergent or divergent air circulation -

two contrasting air masses "fronts"

- The ascent or descent of air and its adibatic cooling or heating which in turn determines the amount of precipitation.
- The convergence of two contrasting air masses creates front e.g. ITC zone recive high rainfall.

iii) Topographical condition -

physiography

- presents both fevorable and unfavourable conditions for precipitation.
- mountain barrier to parallel coastal land recive high rainfall.

iv) Distance from the source of moisture -

distance from coast

- The distance from the source of moisture (mainly oceans) increases, the moisture content, hence the amount of precipitation decreases. e.g- India w.r.t that effect to Arabean sea

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* Haurwitz & Austin : Intensity of rainfall regimes.
* Patterson : Globe divede into 15 rainfall zones.

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* Zonal Distribution of Rainfall :

- Haurwitz and Austin

1) **Equatorial zones of maximum rainfall -**
- This zone extends upto 10° latitudes on either side of the equator.
- The mean annual rainfall ranges betⁿ 1750 to 2000 mm.
- Most of the rain recive convectional rainfall and lightnening.
- The daily rainfall in the afternoon, form of a heavy showers.

2) **Trade wind rainfall zone -**
- It extends betⁿ 10°-20° latitudes in both the hemispheres, is charactrized by NE & SE trade winds.
- These winds yield rainfall in the eastern part of the continents but western part is dry.
- The monsoon regions located in the zone recive much rainfall.

3) **Subtropical zone of minimum rainfall -**
- It extends betⁿ 20°-30° latitudes in both the hemisphere.
- These region H.P. and winds diverge in opposite directions at the ground surface, with result anticyclones are formed.
- The tropical hot deserts are located in this zone, where mean annual rainfall < 250 mm.

4) **Mediterranean rainfall zone -**
- It extends betⁿ 30°-40° latitudes in both the hemisphere.
- Rainfall occurs through westerlies and cyclones during winter season. while summer remains dry.
- mean annual rainfall 1000mm.

5) **Mid latitudnal zone of high rainfall -**
- It extends betⁿ 40°-50° latitudes in both the hemisphere.
- Rainfall occurs through westerlies and temprate cyclones.
- The western part of continents recive more rainfall
- wintere season recives maximum precipitation through temprate cyclones.
- Mean annual rainfall ranges betⁿ 1000 mm and 1250 mm.

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6) Polar zones of lower Precipitation -

- Precipitation decreases from 60° latitudes to poleword in both the hemisphere.
- mean annual precipitation becomes only 250 mm beyond 75° latitude.
- Most of the precipitation occurs in the form of snowfall.

Theories of Rainfall:

a) Cloud Instability Theory / Ice crystal :-

- Tor Bergeron

- The core of theory based on the concept of 'mechanism of the growth of raindrops.'

'The relative humidity of air is greater with respect to an ice surface than with respect to water surface'.

① The fall of air temp. below 0°c out that the formation of ice particles requires freezing nuclei e.g. dust.

② slowly ice crystals grow in size as the deposition of super-cooled water droplets on their surface continues.

③ Ice crystal mutual collision & they form large snowflakes.

④ The ice crystals become large and their falling velocity exceeds, they fall downward.

⑤ when the falling ice crystals pass through a thick layer of air with temprature more than 0°c. They are changed into raindrops and thus begins rainfall.

b) Colligion Theory : - 'Longmuir'

① The terminal velocities of falling drops are directly related to their diameter, The 'larger the drops fall with greate velocity than smaller drops.

② Thus, large drops absorb small drops, smaller droplets are also swept by larger droplets.

③ All these lead to increase in the size of larger droplets which become raindrops which fall rain because they cannot be held in suspension by rising air current.

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Koppen's classification : (1933)

- The German botanist and climatologist 'Waldimir Koppen' presented first world climatic classification in 1918. a book - 'Handbook of Climatology'
- Koppen's classification based on vegetation zones.
- Koppen's original scheme was modified in 1953 by 'Geigger - Pohi' and revised scheme known as 'Koppen - Geigger - Pohi' scheme.
- Koppen's classification more popular because quantitative in nature as numerical values of temprature and precipitation., vegetation and added one more to Altitude (1936)

* Koppen used the follwing five major vegetation zones :

I. **Megathermal zone -**

such plants which depend on high temprature & humidity throughout year and no winter season. The temp. of coolest month < 18°c.

II. **Xerophytic zone -**

such plants thrive hot and arid condition. Here evaporation exceeds precipitation. These plants long roots, thick barks, waxy leaves, thorns & little leaves.

III. **Mesothermal zones -**

- Plants are adopted to moderate temprature & precipitation.
- The temp. for the coldest month are > 18°c but above -3°c.

IV. **Microthermal zones -**

Boreal decidious & steppe vegetatn are termed as microthermal. The temp. coldest month > -3°c & avarage temp. of warmest month > 22°c & above 10°c.

V. **Heistothermal zones -**

Such plants thrive on almost permanantly ice covered arctic and polar areas, say tundra region.

- The charactaristics of lithosols of this zone lichense and mosses.

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- The world climates into five principle types and designated capital alphabets A, B, C, D, E.

1. A climate - Tropical rainy climate (No winter season)
2. B climate - Dry climate.
3. C climate - Middle lattitude rainy climate with mild winter.
4. D climate - Middle latitude rainy climate with cool winter.
5. E climate - Polar climate with (no warm season).

- Koppen has used the following small letters:
  f = No dry season.
  w = dry season in winter.
  s = dry season in summer.
  m = monsoon climate

- Koppen has used the following capital letters:
  S = semi arid & steppi climate
  W = arid or desert climate
  T = Tundra and
  f = Icecap.

* Koppen has divided 5 major climatic types into 11 (sub) types:

A: **Tropical Rainy climates** -
- A climate temp. of the coldest month ~~mo~~ is above 18°C.
- It charactrised by winterless season.

(i) **Af climate** - (Equatorial Rainforest climate)
- Humid tropical climate, precipitation in driest month above 6cm
- very low daily range of temprature.

(ii) **Aw climate** - (Tropical Sawanna climate) -
- Tropical humid and dry climate, winter dry season.
- Precipitation of at least one month less than 6cm.
- High temprature throughout year.

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(iii) Am climate - (Tropical Monsoon climate)
- monsoon climate, sufficient annual precipitation.
- Thus wet ground throughout the year, dense forest.
- Precipitation of at least one month less than 6 c.m.
- short dry season.

(iv) As climate - dry summers, rarely found, for example India's Tamilnadu coast.

B: Dry climate:
- evaporation exceeds precipitation and there is constant water deficit through out the year. ~~Average~~
- B climate are divided in to two types
  (i) BW - Dry Desert climate
  (ii) Bs - semi arid or steppi climate.
- The mean annual temprature is more than 18°c.

- The climate is indicated letter 'h' <18°c temp and letter 'k' represents >18°c.

(i) BWh - Tropical desert climate avarage annual temp. <18°c.
(ii) BSh - Tropical steppe climate mean annual temp. <18°c.
(iii) BWk - middle lattitue cold desert climate, mean annual temp. >18°c.
(iv) BSk - middle lattitude cold desert climate, mean annual temp. >18°c.

C: Humid mesothermal or warm temprate rainy climate:
- The avarage temp. of coldest month below 18°c and above -3°c. avarage temp. of warmest month 10°c.

(i) Cf climate - (European type climate)
precipitation throughout the year, more than 1.2 inches in the summer month.
- This climates represents western Europe type of climate.

(ii) Cw climate - (China type climate)
- Dry winter, 10 times more precipitation in summer & driest month of winter.
- This represents china type climate.

(iii) Cfa/Caf: represent temprate zone where temprature is relatively higher in summer season & rainfall occurs throughout

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(iii) **Cs climate** - (mediterranean climate)
- Dry summers, three times more precipitation in wettest month of winter season.
- This represents mediterranean type of climate.

D: **Humid cold climates** -
- Temprature of coldest month below -3°c but of warmest month above 10°c.
- Ground surface covered with snow for several month of a year.

(i) **Df climate** - cool summer (10-15°c) & cold winter (0-5°c).
- Humid cold climate, no dry season.
- This are further divided into Dfa, Dfb, Dfc.

(ii) **Dw climate** -
- Humid cold climate, dry winter.
- Further divided into - Dwa, Dwb, Dwc.

E: **Polar climates**
- Temprature of warmest month less than 10°c, summerless climate.
- further divided into (i) ET & (ii) EF climates.

(i) **ET climate** - (Tundra climate)
- 'Tundra climate' temprature of the warmest month below 10°c but above 0°c.

(ii) **Ef climate** - (Polar icecap climate)
- Permanent snow field, temprature in all month below 0°c.

* **Limitations**:
1. Inter-relationship of climatic type with soil & vegetation by using faulty method.
2. Koppen ignored many other variables like distance from sea, vegetative cover, rotational impact, air pressure.
3. It use same formula of high lands & low lands are error.
4. The boundaries fixed are rigid boundries.

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CLASSIFICATION OF THORNTHWAITE:

- C.W. Thornwaite, an American climatologist presented climatic classificat° of North America in 1931.
- His scheme of climatic classification for world climates 1933.
- He modified revised second scheme of classification of world climates in 1948.

@ 1931 classification -

- Like Koppen, Thornthwaite also considered natural vegetation of a region as the indicator of climate of that region.
- He accepted the concept of precipitation and temprature control on vegetation, but also important factor of vegetation & climate.
- Thornwaite used two factors e.g. precipitation effectivness, and temprature effectiveness.

1) Precipitation effectivness -

- Precipitat° effectivness refers to only that amount of total precipitat° which is available for the growth of vegetation.
- Precipitat° efficiency ratio is calculated by dividing by total monthly evaporation:

~~P/E Ratio = 11.5 (r/t - 10)$^{10/9}$~~

- Precipitat° efficiency index is derived by summing the pricipitat° efficiency ratio for 12 month of a year:

$$P/E\ Index = \sum_{i=1}^{12} 11.5\ (r/t - 10)^{10/9}$$

where, t = mean monthly temp. in °f.
r = mean monthly rainfall in inches

* He identified 5 humidity zones on the basis of P/E Index -

Humidity Zones	Vegetation	P/E Index
A (wet)	Rainforest	127
B (Humid)	Forest	64-127
C (subhumid)	Grassland	32-63
D (semiarid)	Steppe	16-31

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* Thornwaite further subdivided each humidity zone into 20 subhumidity zones on the basis of distribution of precipitation -

1. Ar	5. Br	9. Cr	13. Dr	17. Er
2. As	6. Bs	10. Cs	14. Ds	18. Es
3. Aw	7. Bw	11. Cw	15. Dw	19. Ew
4. Ad	8. Bd	12. Cd	16. Dd	20 Ed.

where, r = adequate rainfall in all seasons.
s = rainfall deficient in summer.
w = rainfall deficient in winter.
d = rainfall deficient in all seasons.

2) Thermal effectivness -

- He belived that temp. had important contribut^{n} in the growth of vegetation
- He divised index of 'Thermal efficiency' or 'Temprature effectivness'.

① Thermal efficiency ratio — ~~T-E Ratio~~ $= (t-32)/4$

② Therm efficiency Index — $\sum_{i=1}^{12} (t-32)/4$

where,
t = mean monthly temp in °f.

* Thornwait divided the world into 6 temprature provinces:

Temprature Provinces	T-E Index
A' - Tropical	127
B' - Mesothermal	64-127
C' - Microthermal	32-63
D' - Taiga	16-31
E' - Tundra	1-15
f' - frost	0

* Temprature provinece sub-divided in to 32 types:

1.	A A'r	4	B A'r	11. 13	C A'r	21. D A'w	27. E A'd	30 B'	31. E' 32 f'
2.	A B'r	5	B A'w	12. 14	C B'r	22. D B'd	28. E B'd		
		6	B B'r	13. 15	C B'w				
3.	A C'r	7	B B'w	14. 16	C B's	23. D B'dw	29. E A'd		
		8	B B's	15. 17	C B'd	24. D B's			
	classmates			16. 18	C e'r	25. D B'd			
				17. 19	C e's				

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⑥ **1948 classification :**

- Thornwaite presented his modified scheme of climatic classificatn 1948.
- He again used previously devised three indices of - precipitation effectiveness, thermal efficiency and seasonal distribution of pricipitation.

• **Potential evapotranspiration :**

- He based on his new scheme of climatic classification on the concept of 'Potential evapotranspiration'
- The amount of transfer of both moisture and heat to the atmosphere from soils & vegetation, and is a function of energy recived from the sun.
- PE is calculated from the mean monthly temp. in °C with correlation for day length-

$$PE = 1.6 (10t/I)^a$$

Where, PE = Potential evapotranspiration.

I = the sum for 12 months of $(t/5)^{1.514}$

a = a further complex function of I

t = temp. in°c.

* Thornwait developed four indices to determine boundries of different elimatic types :

1. **Moisture Index - (Im) :**

Moisture index refers to moisture deficit or surplus, calculated given formula :

$$Im = (100S - 60D) / PE$$

2. **Thermal efficiency Index :**

Thermal efficiency is simply the PE expressed in centemeter- as refers above. The thermal efficiency derived from the PE value because PE in itself is a function of temprature.

3. **Aridity and Humidity Indices -**

These indices are used to determine the seasonal distribution of moisture adequacy.

DATE

4. Continental of thermal efficiency -

It refers to the percentage of mean annual potential evapotranspiration accumulating in three summer months.

- On the basis of seasonal moisture adequacy 2 major and 10 subclimatic types -

	Moist climates (A, B, C_2)		Aridity Index
1	r	little or no water deficiet	0 - 10
2	s	moderate summer deficiet	10 - 20
3	w	moderate winter deficiet	10 - 20
4	s_2	large summer deficiet	< 20
5	w_2	large winter deficiet	< 20

	Dry climates (A, B, C_2)		Humidity Index
6	d	little or no water surplus	0 - 16.7
7	s	moderate surplus	16.7 - 33.3
8	w	moderate surplus	16.7 - 33.3
9	s_2	large winter surplus	< 33.3
10	w_2	large summer surplus	< 33.3

Criticism:

① The calculations involves a lot of classification ; hence it is more difficult to use in determining the climatic type.

② Thornwaite does not determine his climatic boundries ~~bet~~ on the basis of vegetation boundries.

③ Thornwaite does not prepare world climatic map.

④ The data of PE are not available for all the places for a worldwide classification of climates.

DATE

World Climatic Types

a) Equatorial zone: (0°-10° N+S) -

1. Hot, wet equatorial: Rainfall all years round - 80 inches
   Equatorial Rain forest.

b) Hot zone: (10°-30° N+S) -

2. i) Tropical monsoon: Heavy summer, rain - 80 inches
   monsoon forest
   ii) Tropical marine: much summer rain - 80 inches
3. Sudan Type: Rain mainly in summer - 30 inches
   Savanna (Tropical grassland).
4. Desert:
   i) Saharan Type: Little rainfall, desert vegetat^n & scrub.
   ii) Mid-latitude Type: rain 5 inches.

c) Warm Temprate zone: (30°-45° N+S) -

5. Western margin: winter rain 35 inches
   (Mediterianean) medeterlan forest & shurb.
6. Central continental: Light summer rain - 20 inches.
   (Ste) steppe or temprate grassland.
7. Eastern margin: Heavier summer rain - 20 inches
   warm, wet forest & bamboo.
   Types: i) China
   ii) Natal
   iii) Gulf.

d) Cool Temprate - (45°-65° N+S)

8. Western margin: - more rain an autumn & winter - 30 inches.
   (British Type) - Decidious forest.
9. Central continental: Light summer rain - 25 inches
   (Siberian Type) - Evergreen coniferous forest.
10. Eastern margin: Moderate summer rain - 40 inches.
    (Laurential type) mixed forest (coniferous and
    Decidious)

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e) Cold zone (65° - 90° N+S)

11. Arctic or Polar : Very light summer rain - 10 inches

Tundra, mosses, lichens.

f) Alpine zone

12. mountain climate : Heavy rainfall (variable)

Alpine pastures, coniferous, fern, snow.

DATE

Instruments

No.	Instrument	Elements
1.	Rainguage	- Precipitation
2.	Barometer	- Pressure
3.	Hygrometer	- Relative Humidity
4.	Wind vane	- Wind Direction
5.	Anemometer	- wind speed
6.	Altemeter	- Altitude
7.	Evaporimeter	- Rate of evaporation.
8.	Hydrometer	- Specific gravity of liquid.
9.	Hypsometer	- absolute height above sea level.
10.	Solarimeter	- Intensity of solar radiation.
11.	Barograph	- Recording of atmospheric pressure.
12.	Cathetometer	- Height.
13.	Pyrometer	- very high temprature.
14.	Cryometer	- very low temprature.
15.	Fathometer	- Ocean depth.
16.	Manometer	- Pressure of gases.
17.	Photometer	- luminous intensity of the source of light.
18.	Radio micrometer	- Heat radiation.
19.	Salinometer	- Salinity of solutions
20.	Atmometer	- Rate of evaporation.
21.	Actinometer	- solar radiation.
22.	Nephoscope	- Height, movment & velocity of clouds.
23.	Lysimeter	- Actual evapotranspiration.
24.	Psychometer	- Relative Humidity.
25.	Pyranometer	- scattered radiation on a surface.
26.	Thermostat	- Regulates temp. to a particular point.

DATE

Isopleth

No.	Type	Connect point of equal
1.	Isallobar	- change in atmospheric pressure.
2.	Isobath	- Depth below the surface of an ocean.
3.	Isobathytherm	- Temp. at a given depth.
4.	Isobar	- Atmospheric pressure.
5.	Isotherem	- mean summer temp.
6.	Isocheim	- mean winter temp.
7.	Isogeotherm	- Temp. of earth's interior.
8.	Isotach	- wind speed.
9.	Isohel	- sunshine duration.
10.	Isohyet	- Rainfall amount.
11.	Isohypse	- Height above sea level.
12.	Isoneph	- Degree of cloudiness.
13.	Isonif	- Amount of snowfall.
14.	Isoryme	- frost intensity
15.	Isohaline	- salinity.
16.	Isotherm	- Temprature.
17.	Isoseismal Line	- Intensity of shock from an earthquake.
18.	Isothermobath	- Sea water temp. at a given depth.
19.	Isobront	- Thunderstorm at the same time.
20.	Homoseismal Line	- Affected at the same time by an earthquake shock.

DATE

Heat Island:

'The urban areas are slightly warmer than the adjoining regions due to absorption and storage (failure to radiate) of solar radiation by the urban fabric & the heat generated by the city's, industries, building & traffic. This is known as heat island'.

DATE

Economic Geography :

- Location of economic activities and spatial organisation of economies.
- Classification of economies.
- Sectors of economy : Primary, Secondary, Tertiary & Quaternary.
- Natural Resources : Renewable and non-renewable.
- Conservation of Resources.

Industrial Geography :

- Classification of Industries:
- Weber's and Losch Approches.
- Resource based and foolloose Industries.

Geography of Transport and Trade:

- models of Transportation and transport cost.
- Accessibility and Connectivity: Inter-regional and Intra-Regional, Comparative cost advantages

Agriculture Geography :

- Concept and techniques of delimitation of agricultural regions.
- Measurment of agricultural productivity and efficiency.
- Crop combination and Crop Diversification.
- Von Thunen's Model.
- Agricultural system of world.

DATE

Books:

- Human and Economic Geography : Leong and Morgom
- A Handbook of Commercial Geography : George chishlom.

Concepts :

- Diffusion of innovation - Hagerstand.

DATE

Economic Geography:

'Economic Geography is the study of areal variation on the earth's surface in man's activities related to producing, exchange and consuming wealth'. or:

'A study of interregional and intraregional cause and effect relationship of economic activities'.

Location of Economic Activity:

- The fundamental geographic fact is location. Some one asking where is corn being farmed?
  maps provide clearest and quickest answer to the location.
- Maps exist the geographers will have to construct one for himself. maps as a basic tools & ultimate essential understanding of areal relationship.

- The idea of pattern or distribution may facilitates our grasp of the concept of location.
  e.g. Population map show the distribution of people over the earth.

'An area is any portion of the earth's surface that is homogeneous in terms of any selected geographic element or group of element'.

- It is a distinctive portion of the earth surface. The terms region, belt, zone, land and relam to identify such portion of the earth.

Q. What are the characteristics of Economic Activity?

After the geographer has pinpointed all the places where corn grown,

(i) what are the characteristics of corn farming?
(ii) How many acre farm occupy?
(iii) what kind of animals, buildings are them?

- The Geographer must first decide what are the significant characteristics of corn-farming regions are.
- He finally decides wherein on his map to draw the boundries of those distinctive regions.

Member of SAARC : India, Pakistan, Bangladesh, Nepal, Bhutan, srilanka, Maldive.

DATE

Economic Activity and their relationship to other Phenomena :

1) Cause and effect -

- An understanding of causal relationship us to answer such questions are these
  Where? what? & why? it is there.
- Geographers belive these questions to be the important part of analysis.

e.g. The impact of corn farming upon soil erosion?
What roles does corn farming play in economic life?

2) Physical and Cultural Relationship :

- The physical enviorment i.e. moisture, heat, soil, terrain & soon that exist in a region apart from man and his works.

e.g. coal cannot be mined in regions that lack coal deposits.

- Cultural attributes differ from place to place as surely as do physical ones, and economic activity is strongly related to both.

e.g. N. Africa & N. Australia similler physical enviorment, But there relation to European countries are different.

3) Internal and External Relationship -

- To analyze relationship betn spatial variables is to consider those that involve features with a region and those that link the region to other region.

ex (i) Corn farming related to local phenomena season, climate, degree of mechanization & transportation.. such association within a region are termed 'internal relationship'.

(ii) Demand for meat in one region related to specilized agriculture in another. such associatn betn different regions are termed external relationship.

4) Analysis of Correlation :

- These Ist three approches to the question of relationship have been used for some time and are rather well known. more recent in fourth approch, analysis of co-rrelation.

DATE

Classification of Economies:

- All town and cities are provided with nine industrial categories of workers:

- **Standerd Industrial classification-**

i. Cultivation.
ii. Agricultural Labour.
iii. Forestry, fishing, mining.
iv. Household Industry.
v. Manufacturing other than household industry.
vi. Construction.
vii. Trade and commerce.
viii. Transport, storage and communication.
ix. Services.

'CAFHOCTTS'

- The 1st three categories represent primary activities.
The categories IV and V th represent secondary sector. and
The categories VI, VII and VIII, IX represents tertiary activities.

- आर्थिक भूगोल' हा शब्द सर्वप्रथम 1882 मध्ये 'ग्रॉलमन' या जर्मन तज्ज्ञाने प्रचलित केला.
"स्थानदृष्या प्रदेशातील वस्तू व सेवा यांचे उत्पादन, विनियोग, उपभोग यांच्यातील क्षेत्रीय भिन्नता, श्रेणी त्या प्रदेशातील आर्थिक हालचालींचा कार्यात्मक सहसंबंध यांची चौकशी करणारे आर्थिक भूगोल होय."

DATE

SECTORS OF ECONOMY :

a) **Production :**

Human activities which generate income are known as economic activities. Economic activities broadly grouped into primary, secondary, Tertiary and Qutarnary activities.

1) **Primary Sector -**

"The economic activities which are concerned with direct extraction of materials from the earth surface".

Example - Gathering, Fishing, Hunting, Agriculture subsistance and modern, mining etc.

- The output of such primary production often needs further processing and is the basis of secondary activities.
- Primary producer might be labled as 'Red collor'.

* **Charactaristics :**

(i) These occupation totaly depend on nature.
(ii) A lot of man power required.
(iii) Depending on the availablity of natural resources, different primary occupations are carried out in different areas.
(iv) Compared to the labour inputs, the returns are quit low.

2) **Secondary Sector :**

"These are used as raw material and processed to obtain new and more useful things. The things thus obtained are called finished products".

* Occupations that involve manufacturing of finished products from raw material are called secondary occupations".

Example : Obtaining cloth from cotton or sugar from sugarcane.

- It includes manufacturing industries and footloose industry Processing, Transforming and Assembling.
- These producers called 'Blue Collor' labour force.

* **Charactaristics -**

(i) The manufacturing items better utility and greater value.

DATE

(ii) Machinary used on large scale.
(iii) Mass production of items become possible.
(iv) Compaired to the labour inputs, the returns are high.
(v) From perishable material, long lasting items can be obtained.

3) **Tertiary Sector:**

'Those economic activities which are concerned with the exchange and consumption of goods and services are called tertiary activities'. 'Pink colour sector.'

* **Example -**

(i) Trade & commerce - wholesale and retail.
(ii) Transport - road, rail, air, water.
(iii) Communications - Telephone. T.V. Radio, Newspapers.
(iv) Services - Banking, Insurance, Personal and Professional
- The people worked in this sector are called 'Pink Collor' labour force.

* **Charactaristics -**

(i) These not produce any item.
(ii) These sector provide service to the society.
(iii) The availabof these services, one has to pay the cost.

4) **Quaternary Sector:**

- It include special type services, focusing on professional and administrative services.

Example:

Financial and Health services, focusing on proffessional and administrative services, Education, Information and data processing services, middle manggment, administrativ and Government services

- These people called 'White collar' work force.

* **Charactaristics -**

(i) Certain services need special skills.
(ii) All these people work in service sector i.e. knowldge oriented.
(iii) Quaternary activities involve research, development and classmate services.

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5) Quinary Sector :

- The highest level of decision makers or policy makers perform quinary activity.
- It is more small size in comparision to other group of direction.
- Cheif executive officer, scientific research and development services.
- The people engage in this activity called as 'Gold collar'.

6] Exchange :

- Besides the goods and services, occupations people engaged in exchange of item. Wherever it involving handling fright, wholesaling, storage, telecommunication or transport also play an important role in modern economies.
- most exchange increase the value of an item because of service provided.

7] Consumption :

- The third aspect of all economic activity involve the consumption of goods and services.
- The term consumption refers to their final or direct use of goods and services to satisfy the wants and needs to human being.

- जगातील 16% लोकसंख्या आयातीत आघाडीचा देश 1.5% पेक्षा जास्त आयात होतो, तर अविकसित जगातील लोकसंख्या 0.25% पेक्षा जास्त 33% होतो.

→ 'Resources' as 'Resources are not they become' — Hartshorne. DATE

Natural Resources: Renewable and Non-Renewable -

Net-Dec. 2009

* **Natural Resources -**

'All those element of the earth which are useful and necessary to man are consider as Natural Resources'.

- Those are belong to natural enviorment and include both:
  (i) Abiotic - such as land, air, water, soils, minerals etc.
  (ii) Biotic - such as plant and animals.

- man is able to exploit to these resources through his skill and technology. All economic activity are raised with the development of resources. So, Natural resources called 'Nature free Gift'.

• **Classification of Natural Resources:**

1) **Renewable resources:**

- The capacity of reproduction and growth. As long as the rate of use is less than their rate of regeneration and as long as their enviorment kept suitable, They will go replacing themselves.
e.g. Solar, Wind, Tide, Biogas energy etc.

2) **Non-Renewable Resources:**

- Are not generated or reformed at rates equivalent to the rate at which we use them'.
- When these resources are gone, there is no hope of their replecment e.g. coal, Petroliam, Iorn-ore etc.

3) **Recyclable Resources:**

- A special type of non-Renewable resources - which are not lost or worn out by the way we use them and can be reprocessed and used again and again. e.g. metals etc.

4) **Inexhustible Resources:**

- 'Those such as sunlight, which will continue to pour on to the earth as long as huminity will be around, whether we use it in certain way or not'.

classmate PAGE

DATE

Renewable Resources :

Dec 06

- The non-convectional source of energy from waste material, sun, wind, biomass, tidal energy, & geothermal energy.
- These energy is abundant, renewable, pollution free and eco-friendly.
- The renewable energy programme started with the establishment of the Department of Non-Convectional energy sources in 1982.
- Indias non-convectional energy at about 1,95000 mw. as estimate (32%) sun, Ocean-thermal (30%), Biofuel (26%), wind (13%).

a] **Solar energy :**

- The solar energy is an extremely important component of renewable energy sector through both the thermal & photovoltaic routes.
- for application like cooking, water heating, water pumping, power generation etc.
- Scientist opinion that 'Thar Desert' could beggest solar power by the year 2010, producing 10,000 mw of electricity.
- A major chunk of the desert will be declared as 'solar Energy Enterprises zone' like the one in 'Nevada' (USA).

* solar photovoltic-(SPV) - conversion of sunlight into electricity without causing pollution.

b] **Wind Energy -**

- The cost inputs are only at the initial stage, once the generation starts, cost free power is available about 20 years.
- The first wind farms in India areas of Tamilnadu, Gujrat, maharashtra & Orissa. in 1986. 'Mandavi' (GJ).
- Wind energy potential in India at 45,600 mw.
- India 5th position after Germany, USA, Denmark & Spain.

c] **Biogas :**

- Biogas is based upon the use of dung to produce gas in the rural areas.

DATE

- The decomposition of organic matter consisting of methane (55-1.) CO_2 (45%) which can be used as a source of energy.
- These energy used cooking, lamps & stoves respectively.
- The community of Institutional Biogas plants programme was initiated in 1982-83.

c] Hydropower :

- Generation of electricity from hydropower source is a low cost, enviornment friendly & renewable source of energy.
  - (i) micro hydro : >100 KW
  - (ii) mini hydro : 101-2000 KW.
  - (iii) small hydro : 2001-15,000 KW.
- Models have been developed by the regional flow curves, geological and seismological data, vegetation cover etc. & using letest technique of GIS.

d] Geothermal Energy :

- Extensive surveys are being conducted to develop geothermal energy for direct heat & power generation.
- Geothermal pilot power plant has been commissioned at 'Manikaran' of Himachal Pradesh.
- Hot water converts in to steam drill to turbines, hot spring used for heating process.

e] Tidal Energy :

- These energy are created by ocean tide speed depend on a energy generation.
- In India Gulf of Khaimbhat, Kacchh, sunderban are major tidal power plant.

f] Urban Waste :

- Generation of waste is inevitable in many human activities, animals and plants life.
- In addition by industries, sugar mill, distilleries, pulp & paper mill, daires & farmaceutical industries etc.
- Twenty five 'waste-to-energy' projects for generation till march 2004

CLASSMATE PAGE

DATE

b] Non-Renewable Source Energy:

'Those resources which can-not generate or produce after once exploitation is called non-renewable resources'.

- The coal, petroleum, natural gas and electricity are convectional energy sources.

a] Coal:

- coal is found in the form of 'sedimentary rock' and used as fuel to supply light or heat.
- It is often called 'Black Gold' as the bridge in to the future.
- Coals originated forest land were burried under sediments in the 'Carboneferous age'.

Product^n Co8

1. China
2. USA
3. India
4. Aus
5. Russia
6. S. Africa

* Varities of coal -

(i) Anthrasite : (85-95%.) Black. Pennsylvania (U.S.A) 5%.
(ii) Bituminous : (60-80%.) Brown Black. 80%.
(iii) Lignite : (40-60%.) Brown coal, 15%.
(iv) Peat : (>40%.) Yellowish.

* Distribution:

(i) N. America - 38%. (ii) Asia - 46%. (iii) Europe - 14%.

b] Petroleum:

Product^n Co8)

1. S. Arabia
2. Russia
3. U.S.A.
4. Iran
5. China

- Petroleum (Petra 'rock' + Oleum 'oil') lattin word.
- This petroleum is oil obtained from rocks of the earth. Therefore it is called mineral oil.
- It consits of 90 - 95% hydrocarbons, remainig O_2, N_2, sulphar and organic metalic compounds.
- It used transportation on land, air and water.
- Oil and natural gas originated from animal or vegetable matter formation in middle or lower Tertiary Period.

c] Natural Gas:

Product^n (08)

1. Russia
2. USA
3. Canada
4. Iran
5. Norway

- Natural gas usually accompanies petroleum accumulations. Whenever a well for oil is drilled it is natural gas which is available before oil is struck.
- Dicovery of gas made rapid strides after 1985.

DATE

d) **Electricity:**

- Electricity plays a dominant role in the progress & prosperity.
- India's 1st power plant established on 'Kolkata'.

* Region: (i) requirment of power is very high. e.g. Mumbai.
(ii) Regions are located near coalfield e.g. singrauli
(iii) Power less developed in backward & sparce popln region.

* Types: The La Grande Complex in Quber (canada).

1) Hydroelectricity - The great extent on our ability to produce & use hydroelectricity other coal & petroleum exhaustable.

2) Thermal electricity -

It is generated by using fossil fuels like coal, diesel, and natural gas it is availablity of these fuels.

3) Nuclear energy -

It is obtained from uranium & Thorium. Uranium is available copper belt Jharkhand & Aravali range in Rajsthan, Kerala coast. Thorium Gaya (BI), Nellore. (Andhra), Udaipur, Jaipur (RJ).

Renewable	non-renewable
1. Natural resources can be genrated again & again e.g. -sun.	1. They are ~~re-generated~~ finished within a short span of time.

	Uranium:	Thorium
1.	Canada	1. Australia
2.	Kazakstan	2. India - Rajstant & A.P.
3.	Australia	3. Norway
4.	Namibia	4. USA
5.	Russia	5. Canada
		6. S. Africa.

Concept of 'Phantom Pile' - ~~शिमगा~~

DATE

June. 2018

Conservation of Resources :

'Resources needs to be conserved to protect our enviorment from drastic changes, to save the depleting resources for our future generations.'

1. Control on resources consume & damage.
2. Useful to us & how can we avoid it getting wasted.

DATE

Dec. 2008.

* TYPES of Economies :

1) Market Economy -

'An economic system in which individuals own and operate the factors of production'.

e.g. U.S.A., U.K., Japan etc.

2) Command Economy -

'An economic system in which the goverment owns and operates the factors of production.

e.g. - Cuba, china & Laos..

3) Mixed Economy -

'An economic system that has features of both market and command economies.

e.g. - India.

4) Traditional Economy -

'An economic system based on customs & traditions. Economy based upon agriculture and hunting.

e.g. - Chad, Haiti & Rawanda.

- U.S.A. - (where free enterprise regions, the goverment plays a major role in the economy.
  - minimum wages, social security, & regulatory policies are are examples of goverment involvment.

- China - some private ownership of buisness is allowed, however the goverment still maintain tight control over the factors of production and prices.

- USA & china are mixed economies because they contain both market & command economies features, the role that the respective goverment play in the economy are quite.

DATE

(a) Land Resources :-

1) World - i) Urbanized & non agricultured - 37%.
ii) Forest - 30%.
iii) Grassland & Grazing - 22%.
iv) Agriculture - 11%.
100%.

2) India :
(i) Agricultural 154
(ii) Forest 74
(iii) ~~Non~~ Urbanised & Industralised 45
(iv) Non-agricultural 35
(v) Fallow land 11

(b) Forest Resources :

(i) Africa - 38%.
(ii) Latin America - 25%.
(iii) Asia - 14%.
(iv) U.S.S.R. - 14%.
(v) Europe - 8%.
(vi) N. America - 11%.
(vii) ~~Global~~ = - ~~100~~ %.
0

India :

(c) Energy Sources -

(i) mineral oil - 37.73 %.
(ii) Coal - 25.23 %.
(iii) Natural Gas - 24.26 %.
(iv) Atomic energy - 6.49 %.
(v) Hydro electricity - 6.29 %.

DATE

- **National Income Index :**
  - एखाद्या देशाचा वास्तव राष्ट्रीय उत्पादनात दीर्घकाळ वाढ होत असेल तर त्या देशाचा आर्थिक विकास होत आहे असे समजले जाते.
  - राष्ट्रीय उत्पादनात दीर्घकालीन होणारी सातत्यपूर्ण वाढ ही आर्थिक विकासाचा मानदंड मानला जातो.

- **Per capita Index -**
  - वास्तव राष्ट्रीय उत्पादनाचा देशाच्या लोकसंख्येने भागले असता दरडोई उत्पन्न मिळते. दरडोई उत्पन्नावरून देशातील प्रत्येक व्यक्तीचा राहणीमानाचा दर्जा समजतो.

$$P.C.I = \frac{\text{Nation Production}}{\text{Country Total population}}$$

- **Economic Welfare Index -**
  - एखाद्या देशाचा आर्थिक विकास किती झाला हे त्या देशातील लोकांच्या कल्याणावरून लक्षात येते.
  - आर्थिक विकास प्रक्रियेत राष्ट्रीय उत्पन्नाचे समान वितरण व किमतीच्या पातळीचे स्थैर्य ही घटकिया राखायलेही आवश्यक आहे.

- **Social Index -**
  - यामध्ये आरोग्य, अन्न व पाणीयांचे सेवन, साक्षरता, शिक्षण, रोजगाराच्या संधीचे विकासाचे पर्यावरण, मूलभूत गरजांसाठीचा उपभोग, चांगली निवासव्यवस्था, कुटुंबनियोजन, मनोरंजन व सामाजिक सुरक्षितता इ. निर्देशकांचा समावेश केल्याचे आढळते.

- **Human Development Index -**
  - मानवी विकास मापकामध्ये आंतरराष्ट्रीय पातळीवर आयुर्मर्यादा, बालमृत्यूदर, बालकल्याण, महिला सबलीकरण, आयुर्मान, शिक्षण, साक्षरता, उत्पन्न, सार्वजनिक आरोग्य, वैद्यकीय सुविधा, आहार व पोषण, दारिद्र्य निर्मूलन, रोजगाराच्या संधी इ. समावेश असल्याचे आढळते.

HDI No.	Country	HDI value	HDI No.	Country	HDI value
1	Norway	0.939	81	Srilanka	0.735
2	Australia	0.936	87	China	0.715
3	Canada	0.936	115	India	0.571
6	USA	0.936	127	Pakistan	0.498
9	Japan	0.934	132	Bangladesh	0.476
55	Russia	0.775			

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शाश्वत विकास (Sustainable Development) -

'It is development that meets the needs of the present without compromising the ability of future generation to meet their own needs'.

The Earth summit / Rio Conference - 'Rio-de-Ganerio'

1992 United Nations conference on Enviorment & Development (UNCED.)

Agenda - 21 :

हा या परिजदेतील पाच महत्वपूर्ण करारांपैकी एक होता.

- या करारामध्ये 21 व्या शतकाच्या शाश्वत विकासासाठी सामाजिक, आर्थिक व राजकीय क्षेत्रासाठी जागतिक स्तरावर कृती आराखडा निश्चित करण्यात आला.

Globalisation (जागतिकीकरण) -

(i) उपभोग्य वस्तूंसह सर्व वस्तूवरील आयात निर्यातीचे इच्छा-रद्दाने शुल्क करणे.

(ii) आयात जकातीचे दर कमी करणे.

(iii) सार्वजनिक क्षेत्रातील उपक्रमांचे खाजगीकरण करणे होय.

'जागतिकीकरण म्हणजे जागतिक अर्थव्यवस्था निर्माण करण्याची प्रक्रिया होय'.

DATE

Concepts:

- ~~Wes~~Losch - Market Area location Theory.
- ~~Fes~~Weber - Least cost Theory.
- Reily - ~~Agglomeration~~ Theory of Gravitation
- Thombson - Agglomeration Theory

DATE

INDUSTRIAL GEOGRAPHY :

Factors Influencing The Location of Industries :

I] Geographical factors :

1) Raw materials -
- The location of industrial enterprises is sometimes determined simply by location of the raw materials.
- The jute mills (W. Bengal), Sugar mills (U.P.), cotton textiles (MH) are concentrated close to the source of raw materials.

2) Power -
- Regular supply of power is a pre-requisite for the localisation of industries.
- Coal, Petroleum oil & hydro-electricity are three important conventional source of power.
- TISCO (Jamshedpur), Khetri (RJ), Renukoot (UP), Ranga (PB). are near the source of power.

3) Labour -
- The location of any industrial unit is determined after a careful balancing of all relevant factors.
- The light consumer goods & agro-based industries generally require a plentiful of labour supply.

4) Transport -
- Transport by land or water is necessary for the assembly of raw materials and for marketing of the finished products.
- A particular industry owes to original transport facilities available in a particular area.

5) Market -
- Nearness to market is essential for quick disposal of manufactured goods. It helps to reducing transport cost.

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- Ready market is most essential for perishable and heavy commodities.
- It is more true that industries are seeking locations.

6) Water -
- Many industries are located near rivers, canals & lakes. e.g. Iorn & steel ind, Textile Ind, chemical industries. require large quantities of water.

7) Site -
- It should be flat & well served by adequate transport facilities.
- Large areas are required to build factories.
- To set up industries in rural areas to shot up land cost, labour cost as compair urban centres.

8) Climate -
- Climate plays an important role in the establishment of industries at a place.
- Extremely hot, humid, dry or cold climate is not suitable for the establishment of industries.
- Cotton textile industry requires humid climate.

II) **Non -Geographical factors:**

1) Capital -
- Modern industries are capital -intensive and require huge investments.
- Capitals are available in urban centres. eg. Mumbai.

2) Goverment policies -
- Goverment activities in planning the future distribution of industries, for reducing regional disparities.
- It is of relevance to examine the influence of India's

DATE

3) Industrial Inertia -

- Industries tend to develop at the place of their original establishment though the original cause may have disappeared.
- This phenomenon is referred to as inertia, sometimes as geographical inertia & sometimes industrial inertia.

4) Efficient Organisation -

- Bad management, financial trouble does not handle the labour force efficiently & tactfully.
- Strikes and lock-outs leads to the closure of industries.
- Hence, there is an imperative need of effective management and organisation to run the industries.

5) Banking facilities -

- Establishment of industries is possible through banking facilities.
- The area with better banking facilities are better suited to establishment of industries.

6) Insurance -

- There is a constant fear of damage to machine and man in industries for which insurance facilities are badly needed.

DATE

CLASSIFICATION OF INDUSTRIES:

I. On the Basis of strength of Labour -

1) Large scale Industry:

'Industries which employ a large number of labourers in in each unitti are called large-scale industries.'

- Cotton or jute textile are large scale industries.

2) Medium scale Industries -

'The industry which employ neither very large nor very small number of labourers are put in the categories.

- Cycle, Radio and Television industries.

3) Small scale Industries -

'The industries which are owned and run by individuals & which employ a small number of labourers are called small scale industries.'

II On the Basis of Raw-material and finished Goods:

1) Heavy Industries -

Industries which use heavy & bulky raw-materials and produce products of the same category are called heavy industries.

e.g. Iorn & steel industries.

2) Light Industries -

The light industries use light raw-materials & produce light finished products.

e.g - electric fans, sewing machins are light industries.

III. On the Basis of ownership -

1) Private sector Industries -

Industries owned by individuals or firms such as Bajaj Auto or TISCO situated at Jamshedpur are called private sector industries.

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2) Public sector Industries -

Industries owned by the state and its agencies like Bharat Heavy Electricals Ltd., Bhilai steel plant or Durgapur steel plant are public sector industries.

3) Joint Sector Industries -

Industries owned jointly by the private firms & the state or its agencies such as Gujrat Alkalies Ltd., Oil India Ltd. fall in the group of joint sector industries.

4) Co-operative sector Industries -

Industries owend and run - co-operatively by a group of people who are generally producers of raw materials of the given industry such as a sugar mill owned and run by farmers are called co-operative sector industries.

IV. On the Basis of Source of Raw Materials:

1) Agro-Based Industries -

Those industries which obtained raw-material from agriculture. Cotton textile, jute, sugar & vegetable oil are on these group.

2) Mineral Based Industries -

The industries that recive raw materials primiarly from minerals, such as iorn & steel, aluminium, cement industries etc.

3) Pastrol Based Industries -

These industries depend upon animals for their raw materials Hides, skins, bones, horns, shoes, dairy etc. are some of the pastrol industries.

4) Forest Based Industries -

Paper card-board, lac, rayon, resin, tanning of leather, leave utinsils, basket industries are included.

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V. Miscellaneous Industries -

1) Village Industries -
- It is located on village due to the needs of the rural people.
- They usually provide employment in local machinary such as oil extraction, grain grinding & agricultural implements.

2) Cottage Industries -
'Industries which artisans set up in their own houses, work with wood, cane, bars, stone etc. are called cottage industries'.
- Handloom, khadi & leather work.

3) Consumer good Industries -
Consumer industries convert raw material in to finished product. Textile, Bakaries, sugar etc. are called consumer industries.

4) Ancillary Industries -
The industries which manufacture parts & components to be used by big industries for manufacturing heavy articles like trucks, buses, railway engine, tractors etc. are called ancillary industries.

5) Basic Industries -
Industries on which depend many other industries for their manufacturing processes are called basic industries.
e.g. Iorn & steel industries.

6) Capital - Intensive Industries :
Industries requiring huge investment are called capital intensive industries.
e.g. Iorn & steel, aluminium & steel etc.

7) Labour - Intensive Industries :
It require huge labour force for running them are called labour - intensive industries.
e.g. - shoe making & Bidi manufacturing.

Classmate

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INDUSTRIAL LOCATION THEORIES:

- The 'optimal Location' - the economically best location, those their give maximum profits.
'When the cost are at their lowest and the revenues their highest.'
- It happens that these two situation are found at the same time or same place.

① Least cost location: 'weber'

'Revenue are taken equal at all location but variation in cost (of production) from place to place examined to find out the least cost location (optimum location)'.

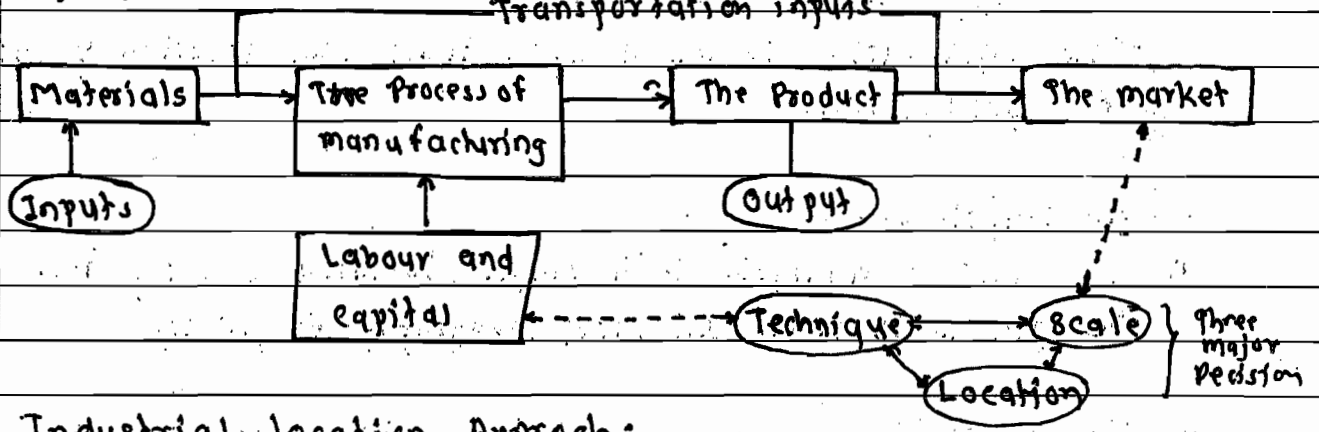
- Least cost theory has its roots in the work of 'Alfred weber'; demand factor is constant.

② Maximum Revenue Location: 'Losch'

'Cost of production takes equal at all places and variation in demand are examined to find out the maximum revenue location'.

- The maximum revenue, market area examine Palander & Hoover, much of 'Losch'.

fig: The location factor in the context of industry -



* Industrial location Approch:

i) Optimiser Behaviour : Least cost Approch
Maximum Revenue Approch or
Market Area or Locational Approch.

ii) Satisfier behaviour : Behavioural Approch
Structural Approch.

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Dec. 2003

A) **LEAST COST APPROCH :**

- The least cost approch emphasizes the search for the least cost location where the demand factor held constant.
- In this approch is the assumption of perfect competition, with no monopolistic advantages with respect to market arising from specific location.

Alfred Weber's Theory : (1909) -

- This theory based on least costs is proposed by 'Weber' in his book 'Theory of location of Industries' in 1909. (Uber den standort der Industries)
- He attempted show how it optimum location with respect to raw material and market.
- His approch 'deterministic' and 'normative'.

* **Aim of theory :**

- To explain the location of industrial activity in terms of three economic factors.
  ~ (i) Transport costs ~ (ii) labour costs and
  ~ (iii) agglomeration economies.
- His explaination is based upon least cost location point for production.

* **Assumptions :**

i. The unit of analysis is a single, isolated country i.e. homogenous in terms climate, topography, people etc.

ii. Transportation cost increasing in direct propotion to distance & weight of cargo.

iii. There is an uneven distribution of natural resources on the plain. Raw material are found specific location.

iv. Costs of land, building equipment, intrest are fixed capital.

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v. Labour is geographically fixed.

vi. The entrepreneurs seeks to minimise the total cost of production.

* **Principles :**

- Webers analysis of industrial location is divided in two sections:
  ① Identification of the point of minimum transport costs.
  ② A discussion of the circumstances under which production will be attracted away from this least cost point.

A] **Least cost Location Point -**

- There are three regional factors:
  ⓘ Cost of raw materials ⓜ transporting ⓛ Labour.

Ⓐ **Least transport cost point :**

- We suggest that transportation cost effects two factors:

i. The weight of materials to be assembled together with the weight of the final product to be shipped to the market.

ii. The distance over which the materials and the product have to be moved.

$$MI = \frac{\text{Weight of the localised materials used in the industry}}{\text{weight of the product}}$$

e.g. If 4 tonnes of raw material to make 2 tonnes finished goods, the material Index is

$$MI = \frac{4}{2} = 2.$$

1. **Case A :** One maket and one raw material -

① If the raw material is 'ubiquitos' - then factory will be located at market, because lowest transport costs.

② If the raw material is fixed i.e. specific location and pure i.e. weight loss zero, then factory will be located either market or at the source of raw materials.

either

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③ If the raw material fixed and gross, then the factory will be located source of raw material.

II. **Case B**: One maket and Two raw materials -

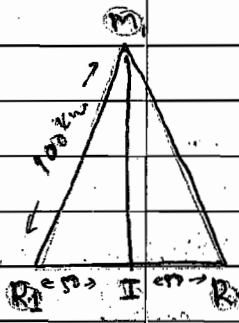
- The second case raw materials are available two plares 'R_1' & 'R_2' & finished product consumed at market 'm.'

① If R_1 & R_2 ubiqutous, then the manufacturing will be at the market.

② If 'R_1' is ubiqutous and 'R_2' are fixed both pure, then manufacturing will be at the market as well alternative location 'R_2'.

③ If both raw material R_1 & R_2 fixed and pure - then factory will be located at the market, otherwise the source of 'R_1' and 'R_2'.

④ If both raw material fixed and gross, the solution is complex.



If, the industry is to be located at R_1, the total transportatn cost will be;

(2 tonnes x 100 km x Rs. 1.00) + 100 = Rs. 300

If, the industry be located at R_2, the total transportatn cost will be:

(2 x 100) + 100 = Rs. 300

If, the industry will be located at marked 'm_1'. the total transportatn cost -

(2 x 100) + (2 + 100) = Rs. 400

If, the industry is to be located at 'I' or intermediate point betn the transportatn cost -

(2 x 50) + (2 x 50) + 86.6 x 1 = Rs. 286.

So, I or intermediate location will be the least cost location.

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b) Role of Labour:

- The effects of labour costs on location since he considered that industries would be located away from the point of least transport costs to the point of least labour costs if savings in labour costs were greater than any additional transport costs involved in such a move.

• Isotimes - 'The lines joining the points of equal transport costs'.

- All along the lines or isotimes the transportatn cost is the same per unit distance.

If, the least transportatn cost R.400 is at R_2 and total labour cost Rs. 500.

The total cost of production

Rs. 400 + Rs. 500 = Rs. 900

In case the labour cost at '0' situated at 12th isotime labour cost Rs. 400 + Transportation cost Rs. 250 + Rs. 120 (additional cost) = Rs. 770

In case of cheap labour, the factory will be located at '0' as the cost of production will be cheaper, being only Rs. 770 as against Rs. 900 of R_2.

c) Role of agglomeration -

- In A, B, C, D and E are least cost locations, but the firms located there could cut their productn costs by Rs. 1 per unit of production if at least three of them operated in the same location.

- However, they must not incur increased transport costs of over Re. 1 unit of production.

• Isodopane - 'The total transport cost'

- with the help of isodopane, identifies the areas in which the cost of productn & supply of the finished product would be the same.

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* **Criticism:**

(1) He gave more emphasis to supply, while the role of demand in the location of an industry completly ignored.

(2) Weber more emphasized the role of transport in the establishment of an industry.

(3) Agglomeration concept, ignored the problem of space, high cost of land & high rent in industrial areas.

(4) The historical factors, which are so important in the location of an industry, have not been considered.

(5) His assumptions about transport cost and effects of agglomeration have also been questioned.

① - Weber's model of industrial location has been usefully applied to interpret the changing location of the British iron and steel industry.

② - webers material index (mi) refers to ratio between: the weight of raw material & weight of product.

③ - steel plants of India has the least cost location in the ideal location triangle concieved by Weber - Bokaro.

Thombson : Agglomeration Theory.

DATE

B] **August Losch Approch : (1940)**

"Market Area Location Theory"

- Losch developed a general theory of location with the major emphasis on demand.
- He sought to draw attention to the marketing factors and the idea of maximum profits related to sales revenue.

* **Aim of the Theory :**

'Losch sought to explain the size and shape of market area which a location would command the largest revenue'.

* **Assumptions :**

1. An isotropic surface.
2. Constant supply of goods / services.
3. Population is evenly distributed.
4. Demand decrease with an increase in price.
5. Entrepreneurs act as economic men, their main aim being up profit maximisation.

- 'If the price increases is the result an increase in transport cost demand would decreases with distance from production centre, the demand curve would be cone shaped and the market area circular.'

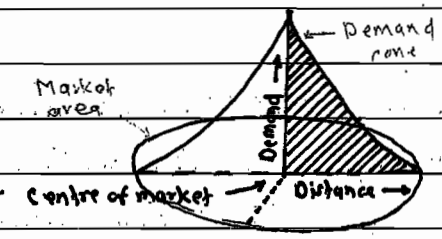


fig: Derivation of circular market area.

* **Statment :**

- There are many producers located on the plane. Each of them is equidistant from the other & their market areas are circular.

- The size of the market area is dependent on the number of producers The producers increas in number, market area become smaller and profits competed away.

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- The circles and producers leave in circular areas some places are unserved and they move closer thus hexagone are develops.
- Each product will represent a different sized market area i.e. the size hexagones varies.

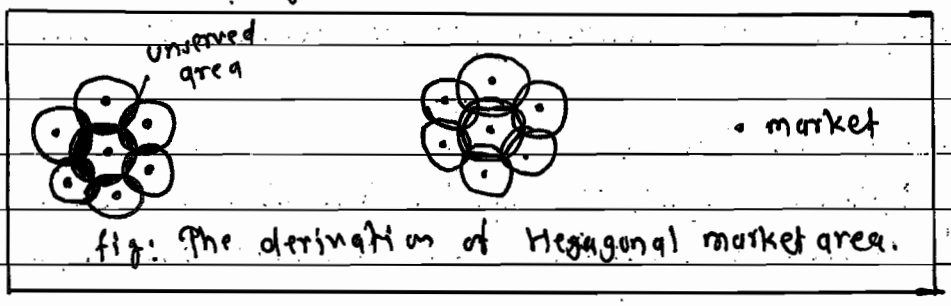


fig: The derivation of Hexagonal market area.

- Losch sought to find a spatial structure for both the producer and consumer.
- He was identified could be the centre for each of the 150 different hexagonal market areas.

- Losch arbitarilly chose just one production centre from the entire set of production points.
- He arranged hexgones so that this one centre was common to them all.
- He then, rotated hexagones around the central point and brought them to rest where the maximum number of hexagones coincided.

- 12 sectors thus emerged, arranged alternatively, so that six sector had many economic activities i.e. point of maximum demand and other six relatively few.
- The points of maximum demand will emerge as concentration of industry.

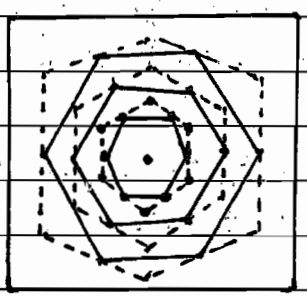


fig: Rotation hexagone around centre point.

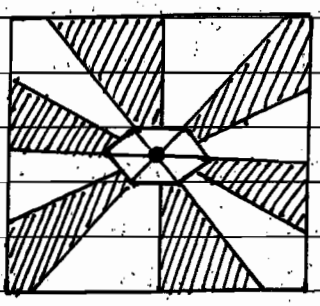


fig: Theoretical arragment of market areas & there derivation.

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+ Distance decay function - is not associated with a 'Transport system'.

DATE

* **Criticisms:**

1. The theory is abstract in nature.
2. It has failed to take into accounts, the problem arising from locational interdependence of plants.
3. It overemphasizes demand.
4. Market for products do not occur in isolation as they overlap.
5. Losch calculation of market demand was too crude and ignored many of the difficulties.

Christiller - C.P.T.	Losch - Location model
(i) Christiller model based on Bavaria province of southern Germany.	(i) Losch sampling for all over Germany.
(ii) Concept based on consumer and sellers behaviour, transport & administrative service.	(ii) Losch consideration into 150 commodities and services developed over 40 network.
(iii) Christiller treated each function as having seprate range, threshold & hexagonal hinterland.	(iii) Losch concept less restrictive than that of christiller.

DATE

Dec-2008
2005

Footloose Industries :

① " A manufacturing activity i.e. free to locate, where wants to and where transportation costs are minor element to total product cost is called footloose industries".

⑪ "These industries located anywhere, raw material are not wedded, such industries are footloose".

- In like manner, a footloose industries is not required to locate near its raw material or a power site".

• Example :
- Watch manufacturing, electronics manufacturing (T.V., Rad fan), Dying industries etc.
- It is assemble component parts, High technology, high level of information, inputs & brainpower.
- Some food processing, lightweight & access anywhere.

* Characteristics :

i. Light industries, which do not use raw material but component part.
ii. Their power required are not high.
iii. End product are small & often cheaper & easier to move.
iv. Non-polluting industries, which can be located near residential area.
v. Employs are small labour force.
vi. Accessibility, need to be near a road network.
vii. They are largely depend on component parts which can obtained any where

* Advantages :

① Locational advantages enjoyed footloose industries, they choose area of the greatest potential profit.
② Cheaper land value on the edge of city.
③ Accessibility to main road.
④ Pleasent environment.
⑤ Labour supply nearly residential areas.

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- Some industries near to market, such as bakaries, newspaper publishing firm and dairy product. Because their sole purpose is to provide their products with near immediacy.

- High technological industries are an ideal example of footloose industries.
e.g. - Computers, T.V., calculator, electronic game, washing-machine. etc.

'These operation are called 'ubiquitos industries' a close relation footloose firm.'

- "आपल्या उत्पादनाच्या बाजारपेठेच्या मागणी अनुरुप सोयी, प्रमाणात सुधारणा करणे आणि कुशल कुशलतेचा प्राप्त करण्याची क्षमता असणाऱ्या उद्योगांना 'स्वच्छंद उद्योग' (foot-loose industries) म्हणतात"

DATE

Resource Based Industries:

- Raw material are the basic requirment for manufacturing industries. These raw material are more important for heavy industries.

e.g. Engineering, metal goods etc.

- But with the expantion & development of means of transportation the role of raw material in the location of industries has almost lost its significance.

e.g. cotton textile in Liverpool (U.K.) and steel Industry (Japan) are established that fact are those countries sufficient capital and Technology.

DATE

- **Industrial Complex -**
  - 'Industrial complex is a large assemblage of manufacturing enterprises concentrated in a relatively restricted area form an industrial region.'

- **Industrial agglomeration -**
  'When two or more industrial complex forms a continious region over a large geographical area, they form industrial agglomeration'.
  ex - Osaka - Kobe metropolitan area (Japan).

- **WHO (world health organisation) -**
  मुख्यालय : जिनिव्हा (स्वित्झर्लंड)
  कार्यान्वित : 7 एप्रिल 1948 '7 एप्रिल' - जागतिक आरोग्य-दिन
- जागतिक आरोग्य संघटना : (W
  ① UNICEF : United Nations International children's Emergency fund
  ② CARE : Co-operative for Assistance & Relief Everywhere.
  ③ रेड क्रॉस : International Red cross.
  ④ FAO : Food & Agricultural organisation.
  ⑤ MCI : Medical council of India.

- जगात इंटरनेटच्या बाबत सर्वात जास्त U.S.A. असून चीनचा दुसरा क्रमांक आहे. तर भारताचा 'नववा' क्रमांक आहे.

- **आय. टी. पार्क :**
  - १९९० च्या दरम्यान 'सॉफ्टवेअर तंत्रज्ञान पार्क' उभारण्यास प्रारंभ झाला.
  - भारतात मुंबई, बंगलुरू, चेन्नई, दिल्ली, हैदराबाद व पुण्यात I.T. पार्क भारतात आढळतो.
- **भारतातील सिलिकॉन व्हॅली - पुणे.**
  - पुण्याची ओळख 'Infotech centre' अशी आहे.
  - C-DAC ने भारतात पहिला सुपर कॉम्प्युटर तयार केला.

DATE

(1) GATT - (General Agreement on Tariffs and Trade) - 1 June 1948.
(2) EEC - (European Economic Community) - 1 June 1958.
(3) EFTA - (European Free Trade Organisation) 1960.
(4) OPEC - (Organisation of Petroleum Exporting Countries) 14. Nov. 1960. 'Bagdad'
(5) UNCTD - (United Nations Conference on Trade & Development) Dec. 1964.
(6) SAARC - (South Asian Association for Regional Co-operation).
(7) ASEAN - (Association of south East Asia Nations) - 1967
(8) NAFTA - (North American Free Trade Agreement) - 1988.
(9) WTO - (World Trade Organisation - 1 June. 1995.

- GATT -
  - सुरुवातीला 23 राष्ट्रे सहभागी (1 जाने 1948).
  - 1974 - 84 तर 1997 - 137 राष्ट्रे सहभागी
  - सदस्य राष्ट्रांची वर्षातून एकदा सर्वसाधारण सभा होते.
- डंकेल प्रस्ताव -
  - गॅटची आठवी परिषद 1986 मध्ये उरुग्वे येथे 'तीव्र मतभेद'.
  - गॅटचे डायरेक्टर 'ड्यूंकी आर्थर डंकेल' यांनी तडजोडीचा मसुदा तयार केला. त्याला 'डंकेल प्रस्ताव' असे म्हणतात.
- WTO -
  - 1 जानेवारी 1995 मध्ये GATT चे रुपांतर WTO मध्ये करण्यात आले.

उद्दिष्टे : (i) उत्पन्नात वाढ घडून आणणे (ii) पूर्ण रोजगार प्रस्थापित करणे
(iii) व्यापाराचा विकास करणे (iv) पर्यावरण संतुलनासाठी उपाययोजना आखणे.

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MODELS OF TRANSPORTATION AND TRANSPORT COSTS:

- The exchange of goods and services is a central feature of economic activity.
- The transport geography is concerned with the study of transport as a space adjusting technique.
- The transport of goods from areas of surplus to areas of deficiency increase their value.

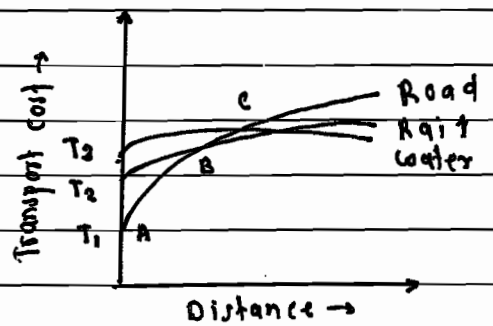
Example:

Iron ore commands a much higher value in 'Tokyo' than in Eastern India.

* Transport cost vary with a no. of reasons -
  1. Distance
  11. Type of terrain to be covered
  111. Type of carriers.
  1v. Type of compdity to be carried.
  V. Degree of competition from other carriers.

* Operating cost in Transport -

(1) mainly fuel cost and wages.
(2) cost of equipment involved.
(3) Indirect cost like insurance.



- Road transport is cheapest over short distance (A-B), rail over medium distance (B-C) and ocean transport long distance (beyond C)

But they may affected by local and some other factors.

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* The cost structure of different method of transport -

① The lowest rate are charged for non breakable, non-perishable commodities.
e.g- iorn ore, coal etc.

② Perishable goods needs special care & special arragment for its carriage.
e.g. milk, vegetables etc.

- In analysis of transportation network which of the follwing indices shows the highest centrality in the lowest value: Alpha Index.

- Taaffe's transportation model has a number of development phase: Four.

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ACCESSIBILITY :

- Geography is a spatial discipline concerned not only with the location of people and places but also, more important with the manner in which these interact.
- The concept of 'connectivity' considers the many pathways i.e. highways, air routes, sea-lanes, email & fax etc. that allow interaction betⁿ distant points.

Define :

① 'Accessibility is the concept that determine the efficiency of these pathways'.

② "It is measure of aggregate nearness, it is a direct expression of mobility either in terms of people, fright or information".

Example : The advent of the telephone dramatically increased the accessibility of users. In recent year cellular phones further increased accissibility.

- Travelling by automobile from suburban to the C.B.D. reflects variable accessibility; depending upon time of day.
These route rush during morning to 8 p.m.

Weather can affect accissibility -

- Blizzard and severe rainstorm will slow highway traffic, airport may be closed.
Here, again accessibility is diminished for a period of time.

Accessibility in Historical context -

- The movment in NewYork to pacific coast could take months. By contrast airport in New York City and arrive in San Francisco, for instance, in a matter of hours.
- Improvment in transportation technology 'bring place closer together' as the saying goes.

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Accessibility applied in social realm -

- During the era of 'apartheid' in south Africa, black south Africans were effectively excluded from access to sectors of the economy and social settings exclusive to whites.

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CONNECTIVITY:

'The directions of route linking pairs of places on indications of degree of internal connection in transport network'.

- More generally all tangible and intangible means of connection and communication betⁿ places.

Defⁿ: " Connectivity is a term applied to all of the possible ways in which people and places are connected."

Example -

In going to work or school, for the school student short walk across on several mile ride school bus in the city.

- People can easily speak with relatives in another state by telephone or through e-mail.

- It follows that there is direct relationship betⁿ the degree of connectivity across space and resultant measure accessibility.
- During the 'quantitative Revolution' numerical measures of connectivity were developed.
  The purpose of these measures was to determine the efficiency of a set of places.

- for Instance, two points (nodes) connected by one line (vertice) would be less efficient than having the two points connected by two lines.

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Rostow's Model:

- W. Rostow's proposed a five-stage model which tried to show how, over a period of many decades, nations develop from a traditional society to one of high mass consumption.

① **Tradition society -**

A traditional society contains a very high percentage of people engaged in agricultural and national wealth.
- Rostow's calls 'nonproductive' activities, such as the military and religion.

② **Precondition for Take-off -**

The influence of these well-educated leaders, the county starts to invest in new technology & infrastructure.
e.g. water supply & transportation.

③ **Take off:**

Take off industries achive technical advances and become productive. Rapid generated in a limited number of economic activities e.g. textiles & food products.

④ **The Drive to Maturity:**

Modern technology, diffuse to a wide variety of industries, which then experience rapid growth comparable to the take-off industries.
- Workers becomes more skilled and specilized.

⑤ **Age of mass consumption -**

The economy shifts from production of heavy industry, such as steel and energy, to consumer goods, like motor vehicles & refrigerators.

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High mass consumption	–	Durable consumer industries service industries
Drive to maturity	–	Growth to all sectors of the economy
The take off	–	Begining of one or more manufacturing industries
Preconditions for take-off	–	Export mining & cash cropping Development of roads & railways
Traditional society	–	Basic subsistance agriculture, craft industries

- more developed countries 4 or 5 stages and less developed countries have 3 stages.

Superlatives : सर्व मंगल मांगल्ये शिवे सर्वार्थ साधिके ।
शरण्ये त्र्यंबके गौरी नारायणी नमोऽस्तुते ।।

- Highest active volcano - ojas del salado
- Most active volcano - Kilauea, Hawaii.
- Highest waterfall - Angle falls
- Largest waterfall - Boyoma falls
- Largest Bay - Hudson Bay
- Largest Gulf. - Gulf of Mexico.
- Broadest Strait - Davis strait
- Largest Delta - Sunderban
- Largest Peninsula - Arabia
- Largest sea - south china sea
- Largest Glacier - Siachen glacier
- Largest gorge - Grand canyon
- Driest place - Atacama desert
- Rainiest place - Mawsynram
- Highest temprature - Al-Aziziyah, Libya.

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- Fundamental Concepts
- Factors Controlling Landform development
- Endogenetic and Exogenetic forces
- Denudation Process : Weathering and Erosion.
- Geosynclines and Mountain building.
- Continental drift and plate techtonics
- Concept of Geomorphic cycle.
- Landform associated with fluvial, glacial, arid, coastal and Karst.
- Slope forms and Processes
- Enviormental and Applied Geomorphology.

Development in Geomorphology.
Historical and Process Geomorphology.
Landforms in relation to climate, rock type, structure and techtonics.
Processes - weathering, pedogensis, mass movment, erosion, transportation and deposition.
Geomorphic processes and landform - fluvial, glacial, eolin, coastal and karst.
River forms and processes - stream flow, stage- discharge relationship.
Hydrographs and food frequency analysis.
Submarine relief.
Geomorphology and topographic analysis including DEM.
Enviormental change - causes, effects on processes and landforms.
Extraterrestrial geomorphology.

Isotasy
Rocks
Drainage Pattern & Process
Deltas
Period of Era

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Books:

- Alfred Wegener - 'Die Entstehung Der Kontinent and Ozeane (origin of continent and orean 1915).
- Morphology of the Earth - G.H. Dury
- Essays in Geomorphology - L.C. King
- Unstable Earth - J.A. Steers
- Techniques in Geomorphology - C.A.M. King
- Thornbury - Principles of Geomorphology.
- Strahler - Physical Geography.

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GEOMORPHOLOGY :

'Geomorphology is a science of landform'.

Greek word : Geo-means earth, morpho-means form & logy-means science.

- "Science of landforms including their history and processes of origin."
- "The science that analyses and describe the origin, evolution, form classification and spatial distribution of landforms."
- "It is discription and interpritation of the earth's relif features."

* Subject matter of Geomorphology -

(i) dimension and scale of relief features,
(ii) processes that shape the landforms, and
(iii) the approches to geomorphic studies.

- first order relief features : continent and ocean.
- Second order relief features: mountain, plateau, plains, fault, valley.
- Third order relief features: erosional & depositional landform e.g. running water, ground water, sea waves, wind, glacier and periglacial agents.

Development of Geomorphology :

a) Ancient Period -

some ideas of landforms were presented by philosopher and Historians of Greece, Romanand Egyptian.

(i) Herodotus :

He named depositional features at the mouth of a river as delta and propounded that -

'Egypt is the gift of Nile'

Herodotus

(ii) Aristotale:

He described the features developed of limestone, origin of spring and stream.

(iii) Strabo :

The size of delta varies depending on the nature of rocks of the region through which the river makes its course.

* James Hutton - Uniformitarianism
* J.W Powell - Base level
* G.K. Gilbert - Dynamic equilibrium
* C.E. Dutton - The Great Denudation Colorado DATE

b) **Rinaissance Period** : (1 A.D - 14 A.D.)

No significant development of geomorphology could take place during 'dark age'.

age of '**catastrophism**' -

- The theory that the earth's surface features are formed by catastrophic forces such as the biblical flood.
- Catastrophists belive in a young earth and a literal interpritation of the biblical account of Creation.

sudden origin & animate & inanimate objects.

'Catastrophism which belived in the quick and sudden origin and evolution of all animate and inanimate objects in very short period of time'.

- Concept of Catastrophism rejected by the advocate of uniformitarianism.

c) **Modern Geographical Ideas** :

- The term uniformitarianism first used by 'William Whewell (1832).

(i) **James Hutton**: 'No vestige of a beginning; no prospect of an end'.

- His concept of 'Present is key to the Past'.

* '**Uniformitarianism**' : 'that the same geological processes which operated today operated in the past and therefore the history of geological events respects in cyclic manner'.

- He was the first geologist to observe cyclic nature of earth history.
- He propounded the concept of 'no vesitage of begining : no prospect of an end'.

* **John Playfair** and **Charles Lyell** - further developed and prapogated the concept of uniformitarianism.

- The framework for geomorphic & geological history of earth.

(ii) **J.W. Powell** -

postulated the concept of limit of maximum vertical erosion by streams to which he proposed the term 'base level', which is determined by sea level.

(iii) **G.K. Gilbert** -

- praposed the concept of 'dynamic equilibrium' and introduced quantitative methods of the analysis landform.

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(iii) C.E. Dutton -
- This erosional epoch he designated as 'The Great Denudation'.
- His penetrating analysis of individual landforms and his recognition of evidence in the 'colorado plateau'.

(iv) W.M. Davis :
* His three major concept :
① complete cycle of river life (1889) ④ Normal cycle of erosion
① geographical cycle (1899) ⑤ Humid cycle.
⑪ slope evolution. ⑥ Two cycle Theory
- He emphasized progressive development of erosional stream valley through the concept of 'complete cycle of river life'.
- There is systematic landform developed by stages Youth, mature and old age stages.

(a) European School :
- Charpentier, ~~Playfair~~, Louis Agassiz : postulated concept of continental glacial and ice ages.
- James Geikie - published book 'The Great Ice Age in 1894'.
- Charpentier, Playfair, Venetz, Esmark - development of glacial geomorphology
- Sir Andrew Ramsay - contribution in marine geomorphology.
- J. Walther, Passarage - developed aeolian geomorphology.
- Penck & Bruckner - identified four glacial periods during Pleistocene Ice Age ① Gunz ⑪ Mindel ⑪ Riss ⑫ Wurm.

(b) American School :
- making maximum contribution in the field of geomorphology.
- from 1875 to 1920 are considered as 'golden age' of geomorphology.

(c) British school :
- The development of classical concept of denudation chronology and erosional surface.
- Concept of palimpsest : The chronological (historical) study of landscape development in historical prespective better known as denudation chronology'.

(d) Indian school : four centres - ① Allahabad Uni. ⑪ Calcutta Univ.

by- Jean de carpentier.

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Fundamental Concept of Geomorphology:

- There are certain fundamental concepts of Geomorphology which may be helpful in the interpretation of land spaces and the changes in the lithospher and asthenospher:

(i) 'The physical processes and laws operated throughout the Geological time with different intensity.'
- The 'principle of Uniformitarianism' wast enuciated by Hutton (1785).
- He gave the concept of 'Present is the key to the Past'.

(ii) Geological structure is a dominant controlling factors in the evalution of landform and is reflected in them.
- According to Davis controlling factors in the development of landforms are structure, process and stages.

(iii) To a large degree earth's surface possesses relief because the 'geomorphic processes operate at differential rates'.
- The intensity of particular possesses in such factors as- temprature, moisture, topographic configuration and type of vegetal cover.

(iv) Geomorphic processes gave their distinctive imprint upon landforms and each geomorphic process develop its own charactanistics assemblage of landforms.
e.g- flood plains, alluvial fans and deltas are produced of stream action.

(v) Due to action of different erosional agents upon the earths surface, an orderly sequence of land forms is produced.
- According to Davis; There are three stages of youth, mature and old in the sequential development of landforms.

(vi) 'Complexity of Geomorphic evolution is more common than simplicity'
Herberg (1952): grouped five major categories of landforms:
① simple ② Compound ③ monocycle ④ multicycle

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(vii) 'An appereciation of world climate is necessary to a proper under-standing of the varying importance of the different geomorphic processes.'
- Climatic variation may be affect the geographic process either directly or indirectly.
(i) Direct Influence - how precipitation, its intensity, temprature, wind.
(ii) Indirect Influence - amount & distribution of vegetal cover.

(viii) 'Geomorphology' concerns itself primiarly with the origin of the present landscape but in most landscape there are present forms that date back to previous geological epoch or period'.
- A geomorphologist must deal with a historical approch if he is to interpet properly the geomorphic history of a region.
- The study of anicent topographer is called 'Paleo-geomorphology'.

* In short:
(i) Principle of uniformitarianism.
(ii) Geological structure controlling landform evolution - structure, process, stages
(iii) Geomorphic process operate at differential rates.
(iv) Geomorphic process develop it's own characteristics.
(v) Landforms produces in orderely sequence - Youth, mature, old.
(vi) Complexity is more common than simplicity.
(vii) climatic variation affect on geomorphic process - directly & indirect
(viii) Paleo-geomorphology.

• climatic Geomorphology: developed in France & Germany'
'each climatic type produces its own characteristics assemblage of landforms'.

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Interior Of The Earth:

- The study of the interior of the earth is out side of the domain of geography, but it's knowledge necessary for geographers, Because the nature and configration of the relief of the earths surface largely depend on interior structure of earth.

* The sources which provide knowledge about interior of the earth:
  1. Artificial sources:- Density, Temprature and Pressure.
  2. Evidences from the theories of the origin of the earth.
  3. Natural sources
     e.g. volcanoes, earthquake and seismology.

1) Artificial Sources -

The change in temprature, pressure and density with depth can be estimated from the velocity of earthquake waves through the earth.

(i) **Density:** Cavendish - 5.48, Poynting - 5.49 gcm^{-3}, attempted.
- The avarage density of earth is = 5.5 $gm\ cm^{-3}$. / 5.517 $g\ cm^{-3}$
- The avarage density of earth surface = 2.6 to 3.3 $g\ cm^{-3}$
- The avarage density of core is = 11 $g\ cm^{-3}$
- Interior of earth increass the density 400 km - 3.5, 2900 km - 5.6, 5000 km - 9.7 & centre of earth - 12 to 12 $g\ cm^{-3}$.
- calculate density of earth on the basis of satellite.
- The density of core is the highest of all parts of the earth.

(ii) **Temprature -**
- The temp. at the rate 1°c for every 32 mtr of increasing depth.
- The temprature is around 1100°c at the depth of 100 km.
- The temp. at the depths of 400 km & 900 km has been estimated to be 1500°c & 1900°c respectively.
- The temp. at the junction of mantle and outer molten core standing at the depth of 2900° km is about 3700°c.
- The temp. at the junction outer molten core and inner solid core standing at the depth 5100 km is 4300°c.
- The temp. about centre of earth 4800°c.
- Tectonically active areas temprature remains (1000)°c higher than in tectonically stable areas (500°c) at 40 km depth.

100 km	3.5	1100	5200
2900 km	5.6	3700°C	23800
5100 km		4900°C	32900
centre	11	4800°C	35400

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(iii) **Pressure:**

- The high density of the core of the earth is due to very high pressure prevailing there because of superincumbent load.
- The earth surface pressure 14.7 lb. Base of lithosphere in 100 km is about 3200 lb
- The junction of upper mantle and transitional core in 2900 km is about 23800 lb
- The junction of Inner & outer core 5200 km about 32,900 lb
- The centre of earth is 35400 lb.
- The core must be composed of intrinsically heavy metallic materials of high density.

2) **Evidences from the Theories of the origin of the earth-**

- The theories of the earth have assumed the original form of the earth to be solid, liquid or gaseous.

(i) Planetesimal Hypothesis -

- The earth was originated due to accretion and aggregation of solid dust particles known as 'planetesimals'.
- The core of the earth should be 'solid state.'

(ii) Tidal Hypothesis -

- The core of the earth should be 'liquid state'. Because earth is formed by tidal materials ejected from the primitive sun.

(iii) Nebular Hypothesis -

- Nebular Hypothesis of 'Laplace' the core of the earth should be 'liquid state.'
- 'Zoepperitz and Ritter' have opened that the core of the earth has 'gaseous state.'

3) **Natural Sources:**

(i) Volcanicity -

- on the basis of upwelling and spread of hot and liquid lava on the earth surface during volcanic eruption that there is at least such a layer below the earth surface which is in liquid state.

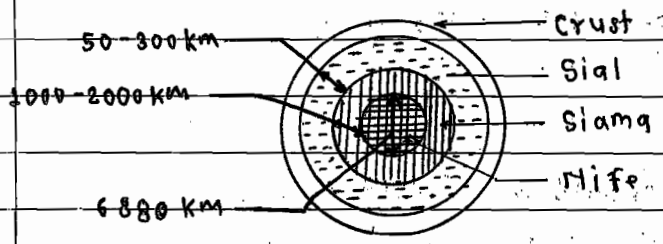
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(ii) Evidences of Seismology-

- 'Seismology is the science which studies various aspects of seismic waves generated during the occurance of earthquake'.
- Sesmic waves are recorded with the help of an instrument known as 'seismograph'.
- The place of the occurance of an earthquake is called 'focus' and the place which exprencies the sesmic event first is called 'epicentre'.
- The different type of termors and waves occurance during earthquake are called 'seismic waves'.
  which are genrally - (i) Primary (P) (ii) Secondry (S), (iii) Surface (L) waves.

Composition of Earth:

- According to 'E. Suess' has identified three zones of different matter below the outer thin sedimentory cover:



1) SIAL-

- This layer is dominated by Silica & Aluminium (SI+AL = SIAL).
- The avarage density of this layer is 2.9.
- Its thickness ranges betn 50 to 300 km.
- This layer is dominated by acid materials and silicates of potasium, sodium and aluminium are abounddantly found.

2) SIMA-

- This layer is dominated by Silica & Magnesium (Si+Mg = SIMA).
- Avarage ranges betn density 2.9 to 4.7.
- The thickness varies from 1000 km to 2000 km.
- The silicates of magnisium, calcium and iorn are most abounddantly found.

* महासागराचे तळ प्रामुख्याने Sima चे बनलेले असून
  ते खंडाच्या पेक्षा कमी घनता असल्याचे आढळून आले.

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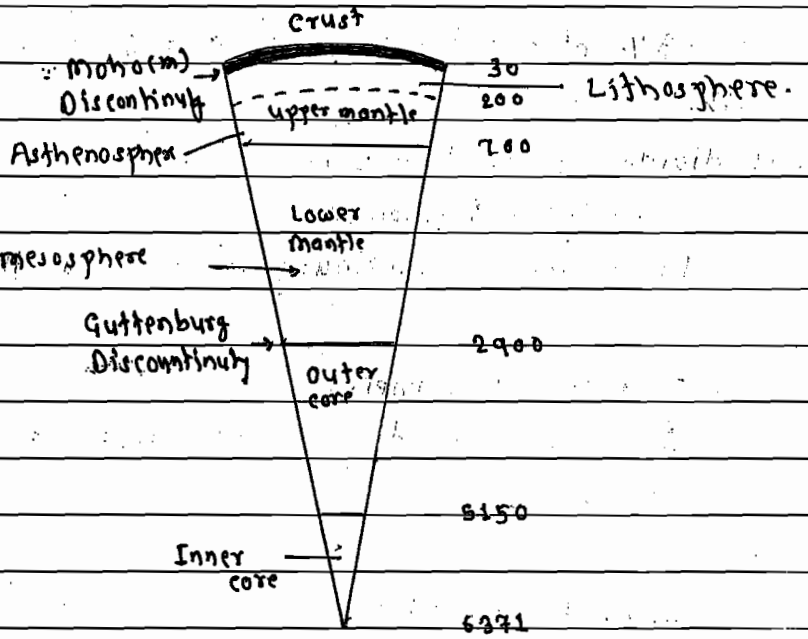
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3) **NIFE :**

- This layer is composed of nickel (NI) and ferrium (fe).
- This layer very high density (11) of this layer.
- The diameter of this zone is 6880 km.
- The presence of lorn (ferrium) indicates the magnetic property of the earth interior.
- 20% silicon + 80% iorn & nickel

Structure of Earth Interior :

- Three zones of varying properties have been identified in the earth on the basis of changes in the velocity of seismic waves while passing through the earth crust, mantle and core.



1) **Crust :**

is the outermost layer of the earth with avarage density 2.8 to 3.0 and avarage thickness of 30 km.

*Crust is further divided in to two parts :

① Upper Crust -

The avarage velocity of 'p' waves in 6.1 km/s and the speific gravity 2 to 2.7.

② Lower Crust -

The avarage velocity of 'p' waves in 6.9 km/s and the specific gravity 2.7 to 3.0.

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- **Moho-discontinuity**: (M-Layer)

The boundry betⁿ 'lower crust and upper mantle', where there is sudden increase in density and velocity of seismic waves downward is called Moho-discontinuity
- M-layer at the depth of about 32-2 to 48-3 km.

2) **Mantle**:

'represents the second zone of the interior of the earth and extends from 30 to 2900 km.'
- The mantle having mean density of 4·6 g cm^{-3} extends from the depth of 2900 km. inside the earth.
- The thickness of the mantle is less than half of the radius of earth (6371).
- It contains 83% of the total volume and 68% of total mass of earth.

* mantle was divided in to two zones:

(i) Upper mantle - or the Asthenosphere.
from moho discontinuity (200km) to the depth of 1000 km.

(ii) Lower mantle - or the mesosphere.
from 1000 km to 2900 km depth. mantle is formed silicate minerals.

- **Guttenberg discontinuity** - (G-Layer)

'The sudden changes in the composition and structure of the interior of the earth at mantle-core boundry is called Guttenberg discontinuity'.
- There is sudden changes of avarage density 5·5 to 10 at the depth 2900 km.
- which seprate lower mantle from outer core.

3) **Core**:

is the deepest and most inaccessible zone of the interior of the earth and extend from lower boundry of the mantle at the depth of 2900 km to the centre of earth up to 6371 km.

mesosphere : (2400 - 2750 km)

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- The density increases from 10 at the mantle core boundry downword to 11.6 at the centre of the core.
- The density of core is more than density at the mantle
- The volume of 16% and total mass of 32%.

volume-16%
mass-32%

*

* The core is divided in to two parts :

① outer core-

- outer core from 2900 km to 5150 km depth.
- 'S' waves disappear in outer core., liquid state.
- The outer core should be 'molten rock'.

② inner core-

- inner core from 5150 to 6371 km depth.
- The lower most zone is solid state.
- The density of which is 13.3 to 13.6.
- P waves travel throughth this zone with the speed 11.32 km/s.

• Boundries bet^{n} :-

① Sial and Sima - Conrad Discontinuty.
② Lower crust and upper mantle - Moho Discontinuty.
③ Upper mantle and Lower mantle - Repetti Discontinuty.
④ mantle and core - Gutenberg Discontinuty.
⑤ outer core and inner core - Lehman Discontinuty.

• Asthenosphere : (100-400 km)

- Upper zone of the earths ~~surface~~ mantle, extending from the base of the lithosphere to depths of about 250 km beneath the continent & ocean basins, relatively weak.
- It allows lateral movment of lithospheric plates and isostatic adjustment. 'soft plastic layer in the upper mantle)

• Lithosphere : (crust + solid uppermost mantle) 50 - 100 km.

- 'The lithosphere consits of the earth crust & the uppermost portion of the earth mantle'.
- ~~which~~ is divided to individual plates that move

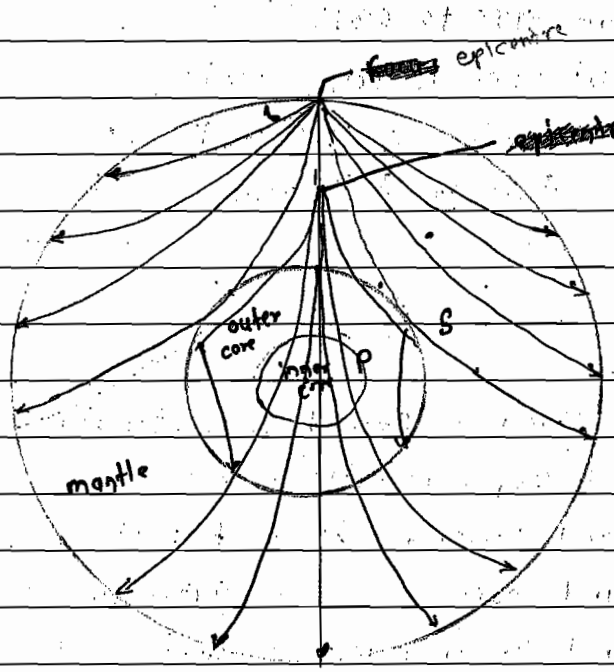
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SESMOLOGY :

'Sesmology is the science which studies various aspects of sesmic waves generated during the occurance of earthquake'.

- Sesmograph -
  - 'Sesmic waves are recorded with the help of an instrument known as sesmograph'.
- Focus - The place of the occurance of an earthquke is called' focus.
- Epicentre - The place which exprences the sesmic events first is called epicentre.
- 'The deepest focus has been measured at the depth of 700 km from the earth surface.



Barysphere -

- represents the innermost zone of the interior of the earth and extends from 2800 km depth to the nucleus of the core.
- The avarage density ranges betⁿ 8 and 11.

Pyrosphere :

- is the middle zone of the earth with a thickness of 2780 km.
- having an average density of 5.6.

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SESMIC WAVES:

- Seismology is the only reliable source which gives reliable knowldge about the interior of the earth.

* There are three types of seismic waves:

1) Primary waves (P-waves): longitudnal / compresional
- P-waves travel fastest, through the solid material.
- They can pass through liquid but their speed slow down.

2) Secondary waves (S-waves): transverse / Distortional-
- S-waves can not pass through liquid.
- The particles move at right angles to the rays.

3) Surface waves (L-waves):
- These wave covers the longest distance of all the seismic waves.
- Though their speed is lower than 'P' and 'S' waves but these are most violent and destructive.
- These can travel through solids, liquids as well as through gases.

* On the basis of Velocity sesmic waves are divided in three sets of waves:
  - (i) P-S waves - maximum velocity. 7-8 & 5-6 km/sec
  - (ii) Pg - Sg waves - minimum velocity. 5.4 km & 3.3 km per second
  - (iii) P* - S* waves - medium velocity. - 6-7 km & 3-4 km

1. Upper Layer - Jeffreys identified:
- Pg and Sg waves travel at the rate of 5.4 km & 3.3 km per second respectively in the upper part of earth.
- The density of the rocks is about 2.7 and is composed of granitic rocks.

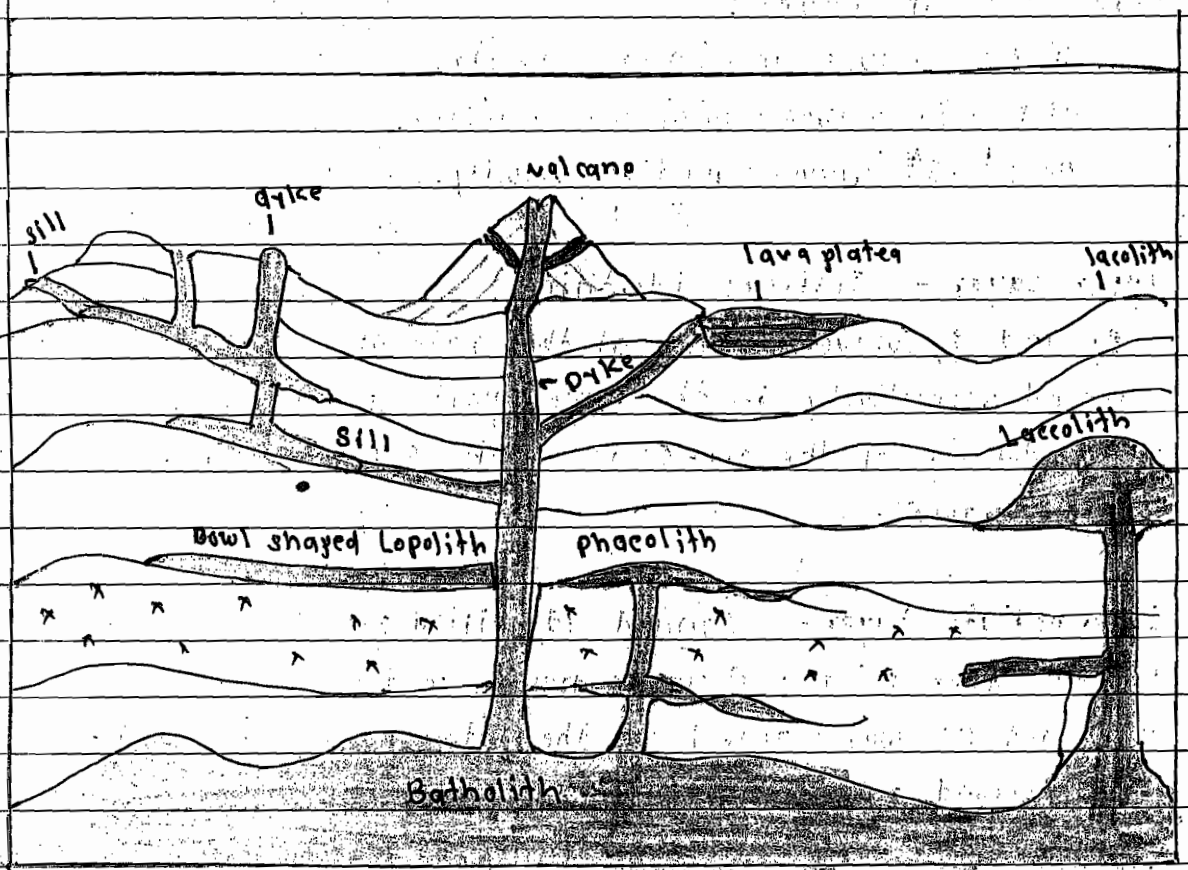
2. Intermediate Layer - Conard identified:
- These layer P* and S* waves travel on these layer.
- P* and S* waves travel at the rate of 6-7 km and 3-4 km per second respectively in middle zone of earth.
- Intermidiate layer avarage density of 3 inside the earth; and classmate layer is composed of basalt.

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3. Lower Layers -

- P and S waves penetrate up to greatest depth inside the earth.
- The velocity of P and S waves is 7.8 km & 4.5 km per second respectively.
- Lower layer of heavier materials, most probably peridotite or dunite.



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Vulcanism:

- Vulcanism includes all those processes and mechanisms which are related to the origin of magmas and gases, there ascent and appearance on the earth surface in various forms.

I] Extrusive Volcanic Topography:

a) From explosive type of eruptions -

1) Elevated forms (volcanic cones) - Explosive type of volcanic eruptions leads to the formation of several types of volcanic cones.

(i) **Ash or Cinder cones** -
- They are built where eruptions have predominance of pyroclastic materials e.g. - dust & ashes.
- They don't attain much height, hardly in excess of a few hundred meters and slopes ranges bet^n 30° - 45°.

(ii) **Composite cones or strato cones**:
- These are formed by alternating sheets of lava & pyroclastic materials & are height of all volcanic cones.
e.g. Fujiyama (Japan), Cotopaxi (Equador) etc.

(iii) **Parasite cones** -
- In these several branches of pipes come out from the main centrle pipe of the volcano & the cones are generally enlarged.

(iv) **Acid Lava cones** -
- These high cones of steep slopes are formed by the highly viscous & silica-rich lava.

(v) **Basic Lava or shield cones** -
- These long cones of low height are formed of light and less viscous lava with less quantity of silica.

(vi) **Basal Domes** -
- Hawaiian volcanoes are excelent examples of it formed by the extrusion of fluid basaltic lava. They often attain great height.

2) **Depressed forms**: under this group -

(1) **Creaters** -
The funnel shaped depression surrounding the vent at the summit of a volcano is known as creater.

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(iii) Caldera:

- It is a very large creater which may arise by the coalescence of several small creaters or by repeated explosions or by collapse. e.g. Crater lake, Oregon, Mt. Katmai.

b) Extrusive Volcanic Topography -

1) Lava plateau -

- The plateau which are formed due to accumulation of thick layers of basaltic lava coming through the fissure eruption are called lava plateau.

2) Lava plains:

- These plains are formed due to deposition of thin sheets of lava coming out through fissure flows.

II) Intrusive volcanic Topography -

- These volcanic features formed just below the earth's surface are seen only when overlying country rocks are removed through prolonged erosion.

1) Batholith -

- These are large irregular & undulating mass of solidified magma with no observable bottom & very steep side walls.

2) Locolith -

- They are of 'mushroom shape' having convex summital form.

3) Phacolith -

- They assume a 'wave like forms' of solidified magma.

4) Lopoliths -

- They are 'bowl-shaped' body solidified in a concave basin.

5) Sills -

- Thick beds of magma parallel to the bedeling planes of rudimentry rocks are called sills.

6) Dykes -

- These are wall like formation of solidified magma perpendicular of the beds of rudimentary rocks.

* Other landscape associated with vulcanism are hot springs, geysers, fumaroles, solfatara etc.

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FACTORS CONTROLING LANDFORM DEVELOPMENT

- The study of forces affecting the crust of the earth or geological processes is of paramount of significance because these forces and resultant movments are involved in creation, destruction, recreation and mentanance of geomaterials and numerous types of relief featurs of varying magnitude.

* The geological changes are genarally two types:

(i) Short-period changes -

It takes place so suddenly that these are noticed within few seconds to few hours.

e.g - sesmic events, volcanic eruptions etc.

(ii) Long-period changes:

It occur so slow that man is unable to notice such changes during his life period.

* The forces which affect the crust of earth, are divided into two broad categories:

a] **Endogenetic forces:** 'Constructive'

"The forces comming from the deep within the earth caused by thermal variations are called endogenetic forces, which create reliefs of various dimentions".

- Endogenetic forces are also called as 'constructive forces'.

* The endogenetic forces and movments are divided on the basis of 'intensity', in to two major categories:

1) **Sudden Forces:** 'catastrophism'

- "These forces work very quickly and their results are seem within minutes' only their cumulitive affects on the earth's surface are quickly and sudden".

e.g - ① volcanic eruption
② Earthquke.

- Geologically these forces are constructive forces.

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Epirogenic
- meaning continent origin.
- working verticle manner.

Orogenic
- meaning mountain origin.
- working horizontal manner.

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Forces which Affect the Earth's Crust

- Endogenetic forces
  - Diastrophic forces
    - Epirogenetic
      - 1) Upword movment
      - 2) Downword movment
    - Orogenetic
      - Tensional force
        - cracking
        - faulting
      - Compressional force
        - warping
          - 1) Upwarping
          - 2) Downwarping
        - folding
  - Sudden forces (Catastrophism)
- Exogenetic Forces
  - Degradation
    - 1) weathering
    - 2) erosion
    - 3) mass wasting
  - Agradation

2) **Diastrophism forces:**

"The forces caused by both verticle and horizantal movments originating from deep within earth are called diastrophic forces"!

- These diastrophic forces operate slowely and their effect becomes discernible.

- Diastrophic forces further divided in to two groups:

i) **Epirogenetic movment -**

"The endogenetic movments responsible for the creation of upliftment and subsidence of continental masses through upward and downward movment are called epeirogenetic movment."

- 'epiros' meaning - 'continent' & 'genesis' means - origin.

⊛ These are further divided in to two part:

a) **Upward movment -**

- Upward movment causes upliftment of continental masses of two ways: ① upliftment of whole continent.
  ⑪ upliftment of coastal land.

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b) Downward movement :

- Downward movement causes subsidence of continental masses in to two ways :

① Subsidance of land area downward movement called 'subsidence'.

② The land area near the coast is moved downward is called as 'submergence'.

ii) Orogenetic movment :

- Greek word : 'oros' means - mountain & 'genesis' means - origin.

'The horizantal compresional and tensional forces responcible for the origin of mountains are called orogenetic movments'.

ⓐ Tensional forces -

- Horizantal forces are also called as tangential forces
- Horizantal forces work in two ways :

① in opposite directions ② towards each other.

This is called 'tensional forces' when operates in oposite direction'.

- Tensional force create - rupture, cracks, fractures and faults.

ⓑ Compresional forces -

'The force, when operate face to face is called as compresional or convergent force'.

- Comperational force causes formation of 'folds' or 'crustal warping'.

FOLDS

- A bend, or flexur in a rock.

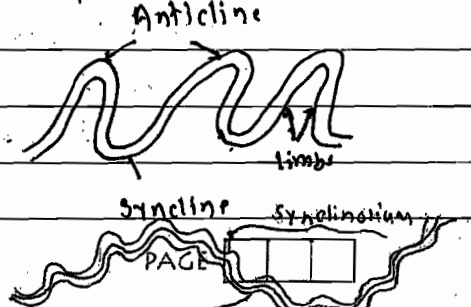
" wave-like bends are formed in the crustal rocks dye to tangential compresive force resulting from horizantal movment caused by endogenetic force originating deep within the earth. such bends are called folds"

i) Anticline - upfold rock strata in 'arch'.

ii) Syncline - down folded structure 'trough'

iii) Limbs - The two sides of fold are called limbs of the fold.

iv) Anticlinorium - series of mionor anticlinonium.

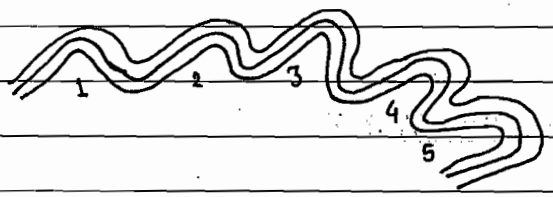


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Types of Folds :

- The nature of fold depends on several factors e.g. the nature of rock, intensity of forces & duration.
- Thus, inclination of the limbs based on five types.



1) Symmetrical folds :

'when both the limbs of the fold are equally inclined on either side is called symmetrical folds'.

2) Asymmetrical folds-

One limb is relatively larger and the inclination is moderate and regular while the other limb is relatively shorter with steep inclination.

3) Monoclinal fold-

One limb inclines moderatly with regular slope while the other limb inclines steeply at right angle and the slope is almost verticle.

4) Isoclinal fold-

The compresive forces are so strong that both the limbs of the fold become parallel but not horizantal.

5) Recumbent Folds-

The compresive forces are so strong that both the limbs of the fold become parallel as well as horizantal.

6) Overturned folds-

are those fold in which one limb of the fold is thrust upon another fold due to intense compresive forces.

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7) ~~Overturned~~ plunge fold -

The axis of the fold instead of being parallel to the horizantal plane becomes tilted and forms plunge angle which is the angle betn the axis and the horizantal plane.

8) Fan fold -

It represents several minor anticline or synclines, such fold resembles a fan. Such features is also called as anticlinorium or synclinorium.

9) Open folds -

are those in which the angle betn the two limbs of the fold is more than 90° ~~but~~ less than 180°, are formed wave-like folding.

10) closed folds -

are those folds in which the angle betn the two limbs of a fold is acute angle.

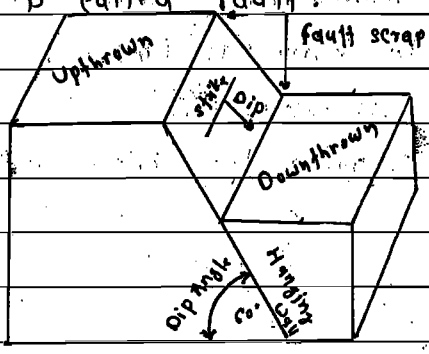
11) **Nappes** : are very complicated form of folds and are the result of complex folding mechanism caused by intense horizantal movment and resultant compresive force.

complex folding mechanism

- In a simple term nappes are defined as a complex overturned anticlinal fold.
- 'Broken limb of the fold is called nappe'.

FAULTS

"The crustal rocks are displaced due to tensional movment caused by the endogenetic forces, along a plane the resultant structure is called fault".



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i) **Fault plane**: A fault is a fracture in the crustal rocks where in the rocks are displaced along a plane called as fault plane'. 3)

ii) **Fault dip**: is the angle betⁿ the fault plane and horizantal plane. 4)

iii) **Upthrown** - represents the upper most block of a fault.

iv) **Downthrown** - represents the lower most block of a fault.

v) **Hanging wall** - is the upper wall of a fault. 5)

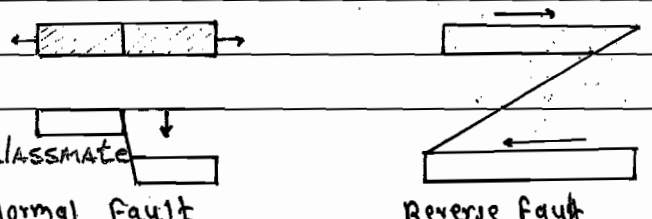
vi) **Foot wall** - represent the lower wall of fault.

vii) **Fault scrap**: is the steep wall like slope caused by faulting of the crustal rocks.

Types of Fault:

1) **Normal Fault** -
- The displacement of both the rock blocks in opposite directions.
- The fault plane is usually betⁿ 45° and the verticle.
- The fault plane very steep slope.
- These fault generaly takes place due to tension in the upper part of crust.

2) **Reverse fault**:
- The movment of both the fractured rock blocks toward each other.
- At an angle betⁿ 40° and the horizantal (0°).
- The slope of the fault plane is gentle.
- The verticle stress is minimum while the horizantal stress is maximum.



Normal fault Reverse fault

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3) **Thrust fault:**

'One block of the fault rise over the other along the fault plane it known as thrust fault'.

- The fault plane becomes almost horizantal.

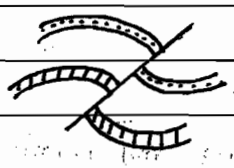
4) **Strike-slip or Transcurrent faults:**

- The rock blocks are displaced horizontally along the fault plane due to horizantal movment.
- In majority of the cases there are no scrap in such faults, if they occur at all, they are very low in height.

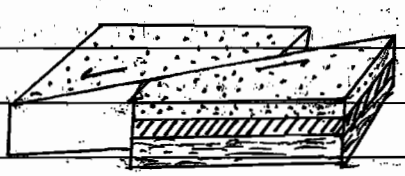
5) **Step faults:**

'The slopes of all the fault planes of all the faults are in the same direction, the resultant fault are called step faults.'

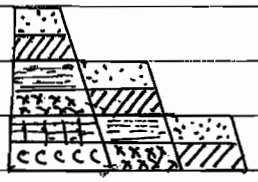
- The downward displacment of all the downthrown blocks must occur in the same direction.



Thrust fault



Transcurrent fault



Step faults.

Rift valley and Graben: represents a trough, depression or basin between two crustal parts. In fact, rift valleys are long and narrow trough bounded by one or more parallel normal faults caused by horizantal and verticle movment motioned by endogenetic forces.

- Rift valley is generally known as 'graben'.

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b] **Exogenetic Forces:**

'The forces generated from the atmosphere due to varying combinations of 'temprature' and 'moisture' are called exogenetic or denudational processes.'

Denudation:

Denudation = weathering + erosion

- Latin word = Denudare means to 'laybare'
- The term denudation include three processes:
  - i) The disintigratn or breaking up of original rock mass. (weathring)
  - ii) The wearing away of the land surface - (erosion).
  - iii) The removal of lose materials. (mass wasting).

1] **WEATHERING:**

i. 'The disintegration and decomposition of rocks at situ is called weathering'.

ii. 'weathering is the mechanical fracturing and chemical decomposition of rocks, in situ, by natural agents at the surface of the earth'.

* **Controlling factors of Weathering:**

1. **Composition and structure of rock -**
   - soft rocks are broken much quickely than hard rocks.
   - weathering involves mineral composition, joint patterns, layering system, faulting, folding etc.
   - Rocks having verticle strata easily loosened and horizantal beds are less affected by the mechanism.

2. **Climatic variations:**
   - chemical weathering is more dominant in 'humid tropical areas' because of more available water & high temp.

classmate e.g. leaching processes.

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Chemical - Humid Tropical climate
mechanical - Tropical & semi-arid, temprate

equatorial - chemical
Tropical - mechanical
Temprate - mechanical
polar - chemical.

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- mechanical weathering more dominant in tropical & semi-arid region
- Rocks are expantion (day) and contraction (night) because of diurnal change of temprature.
- In temprate climate mechanical weathering susceptible than chemical weathering.
- In polar climate mechanical weathering least affected.

3) **Floral Effects :**
- The nature of weathering is largely determined by the presence or absence of vegetations.
- 'The vegetations is partly a factor of weathering and partly a protector of rocks'.
- Dense vegetation protect the ground surface and roots of plants and trees associated with micro-organisms encourage decomposition & disintegration of rocks.

4) **Nature of Ground slope :**
- Ground slope controls mechanical disintegration of rocks and mass movment.
- The rocks in the steep slope are easily disintegrated and gentle slope moderate disintegration.

TYPES OF WEATHERING PROCESS :

1) **Physical Weathering :**
- 'Thus the weathering disintigrate rocks without changing their chemincal composition'.
- mechanical weathering is mainly carrid out by changes in temprature frezzing action of water & direct impact of raindrops.
- Agents : (i) moisture and water (ii) frost. (iii) Insolation (iv) wind.

Def": "Physical weathering may be defined as the disintegration of rocks due to temp. variations, frost action, wind action and unloading of confining superincumbent pressure."

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i) Block disintegration due to temprature change -
- The during day time rock surfaced heated which their outer layer expand and opposite to night time rock surface cooled to contraction in the outer layer.
- The rocks disintegrated along joints, broken big blocks of rocks are dislodged from the main rock mass and fall down the slope under the impact of gravity.

ii) Granual disintegration due to temprature -
- The coarse-grained rocks are more affected by shattering processes.
- The different part of the same rock mass recive different amount of insolation.
- shattering of rocks is called grandal disintegration which is more active in hot desert areas.

iii) Shattering due to rain shower and heat -
- The outer shell of rocks are shattering due to sudden light showers in hot climatic areas.
- The highly heated rocks when struck by sudden drizzles develop numerous cracks.

iv) Block disintegration due to frost -
- Disintegration of rocks due to freezing & thawing action of water in cold climatic region.
- This diurnal freeze & thaw cycle causes alternate expansion and contraction which introduce tension and strees, due to rock are disintegrated in smaller particles.

v) Exfoliation due to temprature and wind -
- Exfoliation weathering is also known as onion weathering.
- Exfoliation are more common in crystaline rocks.
- The outer shells of rocks become loose due to alternate expansion and contraction of temp. variation & strong wind.
- Differential heating of outer and lower shells of a rock mass causes 'flaking'.

- Olivine: resistant to chemical weathering.
- A group of greenish mineral.
- It is rock-forming ferro-magnesian silicate mineral that crystalizes early from a magma & weathered readily at the earth's surface.

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2) Chemical weathering:

'Decomposition and disintegration of rocks due to chemical reaction is called chemical weathering, where in the minerals of rocks weather away.' water + CO_2.

due to chemical reaction

* Agent: (i) Oxygen (ii) Carbon dioxide (iii) Hydrogen.

- Chemical weathering is most prominent in 'Humid Tropical Region'

i) Oxidation -

The atmospheric oxygen after reacting with the rocks produces several types of oxides, iron oxides being the most important, which weakens the rocks to disintegrate.

$$Fe + H_2O + O_2 \longrightarrow Fe_2O_3$$

(ferrous) (water) (oxygen) (ferric oxides)

ii) Carbonation -

'Carbonation is the reaction of carbonate or bicarbonate ions with minerals'.

- The atmospheric CO_2 after mixing with water forms carbonic acid which reacts with carbonate rocks, say limestones forms calcium bicarbonate which is easily dissolved in water.

iii) Hydrolysis -

'Hydrolysis is chemical reaction bet^n mineral and water, i.e. bet^n hydrogen (H) ions or hydroxyl (OH) ions and ions of the minerals'.

- The hydrolysis is that process where in both the minerals of the rocks and water molecules decompose and react in such a way that new compounds minerals are formed.

iv) Solution:

'Solutions refer's to the dissolution of soluble particles and minerals from the rocks with the help of water in motion but thin film of water around a solid particles also leads to chemical dissolution'.

- solutions of rocks depends upon the nature of rocks, solublity of rocks or solids and the ratio bet^n the volumes of solvent and the solids.

Augite: resistant to chemical weathering.
- 'A rock forming feromagnesium silicate mineral chiefly of calcium, mg, iorn & aluminium; a dark green to black variety of minoclinic pyroxene, chgnacturistics of basic rocks'.

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v) Hydration:

'The process of hydration is related to the addition of water to the minerals of rocks and thus the volume of hydrated rocks increase remarkably'.

- The increase in the volume of rocks due to increase in the volume of minerals causes stresses and strain ultimately lead in to disintegration of rocks.

vi) Chelation-

'chelation is a complex organic process by which metallic actions are incorporated into hydrocarbon molecules'.

- 'chelat': means a co-ordination compound in which a central mettalic ion attached to organic molecules at two or more positions.

3) **Biotic Weathering:**

'plants and animals including man largely controlled breakdown of rocks'.

- Agents: (i) Plant (ii) Animals (iii) man.

i) faunal weathering -

- The burrowing animals, worms and other organisms help in gradual breakdown of rocks or fragments there of.
- Burrowing animals include- gophers, rabbits, jackles, termits and rats etc.

ii) Floral weathering-

- weathering of rocks by vegetation by two ways:

(i) Physical weathering - by root penetration & root pressure.

(ii) chemical weathering - root respiration, humus.

iii) Anthropogenic weathering-

- 'man being a biological agent accelerates and decelerates the natural rates of weathering by many folds'.
- causes: modern technology, economic activities, mining, Road & dam construction, industrial and

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iv) Biochemical weathering -

'Biochemical weathering refers to decomposition and disintigration of rocks due to organic materials of both flora and fauna.'

- Different biochemical processes such as cation root exchange, chelation, solution by root.
- Different kind of organic acids such as humic acids, bactarial acids, microfaunal acids etc. produced by organic materials help in the decomposition and disintegration of rocks.

Geomorphic Importance of Weathering:

1) Production of Rockwastes:

- Rocks are disintegrated and decomposed are broken into small pieces.
- Different weathering process produce immense volume of rorkwastes, or weathered materials.

2) Weathering helps erosional processes:

- weathering loosens the rocks by the way for erosional processes to operate easily.
- Different agent of erosion these weathered material and move them to other places.

3) Lowering of surface:

- Continious ~~weath~~ removal and transfer of weathered materials through different processes.
  e.g. landslide, rockfall, rockslides, talus creep etc.
- The agent of erosion causes gradual lowering of the height of the affected area.

4) Evolution of Landform & their modification:

- Differential weathering helps in the evolution of different type of landforms e.g - tors, lattice, talus cone, sand stone anvils etc.
- weathering & erosion in the development of a particular type of landform.

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2] EROSION :

'Denudation by wind, water and ice which dislodages, or remove surface material.'

* **Agents of erosion are** - (i) Running water
(ii) Ground water
(iii) Wind
(iv) Glaciers
(v) sea waves and ocean currents.

- Each of these agents does erosion by distinctive process and gives rise to distinctive landforms.

* **Erosional Processes :**

(1) The acquisition of weathered material.
(2) wearing away of the surface through impact of rock materials in transit and in some case by solution.
(3) The breaking down of rock particles by mutual wear while in transit.
(4) Transportation of the acquired rock debris by moving through medium.
(5) Deposition either in transit or in sea or lake.

* **Erosional Landforms :**

- class of the sequential landforms shaped by the removal of regolith or bedrock by agent of erosion.

Example : canyon, glacial cirque, marine cliff. etc.

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3] **MASS WASTING :** "Sharpe" (1988)

- The concept of mass wasting was advocated by 'Sharpe' in (1938.)

① "The collective term for gravitational or downslope movements of weathered rock debris is mass wasting."

② "Spontaneous downward movment of soil, regolith, and bedrock under the influence of gravity, does not include the action of fluid agents."

- The term implies that gravity is the sole important force and that no transporting medium such as wind, flowing water, ice, or molten lava is involved.

* **Factors of mass Movment :-**

"Mass movment is the detachment and downslope transport of soil and rock material under the influence of gravity".

i) Natural factors-
- stream, glacial, marine erosion by sea waves.
- weathering, rockfall, slide, subsistance or faulting.

ii) Anthropogenic factors-
- construction of quarries, pits, canals, roads, mining
- alteration of water levels in lakes and reservoirs.

iii) Endogenetic process-
- Earthquake, vibration, blasting., traffic,
- swaying of trees in wind.

iv) Lateral pressure-
- water in cracks, freezing of water in cracks, swelling mobilization of residual stress.

v) Organic- burrowing animals & decay of roots.

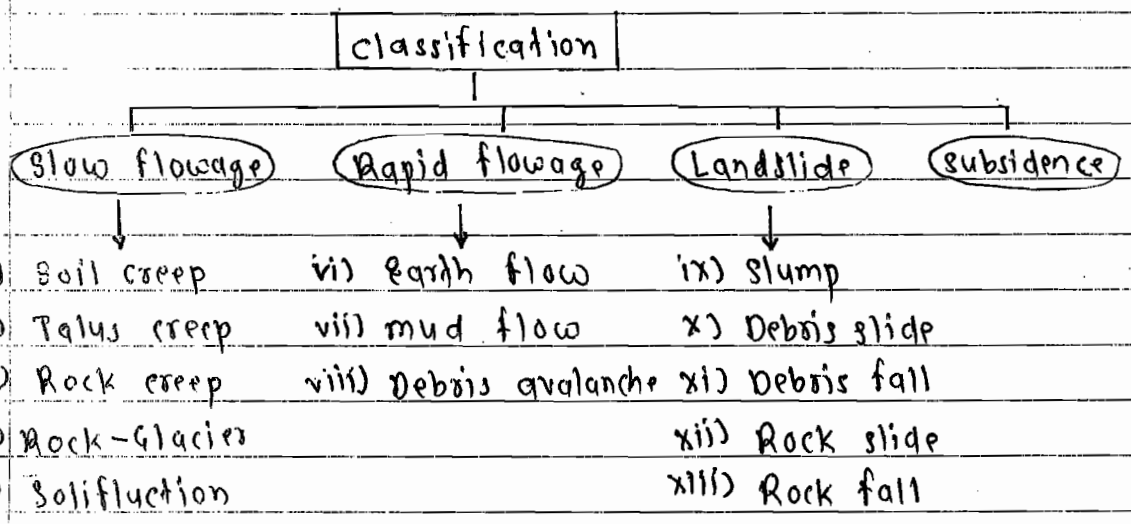
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Classification of Mass Wasting:

'Sharpe' has recognised four major classes of mass wasting:



a) **Slow flowage:**

Very slow and imperceptible downslope movment of matarial is called 'creep'.

i) Soil creep - The imperceptible but continious movment of soil down a slope in responce to gravity is known as soil creep.

ii) Talus creep: Talus is generally regarded as a synonyms of scree. Talus is slow downslope movment of rock fragments.

iii) Rock creep: The movment of rock fragments across an inclined surface by means of intermitant slip along a plane betⁿ the fragment and the ground surface.

iv) Rock-Glacier creep - Rock glaciers creep is the downslope movment of tongues of rock waste.

v) Solifluction - The slow downhill movment of masses of rock debris which are saturated with water and not confined to definite channel.

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b) **Rapid flowage:**

vii) Earth flow: 'The rapid movment of water-laden material down a slope is known as earth flow:
- It results from slope instability, perhaps due to human interferance, and heavy rainfall.

viii) Mud flow: Mud flow is a type of mass movment on an unstable slope, similar to an earth flow but of greater velocity because of the high percentage of water present in the mixture.
- The conditions pramote the mud flow (i) steep & verticle slope (ii) unconsolidated material (iii) water as lubricant (iv) absence of vegetation

viii) Debris flow: involves downslope movment of enormous amont of viscous soils and boulders either seprattley and mixed togethers, and occurs mostly along river valley sides.

- The differance betⁿ debrisflow, earth flow and mud flow is related to size of particles decreases from debris flow to mudflow.

c) **Landslide:**

"The mass movment of rock wastes down the slope are called landslides."

ix) Slumping - involves intermittent sliding of rock fragments, rock blocks or soils downslope along a curved plane caused by rotational movment and displaced blocks cover very short distance.

x) Debris slide - The rapid rolling or sliding of unconsolidated earth debris without backward rotation of the mass.
- In debris slide amount of water is usually small.

xi) Debris fall - The nearly free fall of earth debris from a verticle or over hanging cliff or bluff.
- It is mainly found in undercut bank of stream.

xii) Rock slide - The sliding or falling of individual rock masses down bedding, joint of fault surface.
- Rock slide is most significant of all types of slides where in large rock block slide down the hillslope.

xiii) Rock fall: The free falling of rock blocks over any steep slope.
- In this process small blocks of rock becomes detached from a cliff face and fall freely through space to the cliff foot.

d) **Subsidence:**

Subsidence is the downward displacement of superficial earth material without a free surface and horizontal displacement.
e.g. Rift valley and Karst region etc.
- The most common cause of subsidence is slow removal of material beneath the subsiding mass.
e.g- removal of material at depth by mining. and removal of fluid lava beneath a solid crust.

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Catastrophism :

'refers to the concept of quick and sudden origin and evolution all animate and inanimate objects in very short period of time'.

Palimpsest Topography -

'Palimpsest refers that manuscript which has been written, erased and rewritten seveal times. Thus palimpesest topography represents complex multicyclic relief'

Radio carbon dating - 'C-14'

is the method of 'determination of the age of objects of organic origin by measurment of the radioactivity of their carbon content.
-This method is also called C-14 dating.

Gradation :

Aggradation :

'The process which tend to build up the land surface by deposition of solid material in its lower areas is know as aggradation'

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GEOSYNCLINES

- 'Hall & Dana' elaborated by [illegible]

- The geological history of the continents and ocean basins denotes two important features:
  - i) rigid masses
  - ii) geosynclines
- Rigid masses representing 'continents' remains stable for considerably longer period of time.
- These mobile zone is surrounded by rigid mass charactarised by extensive sedimentation, These mobile zone of water have been termed 'geosynclines'.

- **Defⁿ** - ① 'Geosynclines are long but narrow and shallow water depressions charactrized by sedimentation and subsidence'.

② 'The geosynclines have been long and relatively narrow depressions which seem to have subsided during the accumulatⁿ of sediments in them'.

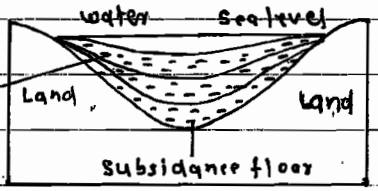
* **Charactaristics:**

i) Geosynclines are long, narrow and shallow depression of water.
ii) These are charactrized by gradual sedimentation & subsidence.
iii) The location, shape dimension and extent of geosynclines have considerably changed due to earth movments & geological processes.
iv) Geosynclines are mobile zones of water.
v) Geosynclines are mobile zone of generally bordered by two rigid masses which are called as 'forelands'.

* **Stages of Geosyncline:**

- The geosynclinal history is divided into three stages:

1) **Lithogenesis:**



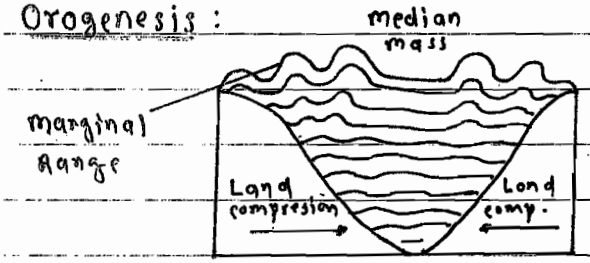
- The stage of Geosyncline followed by sedimentation and subsidence.

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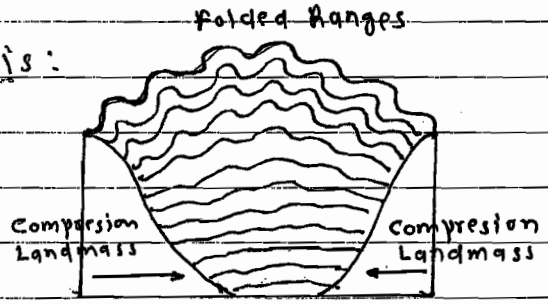
- The stage of litogenesis: creation of geosynclines, sedimentation and subsidence of the beds of geosynclines.

2) Orogenesis :



- The stage of orogenesis : squizing and folding of geosynclinal sediments due to compressive forces, the whole of geosynclinal sediments are folded when the compresive forces coming from the sides of geosyncline is enormous and acute.

3) Gliptogenesis :



- Folding and marginal sediments into marginal ranges and formation of median mass when the compresive forces are moderate.

* Concepts of Geosynclines :

- The concept of geosynclines was given by James 'Hall and Dana', but the concept was elaborated and developed by 'Huge'.

1) Concept of 'Hall and Dana' :

- 'Dana'-studied the folded mountains and postulated that the sediments of rocks of folded mountains were marine origin.
- He defined geosynclines as long, narrow and shallow and sinking beds of seas.
- Hall elaborated concept of geosynclines as advanced by Dana.
- According to Hall the beds of geosynclines are subjected to subsidence due to continuous sedimentation but the depth of water in the geosynclines remains same.
- Geosynclines are much longer than their widths.

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2) Concept of 'E. Haug':

According to Haug 'geosynclines are relatively deep water areas and they are much longer than they are wide'.

- He draw the 'paleogeographical maps of the world' and depicted long and narrow oceanic tracts to demonstrated the facts that these water tracts were subsequently folded in to mountain ranges.

* He identified 5 major rigid masses during Mesozoic era:

e.g. (i) North Atlantic mass.
(ii) Sino-saiberian mass.
(iii) Africa-Brazil mass.
(iv) Australia-India-madagascar mass.
(v) Pacific mass.

* He located 4 geosynclines masses:

e.g. (i) Rockies geosynclines.
(ii) Ural geosynclines.
(iii) Tethys geosynclines.
(iv) Circum-pacific geosynclines

3) Concept of 'J.W. Evans':

- According to Evans the geosynclines are so varied that it becomes difficult to present their definite form and location.
- The form and shape of geosynclines change with changing environmental conditions.
- There may be several alternative situations of geosynclines:

(i) It may be bet^n two land masses e.g. Tethys geosyncline between Laurasia and Gondwana.
(ii) It may be in front of a mountain or a plateau. e.g. Himalayas filled with sediments to form Indo-Gangetic Plains.
(iii) It may be along the margins of continents.
(iv) It may be in front of river mouth.

4) Views of 'Schuchert':

- He attempted to clasify geosynclines on the basis of their characteristics related to their size, location, evolutionary history etc.

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* He categorised geosynclines into 3 stages:

(i) Monogeosynclines -

- Monogeosynclines are exceptionally long and narrow but shallow water tracts as concived by Hall and Dana.
- These are called mono because they pass through only one cycle of sedimentation and mountain building.

Example: Applachian Geosyncline.

(ii) Polygeosynclines:

- They were long and wide water bodies. These were definitely border than polygeosynclines.
- These geosynclines existed for relatively longer period than the monogeosynclines and these have passed through complex evolutionary histories.
- Example: Rocky and Ural geosyncline.

(iii) Mesogeosynclines:

- These are very long, narrow and mobile ocean basins which are bordered by continents from all sides.
- These geosyncline passes through several phases; e.g. - phases of sedimentation, subsidence and folding.

5) Concept of **Arthur Holmes**:

- A. Holmes has also elaborated the causes of the origin of different types of geosynclines.
- He further pointed out that the process of subsidence of the geosynclinal beds was not a sudden processes rather it was gradual process.

* Holmes has identified 4 major types of geosynclines:

i) Formation of geosynclines due to migration of magma -

- He has further pointed out that migration of magmas from the intermediate layer to neighbouring areas causes collaps and subsidence of upper or outer layer and thus is formed a geosynclines.

e.g: Persian coral Reef, Tasman sea, Arafura sea.

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ii) Formation of geosynclines due to metamorphism -

- The lower layers of the crust, as referred to above, are metamorphosed due to compresion caused by converging convective current.
- The metamorphism increase the density of rocks, with the result the lower layer of the crust is subjected to subsidence and thus a geosynclines formed.

e.g - Caribbean sea, Mediterranean sea.

iii) Formation of geosynclines due to compresion:

- Some geosynclines are formed due to compresion and resultant subsidence of outer layer of the crust caused by convergent convective currents.

e.g - Persian Gulf, Indo-Gangetic trough.

iv) Formation of geosynclines due to thining of sialic layer:

- The sialic layer is stretched appart due to tensile forces exerted by diverging convective current.
- This process causes thining of sialic layer which results in the creation of geosyncline.

e.g - Tethys geosyncline.

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MOUNTAIN BUILDING

- Mountain are significant relief features of the second order on the earth surface.

* A mountain may have several forms:

i) **Mountain ridge:**
is a system of long, narrow and high hills.

ii) **Mountain range -**
is a system of mountains and hills having numerous ridges, peaks and summits and valleys of same age but with structural variations.

iii) **Mountain chane -**
consits of several unsystematic parallel long and narrow mountains of different periods. Sometimes, mountain ranges are seprated by flat upland or plateaus.

iv) **Mountain system:** consits of different mountain ranges of the same period and these ranges are seprated by valleys

v) **Mountain group:** consits of several unsystamatic pattern of different mountain systems.

vi) **Cordilleras:** consits of several mountain groups and systems.
In fact, cordillera is a community of mountains having different ridges, ranges, mountain chains & mountain systems.

Classification of Mountains:

a) **On the basis of height -**

i) Low mountains - 700 to 1000 m.
ii) Bough mountains - 1000 m to 1500 m.
iii) Rugged mountains - 1500 to 2000 m.
iv) High Mountains - above 2000 m.

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b) On the basis of location:

1) Continental mountains -

(i) Coastal mountains - Appalachians, Rockies, Alpine, west & East Ghat.

(ii) Inland mountains - Ural, Himalaya, Aravali, Tienshan, Altai etc.

2) Oceanic mountains -

most of the oceanic mountains are below the sea level.

- oceanic mountains are located on continental shelves and ocean floors.
- Many of the mountains will become much heighes than the mount everest. for e.g - Mount Kea (9140 m.), Antielan mount (8400 m.).

c) On the basis of mode of origin -

1) Tectonic mountains:

are caused due to tectonic forces e.g. - compresive and tensile forces, motored by endogenetic forces;

(i) Folded mountains:

- These are originated by compresive forces, further divided in to 3 types - (i) Young (ii) Mature (iii) Old folded mountains.

(ii) Block mountains -

are originated by tensile forces leading to the formation of rift valley, They are also called horst mountains.

(iii) Dome mountains - ~~are~~

are originated by magmatic intrusions and upwarping of the crustal surface.

(iv) Mountains of accumulations -

are formed due to accumulation of volcanic materials.

2) Circum-erosional or relict mountains: Vindhyanchal, Aravalies, Satpura, Eastern Ghats, Western Ghats.

d) On the basis of period of origin -

1) Pre-cambrian mountains - Laurentian mountains, Algoman, Kilarnean (North America), NW Highlands & Anglesey (Europe).

2) Caledonian mountains - mountains formed during Silurian & Devonian period. e.g - Taconic mt., Brazilides mt., Aravali, Mahadeo.

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3) Hercynian mountains - formed during Permian and Permocarboniferous periods e.g - Iberian penninsula, Spanish mesata, France plateau etc.

4) Alpine mountains - mountains formed during tertiary period
e.g - Rockies, Andies, Alpine, Balkhans, Pamir knot of Asia etc. Himalaya.

Block Mountains:

"The mountains formed by faulting caused by tensile and compresive forces motored by endogenetic forces coming from within the earth is called 'Block mountains'.

- Block mountains are also called as 'horst mountains'.
- Block mountains represent the upstanding parts of the ground betn two faults or on either side of rift valley or a garben.

* Block mountains are generally two basic types:

1) Tilted Block mountains -
having one steep side represented by fault scrap and one gentle side.

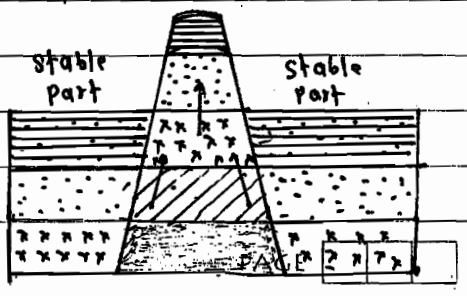
2) Lifted Block Mountains:
represent real horst and very steep slopes by two boundry fault scraps.

* Theories for the origin of Block mountains :-

1) Fault Theory :
- W.M. Davis: also advocated for the fault theory of the origin of Block mountains.
- Block mountains are formed number of ways.

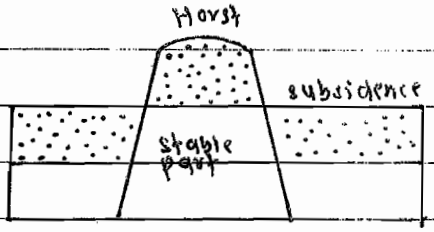
I) Block mountains are formed due to upword movment of middle block betn normal faults.
- The upthrone block is also called as horst.

Horst

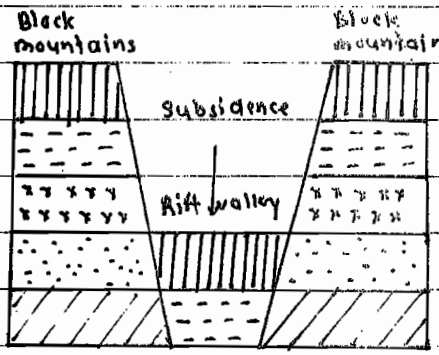


but is strictly a structural feature, it thus continues to exist even if the surrounding land is demanded DATE to the level of the graben & no valley remains.

(II) Block mountains may be formed when the side blocks of two faults move downward whereas the middle block remains stable at its place.



(III) - Block mountains formed when the middle block betn two normal faults moves downward.
- Thus, the side blocks become horsts, such mountains are associated with the formation of rift valley.



b) **Erosion Theory :**

'J·A· Spurr'- on the basis of detailed study of Great Basin Range mountains of the U·S·A.

Principle - 'His opined that these mountains were not formed due to faulting and tilting, rather they were formed due to differential erosion'.

- According to spurr the mountains, after the origin in mesozoic era, were subjected to intense erosion.

- Erosional theory of mountain building is not acceptable to most of the scientist.

Because they belive that denudation may modify mountains but can not form a mountain.

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FOLDED MOUNTAINS

"The mountains having series of anticlines and synclines due to folding of sedimentry strata caused by lateral compressive forces are called folded mountains'.

Example - Rockies, Andes, Alps, Himalayas, Atlas etc.

Classification of folded Mountains:

1) On the basis of nature -

i) Simple folded mountains: -Such mountains are well-developed system of anticlines and synclines are simple fold.

ii) Complex folded mountains:

It represents very complex structure of folds intensly compressed folds.

2) On the basis of age-

i) Young folded mountains -

- The process of mountain building is exceedingly slow process and thus denudational processes start origin of mountains.

ii) mature fold mountains -

mature fold mountains are charactrized by monoclinal ridges and valleys.

3) On the basis of period -

i) old folded mountain -

All the folded mountain originated before Tesitary period.

e.g - Aravallies, Vindhyanchal etc.

ii) New folded mountains -

Tertiary period are grouped under the category of new folded mountains.

e.g - Rockies, Andies, Alps, Alpine, Himalayas etc.

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* **Charactaristics :**

1) Folded mountain are youngest mountain on the earth surface.

2) The fossils are found inthe rocks of folded mountains were formed due to depositional and consolidation of sediments in water bodies.

3) The sedimentry rocks of folded mountains were deposited in shallow seas.

4) Folded mountains extend for greater lengths but their widths are smalled than their length.
e.g - Himalayas length 2400km, but width 400 km.

5) Folded mountains are generally found in arc shape having one side concave slope and the other side convex slope.

6) Folded mountains are found along the margins of the continents facing oceans.
e.g - Rockies & Andies located along N & S Americas & face of pacific.

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* THEORIES OF MOUNTAIN BUILDING:

a) Geosynclinal Orogen Theory of 'KOBER'-

- Kober has presented a detailed and systematic description of the surface features of the earth in his book- 'Dre Bau der Erde'.

* Objectives-

i) To established relationship betn rigid masses and mobile zones.

ii) Kober explain the origin of the mountains on the basis of his geosynclinal theory.

iii) He also attempt to elaborate the various aspects of mountain buildings. e.g- formation of mountains, their geological history, evolution and development.

* Orogenetic Force:

- Kober geosynclinal theory is based on forces of contraction produced by the cooling of the earth.

* Base of Theory: According to kober there were mobile zones of water in the places of present-day mountains.

Orogen- He called mobile zones of water as geosynclines or Orogen.

Kartogen- These mobile zones of geosynclines are surrounded by rigid masses which called as kartogen.

* Kober has identified six major period of mountains buildings.

(i) Pre cambrian period.
(ii) Palaeozoic era.
(iii) Caledonian period.
(iv) Silurian period.
(v) Carboniferous period.
(vi) Tertiary period.

- He opined that mountains are formed out of geosynclines, the geosynclines places of mountain formations.

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Mechanism of Theory :

According to Kober the whole process of mountain buildings passes through three stages:

1) **Lithogenesis -**

① Ist stage related to creation of geosynclines due to the force of contraction caused by cooling of the earth.

② Geosyncline are long and narrow mobile zones of water which are bordered rigid masses called 'foreland or Kartogen'.

③ foreland continious erosion process by fluvial process & sediment deposited called 'sedimentation'.

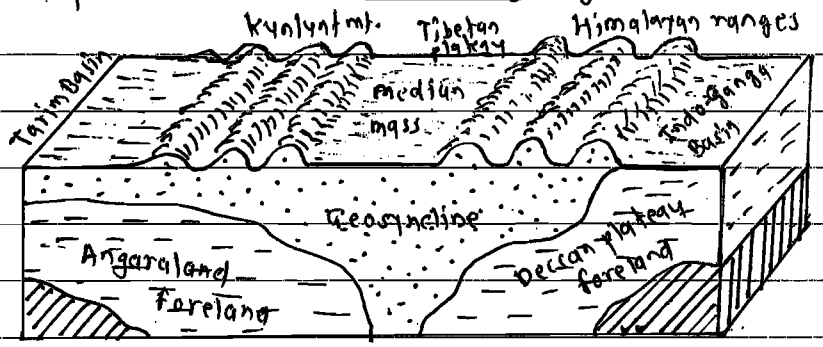
2) **Orogenesis -**

① 2nd stage related to mountain building called orogenesis.

② Both the forelands start to move towards each other because of horizantal movments results folding mountain ranges.

③ The parallel ranges formed on either side of the geosyncline has called 'Randketten'.

④ The geosynclines are folded to form two marginal sediments randketten & middle portion of geosynclinal remains unaffected these portion called 'zwischengebirge or median mass'.



3) **Gliptogenesis :**

- Third stage of mountains building is charactrized by gradual rise of mountains and their denudation by fluvial and other processes.
- Continious denudation results in gradual lowering height of mountains.

* **Criticism -**

1) Force of contraction not sufficent to cause of mountain building.

2) **Suess'** - only one side of the geosyncline moves whereas the other side remains stable not true, but both side are moves plate tectonic prove.

3) **Kober** - only explain west-east extending mountains but

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b) Thermal Contraction Theory of 'JEFFERYS'-

'Jefferys was a contractionist'

* Objectives:

① Jeffery's 'The thermal contraction theory' to explain the origin, evolution and distribution major relief of earth surface.

② major objective to explain the origin & distributional patterns mountains systems of the globe.

* Orogenetic force -

- The force involved by Jeffreys are divided into two groups:

① cooling of the earth -

- Force coming through the cooling of the earth.
- This process resulted in the gradual decreases of the size of the earth due to contraction on cooling.
- The resultant contraction provided adequate force to form various relief features including mountains.

② Due to decrease in the speed of earth rotation -

- About 1600 million yrs ago earth rotation speed 0.84 hour & presently 24 hours.
- The decreass in the rotational speed caused in the equatorial circumferance of the earth.

* Mechanism of the Theory:

(i) According to Jeffreys the earth began to shrink because of contraction caused by gradual cooling of the earth due to loss of heat through radiation from the very begining to its origin.

(ii) He has mathematically calculated the extent contraction of cooling A decrease of temp. up to 400°c in the 400 km thick outer layer shortning of the diameter 20 km & circumferance 130 km.

(iii) The cooling & resultant contraction take place layer after layer but the cooling is effective up to depth 700 km from earthsurface.

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- This process of collaps upper layer on lower layer an results in the decrease in the radius of the earth which causes horizontal compresive stress which leads to blucking and folding of the rocks of upper layer. Thus mountains are formed.

* Jeffreys aspect of mountain building:

1. Period of mountain building -
- mountain building is not always active throughout the geological period, confined of certain period only.
- This state accumulated & compressive is reached folding & faulting introduced to mountain building.
- This forces become weak, mountain building stops & the period of quiescence sets in.

2. Zones of mountain building -
- mountain building depend on nature & strength of rocks
- The areas of soft & elastic rocks are most affected mountain building.
- Mountain building is localized in certain zones of the globe.

3. Direction of force -
- The cooling process is more active below the oceanic crust than the continental crust.
- The force of contraction is directed from oceanic crust towards the continental crust.
- This mechanism results in the formation of mountains along the continental margins parallel to the oceans. eg. Rockies & Andies.

4. Direction of mountains:
- The compresive force generated by contraction of the earth due to cooling was directed from oceanic areas toward the continental areas almost right angle.
- The mountain runs North-South direction.

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* Criticism:

1) The force of contraction resulting from the cooling of the earth is not sufficent.
2) The concept of 'cooling of the earth in the system of concentric shells (layers) is not acceptable.
3) The impact of decrease in the speed of rotation of the earth on mountain building is doubtfull.
4) Jefferys says continent and oceans uniformly distributed, but presently there is uneven distribution.
5) The situation of mountains should always be parallel to the oceans, Alpine mt. & Himalayas can not explained.

C7 Sliding Continent Theory of 'DALY':

- Daly postulated his theory of sliding continents in his book - 'Our mobile Earth' in 1926.

* Objectives -

1) To explain the origin and evolution of different relief features of the earth surface.
2) To explain the cause and processes of mountain building.

* Orogenetic Force:

- The origin of the mountains has been the force of gravity.
- These theory based on 'The nature & rate of downward slide of the continents fostered by gravitational force'.

* Axioms of Theory:

- axioms means - self proved fact: 'his theory can well explain the problems of orogenesis on the force of gravity alone'.
- The polar and equatorial domes are rigid masses were seprated by depressed region mid lattitude furrows & primeval paritic ocean.
- The polar and equatorial domes were sloping towards mid-lattitude furrows.

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* **Mechanism of the Theory:**

- Daly has belived in the collaps of primitive crust, but has not elaborated mechanism of collapse.
- crust would have collasped on the still contracting interior due to:
  - (i) The weight of oceanic water.
  - (ii) The weight of geosyncline sediments.
  - (iii) Gravitational force of the centre of the earth.
- The gravitational force more under oceanic crust than the continental domes, because near the centre.

- The sediments derived through the erosion of polar & equatorial domes & were deposited by the river into mid-latitudnal furrows & pacific oceans.
- Continues sedimentation and resultant subsidence of geosynclinal beds caused lateral pressure on the continental masses.
- The gradual increase in the lateral pressure resulting from continious downward movment of geosynclinal beds was responsible for increase height of continental domes.
- The strong tensional movments due to which larger blocks of continental mass began to slide towards the geusynclines.

- Thus geosynclinal sediments were thus squzzed & folded due to compressive force coming from the sliding continental blocks giving birth to 'folding mountains'.
- Thus west-east extending mountains e.g. Alpine, Himalayas were formed due to sliding of polar and equatorial domes towards mid-lattitude furrow (Tethys geosyncline).
- North-south extending mountains e.g. Rockies & Andes were formed due to sliding of continental masses towards Pacific oceans.

* **Criticsms:**

i) These theory wide gap betn practical & theoratical aspects.
ii) Daly's theory is based on several guesses and sumises.
iii) Daly has also presented confuring ideas of mountain building.
iv) These theory provide wrong views about the mechanism & process of

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Thermal Convection current Theory of 'HOLMES':

* Objectives:
  1. To explain the intricate problems of the origin of major relief features of the earth surface.
  2. To search the mechanism of mountain building.
  3. To scientific explaination for the origin of the continent and ocean basins in term of continental drift.

* Orogenetic force:
- Thermal convection current originating deep within earth.
- The main source of the origin of convective current is excessive heat in the substartum wherein disintegration of radioactive elements generate heat regularly.

* Base of Theory:
- According to Holmes the earth consits of 3 zones:
  1) Upper layer of granodiorite (10 to 12 km).
  2) Intermidiate layer (20 to 25 km)
  3) lower layer of ecogolite
- He has further grouped these three layers in to two zones:
  1. crust - consisting of upper, middle & lower layer.
  2. substartum - representing molten part of lower layer.

* According to Holmes:-
- There is maximum concentration of radioactive elements in the crust.
- There is very low concentration of radioactive elements in substartum.

* The convection currents depends on two factors:
  1. Thickness of the crust near the equator and the poles.
  2. uneven distribution of radioactive element in the crust.

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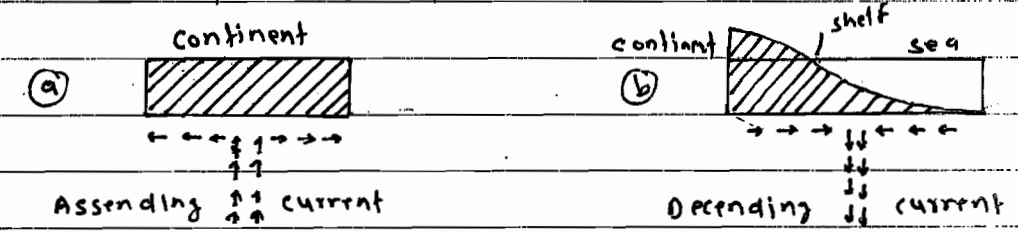
Mechanism of the Theory:

- Convective current are generated at some palaces in the substarturn.
- The convective current are generated more powerfull under the continental crust than the oceanic crust.
- The currents originating under the equatorial crust move towards the poles.

* There are two situation rising a convectional current:

(a) The two rising convective currents divergen in oposite direction due to tensional forces. The divergent convective current, cause opening of the land and creation of oceans.

(b) Convergent convective currents cause closing of land masses and oceans and creation mountains.



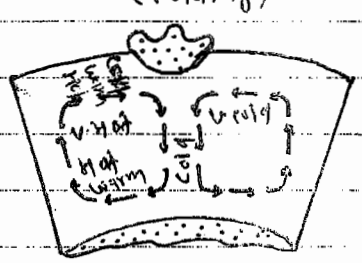
* Stages of Thermal convective current:

1) First stage - (lithogenesis)



- The continental shelves and thus form geosynclines due to compresion coming from the convergence of two sets of latteral current.
- first stage high velocity of convectional current. fig- Gradual increase velocity
- The stage of geosynclines creation, sedimetation and subsidance of materials.

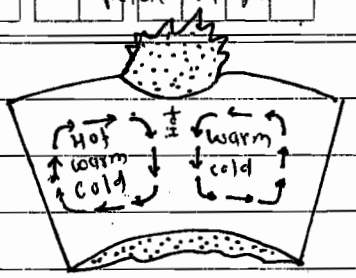
2) Second stage: (Orogenesis)



- The increase velocity of convective current, but relatively short duration, because downward movment of cold materials.
- The high velocity convergent convective current buckle geosynclinal sediments and thus initiate process of mountain building.

fig. Very high velocity convec.

3) Third stage: (Epeirogenesis) -



- These is warming phase of thermal convective currents due to incoming hot materials in the falling coloumn and upword movment of colder material rising coloumn. fig-warming velocity
- The cold matarials are accumulated at the centre and deposition of materials causes further rise of mountains.

* Criticism -

1) Rising and falling coloumns are doubtfull phenomena and therefore doubtfull stages.
2) The whole mechanism of convection current are depend upon by radioactive element would not be possible.
3) If horizantal movment of convective current is not possible.
4) According to this theory convective currents are originated few centres only, why are not they originated all places?

2) Radioactive Theory of 'JOLY' -

- Joly postulated his theory based on radioactivity of certain radioactive minerals in 1925, in his book - 'suface History of earth'.
- His theory is also known as 'thermal cycle theory' or 'theory of the surface of the earth'.

* Objectives -

i) To account for the origin and evolution of surface features of the earth.
ii) To present a detailed account of the thermal history of the earth and mathematical explaination of the structure of the interior of the earth.
iii) To explain the problems of mountain building and the continental drift.

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* **Orogenetic force :**

- The expansion and contraction of the substartum are based on the mechanism of heat genrated by radioactive elements of the rocks.
- He also implied 'tidal force' and 'friction' to explain continental drift.

* **Based of the Theory :**

- Joly's theory is based on the presence of radioactive elements of the rocks of the earth.
- He has describe first structure of the earth, According to Joly the rock of The earth contain radioactive element but their distribution is not uniform in all zones of the earth.
- Radioactive elements found in sialic zones of the continental rock, but the rock of sima forming oceanic crusts are less radioactive.
- Continious breakdown of certain radioactive elements like urainuam, thorium genarates heat.

Mechanism of the Theory :

'The disintegration of radioactive elements of sialic or continental rocks produces heat but it does not accumulate in the continents or sial.'

- Because the total loss of heat through radiation from the sialic crust is more than the total heat produced by the radioactive elements.

- He pointed out that temp. increases with increasing depth in the substartum, Because of accumulation of heat from the lower part produce radioactive elements.

a) **Period of Transgressional sea -**

Several interesting events take place when the substartum reaches the molten condition due to accumulat of greater amount of heat produced by the breakdown of radioactive elements.

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(i) The expansion of sima due to melting causes increase in the radius of the globe.

(ii) Continental masses or sialic masses are raised relative to the centre of the globe.

(iii) The density of sima decreases due to melting & hence sialic masses began to sink in molten sima.

(iv) The level of oceanic water rises due to sinking of sialic or continental masses into liquid sima.

(v) Transgression of sea results in sedimentation on the submerged continental margins.

Def^n - "This mechanism causes extension of oceanic water over the continental margins. This process of expansion of oceanic waters and their encroachment on continental margins is called transgression sea".

b) Period of regressional sea :

"~~Relative increase~~ The period of withdrawl of seawater from the land areas is called phase of regression sea." and

"The period of extension of seawater over land area is called the phase of transgressional sea".

* Criticism :

1) The force of expansion and contraction of the sima based on radioactive element is doubtful.

2) The thickness 30km of the continental masses as envisteged by Joly, but Jeffery's did not agree his says 16km thickness.

3) Joly's concept of cyclic nature of mountain building has been disputed by some critics.

4) Joly's geosynclines recives sediments but do not undergo the process of subsidence, without sediment subsidence mountains building can not be explained.

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CONTINENTAL DRIFT THEORY

* Introduction - - Alfred Wegener (1912).

- A. Wegener propounded his concept 'continental drift theory' in a book entitled 'Die Entstehung der Kontinente and Ozeane'.
- The drift of continent was Ist suggested by french scholar 'Antonio Snider(1858)
- F.B. Taylor postulated his concept of 'horizantal displacment of the continents' (1908), but he published in 1910.

These theory main purpose - 'To explain the problems of the origin of the folded mountain in tertiary period'.

* Aim of the Theory:

- wegener displacment hypothesis based on the work geologists, paleo-climatologists, paleontologists, geophysicist and others.
- The continental drift theory of wegener 'grew out of the need of explaining the major variations of climate in the past'.

* - These climatic changes on the basis of two possibilities:

① If the continents remains stationary at their places and climatic zones may be shifted from one region to another region.

② If the climatic zones remained stationary the land masses might have been displaced or drifted.

* Evidences of the Theory:

1) Jig saw fit: There is geographical similarity along both coast of the Atlantic ocean, Africa, S. India & W. Australia.

2) Geological - both the coasts of the Atlantic are also identical, and simillar geological structure.

3) Fossils - The fossils and vegetations remains found on the eastern coast of South America and the western coast of Africa.
- Present world coal deposit in Europe ancient time these area equator pass.

4) Carboneferous Glaciation: The carboneferous glaciation of Brazil, Falkaland, S. Africa, Peninsular India, But present times these region are

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5) Zoological evidences - The lemming of the north part of scandinavia run westward but they are founded in sea water due to absence of any land beyond Norwegian coast.

6) floral evidences - The distribution of glossopteris flora in India, S. Africa, Australia, Antartica, falklands etc. proves that all landmasse were previously united.

7) folded mountains - Geologically evidences denotes that the calodonian and Hercynian mountain and Hercynian mountains system of the western & eastern coastal areas of Atlantic.

8) Geodetic evidences - Greenland is drifted westward at the rate of 20 cm per year.

Process of the Process:

- The main aim of wegener behind the postulation of his 'drift theory' was to explain major 'climatic change'. which are reported to have take place in the past geological history on the earth.

1) force responsible for the drift -
- The continents after breaking away from the Panagaea drifted in two directions
① Equatorward movment - caused by gravitational differential force and 'force of buoyancy'. & form Alps, Atlas, Himalayas.
② westward movments - of the continents was caused by the 'tidal force' of the sun and moon, & formed by Atlantic ocean.

2) Actual drifting of the continents:
- Panthalasa: The huge water body surrounded Pangea from all sides during carboniferous period was called 'Panthalasa'.

- Pangea: The united form of all landmasses in one landmass during carboniferous period was called 'Pangaea'.

classmate "All movments are related and made relative to Africa."

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opening of Pengea II started at - Jurasic area

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① Pangea broken in 'late carboniferous period' (30 carore) in two parts. The northern part is 'Laurasia' & southern part is 'Gondwana.'

Laurasia : N. America, Europe, Asia, Greenland and north of Indian subcontinent.

Gondwana : S. America, Africa, Australia, Antartica & Pennisular India, Madagascar, Arabia, Malaysia, East - Indies.

(ii) Ecocene period : Laurasia (Angaraland) & Gondwana came near to each other and size of 'Tethys' sea reduced. (35 carore ago)

- North & south America moved westward and Atlantic ocean are formed.
- Due to northward movment of Indian peninsula to Indian ocean formed.
- The remaining portion of Panthalasa became the pacific ocean.

(iii) early pleistocene period - It may be mentioned that disruption, rifting and displacment of continental blocks continued from carboniferous period to plicocene period.

- The continents assumed their position more or less similar to their present position in the pleistocene age about 5-6 crore yrs ago.

3) Shifting of Position of Poles:

(i) Silurian period - north pole; 14°N & 124°W near north Norway
south pole : to the northwest Madagascar.

(ii) Carboneferous period - north pole - 16°N & 147°W passed through London.
south pole - near Durban in Natal.

(iii) Tertiary period - north pole : 31°N & 153°W the European Alpine mountain.
south pole : near 53°S lat. to the south Africa.

- 'The changes in the positions of poles in the geological period called polar wandering'.

* Criticism :

1) The gravitational force and tidal force are not sufficient enough to drift the continents so part.

2) The concept of jig-saw-fit cannot be validated, Because both coast of Atlantic cannot completly refitted.

3) It is difficult to show that how the sial blocks, in their passage through the sima.

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PLATE TECTONIC THEORY

- The 'Plate Tectonic' term first used by 'Tuzo willson' in 1965.
- This theory first published by 'W.J. Morgon' in 1967.
- Plate tectonic concept based on 'sea floar spreading' theory by 'Harry Hess' (1960) & continental drift theory by Wegener (1912).
- These theory, a great scientific achivment of the decade 1960's.
- Tectonic - 'Greek word' tectonikos means building or construction.
- Plate - The rigid lithospheric slab.
- Plate-Techtonic: The entire mechanism of the evolution, nature and resultant reactions is called 'Plate-Techtonics'.

* Assumptions:

1) The continents are drifting discuss in Wegener continental drift theory. plates moves rates less than 1-16 cm/year.
2) The sea floar spreading occurs i.e. the new oceanic crust is continiously generated at irregular line 'sources'.
3) The earth is of a constant surface area which changes at very small rate & which negligible rate of generation of new surface.
4) The newly formed crust farming as a part of rigid plate.
5) All plates are in motion. single plate carry both oceanic (75 km) & continent (125km) lithosphere covered.
6) The number of rigid plates which are grouped in to
   - ① Six major plates: African, American (N & S.), Antartic, Australian-Indian (7), Eurasian and Pacific. (Big plate) N. America (small plate)
   - ② 20 minor plates: Arabian, Bismark, cocous, Nazca, Philipines, caroline, Fuji, Juan De fuca plates. etc.

* Boundries or margin of Plates:

- Boundries of lithospheric plates can be curved as well as a straight, and individual plates can pivot as they move.
- There are many geometric variations in the shapes and motions of individual plates.
- 'Convectional Currents' are said to be the driving force behind the

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(ii) convergent two oceanic crust - Japanies & Honsu island.

(iii) convergent two continent crust - Himalayas, Alps, Appalacians.

a) Constructive or Divergent plate boundries: Two plates moving away.

'Constructive plate margins represent zones of divergence where two plates moves in opposite directions and there is continious upwelling of molten material (lava) and thus crust is continously formed.' e.g. mid oceanic ridge, Rio Grande rift, S. Colorado to El Paso.

b) Distructive or consuming plate margins:

'Convergent plate margins two plates move towards each other or two plates converge along a lime and leading edge of the one plate over-rides the other plates leadings to subduction of relatively heavier plate and thus there is loss of part of crust.'

c) Conservative Plate Boundries: 'Two plates moving towards each other'.

'represents the margin of those two moving plates which pass or slide past one another along transform result and thusl the crust is neither created nor destroy. This is also called share plate boundry. e.g. California San Andreas fault.

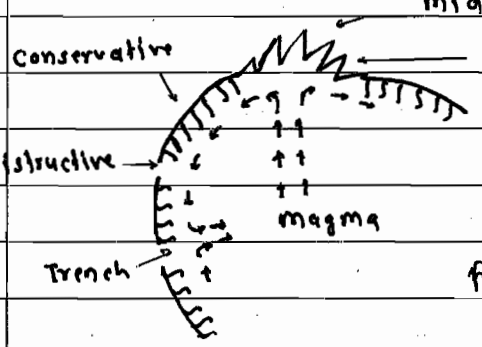


fig: Plate margins

Causes of Plate Motion:

1) Thermal - All active oceanic ridges are charactrised by a wide scatter of heat flow values, some of which are very high.

2) Rates of motions - spreding occurs symmetrically at ridges at rates ranging from less than 1 to 6 cm per year and consuming rates from 5 to 15 cm peryear.

3) Oceanic crust formation - The detailed process of crustal deformation at mid oceanic ridges, it seems that crust of approximetly the same thickness is genrated whatever the spreading rate.

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4) Oceanic Topography - The development of topographic ridges at centres of spreding; ridges 2 to 4 km above the sea level.

5) Gravity - Observations show that ridges are close to isostatic equilibrium.

6) Strength of lithosphere: In some cases the plates are twenty times as long as they are thick.

* Consequence of plate Techtonic:

i) Mountain Buildings:

When two plates colide the leading edge of one is subducted under the edge of another plate and plunge down into the mantle. Therefore the continental plate is rises over and the mountains are formed.

ii) Sesmology or Sesmocity -

- The world earthquake zones are located at constructive and distructive margine of the plate.
- The motion of the plates are associated with the earthquakes of the constructive margine of the plates.
- The distribution of earthquake & volcanoes are circumpatific belt, Alpine - Himalayan Belt.

* Criticism:

1) The rate of creation of new crust appears to be much greater than its rate of distruction.

2) Plate tectonics theory is unable to explain why subduction is limited to Pacific coast while spreading is found in all the oceans.

3) There are evidence to show the movment of the same plate in opposite directions which is almost impossible.

4) The theory of plate techonics has failed to provide a fully satisfactory explainaition of mountain building.

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Sea-Floor Spreading -

- Harry Hess (1960)

- The concept of sea floor spreading was first propounded by professor 'Hary Hess' in 1960.
- The mid oceanic ridges were situated on the rising 'thermal convection currents' coming up form the mantle.
- The oceanic crust moves in opposite directions from mid-oceanic ridges and thus there is continious upwelling of new molten materials (lavas) along the mid oceanic ridges.
- These molten lava cool down and solidify to form new crust along the trailing ends of divergent plates.
- Thus, there is continious creation of new crust along the mid-oceanic ridges.

- According to Hess, proves the fact that 'sea-floor spreads along the mid-oceanic ridges and the expanding crusts destroying along the oceanic trenches.'
- These facts prove that the continents and ocean basins are in constant motion.

Tetrahedral Hypothesis:

- Lowthian Green (1875)

- 'Lowthian Green' is most significant of all the hypothesis based on geometrical principles, in 1875.
- His hypothesis after considering the characteristics of the distributional pattern of land and water over the globe.

Characteristics:

① Dominance land area in northern hemisyhere and water area in soluthern hemisyhere.

② Triangular shape of the continents and oceans.

③ situation of continious ring of land around noath polar sea and location of south pole in land area (Antarkica) surrounded by water from all sides.

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④ The antipodal arragment of continents and oceans.

⑤ Largest extent of the Pacific Ocean covering one third area of the globe.

⑥ Location of chain of folded mountains around the Pacific oceans.

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* He baised on this hypothesis on the follwing two bassic principles of geometry -

i) A sphere is that body which contains the largest volume with respect to its surface area.

ii) A tetrahedron is that body which contains the least volume with respect to its surface area.

Tetrahedron - 'A tetrahedron having four faces is that body which contains the least volume with respect to its surface area'.

- The inner part of the earth was subjected to more contraction due to continued cooling and thus there was marked reduction in the volume of the inner part of the earth.
- Since the upper part, the crust was already cooled and solidified and hence could not be subjected to further contraction.

- This resulted into possible gap betn the upper part collapsed on the inner part and ultimetly the earth began to assume the shape of a 'tetrahedron.'

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REJUVENATION:

Net note

"Rejuvenation simply means acceleration of erosive power of the fluvial process (rivers) caused by negative change in base level of erosion."

Example- If the cycle of erosion is passing through old stage charactsized by gentle channel gradient, sluggish rives flow and broad and shallow alluvial valleys, after rejuvenation the cycle is interupted and is driven back to youth stage charactrized by steep channel gradient accelerated valley incision.

* Rejuvenation of Three types:

1) **Dynamic Rejuvenation:**

Causes - (i) upliftment in the landmass
(ii) Tilting of land area.
(iii) lowering of outlet.

2) **Eustatic Rejuvenation:**

causes: changing in sea level due to
(i) Diastrophism events. (subsidence of sea floor or rise of coastal land)
(ii) Glaciation causing fall in sea level.

3) **Static Rejuvenation-**

Causes: (i) Decrease in the river load.
(ii) Increase in the volume of water and consequent stream discharge due to increased rainfall or melt water
(iii) increase in water volume of the main river due to river capture.

Rejuvenated landforms thus imply a topographic unconfirmity or discordance. In case of rejuvenation a new cycle of erosion is initiated & the consequent landforms can be lebelled as '**Polycyclic**'.

* **Landforms of rejuvenated rivers:**

- (i) Alluvial fan
(ii) Terrace
(iii) Incised meander.

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* Paleomagnetism:

- W.G. Vine and Mattheys conducted the magnetic survey of the central part of Carlsberg Ridge in Indian Ocean in 1963; and computed magnetic profiles on the basis of general magnetism.
- "The age of magnetic stripes, the rate of sea floor spreading up to 4.5 million years calculated on the basis of information obtained from the survey of paleomagnetism".

• Escarpment: R.J. Chorley

'A steep slope separating two or more gently slope surfaces'. It is also used as a general term of a continious scarp face, used often as equivalent to 'cuesta'.

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CYCLE OF EROSION

A) Geographical cycle of DAVIS :

- W. M. Davis was the first geomorphologist to present a general theory of landform development.
- Another theories explained by Davis :
  - (i) Complete cycle of river life - 1889, propounded in essay of 'The Rivers and valleys of Pennsylvania.
  - (ii) Geographical cycle in 1899.
  - (iii) slope evolution. etc.
  - (iv) arid cycle of erosion (1909)
  - (v) glacial cycle of erosion (1906)

* **Defination** : "Geographical cycle is the period of time during which an uplifted landmass undergoes its transformation by the process of land selupture ending in to a low featurless plain a peneplane."

- According to Davis three factors - structure, process and time play important role in the origine and development of landform of a particular place.
- These three factors are called as 'Trio of Davis', and his concept expressed as follows.

'Landscape is a function of structure, process and time' :

i) Structure -

- Topographical characteristics : steep slope, gentle slope.
- rock type : Hard rock, soft rock, sedimentry rock.
- structural characteristics - folding, faulting, joints etc.

ii) Process -

- Endogenetic process : volcanocity, earthquake
- Exogenetic process : agents of denudation including both, weathering and erosion. (running water in the case of geographical cycle).

- 'Sequential change in landforms through time like the evolution of organic life'.

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iii) Time -

- Time was not only used in temporal context by Davis but it was also used as a process itself leading to an inevitable progression of change of landforms.
- The time required of slope development by thousand's of year.

* Assumptions :

1. Every landform is function of structure, process and time.
2. Initial surface emerged from the sea.
3. Erosion is insignificant during the upliftment.
4. Normal cycle run under 'Humid Temprate climate'.
5. Evolution through youth, mature, old age stages.

* The main erosional and depositional processes of erosion cycle passes through following three stages :

1) Youth stage : (vertical erosion)

- The youthfull stage is characterized by rapid rate of vertical erosion and valley deepening.
  Because steep slope, high velocity of river flow, transporting capacity is high, and carry big boulders.
- The lower curve (LC) falls rapidly because of valley deepening, but upper curve (UC) remains almost parallel to horizontal axis.
  Because of upper part not affected by erosion.
- Youthfull stage ultimate maximum relief 'Ef' is attained.

* Charactaristics -

(i) Absolute height remains constant because of insignificant lateral erosion.
(ii) Relief continious to increase.
(iii) overall valleys from gorges and canyon, rapids & waterfalls.

2) Mature Stage - (Lateral erosion)

- The early mature stage is heralded by lateral erosion and well integrated drainage network.
- Vertical erosion or valley deepening is remarkably reduced.

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- There is marked fall in upper curve (UC) i.e. there is marked lowering of absolute relief.

* Characteristics -

(i) The lateral erosion leads to valley widening.

(ii) meanders and oxbow-lake are found in this stage.

(iii) The maximum possible relief exists.

(iv) The duration of ~~mature~~ stage longer than youth stage & shorter than old stage.

3) Old stage : (accumulation zone) -

- Almost total absence of valley incision but lateral erosion and valley widening still active process.
- Thus upper curve falls more rapidly decreas in absolute height.

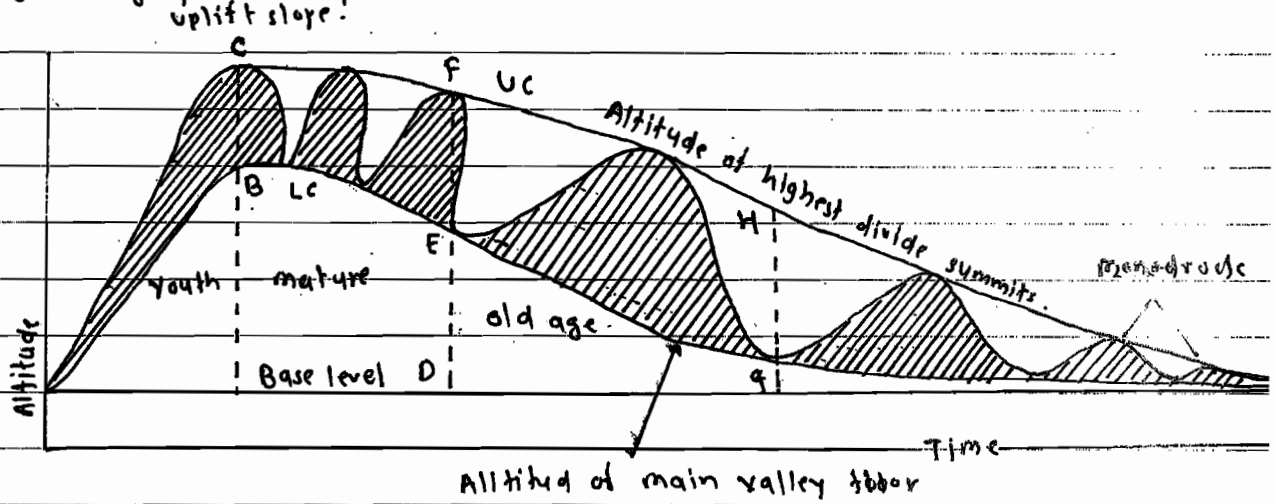
* characteristics -

(i) valley are extremely broad and generally sloping both laterally and longitudnally.

(ii) Valley almost flat, floodplains, monadnocks, undulating plain, low relief are formed.

(iii) Extensive areas are at or near the base level of erosion.

fig: Geographical cycle of W. M. Davis :



* Positive aspects of Davis Model -

1) Davis model of geographical cycle was highly simple and applicable.

2) Davis based his model on detailed and careful field observations.

3) He presented his model in a very lucid, compelling and disarming style using very simple but expressive language.

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4) This model synthesized the current geological thought.
5) Davis model development after a long gap of Hutton's cyclic nature of earth history.
6) His model is capable of both predictions and historical interpretation of landform evolution.

* Negative aspect of Davis model -

1) He has described rapid upliftment of short duration but as as evidenced by plate techtonics long continued process.

2) Davis concept of relationship bet" upliftment and erosion is erroneous.
- He said erosion is start afterupliftment complete, Because i.e. not possible.

3) The Davisian model requires a long period of crustal stability for the completion of cycle of erosion.
- But long period is tectonically not possible.

4) 'Walther Penck' objected to over emphasis of time in Davis model
- Davisian model : 'time dependent series' of landform development.
- Penck pleaded : 'time independent series' of landforms.

5) 'Strahler' and 'Chorley' rejected the Davisian concept of 'historical evolution' of landforms.

"Endogenetic forces create verticle irregularities by forming relief features of different dimension, whereas exogenetic processes originating from the atmosphere try to remove verticle irregularities and the end product will be featurless peniplain. This whole process of creation & distruction is called "cycle of erosion".

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B) Penck's model of cycle of Erosion: (morphological system and morphological Analysis) (1924)

- The model of 'morphological system' was put forward by W. Penck in 1924. who rejected the Davisian concept of 'geographical cycle'.
-
- Penck's found escape from the concept of cyclic change marked by the stages youth, maturity and old age'.
- In the place of 'stage' he used the term 'entwickelung' meaning thereby 'development'.

a) Phase of waxing (Accelerating) or Aufsteigende entwickelung:

- Primprumpf: 'as envisaged by W. Penck, is the initial geomorphic unit for the beginning of the cycle of erosion and development of all sorts of landforms during three phases of cycle of erosion'.

- The land surface rises slowely but after some time the rate of upliftment is accelerated.
- As the rate of upliftment continues to increase the 'V' shaped valleys are further deepened and sharpened.
- Thus both maximum relief and maximum altitude increase. The slopes valley sides are convex in plan.
- The passage of time due to parallel of the steeper slope segments and more accerlated upliftment and degradation primary peneplain is called 'piedmonttreppen'.

b) Phases of Uniform Development (Equilibrium stage)/
Gleichformige entwielunge: means uniform development of landforms.

* This phase may be divided in to 3 subphases on the basis of rate of upliftment and degradation.

① Absolute height increase -
- is charactrised by still accelerated rate of upliftment.
- Absolute height still increases because the rate of

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- This phase is called the phase of uniform development probably because of uniform rate of valley deepening and lowering of divide summits.

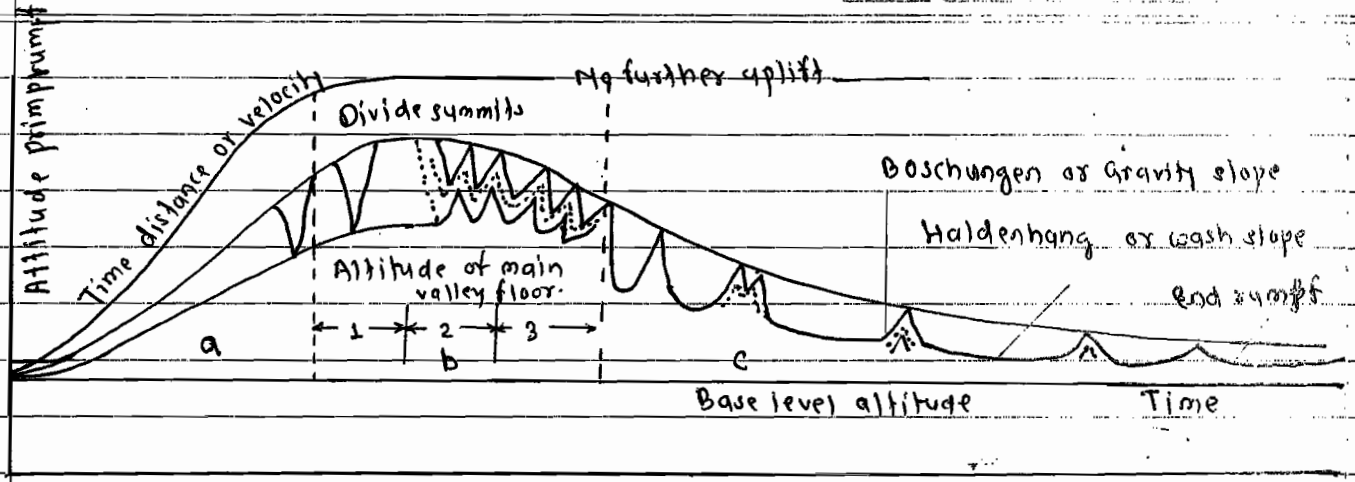
② Absolute Relief stagnant:
- Altitude neither increase nor decreases i.e. remains constant, This is due to the matching upliftment with rate of erosion.
- The slope are valley side still straight, in phase 2 because of parallel retrate.
- This phase constant relief & uniform development of landform.

③ Absolute relief decreases:
- Upliftment of the land stops completely.
- Absolute relief decreses because absence of upliftment but continued to erosion.
- Relative relief remains constant because rate of lowering is equal to the rate of valley deepening.

c) Phase of wanning (Absteigende entwickelung):
- This phase is marked by progresive decline of landforms.
- Absolute relief decreases remarkably because of total absence of upliftment but continue downcutting.
- Parallel retrate of valley side slopes still continues.
- The uppermost segment maintain its steep angle inspite of continuous lowering of ridge creasts.
- This slope is called 'gravity slope' or 'Boschungen'.

- The lower segment of valley sides called 'wash slope' or 'haldenhang'
- The gravity slopes or boschungen are reduced to steep-sided conical residual called 'Inselberg'.
- At the end of absteigende entwickelunge is called 'endrumpf' which may be considered equivalent to Davis 'peneplain'.

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* Criticism:

1) To the difficult technical terminology he used in his model.

2) Pencks concept of parallel retrate of slope and continued crustal movments were not acceptable to the experts.

3) His concept of long continued upliftment and tectonic speculations could not find any support.

4) penck's concept as an alternative to the concept of Davis.

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	W. M. Davis (1899)	Walther Penck (1924)
①	**Objective -**	
	- To provide basis for a systematic description & genetic classification of landforms.	- To understand & interpret the nature of endogenetic forces that were acting to influence the topographic characteristics.
②	**Assumptions -**	
	- Erosion does not start until the upliftment is complete.	- upliftment & erosion go together.
	- There is a short period of rapid rate of upliftment in landmass.	- Time of upliftment may be short, intermediate or long.
③	**Models :**	
	- Davis model of geographical cycle in three stage: (i) Youth (ii) mature (iii) old	- Model of morphological system (i) waxing phase (ii) Uniform Development (iii) waning Phase.
④	**Slope Development -**	
	- His view was that as the cycle progresses, slopes flatten which he described as 'Downwearing.'	- According to Penck, landscape evolution shows evidence of 'Backwearing' & parallel retrate.
⑤	**Definations -**	
	- To Davis, landscape is a function of structure, processes & time.	- To Penck, landscape is an expression of the phase & rate of degradation.

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• **Peneplain** - W.M. Davis

'Peniplain is an undulating surface of low relief, interspred with occasional residual hills, known as monad-rocks, floodplain and wearing down of interfluve of sub-areal denudation'.

- The concept itself pioneer work of Powell (base level) & Dutton.

* Charactaristics -

① Peneplain is not a plain of flat surface but extremely gentle slope.
② The main rivers minimum necessary slope to transport the debris.
③ The predominance of low laying surface & presence of monadnocks.
④ There should be a deep cover of weathered debris & soil.
⑤ The drainage pattern is well adjusted to the geological structur of the underlying rock in a peneplain.

• **Polycyclic Landforms : / Rejuvenation-**

- To various endogentic & exogenetic causes a particular phase of cycle of erosion retrats or advances suddenly or repeats time and again, this feature of cycle has been dealt under Polycyclic Landforms.

- In case of rejuvenation a new cycle of erosion is initiated and the consequent landform can be labelled as "Polycyclic"

- Polycyclic means : as have been produced by more than one cycle of erosion.

* Landforms : ① Valley in the valley ② Two storey valley ③ Two cycle valley ④ Uplifted peneplaines ⑤ Enclosed Meanders ⑥ shifting stream divides ⑦ Misfit Rivers ⑧ River Terraces

• **Ice Age** - Jean de Carpentier

An time in the earth's history when ice spread towards the equator covering large parts of the continents. The most recent of these periods, the plestocene or quaternary glaciation is popularly known as the ice age.

DATE

Screes :

'The broken up rock materials due to weathering fall along the steep slope & collect at the bottom of slope is known as screes'.

Talus cones :

'The loose, angular fragments, produced by ice wedging, developed by gravity & accumulates at the base of the cliff are known as Talus cones'.

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A] RUNNING WATER AND FLUVIAL LANDFORM:

'The landforms either curved out due to erosion or built up due to deposition by running water as called fluvial landform or Running water erosion'.

* **Factors affecting of fluvial erosion:**
  i) Volume of river water
  ii) velocity and thus kinetic energy of water.
  iii) sediment load of water - graval, sand, silt, and clay.
  iv) channel gradient.
  v) water discharge.

Types of Fluvial erosion:

1) **Solution or corosion:** The water as it flow over the rock surface, The minerals material as disolved in water.
Example - Some such rocks are limestone & chalk.

2) **Abration or corasion:**
The removal materials of the rocks of valley and walls with the help of erosional work tools i.e. boulders, pebbels, cobbles.
- Abration operated two ways: ⓘ vertical erosion
ⓘⓘ Lateral erosion.

3) **Attrition:**
'The mechanical tear and wear of erosional tools, while moving with water eolides against each other and smallest finer pices in the transits'.

4) **Hydrolic action:**
is the mechanism of breaking down of rocks due to impact of great force of water currents of channel or sea coasts.
Infact hydrolic action is the mechanical loosing and removal of materials of rocks by water alone i.e. without erosion tools.

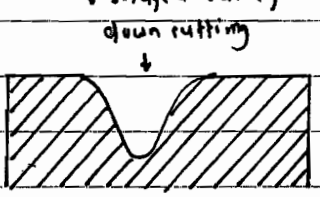
- The climatic conditions under which erosion is most rapid are: hot and moist.
- Bad land topography : Rainstorm

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EROSIONAL LANDFORM:

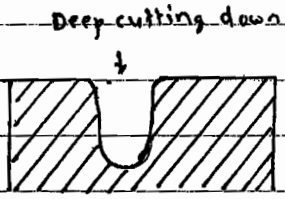
a] The upper coarse of the River:

1) **'V' shaped valley** -



The river valley becomes deep due to its ~~its~~ downward cutting and side cutting are carried on simultaneously by the river.
- The most world have 'V'-shaped valley occur.

2) **Gorge ('V' shaped)** :



"The deep and narrow river valley having steep valleysides, say wall-like valleysides called gorge".
- The rivers flow through areas having hard resistant rocks.

3) **Canyon** -

The extended form of a very deep and narrow valley for long distance is called canyon.
Example- Grand canyon of colorado river.

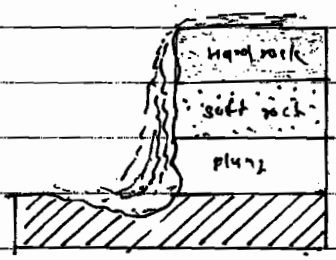
4) **Pot Hole** -



"The rock in the river bed have joints stones and pebbles get trapped in such joints. Due to the stream of water, this trapped material starts moving in a circular manner are called pot hole."

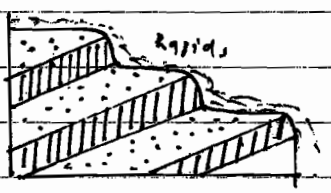
5) **Water falls** -

"A steep fall or flow of water in a watercourse, say a river flow, from a great height is called waterfall."
- This is due to presence of hard & soft rock across the river valley, the soft rock easily eroded & hard rock remains position.



6) **Rapids** -

"The hard & soft rock transverce with the river coarse. The soft rock quickly eroded while hard rock its condition. This leads formation of rapids".



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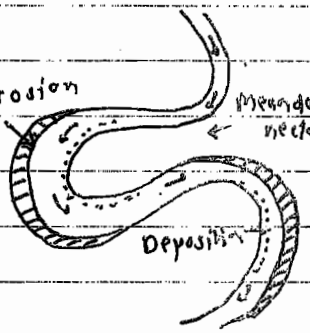
b] The Middle course:

- The intermediate section that lies betⁿ its upper and lower course.

~~Alluvial fans~~ -

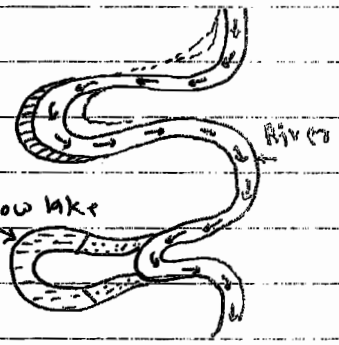
Meanders and ox-bow lakes:

i) **Meanders** - The course of river in the form of large rock or a mound, natural tendancy of the river is to avoid it. In this process, small loops or widening sections occurs in the course. These are known as 'meanders'.



ii) **Ox-bow Lake:**

- Gradually the meanders become more pronounced and the strip of land betⁿ two adjacent loops becomes very narrow.
- During flood time water follows a straight shortcut course by completly avoiding meanders.
- **Defination** - 'The lake formed due to impounding of water in the aboundance meander loops are called ox-bow lakes or 'horse shoe lakes'



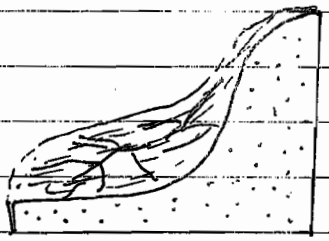
DEPOSITIONAL LANDFORM -

c] The Lower course -

1) **Alluvial fans:**

'The fan-shaped depositional features at the foot-hills are called alluvial fans'.

- The shape of alluvial fans is usually semi-circular circular or arcute.
- The apex of which is located at the mouth of narrow opening through which the stream come out of the hills and entre the surface of low height and gentle slope.



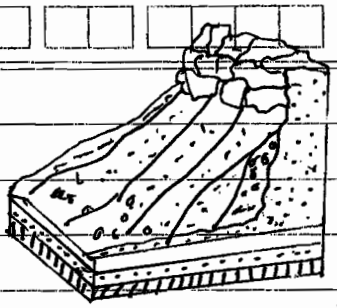
2) **Alluvial cones:**

- Alluvial cones differ from alluvial fans in terms of slope as the former have steeper slopes than the later.

Etchplain: a small erosion platform.
Deep weathering feature in the sub-humid temprate region.

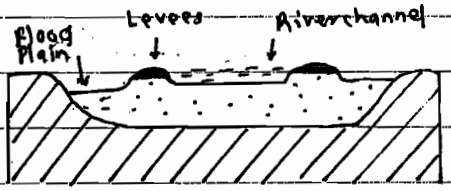
DATE

- Alluvial cones are formed when the slope of hill or mountain front, through which the stream decends, is steep so that debris collect at the foot of the hills.



3) Flood Plains-

During the flood material gets bank itself. on either sides of the river plains are formed due to the deposition of materials such plains are called 'flood plains'.

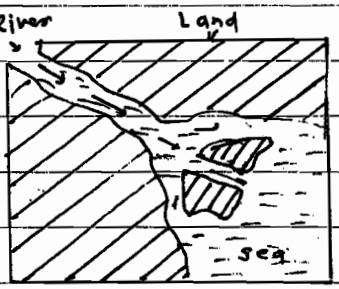


4) Levees:

'The elevation along the bank increase due to the deposition of coarser materials. This gives rise to hillock like forms parallel to river bank are called levees'.

6) Delta:

'The depositional features of almost triangular shape at the mouth of a river debouching either in a lake or sea is called delta.' ~~on the basis~~
- On the basis of Greek letter 'Δ'.
- The word delta was first given to 'Hirodotus'.



* Types of Deltas:

1) on the basis of shape-
   (i) Arcute Delta - e.g. Ganga, Rhine, Nile etc
   (ii) Bird foot Delta - e.g - Mississippi river.
   (iii) Esturiaa Delta - Ex: Narmada, Tapi, Elb, ob delta etc.
   (iv) Truncted Delta
   (v) Blocked Delta
2) on the basis of growth:
   (i) growing delta
   (ii) Blocked delta.

- fluvial action or by running water is more pronounced as compared to glacial action.

PAGE

Hydrofracturing : Felsenmeer DATE

EROSIONAL LANDFORMS:

1) Lapies : 'The highly corrougated and rough surface of limestone lithology charactrised by low ridges and pinnacles, narrow cliffs and numerous solutions holes is called Lapies'.

or Bogaz / ~~Grykes~~ / ~~Karren~~.

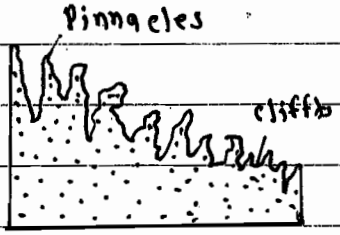
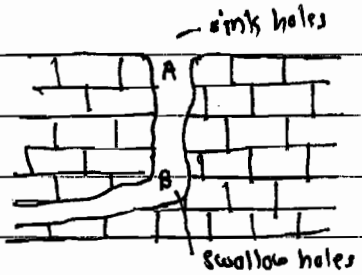


fig : Lapies

-Lappies (France), grykes (N. England), Karren (Germany), Bogaz (Yugoslavia)

2) Sink holes or Avens : 'The funnel-shaped or cylinder-shaped solution holes developed due to dissolution of ~~of~~ limestones are called sink holes'
- funnel shaped, depth 3 to 9 mtr. area 1 sq. m. to more.

3) Swallow holes - 'The enlarged form of sink holes due to coalsence of sink holes in limestones areas is called swallow holes'.



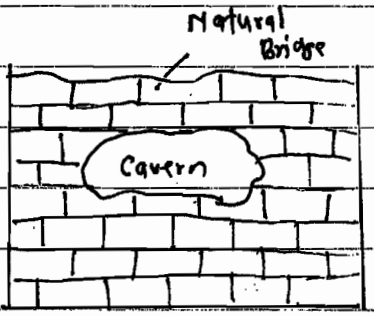
4) Dolines : The enlarged forms of swallow holes due to continuous solution of carbonate rocks or large depressions formed due to coalsencence of few swallow holes in the karst regions are called 'doipstones'.

5) Poljes/Uvala - Most extensive larger than dolines, depresions in limestone regions are called poljes which are charactrized by verticle side walls, flat alluvial floors, irregular border and central lakes.

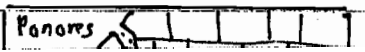
6) Cavern and Natural Bridges :

'Flows the stream that have plunged beneath the earth but as soon as the ground water drained their celling collaps are called cavern'.

Sometimes some portion of the cavern roof remains intact and the remanant called Natural Bridge'.



7) Ponores :



Depositional Environment :

1) **Stalactites** - 'The solution of limestone drop is hanging from the roof of the cavern, some of the water evaporates, thus deposition are of lime grows downward the roof till it begins to hang like a pointed pillar are called stalactite'.

2) **Stalagmite** - The vertical coloums of dripstones having calcite growing upward from the floor of limestone cave are known as stalagmite.

3) **Cave piller** (pillous) : 'is a cloumn of calcite deposite that is formed when stalactite and stalagmite meet together'.

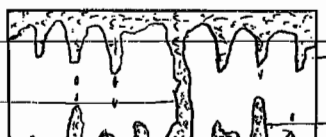
4) **Speleothem** - 'All types of deposits of calcite in limestone caves are collectively called speleothem.'

5) **Travertine** - 'Banded calcareous deposits in limestone caves are called travertine'.
- wheare as the calcareous deposits, softer than travertine, at the mouth of cave are called 'tufa' or 'cale tufa'.

6) **Dripstones** - 'The calcareous deposits from driping of water in dry limestones caves are called dripstones'.

7) **flowstones** - 'The calcareous deposits on the floors of limestones caves formed by seepage water and water flowing out of stalagmite are called flowstones'.

8) **Cockpits** : 'If the dolines, which are cone-shaped solution depressions, are closely spaced, they expand in size due to fast rate of solution and change in to star-shaped depression. Such star-shaped solution features are called cockpits'.
- found in Jamaica, Vietnam, china, Java, Newzeland etc.



classmate
cavern

DATE

Karst Cycle of Erosion:

- Beddre (1911) & Civijic (1918)

- The concept of cycle of erosion was also applied in limestone area by J.W. Beede in (1911) and by Jovan Civijic in (1918).
- The karst cycle of erosion is simpler than other geomorphic cycles because of limestones structure & dominance of solution process.

- Two types of conditions have been recommanded for the initiation of karst cycle of erosion.
  e.g. (i) exposure of thick limestone cover at the ground surface.
  (ii) limestones cover overlain by non-soluble rocks e.g. sandstone.

- 'Beede' postulated 3-stages karst cycle : Youth, mature & old stages. whereas 'Civijic' present 4 stages : Youth, maturity, late maturity & old.

1] Youth -

- The karst cycle starts with the initiation of surface drainage in the regions of thickly bedded limestones.
- The rainwater mixed with CO_2 and reacts with limestones and thus form sink hole and swallow holes.
- The sink & swallow holes gradully increasses and form dolines and caves.
- The charactaristics geomorphic feature of this stage of sink & swallow hole, dolines, lapies, blind valleys, sinking creeks, caves & cavern dimentions.

2] Maturity -

(i) The early maturity stage - total disappearance of surface drainage underground.
- The surface drainage disappears underground through dolines and blind valleys. Thus, numerous sinking creeks are formed.
- The thining of cave roofs causes their colapse giving birth to uvalas, poljes and karst windows.

(ii) The late maturity stage - charactrized by the destruction of most

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3] Old stage -

- The cave roof are totally collapsed and ridges with pitted surface and reduced in height.
- The carbonate rocks project slightly above the ground, these are called 'hums'.
- The ground surface is levelled and thus resemblence the peneplain, nearly all of the karst valley, holes & creeks are eliminated.
- The second karst cycle of erosion may start with fresh upliftment of karst plain.

DATE

C] SEA WAVES AND COASTAL LANDFORM:

- The work of sea water is performed by several marine agents like : (i) sea waves (ii) oceanic currents (iii) tidal waves (iv) tsunamis but the sea waves are most powerfull & effective erosive agent of coastal areas.

* Sea waves : 'It is a undulations of sea water charactrized by well developed crests and troughs'.

* Factors affecting of sea wave erosion :

i) Types of coastal rock i.e. nature and hardness.
ii) structural features of the coast.
iii) The tidal range.
iv) Expose of shore.
v) Depth of water and shore.
vi) Avalability of abrasive tools.
vii) Presence & absence of protective vegetation.
viii) Stability of sea level.

* Process and Mechanism of Marine Erosion :

1) Hydrolic Action : Sea waves are smashed against the cracked or fishured sea cliff the water with air penetrate in to the cliff, which dislodage the rock most and collaps in to the sea.

2) Abration or corrasion :

Coastal erosion by marine waves with the help of tools of erosion i.e. coarse sands, pebbles, cobbles and some time boulders.

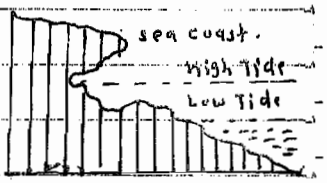
3) Corosion or solution :

It refers to the chemical alteration of rocks mainly carbonate rocks i.e. limestone, dolomites & chalk due to contact with sea water and results are rocks dissolved in water

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EROSIONAL LANDFORM:

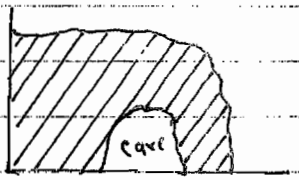
1) **Sea Cliffs:**



'steep rocky coast rising almost vertically above seawater is called sea cliff'.

- Due to continious attack of sea waves the base of headlands gets eroded & it gives rise to near-verticle slopes.

2) **Sea caves:**



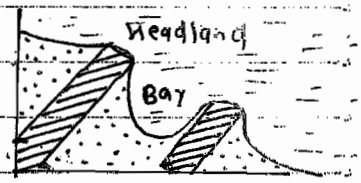
If there is soft rock position in the cliff, it is eroded very fast & the cut away position grown in to a cave.

3) **Coves:**



Hard rocks & soft rocks are parallel to each other along the coast. Soft rock eroded and hard rock behind them, these small gulf care coves.

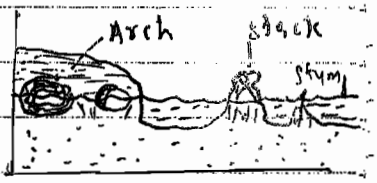
4) **Bay and Headlands:**



'The soft rock surrounded hard rock, the hard rock stand and soft rock is eroded. Hard rock much head of surrounding is known as 'Headland'.

'Erosion of soft rocks long & narrow formed by creeks, with the passage of time creeks are widened are called 'Bays'.

5) **Arch:**



Sea cave meet each other, they form water passage across the headland which known as 'Arch'.

- The arch over the passage called 'Natural Bridge'.

6) **Stack -**

'Natural bridge collaps, the remains of natural bridge stand as pillars are called stack.' This is also called chimney, rocks, needles, pillers, sherries etc.

- The stack are reduced in size are called 'stump'.

7) chimney 8) Inlets 9) wave-cut platforms

PAGE

- Half Coast - A mountainious coast.
- Ria Coast - Inundated coastal valley.
- Fiord Coast - Glacial valley covered with ice.
- Dalmation coast - Karst valley covered with water.

DATE

DEPOSITIONAL LANDFORM :

1) Beaches -

'Large amount of sediments come from the landward side in the areas betⁿ two adjoining headlands. Predominantly fine sands gets settled along the coast, such deposite called Beaches'.

2) Sand Bars -

At times the material from the beach eroded by sea waves form a chain of islands at some distance away from the beach. This also gives rise to the development of sand bars.

3) Lagoons :

The brackish water seprated from the sea water by sand bars and laying in the areas between coast and bars is called as 'Lagoons'. e.g- Chilka lake, Pulicat lake.

4) Spits :

'Spits are ridge made up, at one end they are attached to the land and other end terminates in the sea which is curved part are called pits'.

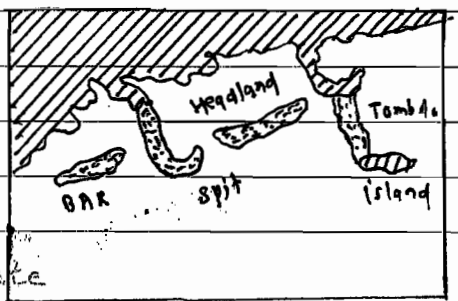
5) Sand Dunes -

Sand dunes are supply associated with extensive sand beaches (i) supply of sand should be large.

(ii) Plants near the coast to trap the sand.

6) Tombolo :

'A bar connecting two headlands or a headland and an island is called tombolo, which acts as bridge betⁿ the coast & an island'.



7) Geos & Gloups - The splashing of

the waves against the roof of a cave may enlarge the joints when compressed air is trapped inside. such shaft is termed as Gloup.

classmate

8) Barrier Island 9) Tidal Inlets
10) Winged headlands 11) Progradation
12) Wave-built platform DATE

* MARINE CYCLE OF EROSION:

- Davis (1932), D.W. Johnson (1919).

a) Along a shoreline of Submergence -

1) Initial stage -

- The initial stage of marine cycle of erosion of shoreline of submergence bighins with the submergence of coastal land under sea water.
- submergence of coast land takes place in two ways -
  - ① either due to rise in sea level.
  - ⑪ subsidence of coast land is submerged under sea water due to its transgression on main land.
- The initial stage charactrized by coves, bays, headlands, islands etc.

2) Youth -

- marine waves mainly swash the mechanism of hydrolic action and corrasion.
- In the begnining the cliffs are of low height and are imperfectly developed, and wavecut platforms are formed.
- Such as arch, stacks, caves and natural chimneys.
- The depositional features formed by e.g. bars, hooks, loops, tombolo etc.

2) Maturity -

- most of the features developed during youthful stage are obliterated.
- Profile of equilibrium is attained due to balance in the rate of erosion and deposition.
- The height and gradient of coastland decreases significantly.
-

3) Old stage -

- Coast and shore are significantly lowered in height because of continued weathering and erosion.
- Adjoining land areas are eroded down to sea level.
- Thus, the coast & shore become straight and slope very gently towards the sea.

DATE

b) Along a shoreline of Emergence:

1) Initial stage -

- Shoreline of emergence is evolved in two ways:
  (i) Due to upliftment of coastaland by tectonicaly events.
  (ii) Due to fall in sea level because subsidence of oceanic floor.
- Initially shorelines of emergence are straight and regular.

2) Youth -

- The youthful stage of marine cycle of erosion on shoreline of emergence begins with the appearance of submarine bars above sea level.
- The small bars are united and thus form offshore bars.
- Late youth is characterized by migration of offshore bars towards the coast.
- This process causes gradual shifting of offshore bars coastward with the result lagoons becomes narrower.

3) Maturity -

- offshore bars, lagoons, swamps and marshes, tidal inlets etc. are distroyed by the beginning of mature stage.
- Sea waves erode the submerged coastal platform up to wave base.
- The slope of the coast beromes steep and the depth of water increases.

4) old stage -

- The development of old stage of marine cycle of erosion on shoreline of emergence can be deducted theoretically only as its practicability is not possible.

DATE

WIND AND AEOLIAN LANDFORM:

- Winds are active in those arid and semi-arid enviornments where the ground surface is covered with loose and friable geomaterials.

* Desert enviorment are charactrized by -
  (i) The mean annual rainfall less than 25 cm.
  (ii) The practicle absence of vegetations.
  (iii) very high daily & annual ranges of temprature.
  (iv) world 1/3 part are covered by deasert.
  (v) The hot deasert are found in 20° to 30° of N & S. hemisphere.

* Erosional work of Wind :-

1) **Deflation** : 'The process of removing, lifting blowing away dry and loose particles of sands and dusts by wind is called as defution'.

2) **Abration** - 'Thus dust and sand particles present in the air float faster wind, and these particles act on the rocks'.

3) **Attrition** - 'The sand particles tear and wear against one another & get reduced and rounded by friction, these process are called attrition'.

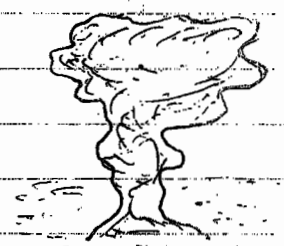
Erosional Landforms :

1) **Deflation Basins** -

'Depresion formed in hot deaserts due to removal of sands through the process of deflation are called **deflation Basins** or **Blow outs** or **desert hollows**'.

2) **Mashroom rocks** -

'The rock having broad upper part and narrow base resembles an umbrella or mashroom are called mushroom rocks or **pedastal rocks**'.



classmate Gara - in sahara & Pilzfelsen - Germany.

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10) **mesa**:- 'Flat topped steep sided upland capped by a resistant rock layer normally formed in arid land is called mesa'.



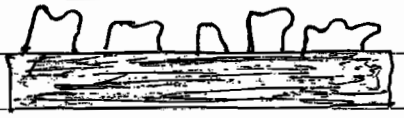
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3) **Yardang**:



'The hard rock & soft rock are parallel to vertically, the soft rock are eroded, hard rock keep standing in their position. Thus rock with steep slope are called as Yardang'.

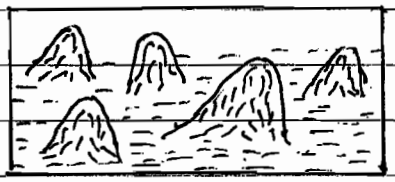
4) **Zeugen**:



The layers of alternate hard & soft rocks lie horizantally on one another. softer rocks are eroded at faster rate leaving behind tabular masses of hard rock are known as 'Zeugen'.

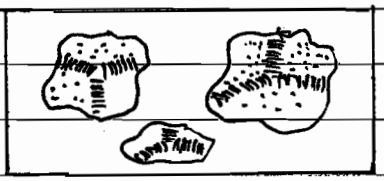


5) **Inselberg**-



sharply rising residual hills above the flat surfaces in arid regions are called 'inselbergs' or 'Bornhardts'

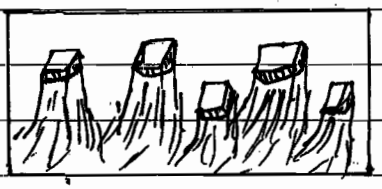
6) **Direketan or ventifacts** -



'These are also called as beveled stones. Faceted rock boulders, cobbles and pebbles abraded by long periods of wind erosion are called ventifacts.'

'A ventifacts or faced rock blocks having three abraded facets are called **drikatan**'. while the boulders with two abraded facets are called '**zweikanter**'.

7) **Demoiselles**:



represent rock pillars having relatively resistant at the top and soft rocks below. These are formed due to differential erosion of hard rock (less erosion) and soft rocks (more erosion).

8) **Stone Lattice** -

Pitted and flutted rock surfare are called stone lattice which are formed due to abrasion by powerful wind charged with erosion tools (rock particles).

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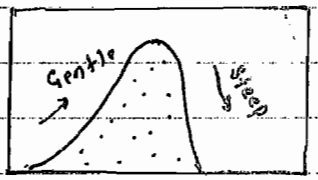
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Depositional Landform:

1) Loess:

'Thick deposited of unstartified, non-indurated, buff-coloured, well sorted, fine grained sediments consisting of quartz silt with small clay fraction and high content of carbonate minerals are called Loess'.

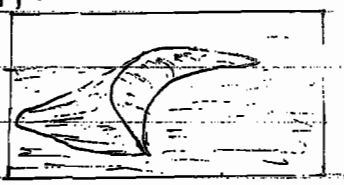
2) Sand Dunes:



Dunes are low hills of sand that vary in their shape, size and height. A typical dune has an uneven slope. Along the windward side the slope is gentle while along the leeward side slope is steep.

- Essential conditions: sand is carried, presence of an obstacles and large supply of sand.
- 'whaleback dunes' are characterised by 'Sahara Desert'.

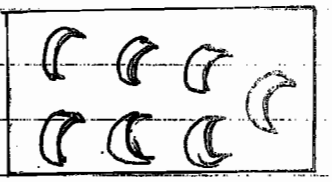
3) Barchan:



The crescentic shape sand dunes having two horns are called barchans or barchan dunes which are special transeverse dunes.

- They occur a gentle slope on windword side and a steep slope along leeward side.

4) Seif Dunes:



'A long narrow sand dune parallel to prevailing wind direction is called seif dunes'.

- They come in to existance due to merging of aline of Barchan.
- Seifs are produced by winds.

* Development of Pediment Theories:

1) Recession Theory - A.C. Lawson (1915)

pediments are developed because of gradual recesion of mountain front caused by weathering and erosion.

2) Sheet flood Theory - W.J. McGee (1897) -

pediments are formed due to erosion of wheathered bedrocks by sheet flood originating from occasional torrential rainfall in dequest.

Pediments: 'situated betⁿ mountain front and bajada in intermontane basin are broad extensive, and gently sloping areas of rockcut surfaces which spread as aprons around the base of mountains.' DATE

3) Lateral erosion Theory - G.K. Gilbert
attributed the formation of pediments to lateral corrasion by streams.

4) Composite Theory - Kirk Brayan (1923), W.M. Davis (1938), sharp (1940).
pediment formation are based on the mechanism of mono-geomorphic process.

Arid cycle of erosion:

- The concept of arid cycle of erosion was postulated first by W.M. Davis in (1905)
- These concept applicable in only mountainious deasert.
- Wind, water also plays important role in arid cycle of erosion.

1) Initial stage -
- The initial stage of arid cycle of erosion of mountain-grit deserts is charactrized by:
① extremly dry climate ⑪ uplifitment of desert by folding & faulting.
⑪ intermontain basins ⑫ evaporation is very active
⑬ stream are enclosed basins etc.

2) Youth -
- Erosion and deposition both are similar and relief are gradually reduced.
- There are two zone of geomorphic significance.
① zone of degradation in higher lands
⑪ zone of aggradation.
- Alluvial fans, Bajada, Deflation basins, playa are formed in youthful stage.

3) Maturity -
- Relief decreases rapidly because of progresive erosion.
- The progresive recession of water divides increases the size of enclosed sea.

classmate

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Hamada: Rocky deserts formed by deflation & abration.

Reg : stony desert - gravel, pebble.

Erg : sand desert. DATE

- This process leads to the integration of basins and drainage systems.
- This process causes the formation of bare surfaces - desert pavements.

4) Old stage -

- All the highlands are reduced to almost plain surface of very low height.
- Numerous residual hills project above the general flat desert surface. i.e. inselbergs.
- Several pediments are coalesced and form extensive pediplains.

* Fluvial Desert Landform:

- Badland, pediments, bajadas and playas are special types of landforms of arid & semi-arid region caused by mechanical disintegration of rocks and water action.

i) Badlands -

The regions of weak sedimentry formation and loessic deposits are extensively eroded by numerous rills and channels which are occasionally developed due to occaisional rainstorm. Thus, the resultant ground surface of uneven terrain is called badlands.

ii) Bajada -

Gently sloping depositional plain bet" pediments and playa is called bajada, which is formed due to coalescence of sevaral alluvial fans. The ramp of sand deposited by streams along arid land is called 'Bajada'.

iii) Bolsons - 'The intermontane basins in arid and semi-arid areas are called Bolsons'. The ramp of sand deposited by streams along.

iv) Playa - The intermontane basins, generally known as bolsons, when filled with water are called 'playas' and 'khabari'.



'The basin surrounded by mountain are known as playas'.

DATE

Glaciated Topography:

'The moving ice mass downslope under the impact of gravity is called glacier'.
- About 10% of earth surface is covered by glaciers.

* Types of Glaciers:

1) Ice sheet or ice caps -
Extensive glaciers on earth's land surface are called ice sheets, which covering thousands of sq. kilometers.
- In fact radiating ice masses in all direction are called ice caps.

2) Continental Glaciers -
The glacier covering vast areas of a continent with thick icesheets called continental glacier.'

3) Mountain Glacier -
'The body of ice moving downslope under the impact of gravity through the valley bordered by rock valley walls in the mountains is called mountain glacier or valley glacier'.

4) Peidmont glacier -
'Glaciers formed due to coalescence of several mountain or valley glaciers at the foot hill zone are called peidmont glaciers'.

* Erosional Work of Glacier:

1) Abration: The glacier eroded its bed and side walls with the tools help of erosion through the mechanism of abrasion.

2) Plucking: 'Large particles are well joined rocks are detached by the moving glacial ice. This mechanism is called plucking'.

3) Nivation: 'Attrition, freezing and thawing of snow, the disintegration of the rock mainly by rotating process are called nivation'.

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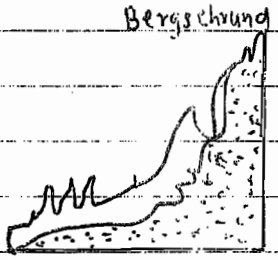
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4) **Scraping:** 'The abracive action of ice takeplace in the process of surface eroded, The abration result in the scrapping'.

Erosional Landforms:

1) **Cirque: / corrie:**

'The armchair-shaped or ampitheatric steep walled head is called cirque or corrie'.



- It is open at one end has a flat bottom and very steep rocky slopes on three sides.

2) **Arête:** 'Intensive erosion of the position bet^n two adjoining series cirques leads to the formation of chain of hills with the sharpe bases is called Arête'.

- Arête is called serrete range in england.

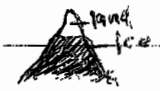


3) **Mattern horne' -**

If 'cirques develop along three or four sides of a mountains, the slopes of that mountain become very steep and the top portion appears like 'horn', it is called 'matternhorn'.

4) **Nunatak:**

'The higher peaks and mounds surrounded by ice from all sides are called nunataks'. i.e. also called glacial island.

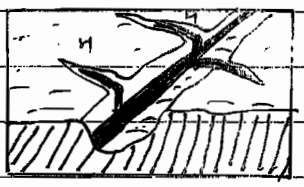


5) **'U' shapped valley:**

'Due to erosion by glacier basal portion becomes flat and side slope steep, these valley are called 'U' shaped valley'.

6) **Hanging valley:**

The tributaries glaciers is much less than that in the main glacier, After the ice melts, these valleys of tributary glacier appears to be hanging over the main glacier, such valley called 'Hanging valley'.



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7) Rouchmountainees:

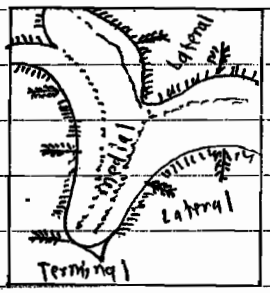
'are streamlined asymmetrical hillocks, mounds or hills having one side smoothly moulded with gentle slope and the steepened and craggy lee side'.

8) Crag and Tail:

'A peculiar glacial landform having verticle eroded steep upglacial side and tail like appearance with lower height downglacial side is called crag and tail'.

9) Trough lakes 10) Tarn 11) Fiords →

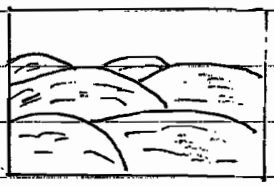
Depositional Landforms:



1) Moraines: are ridge-like depositional features of glacial tills. They are long but narrow ridges with hegght more than 30 m.

* There are mainly divided in four categories:

Ⓘ Terminal Ⓘ Lateral Ⓘ Medial Ⓘ Ground moraines.



2) Drumlines:

'The swarms of clusters of rounded hummocks resulting from the deposition of glacial till are called drumlins' which are look like half egg.

- 'It is also called 'Basket of egg topography'.

3) Eskers:

'At times, the moraines the get deposited in the form of long, widining narrow hills with steep slopes, these are called eskers'.

4) Kames -

Kames are made up of glacial load, varying from boulders to clay particles. Kames are low hills several hundred meters long 50 m in height.

- Delta Kames are the outcome of - Glacial Deposition.

5) outwash plain: deposition by glacier after its melting: the eroded

6) ~~Kettle~~ sediments in the front of the terminal moraine & thus form a plain.

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10) Fiord (fjord):
- A glaciated valley that has been inundated by the sea and forms a deep steep sided coastal inlet, with a 'U' shaped cross profile.
- fiord shows many of the characteristics of glaciated 'U'-shaped valleys & morainer deposits have often been laid down on the sill, which mark the limit of effective erosion by the ice.
- fiords are found in Norway, on the pacific coast of British Columbia, canada & S. chile.

11) Tarn: A rock basin is formed at the floor of the cirque basin due ~~Periglacial cycle of erosion~~: to erosional, after deglaciation this rock basin is filled up with water ~~Peltier~~ (1950) & thus forms a small glacial lake ~~witten~~ which is called 'cirque lake' or simply a 'tarn'.

6) Kettle & Hummocks:
- Kettles are depresions in the outwash plains.
- Kettles are ~~founded~~ formed due to melting of large blocks of ice.

'Large Kettles are dotted with numerous low mounds which are called hummocks'.

DRAINAGE SYSTEMS AND PATTERNS

DATE

A] DRAINAGE SYSTEMS :

"Drainage system refers to the origin and development of streams through time."

* factors :

(i) Nature of initial surface and slope.

(ii) Geological structure. e.g : folds, faults, joints, dips, rock beds & types of rocks.

Major Drainage systems :

a] Sequent Drainage systems : 'Which follow the regional slope and are well adjusted to geological structures'

follow regional slope
adjust geological structure

1) Consequent streams -

- The consequent streams follow the regional slope, These are also called dip streams.
- In a region of folded structure consequent streams are formed in the synclinal troughs.
- It emerged parallel to each other and thus form parallel drainage.
- The longest streams of the whole system of consequent streams is called 'master consequent.'
  e.g. coastal plains of India.
- The direction of flow of streams is controlled by rock structure.

2) Subsequent streams -

'The streams originated after the master consequent stream and following the axis of the anticlines or ridges and strikes of beds are called subsequent streams'

- These streams joint the master consequent at almost right angle.
- The surface over which consequent valley exist have many so belts of weak rocks in which subsequent valley are formed.

Eg : Aslan rivers, Yamuna & Ganga river tributaries etc.

3) Obsequent streams -

'The streams flowing in opposite direction to the master consequent are called obsequent streams'

- Obsequent streams generally flow opposite to consequent stream.

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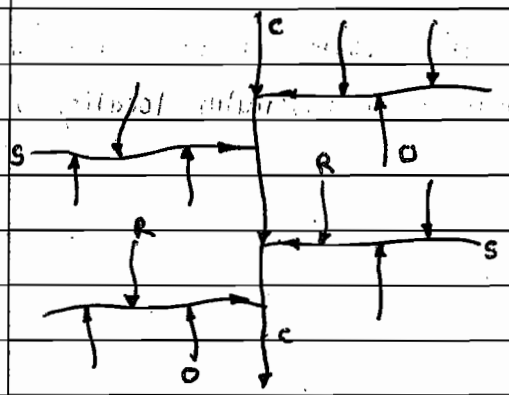
- These valley which were formed on such a land surface where there direction of flows has been reserved on account of erosion. e.g. Beheaded streams.

4) Resequent streams -

'The tributaries streams flowing in the direction of the master consequents are called resequents.'

'A sub-consequent streams flow in the direction of consequent streams and joins the subsequent stream at right angle.'

- They are recent and after master consequent streams origin; and hence called resequent.



C - Consequent streams
S - subsequent streams
O - Obsequent streams
R - Resequent streams.

b) Insequent Drainage system:

'The streams which do not follow the regional slopes and drain across the geological structures are called insequent or inconsequent streams'.

1) Antecedent Drainage systems -

- Antecedent streams are those which are originated prior to the upliftment of land surface. e.g. Indus, Sutlaj, & Brahmputra etc.
- Antecedent streams antedate the upliftment of an upland or mountain across which they have maintained their present courses through continious downcutting of their valleys.
- 'The river maintains its previous course through downcutting its valley at the rate equivalent to the rate of uplift of the land area, the river is called anticedent or anticonsequent.'



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2) Superimposed Drainage System :-

river origin after adjustment of uneven rock with time / river origin with out adjustment of uneven rock with time

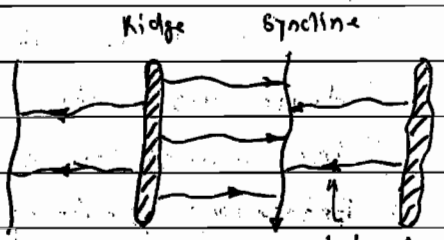
- The river maintains the forms of its valley, the flow direction and its drainage patterns as usual, such rivers are called superimposed rivers.
- Due to continious flow of the stream, even the underlaying strata are eroded and the stream maintain its original slope. Such a valley appears to be unadjusted to its structure, These valley were named superimposed.

B] DRAINAGE PATTERNS :

'The drainage pattern means the 'form' of the drainage systems and the spatial arragment of streams in a particular locality or region'.

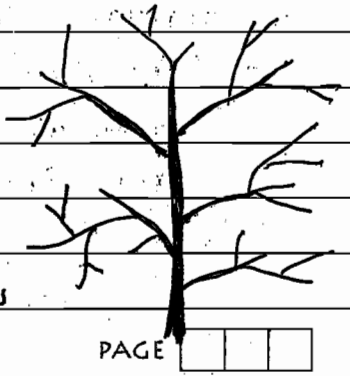
factors : (i) nature of slope.
(ii) structural control.
(iii) Lighological charactaristics.
(iv) Tectonic factors.
(v) climatic condition
(vi) vegetation cover etc.

1) Trellised Drainage Pattern -



- A drillage pattern develops on a folded structure consisting of resistant anticlinal ridges seprated by synclinal valley.
- There are long straight river valleys with their tributaries joining almost at right angles, making it look like a rectangular arragment known as Trellise pattern. Because it resembles the grapes vines spreading on trellis.

2) Dendritic Drainage Pattern :



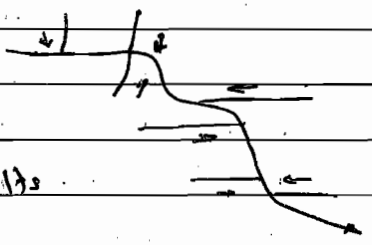
- These pattern on the ground that the network of tributaries of various orders & magnitudes of the trunk or master streams resembles the branches and roots and rootless of a tree.

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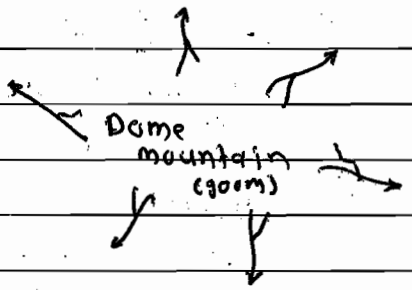
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3) Rectangular Drainage Pattern:



- The tributaries meet the main stream at right angles.
- This pattern develops where joints and faults are formed.
- The geometric joints of metamorphic joints of metamorphic rocks give rise to rectangular drainage pattern.

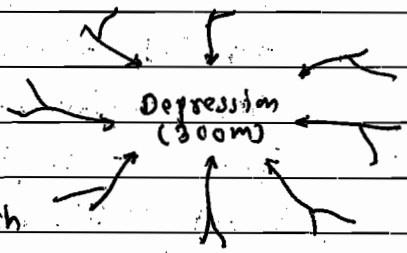
4) Radial Drainage Pattern:



- It is also known as centrifugal pattern, is formed by the streams central higher point in all direction.

Example: the entire drainage network of Sri Lanka.

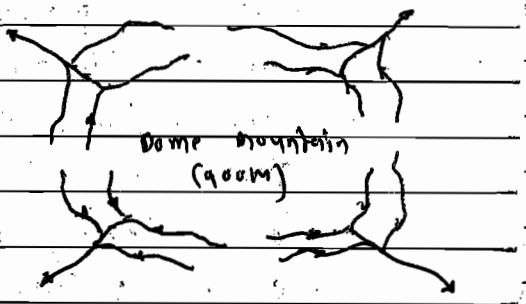
5) Centripetal Drainage Pattern -



- The streams which converge at a point which is generally a depression or a basin.
- It is formed by a series of streams which after emerging from surrounding uplands converge in central low land which may a depression, or a basin or a crater lake.

Example: Kathmandu valley of Nepal.

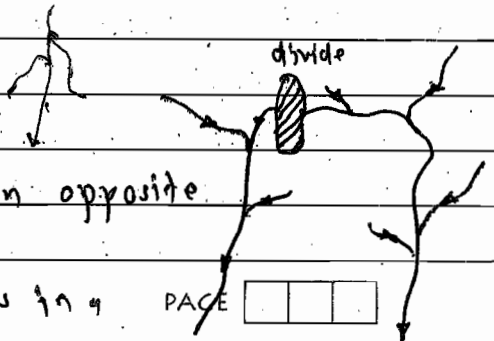
6) Annular Drainage pattern -



- The master consequent streams emerge at the top of the dome and radiate in all directions down the slope like radial drainage pattern, whereas tributary streams develop in the cleaf formed due to erosion due to erosion of soft beds, assume arcute shape and join the master consequet streams and thus annular drainage pattern is formed.

Example: Sonaped dome of Uttaranchal.

7) Barbed Drainage pattern:



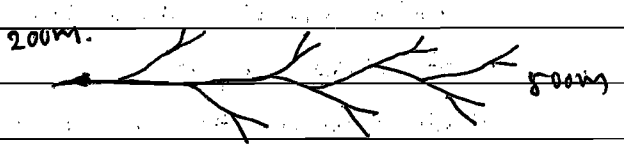
- It is formed when the tributaries flow in opposite direction to their master stream.
- The tributaries join their master streams in a

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- Rating curve: 'It is useful for estimation of stream velocity'.

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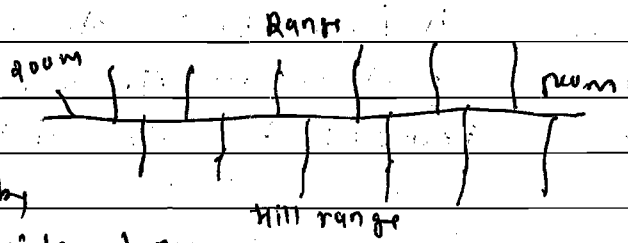
8) Pinnate Drainage pattern:



- Pinnate pattern is developed in a narrow valley flanked by steep ranges.
- The tributaries originating from the steep sides of parallel ridges join the longitudnal master consequent occupying the valley at acute angle.

Example: upper Son and Narmada river.

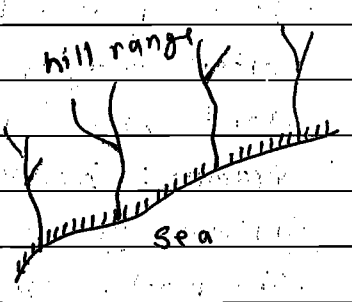
9) Herringbone Drainage Pattern -



- It is also known as 'rib pattern', is developed on mountainous region where broad valley are flanked by paralled ridges having steep hillsides slopes.
- The longitudnal consequent streams as a master streams and join the longitudnal consequent almost at right angle.

Example: River Kosi & Rapti.

10) Parallel Drainage Pattern:



- It is comparises numerous rivers which are parallel to each other and follow the regional slope.
- This pattern is more frequently developed on uniformaly sloping and dipping rock beds such as cuestas or newely emerged coastal plains.

Example: eastern coastal plains of India.

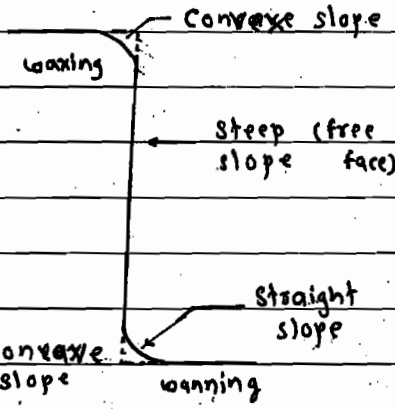
- Esturies: (खाड़ी)
- fresh water from land enters the ocean through rivers, streams & ground water
- 'The embayments where fresh water from the land masses meets salt water from the ocean are called esturies'.
- The most commercially important.

DATE

SLOPE FORMS AND PROCESSES

- **Slope :** 'Slope can be defined as an angular inclination of a landform in relation to the base level elements of slope profile'.

* There are four succesive stages of slope development :



1) **Convex slope :**
- conver are generally developed by chemical and physical weathering process.
- Convex slope mostly observed in tropical areas.

2) **Steep slope :**
- steep slope is created by techtonic movments.
- Steep slope also generated by massive mass - mass wasting or land sliding events steep slope are free face.

3) **Constant slope :**
- Due to accumulation of debris i.e. uncosolidated loose weathering material scree, Talus, Detritual, Rubbles etc.
- The constant & steep slope are formed, it is also called debris slope.

4) **Concave slope :**
- Concave slope are created on the accumulated unconsolidated materials slope was as a fluvial erosion.
- It is dominated over the accumulated debris farming concave slope.

* factors affecting the slope development -

i. Geological structure of rock.
ii. climate
iii. vegetation Pattern
iv. Process of Denudation. - weathering, erosion, transportatn, deposition.
v. Drainage texture & frequency.
vi. Relative Relief.

DATE

a) **W.M. Davis view of slope development - (1899)**

- Davis idea of 'normal cycle of erosion' i.e. erosion by running water in 'humid temprate region' his based observations.

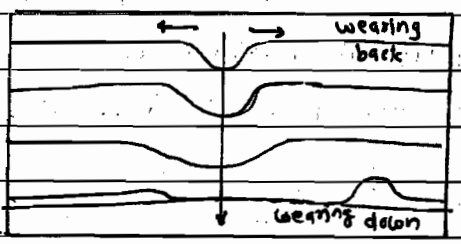
- He considered that as valley became widened there bordering slopes became less and less steep as they 'retreated back'.

- mature stage: At that time the initial surface has practically vanished and only devides betn adjoining valley indicating the existance of the original surface.

- Old age stage: The whole landscape is reduced to the condition of an undulating plane. This lowlaying levelled eroded surface the ultimate product of an old age turmed as a 'peneplain'.

lowlaying levelled

- Davisian slope development linked with two ideas:
  (i) The reduction, smothening & flatenning of hill slopes i.e. Recession.
  (ii) Reduction of the divides produce broad gently conver forms.



- Davis - 'slope decline theory' based on 'Geographical cycle of erosion'.
- The slope passes through Youth (convex slope), mature (uniform / rectiliner slope) and old (concave slope) stages of development.

(i) Youth - It is active down cutting, valley broadening, weathering or there is limited slope retrate.

(ii) mature - 'sidewards erosion dominate over verticle erosion'. occurs decrease in slope angle, slope becomes smooth & graded.

(iii) Old - marked slope decline, general slope become concave, & here slope angle more than 5°.

- Davis describe convexity - by soil erosion.
  straight - gradient & deposition.
  concavity - dominance of lateral erosion over vertical erosion.

DATE

b) **Walther Penck view of slope development:** (1924)

- W. Penck fundamental discussion the matter of slope development in his book: 'Die Morphology Analysis' in 1924.
- 'Penck established a relationship bet^n the nature of slope and tectonic history of region'.

* **Assumptions':**

i) Convex slope - are formed during the period of accelarating uplifting.

ii) Straight slope - are formed during the period of constant upliftment.

iii) Concave slope - are formed by the decline of upliftment or during the stability.

* **Slope development process -**

- He study of the reduction of rock material because of the processes which disintegrate the earth crust.
Therefore the material become mobile & transportable with the processes of downslope movment.

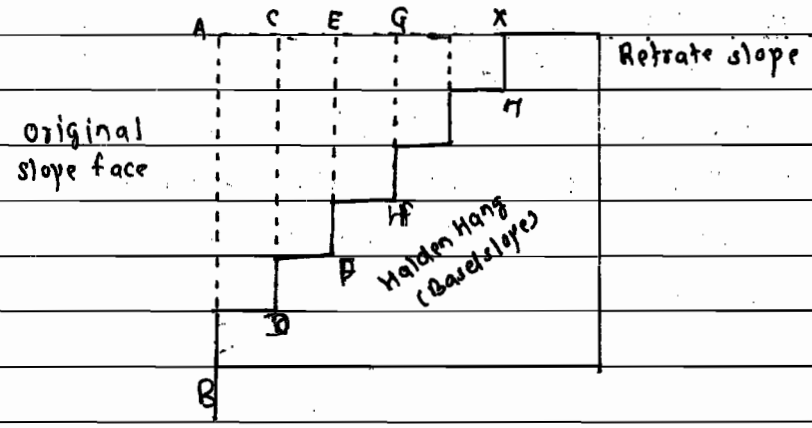
- The development of constant & concave slope with statistical investigation started with straight slope assuming equal weathering.

- The weathered mass of landscape crumbled in to fragments & falls under the pull of gravity at the base level.

- In this way the base part of the original slope is being protected by the 'scree or talus'.

- The newface of slope express to the action of weathering and erosional processes.

- This face again crumbled and fall at the base thus the original slope profile moved back as a result of 'parallel retreat'



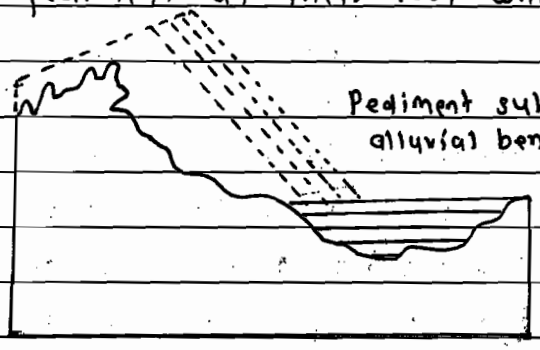
In fig- AB to CD, CD to EF & onwards.. the whole processes extend untill there is the development of new slope which was termed by penck's as 'Halden Hang' (Baselevel).

- Halden Hang is exposed for weathering were the material will removed for in case of previous retrate.
- The slope flatten out giving rise new basel slope which gentler than the former basel slope.
- Thus the entire slope profile show up concavity (convexity).

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c) **L.C. King view of slope development : (1962)**

- Kings has putforwarded the most radical recent, & restatment of the 'problem of slope development.'
- He has accepted 'woods' analysis four elements of hill slope such as (i) waxing slope (ii) free face (iii) constant slope (iv) Debris slope etc.
- King's view free face & detrital slope are actively eroded the hill side by the parallel retrate.
- Such relatively steep slopes by retrating so leave a gently sloping pediment at their foot which is concave in profile.



- Ultimate landscape under this processes in composition of pediment in 'pediplane'.
- L.C. King two ways of fluvial processes, are responcible for this slope development:
  (i) sheet flow of water.
  (ii) Rill wash of water.

over the gentle slope & steeper slopes respectively.
- Name of the book - Morphology of Earth.

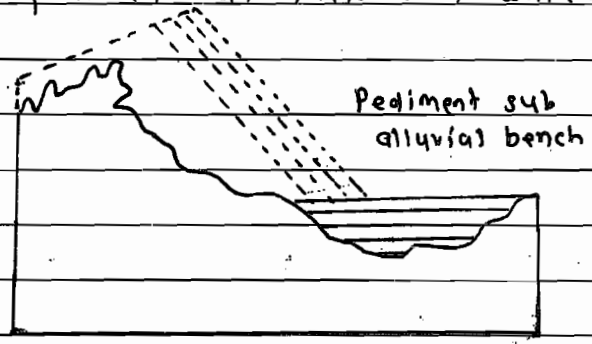
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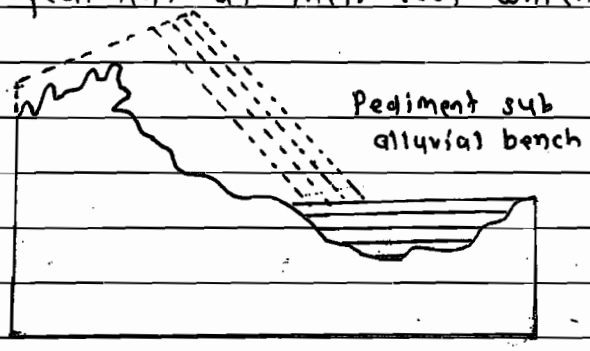
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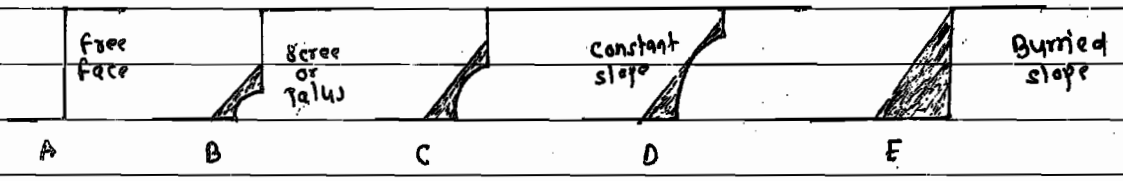
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d) A. Wood view of slope development: (1972)

- Wood's concept of 'Geometric approch of slope development'. thought that the development of steep slope or free face. It causes debris to accumulate as a scree at the base of free face.

i) The Talus or debris will grow gradully untill the free face is burried.

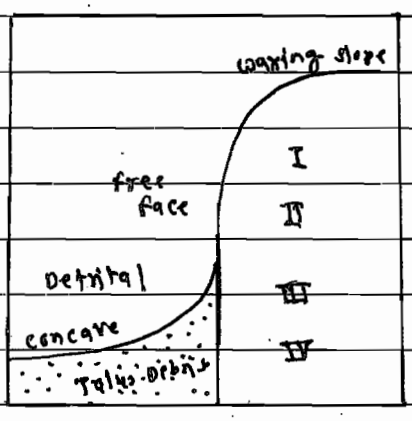
ii) In this way free face or steep slope developed in to a constant slope.



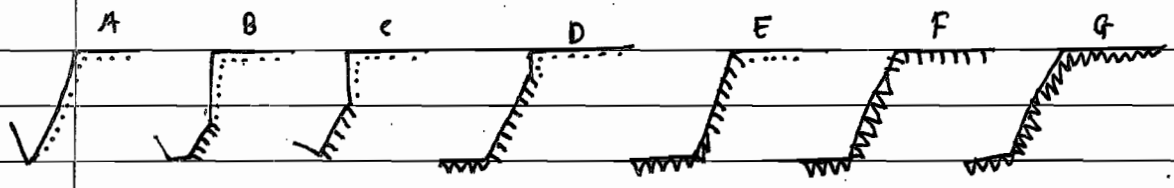
iii) In early stage free face 'B' available to weathering is much larger than the surface of the talus so talus grows upword.

iv) Next stage 'C' & 'D' the material from a very small area of a free face is spread over a very large area of scree.

v) The accumulated scree conceals & protect the lower part of the free face.



1) Upper convex slope : waxing slope
2) Free face : steep slope
3) Constant slope : Debris or Talus
4) concave slope : wanning slope.



1. Increasing dominance of constant slope from stage B to D.
2. Increasing development of wash slope from stage D to G.
3. formation of upper convexity at stage F to G.

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- **Peniplains:**
  - Peniplains represent low featureless plain having undulating surface and remanants of convexo-concave residual hills.
  - these are frequented with low residual hills known as 'monadrocks'.
  - * Named by different geomorphologists:
  - (i) Peneplain - W.M. Davis
  - (ii) Endrumpf - Walther Penck
  - (iii) Panplain - P.W. Crickmay
  - (iv) Pediplain - L.C. King.
  - (v) Etchplain - Pugh and Thomas
  - (vi) Panfan - A.P. Lawson etc.

- **Coastal Wetlands:**
  'flat and rolling marshy lands developed in the coastal areas of humid tropics are called coastal wetlands'.
  - which are generally formed behind spits or bars.
  - There is absence of reliefs and sea water remains stagnant in these wetlands.
  - sediments are fine and water is saline. such wetlands are found Sundarban (W. Bengal).

- **Sabkha -**
  'Depositional coastal area having flat surface in the dry tropical zones are called 'sabkhas' which are flat but barren coastal lands'.
  - 'sabkhas are also called as salt flats'

Davis:

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APPLIDE GEOMORPHOLOGY:

- Each science subject have two main aspects:
  - (i) Historical (Theoratical) asyect.
  - (ii) Applied (Practicle) feature applications
- Geomormorphology affects almost all aspect of human activity for e.g. Agriculture, forestry, mining, industrial etc.

- **Defination** - "Applied geomorphology may be defined as the application of geomorphology to the solution of miscellaneous problems, especially to the development of resources and dimention of hazards."

Example -

Rapid growth of popl^n to leads in the increasing pressure on land resources & large scale deforestration, to promote problem created by like soil erosion, flood & sedimentation etc.

- Geomorphology can help in the identification and solution of an many as this problem.

Branches of Applied Geomorphology:

1) **Enviormental Geomorphology:**

- Concerned with landform material and their related processes.
  - (i) mapping of geomorphological phenomena.
  - (ii) Applying areal photographs, Remote sensing for monetaring the problem.
  - (iii) Recognition of geomorphic problem.
  - (iv) Recording and measuring geomorphic problem.
  - (v) suggetion recommandation.

2) **Anthropo Geomorphology** -

- Human interferance in natural system
  - (i) Agriculture, mining
  - (ii) Construction of dams & roads
  - (iii) Industralization
  - (iv) war creating
  - (v) Disturbence in natural geomorphic development.

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3) Urbangeomorphology -
- study of land, processes, material hazards etc.
- Lithological, topographical characteristics, slope, altitude, structure forms & processes.

Economic activity of Applied Geomorphology :-

① Geomorphology & Agriculture -
- Geomorphology immensly affected agriculture on micro, meso and regional scale.
- The differances in the technique, typology, pattern and problems of agriculture in mountains, plateau and plains.

② Geomorphology & communication -
- Topography plays an important role in highway route. Karst topography, Landslide creates special problem in road construction and maintainance
- Roadways, Railways, water ways, Airways, pipeline, electricline also depend on geomorphic structure.

③ Geomorphology and Trade -
- Trade are also depend on demand on supply in a geographical personality of region.

e.g - Assam valley trade differanciate on Ganga Basin region.

④ Geomorphology & Geology -
- Geological feature are valuble minerals are explorated
e.g. iorn-ore (chota nagpur plateau), coal (zariya)
oil (Bombay high).

All geological material searching with the help of geomorphological studies.

⑤ Geomorphology & Engeneering -
- Geomorphology application in road building.
- construction dams & reservior.

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* Recent trend in Applied Geomorphology:

1. Attendance of Geomorphology in geological studies i.e. mineralogy, paleontology, & glacier deposits.

2. A decline intrest of geographer in physical geography & give increasing importance in human geography.

3. The development of regional geomorphology in micro, meso and macro regional scale.

4. An increasing recognition of the practicle application of geomorphic principle.

5. To drawn of quantitative and expriemental geomorphic processes.

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ROCKS

- The materials of the crust or lithosphere are generally called as rocks. The word 'lithosphere' means 'rocksphere' as literal meaning 'lithos' is rocks.
- Important elements of the whole earth Iron (35%), Oxygen (30%), silicon (15%), magnesium (13%) etc.
- Important element of earth crust Oxygen (46%) & Silicon (28%).

* **The Important mineral groups:**

i) **Silicate minerals -**
- quartz, feldspar, & ferromagnesium.

ii) **Carbonate minerals -**
- Calcite, limestones & marbles.

iii) **Sulphide minerals -**
- include pyrite, iorn sulphide.

iv) **Metalic minerals -**
- like iorn, aluminium.

\# **Classification of Rocks:**

- The crustal rock are classified on several grounds e.g. mode of formation, physical & chemical properties, locations etc.

A) **IGNEOUS ROCKS:**

- Latin word 'ignis' meaning there by 'fire'.
- The igneous rocks are formed due to cooling, solidification & crystallization of hot & molten materials known as magma & lava.
- Igneous rocks are also called as primary rocks because these were originated first of all the rocks.
- Igneous rocks are also called 'parent rocks".

* **Charactaristics -**

1) The igneous rocks are roughly hard rocks & water percolates with great difficulty along the joints.
2) Igneous rocks do not have strata like sedimentary rocks.
3) Igneous rocks are granular or crystaline rocks.

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4) Igneous rocks are affected by mechanical or physical weathering.
5) Igneous rocks do not contain fossiles.
6) It is mostly associated with the volcanic activities.

Granites:
- Granite are plytonic intrusive igneous rocks are formed deep within the earth.
- Granites are composed minerals of quartz, feldspar, & mica.

Basalts:
- Basalts very fine-grained, dark coloured extrusive igneous rocks which are formed cooling & solidification of molten lava.
- Chemically basalts contains 45 to 65% of silica content.

B) SEDIMENTARY ROCKS:

- The word sedimentary derived from Latin word 'sedimentum' which means 'settling down.'
- It is also called stratified or layered rocks, because different layer or strata from different sediments. Some times layers are absent in such rocks e.g. Loess.
- The disintegratn & decomposition of the rocks by the agents of erosion & weathering are gradually deposited and continious sedimentation increases the weight & pressure and different layers are consolidated & compact to form sedimentary rocks.
- The most abundant rock type in the earth's crust is sedimentary.

* **Characteristics -**

1) Sedimentry rocks derived from older rocks, plants & animal remains fossils.
2) Sedimentary rocks are found over the largest surfaces area of the globe about 75%.
3) Sedimentary rocks contains several layers or strata. ~~but~~
4) These rocks are not found in massive form such as batholiths, laccoliths etc.
5) Layers of sedimentary rocks are seldom found in original and horizantal manner.

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6) It is may be well consolidated, poorly consolidated & even unconsolidated.

7) Sedimentary rocks are characterized by different sizes of joints.

8) The connecting plane bet^n two consecutive beds or layers of sedimentary rocks is called 'bedding plane'.

* Classification -

1) mechanical formed - sandstone, conglomerates, clay rocks, shale, Loess.

2) chemically formed - Gypsum, salt rock.

3) Organically Formed - Limestones, Dolomites, Coals, Peats.

C] METAMORPHIC ROCKS:

- 'Metamorphic rocks include rocks that have been changed either in form or composition without disintegration'.
- metamorphic rocks are formed due to changes in form of sedimentary & igneous rocks.
- Rock conglomerate is irrelevant with metamorphism.

* Characteristics -

1) It may be during the process of metamorphism there may be complete alteration in the form of rocks.

2) some rocks after metamorphism that it becomes harder than their original forms e.g. marble.

3) fossils of sedimentry rocks are also destroyed during the process of metamorphism.

4) Agents of metamorphism likes Heat, Compression & solution.

Marbles:

- Marbles are generally formed due to changes in limestones because of temprature changes.
- Limestones are transformed into marble due to contact thermal methamorphism during volcanic activity.
- The colour of limestone depend upons nature of parent limestones. The marble Carara (Italy), Narmada river (India) are pink & white colour available.

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Schits -

- Schits are fine grained metamorphic rocks & are charactrized by well developed foliation.
- The clay & other minerals of the original shale rocks are changed to mica minerals & thus shales in to change schits.

Slates :

- slates are formed due to dynamic regional metamorphism of shales & other agrillaceous rocks.
- slates may be regarded as a special type of fine- grained schits'.

Gneiss -

- Gneiss are coarse- grained metamorphic rocks which are formed due to metamorphism of sedimentary & igneous rocks.
e.g. Feldspar.

Quartzites :

- Quartzites are generally formed from sandstones which are dominated by the aboundance of quartz minerals.
- The sandstones are compacted due to excessive compression & heat also filled with silica, with the result quartzites.

* Classification of Igneous Rocks :

(a) Intrusive Igneous Rocks -

'The rising magmas during a volcanic activity do not reach the earth's surface rather they are cooled and solidified below the surface of the earth, the resultant igneous rocks are called 'Intrusive Igneous Rocks'.

1. Batholiths -

- Batholiths are long irregular and undulating forms of solidified intruded magmas.
- They are usually dome shaped and their side walls are very steep, almost verticle.

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II. Laccoliths -
- Laccoliths are formed due to intrusion of magmas along the bedding planes of horizontally bedded sedimentary rocks.
- Laccolith are mushroom shape having convex summital form.

III. Phacoliths -
- Phacoliths are formed due to injection of magma along the anticlines and synclines in the regions of folded mountains.

IV. Lopoliths -
- Lopas meaning there by a shallow basin or bowl shape body.
- when magma is injected and solidified in a concave shallow basin whose central part is suggested downward, the resultant form of solidified magmas is called a lopoliths.

V. Sills -
- The sills are usually parallel to the bedding planes of sedimentary rocks.
- Sills are formed due to injection and solidification of magmas betn the bedding plaines of sedimentary rocks.
- Thick beds of magmas are called 'sills' whereas thin beds of magma are called as 'sheets'

VI. Dykes -
- Dykes represents wall like formation of solidified magmas
- These are most perpendicular to the beds of sedimentary rocks.
- The thickness of dykes ranges from a few centimeters to several hundred meters but the length extends from a few meters to several kilometers.

(b) Extrunsive Igneous Rocks:
'The igneous rocks formed due to cooling and solidification of hot and molten lavas at the earth's surface are called Extrunsive Igneous Rocks'.
These rocks are also called as volcanic rocks.

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पृथ्वीवरील उंचसखल भागांचे अस्तित्व कसे टिकून राहते की,
गुरुत्व भूपृष्ठाखाली सारखेच वस्तुमान असणे, आणि
सर्व भूरूपे पृथ्वीच्या अंतरंगातील भूकवचाखालील अधःस्तरावर
स्वतःला व इतर भूरूपांना तोलून धरतात. DATE

THEORY OF ISOSTASY

Dutton (1859).

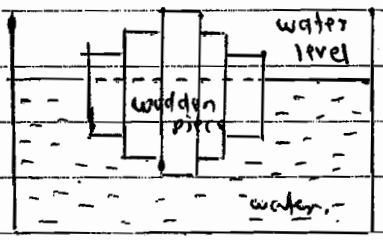
Defination: 'Isostasy means a mechanical stability bet^n the upstanding parts & lowlying basins on a rotating earth'.

- The word isostasy German word - 'isostasis' means 'in equipoise'.
The 1st prapoed by 'Dutton' in 1859.

- According to Dutton the upstanding parts of the earth must become lighter rock material from beneath, so that the crustal relief should remains in mechanical stability.

a) Concept of AIRY:

- According to him the crust of relatively lighter material is floating in the substartum of denser material, sial is floating in sima.
- This concept infact involves the principle of floation.
for e.g. - Iceberg floats one part to be above water level, nine parts remains below water level.
- Airy did not mention the example of the floation of iceberg. He mention that landmasses were floating, like a boat, in the magma of substartum.
- The continents are made of rocks having uniform density but their thickness or length varies from place to place.
e.g. wooden pieces of varying length.



* 'जेवढ्या वस्तुमानाचे क्षेत्र ते भूपृष्ठावर व्यापलेले तेवढेच वस्तुमान त्यांना भूपृष्ठाखाली आधारासाठी असल्याने ते संतुलित अवस्थेत आहेत.'

b) concept of PRATT:

- According to Pratt there is a level of compensation above which there is variation in the density of different coloumn of land but there is no change in density below this level.
- The central theme of the concept of Pratt on isotasy - 'uniform depth with varying density'.
'Bigger the colpumn lesser the density & smaller the coloumn greater the density.

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- Thus, Pratt's concept of isostasy was related to the 'law of compensation' and not to 'law of floatation'

varying density with uniform thickness.

Line of compensation

- Different relief features are standing only because of the fact that their respective mass is equal along the line of compensation.

- The fundamental difference betⁿ Airy's and Pratt's views is that the former postulated a uniform density with varying thickness and the latter a uniform depth with varying densities.

c) Concept of HAYFORD and BOWIE:

- According to them there is a plane where there is complete compensation of the crustal parts. Densities vary with elevations of coloumns of crustal parts above this plane of compensation.

mountain density less than ocean bottom at the compensation plane.

- The density of mountains is less than the ocean floor.
- According to Bowie there is inverse relationship betⁿ the height of coloumns of the crust & their respective densities above the line of compensation.
- The 'plane of compensation' is supposedly located at the depth 100km.

'The assumptions is that the varying volume of matter in several coloumns is compensated by their density, in such a fashion that they exert equal downward pressure at the level of compensation and thus balance one another'.

d) Concept of JOLY: (1925)

- According to Joly there exists a layer of 10 mile (16 km) thickness below a shell of uniform density.
- He did not belive in 'line of compensation' rather he belived in a 'zone of compensation'.
- Joly's concept closer to Airy's 'This is in close agreement with floation idea the areas of low densities in the 10-miles layer corresponding with downward projections of the ~~height~~ light continent crust, while those of high density represent the intervening areas filled

Uniform Density zone
16 km compensation zone

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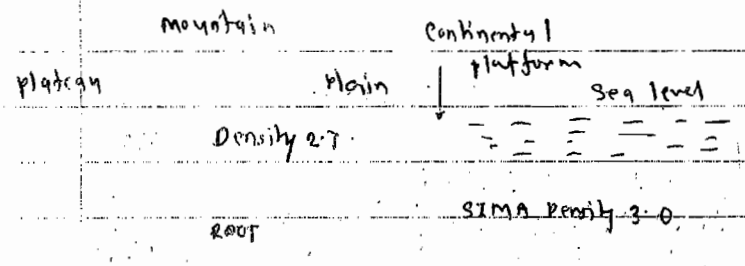
e) Concept of HEISKENEN - (1933) -

density of rocks varies both vertically & horizontally

- According to him density of rocks varies within the column & bet^n the column.
- Density of rocks of different sections (columns) of the earth's crust also varies.
- Thus, it appears that density of rocks varies both vertically and horizontally.

Comparison of Holmes:

- Arthur Holmes on isostasy, to a greater extent, are compatible with the view of Airy.
- Holme assumed that upstanding crustal parts are made of lighter materials and inorder to balance them major portions of these higher columns are submerged in greater depth of lighter materials.



- which show characteristics examples of crustal columns, each of which has the same area and extends downward to the same depth below the sea level, the same depth at which the weight of each column exerts approximately the same pressure on the underlying material, irrespective of its surface elevation.
- To explain the concept of equal weight along the 'level of equal pressure' through four column plateau, mountain, plain and seafloor level of equal pressure ranging bet^n 150.0 to 151.2;

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GEOLOGICAL HISTORY OF THE EARTH :

— F. Press & R. Siever (1974)

- The whole geological history of the earth has been divided in to five eras :

a) PRE-PALAEOZOIC ERA :

1) Precambrian Period - (700 million B.P.)

- The earth change gaseous state to liquid state, solid outer crust formed due to cooling liquid materials.
- formation of atmosphere, water vapour, precipitation, climate was broken glacial period.
- The plant & animal kingdom only marine areas.

b) PALAEOZOIC :

2) Cambrian Period - (600 - 500 B.P.) :

- The earth surface was warm and uniform climate.
- Evolution of plants & vertibrates animals on seas, no land animal evolved during this period.
- Cambrian rocks of Wales, NW scottland, canada & USA were formed.

3) Ordovician Period - (500 - 440 B.P.) :

- This period was charactrized by mountain building, marine areas were affected by active vulcancity.
- The climate on the earth surface was warm, vegetation and animals were still confined seas only. animals only confined vertibrates.
- Ordovian rocks formed were NW Europe & N. America.

4) Silurian Period - (440 - 400 B.P.)

- The mountain building continue but vulcanicity less active.
- Leafless plants were evolved first time on land areas.
- There was increas in species of vertibrate animals.
- Corals were evolved in large scale.
- Periodic rise & fall of which introduced changes on earth surface.

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5) Devonian Period - (400 - 350 B.P.) :
- Mountain building & volcanicity were more active.
- The earth's surface was covered with green vegetation.
- This period evolution a large number of fish. Amphibions were evolved towards the end of this period.
- There was dispersal of vertibral animals from seas to land.

6) Carboniferous Period - (350 - 270 B.P.)
- The coal formation of northern hemisphere, which became dense vegetation cover over such areas.
- Land areas covered with green tall trees (30m).
- Amphibian animal increases, Reptiles are evolved on land areas. smaller animals were evolved in swamps & marshes.

7) Permian Period - (270 - 225 B.P.)
- Inland lake formed due to faulting.
- High mountains were formed due to techtonic movments. e.g - Applacians
- The N. hemisphere dominated dry climate and S. hemisphere were influence under glacier.
- The ratio of evergreen trees decrease but land animal increase.

c) MESOZOIC :

8) Triassic Period - (225 - 180 B.P.)
- Most of the mountains were covered with desert & bushes.
- Coniferous trees & ferns were developed in N. hemisphere.
- Carnivores fishesh like reptiles & lobsters evolved.
- For the first time mammals evolved from reptiles on land areas.

9) Jurassic Period : (180 - 135 B.P.)
- Land areas were dominated by forests & swampy plains.
- The mountains were transformed into low hills due to classmate continued denudation.

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- This period widespread deposition of lime mostly Europe.
- The rainfall was such that dense vegetation.
- For the first time flowering plants evolved.
- The climate becomes subtropical towards the end of this period.

10) Cretaceous Period - (135 - 70 B.P.):

- The process of formation of tertiary or alpine mountains
  E.g. Rockies, Andes, Alps, Himalayas etc.
  Atl Folded mountains
- The Pennisular India was covered with thick basaltic lava.
- Deciduous trees flourished because of seasonal regime of climate.
- Fishesh like modern shark, herring, turtles, mosasaurous etc.
- These period evolution flying reptiles, feathered & featherless birds overdominance by reptiles.

d) CENOZOIC

11) Eocene Period (70 - 40 B.P.):

- The tertiary mountains formed during ereatecreous period were further uplifted & grew in height.
- The Indian & Atlantic ocean extended due to sea floor spreading.
  Indian-Atlantic Ocean
- Several primates of modern mammals were evolved on land areas e.g. elephant, horses, rhinocerous, pigs etc.
  Early monkey and gibbons were evolved in Burma.
- The process of the formation of the Himalayas was initiated.

12) Oligocene Period - (40 - 25 B.P.)

- Most of the areas warm, temprate and cold climate started.
- Several species of crabs, snails & mussels were evolved in water.
- Ancestors of modern cats, dogs and Apes were originated probably as ancestors of man.

13) Miocene Period: (25 - 11 B.P.)

- Mediteranean sea, Alps & Himalayas further formed.
- Humid climate responcible for growth of deciduous trees like maple, oak, & cedar.
- Bony fishesh, & Penguine are evolved in Antartica.

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14) Pliocene Period -
- The continents and oceans basins attained their present position.
- North, Arabalan, Caspian, Black sea were formed due to drifting of the land areas.
- marine plants & animals attained their present life forms.
- The origin of siwalik ranges.

E) MEOZOIC :

15) Pleistocene Period : (1 million - 9,90,000 B.P.) :
- This period known as plestocene Ice Age comprised four glacial & four interglacial periods.
- Retrate of ice sheets brought several changes in N. America & Europe. evolution of great lake in U.S.A. & Canada.

16) Holocene Period - (10,000 yrs B.P.) :
- Marine organisms attained their present life forms and man began farming and animal domestication.

* Glacial Periods :

1) North America : (from south to North)
(i) Nebersakan (ii) Kansan (iii) Illinoian (iv) Wisconsin
- Interglacial period -
(i) Afteonian (ii) Yarmouth (iii) sangman

2) Europe :
(i) Gunz (ii) Mindel (iii) Riss (iv) Wurn.

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- earth's average albedo - 32%.

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- **Meteorites:**

A meteorite is an actual piece of extra-terrestrial matter that has reached the surface of our planet, Earth.

① **Asteroids - / planetoids:**

are rocky bodies upto 800 km in diameter, although most are much smaller with diameter less than a kilometer.

② **Meteroids -**

are small fragments of rock and metal travelling through space.

③ **Comets -**

may originate in a huge cloud called the Oort cloud i.e. thought to surround the solar system.

Orogenic Belts:

'The mobile belts arranged in linear or arcuate tracts that have been subjected to severe deformation & mountain building & are found near the edges of the continents are called orogenic belts'.

- The young orogenic belts are made of sedimentary rocks.
- The older mountain belts extend to the ocean & abruptly terminate at the continental margin.
- All the orogenic belts have been formed due to plate collision.

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Concepts :

- Base level of erosion - Gilbert
- Pedocals & Pedalfers - Johnson
- Basal slapping - Marbut
- Dynamic Equilibrium - Davis

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Concepts:

- ~~Wes~~Losch - Market Area location Theory.
- ~~Fes~~Weber - Least cost Theory.
- Reily - ~~Agglomeration~~ Theory of Gravitation
- Thombson - Agglomeration Theory

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INDUSTRIAL GEOGRAPHY :

Factors Influencing The Location of Industries :

I] Geographical factors :

1) Raw materials -
- The location of industrial enterprises is sometimes determined simply by location of the raw materials.
- The jute mills (W. Bengal), Sugar mills (U.P.), cotton textiles (MH) are concentrated close to the source of raw materials.

2) Power -
- Regular supply of power is a pre-requisite for the localisation of industries.
- Coal, Petroleum oil & hydro-electricity are three important conventional source of power.
- TISCO (Jamshedpur), Khetri (RJ), Renukoot (UP), Ranga (PB). are near the source of power.

3) Labour -
- The location of any industrial unit is determined after a careful balancing of all relevant factors.
- The light consumer goods & agro-based industries generally require a plentiful of labour supply.

4) Transport -
- Transport by land or water is necessary for the assembly of raw materials and for marketing of the finished products.
- A particular industry owes to original transport facilities available in a particular area.

5) Market -
- Nearness to market is essential for quick disposal of manufactured goods. It helps to reducing transport cost.

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- Ready market is most essential for perishable and heavy commodities.
- It is more true that industries are seeking locations.

6) Water -
- Many industries are located near rivers, canals & lakes. e.g. Iorn & steel ind, Textile Ind, chemical industries. require large quantities of water.

7) Site -
- It should be flat & well served by adequate transport facilities.
- Large areas are required to build factories.
- To set up industries in rural areas to shot up land cost, labour cost as compair urban centres.

8) Climate -
- Climate plays an important role in the establishment of industries at a place.
- Extremely hot, humid, dry or cold climate is not suitable for the establishment of industries.
- Cotton textile industry requires humid climate.

II) **Non -Geographical factors:**

1) Capital -
- Modern industries are capital -intensive and require huge investments.
- Capitals are available in urban centres. eg. Mumbai.

2) Goverment policies -
- Goverment activities in planning the future distribution of industries, for reducing regional disparities.
- It is of relevance to examine the influence of India's

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3) Industrial Inertia -

- Industries tend to develop at the place of their original establishment though the original cause may have disappeared.
- This phenomenon is referred to as inertia, sometimes as geographical inertia & sometimes industrial inertia.

4) Efficient Organisation -

- Bad management, financial trouble does not handle the labour force efficiently & tactfully.
- Strikes and lock-outs leads to the closure of industries.
- Hence, there is an imperative need of effective management and organisation to run the industries.

5) Banking facilities -

- Establishment of industries is possible through banking facilities.
- The area with better banking facilities are better suited to establishment of industries.

6) Insurance -

- There is a constant fear of damage to machine and man in industries for which insurance facilities are badly needed.

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CLASSIFICATION OF INDUSTRIES:

I. On the Basis of strength of Labour -

1) Large scale Industry:

'Industries which employ a large number of labourers in in each unitti are called large-scale industries.'

- Cotton or jute textile are large scale industries.

2) Medium scale Industries -

'The industry which employ neither very large nor very small number of labourers are put in the categories.

- Cycle, Radio and Television industries.

3) Small scale Industries -

'The industries which are owned and run by individuals & which employ a small number of labourers are called small scale industries.'

II On the Basis of Raw-material and finished Goods:

1) Heavy Industries -

Industries which use heavy & bulky raw-materials and produce products of the same category are called heavy industries.

e.g. Iorn & steel industries.

2) Light Industries -

The light industries use light raw-materials & produce light finished products.

e.g - electric fans, sewing machins are light industries.

III. On the Basis of ownership -

1) Private sector Industries -

Industries owned by individuals or firms such as Bajaj Auto or TISCO situated at Jamshedpur are called private sector industries.

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2) Public sector Industries -

Industries owned by the state and its agencies like Bharat Heavy Electricals Ltd., Bhilai steel plant or Durgapur steel plant are public sector industries.

3) Joint Sector Industries -

Industries owned jointly by the private firms & the state or its agencies such as Gujrat Alkalies Ltd., Oil India Ltd. fall in the group of joint sector industries.

4) Co-operative sector Industries -

Industries owend and run - co-operatively by a group of people who are generally producers of raw materials of the given industry such as a sugar mill owned and run by farmers are called co-operative sector industries.

IV. On the Basis of Source of Raw Materials:

1) Agro-Based Industries -

Those industries which obtained raw-material from agriculture. Cotton textile, jute, sugar & vegetable oil are on these group.

2) Mineral Based Industries -

The industries that recive raw materials primiarly from minerals, such as iorn & steel, aluminium, cement industries etc.

3) Pastrol Based Industries -

These industries depend upon animals for their raw materials Hides, skins, bones, horns, shoes, dairy etc. are some of the pastrol industries.

4) Forest Based Industries -

Paper card-board, lac, rayon, resin, tanning of leather, leave utinsils, basket industries are included.

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V. Miscellaneous Industries -

1) Village Industries -
- It is located on village due to the needs of the rural people.
- They usually provide employment in local machinary such as oil extraction, grain grinding & agricultural implements.

2) Cottage Industries -
'Industries which artisans set up in their own houses, work with wood, cane, bars, stone etc. are called cottage industries'.
- Handloom, khadi & leather work.

3) Consumer good Industries -
Consumer industries convert raw material in to finished product. Textile, Bakaries, sugar etc. are called consumer industries.

4) Ancillary Industries -
The industries which manufacture parts & components to be used by big industries for manufacturing heavy articles like trucks, buses, railway engine, tractors etc. are called ancillary industries.

5) Basic Industries -
Industries on which depend many other industries for their manufacturing processes are called basic industries.
e.g. Iorn & steel industries.

6) Capital - Intensive Industries :
Industries requiring huge investment are called capital intensive industries.
e.g. Iorn & steel, aluminium & steel etc.

7) Labour - Intensive Industries :
It require huge labour force for running them are called labour - intensive industries.
e.g. - shoe making & Bidi manufacturing.

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INDUSTRIAL LOCATION THEORIES:

- The 'optimal Location' - the economically best location, those their give maximum profits.
'When the cost are at their lowest and the revenues their highest.'
- It happens that these two situation are found at the same time or same place.

① Least cost location: 'weber'

'Revenue are taken equal at all location but variation in cost (of production) from place to place examined to find out the least cost location (optimum location)'.

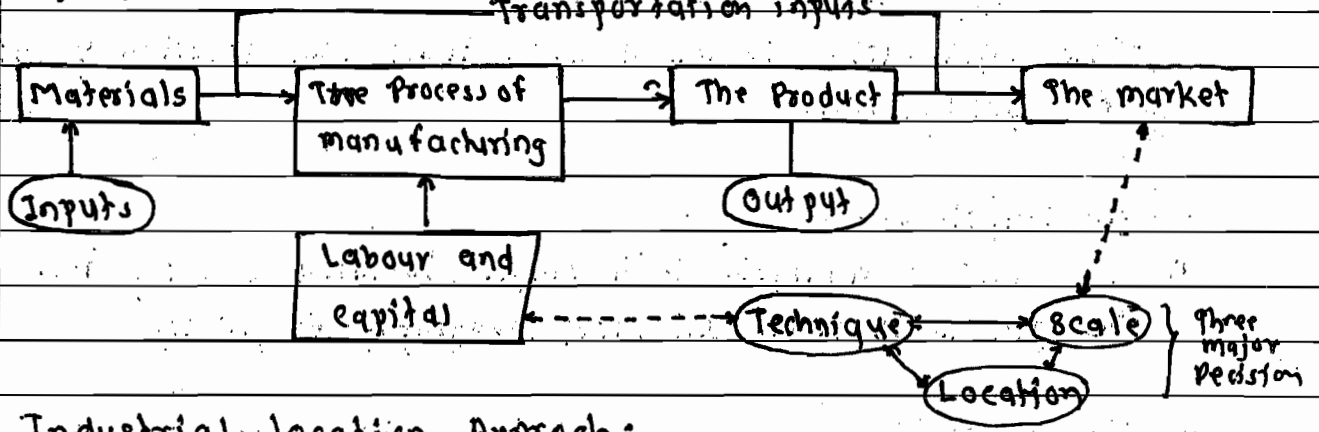
- Least cost theory has its roots in the work of 'Alfred weber'; demand factor is constant.

② Maximum Revenue Location: 'Losch'

'Cost of production takes equal at all places and variation in demand are examined to find out the maximum revenue location'.

- The maximum revenue, market area examine Palander & Hoover, much of 'Losch'.

fig: The location factor in the context of industry -



* Industrial location Approch:

i) Optimiser Behaviour : Least cost Approch
Maximum Revenue Approch or
Market Area or Locational Approch.

ii) Satisfier behaviour : Behavioural Approch
Structural Approch.

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Dec. 2003

A) **LEAST COST APPROCH :**

- The least cost approch emphasizes the search for the least cost location where the demand factor held constant.
- In this approch is the assumption of perfect competition, with no monopolistic advantages with respect to market arising from specific location.

Alfred Weber's Theory : (1909) -

- This theory based on least costs is proposed by 'Weber' in his book 'Theory of location of Industries' in 1909. (Uber den standort der Industries)
- He attempted show how it optimum location with respect to raw material and market.
- His approch 'deterministic' and 'normative'.

* **Aim of theory :**

- To explain the location of industrial activity in terms of three economic factors.
  ~ (i) Transport costs ~ (ii) labour costs and
  ~ (iii) agglomeration economies.
- His explaination is based upon least cost location point for production.

* **Assumptions :**

i. The unit of analysis is a single, isolated country i.e. homogenous in terms climate, topography, people etc.

ii. Transportation cost increasing in direct propotion to distance & weight of cargo.

iii. There is an uneven distribution of natural resources on the plain. Raw material are found specific location.

iv. Costs of land, building equipment, intrest are fixed capital.

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v. Labour is geographically fixed.

vi. The entrepreneurs seeks to minimise the total cost of production.

* **Principles :**

- Webers analysis of industrial location is divided in two sections:
  ① Identification of the point of minimum transport costs.
  ② A discussion of the circumstances under which production will be attracted away from this least cost point.

A] **Least cost Location Point -**

- There are three regional factors:
  ⓘ Cost of raw materials ⓜ transporting ⓛ Labour.

Ⓐ **Least transport cost point :**

- We suggest that transportation cost effects two factors:

i. The weight of materials to be assembled together with the weight of the final product to be shipped to the market.

ii. The distance over which the materials and the product have to be moved.

$$MI = \frac{\text{Weight of the localised materials used in the industry}}{\text{weight of the product}}$$

e.g. If 4 tonnes of raw material to make 2 tonnes finished goods, the material Index is

$$MI = \frac{4}{2} = 2.$$

1. **Case A :** One maket and one raw material -

① If the raw material is 'ubiquitos' - then factory will be located at market, because lowest transport costs.

② If the raw material is fixed i.e. specific location and pure i.e. weight loss zero, then factory will be located either market or at the source of raw materials.

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③ If the raw material fixed and gross, then the factory will be located source of raw material.

II. **Case B**: One maket and Two raw materials -

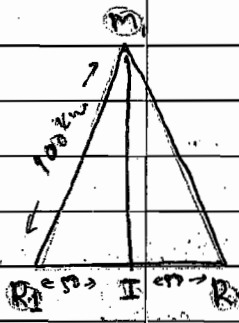
- The second case raw materials are available two plares 'R_1' & 'R_2' & finished product consumed at market 'm.'

① If R_1 & R_2 ubiqutous, then the manufacturing will be at the market.

② If 'R_1' is ubiqutous and 'R_2' are fixed both pure, then manufacturing will be at the market as well alternative location 'R_2'.

③ If both raw material R_1 & R_2 fixed and pure - then factory will be located at the market, otherwise the source of 'R_1' and 'R_2'.

④ If both raw material fixed and gross, the solution is complex.



If, the industry is to be located at R_1, the total transportatn cost will be;

(2 tonnes x 100 km x Rs. 1.00) + 100 = Rs. 300

If, the industry be located at R_2, the total transportatn cost will be:

(2 x 100) + 100 = Rs. 300

If, the industry will be located at marked 'm_1'. the total transportatn cost -

(2 x 100) + (2 + 100) = Rs. 400

If, the industry is to be located at 'I' or intermediate point betn the transportatn cost -

(2 x 50) + (2 x 50) + 86.6 x 1 = Rs. 286.

So, I or intermediate location will be the least cost location.

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b) Role of Labour:

- The effects of labour costs on location since he considered that industries would be located away from the point of least transport costs to the point of least labour costs if savings in labour costs were greater than any additional transport costs involved in such a move.

• Isotimes - 'The lines joining the points of equal transport costs'.

- All along the lines or isotimes the transportatn cost is the same per unit distance.

If, the least transportatn cost R.400 is at R_2 and total labour cost Rs. 500.

The total cost of production

Rs. 400 + Rs. 500 = Rs. 900

In case the labour cost at '0' situated at 12th isotime labour cost Rs. 400 + Transportation cost Rs. 250 + Rs. 120 (additional cost) = Rs. 770

In case of cheap labour, the factory will be located at '0' as the cost of production will be cheaper, being only Rs. 770 as against Rs. 900 of R_2.

c) Role of agglomeration -

- In A, B, C, D and E are least cost locations, but the firms located there could cut their productn costs by Rs. 1 per unit of production if at least three of them operated in the same location.

- However, they must not incur increased transport costs of over Re. 1 unit of production.

• Isodopane - 'The total transport cost'

- with the help of isodopane, identifies the areas in which the cost of productn & supply of the finished product would be the same.

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* **Criticism:**

(1) He gave more emphasis to supply, while the role of demand in the location of an industry completly ignored.

(2) Weber more emphasized the role of transport in the establishment of an industry.

(3) Agglomeration concept, ignored the problem of space, high cost of land & high rent in industrial areas.

(4) The historical factors, which are so important in the location of an industry, have not been considered.

(5) His assumptions about transport cost and effects of agglomeration have also been questioned.

① - Weber's model of industrial location has been usefully applied to interpret the changing location of the British iron and steel industry.

② - webers material index (mi) refers to ratio between: the weight of raw material & weight of product.

③ - steel plants of India has the least cost location in the ideal location triangle concieved by Weber - Bokaro.

Thombson : Agglomeration Theory.

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B] **August Losch Approch : (1940)**

"Market Area Location Theory"

- Losch developed a general theory of location with the major emphasis on demand.
- He sought to draw attention to the marketing factors and the idea of maximum profits related to sales revenue.

* **Aim of the Theory :**

'Losch sought to explain the size and shape of market area which a location would command the largest revenue'.

* **Assumptions :**

1. An isotropic surface.
2. Constant supply of goods / services.
3. Population is evenly distributed.
4. Demand decrease with an increase in price.
5. Entrepreneurs act as economic men, their main aim being up profit maximisation.

- 'If the price increases is the result an increase in transport cost demand would decreases with distance from production centre, the demand curve would be cone shaped and the market area circular.'

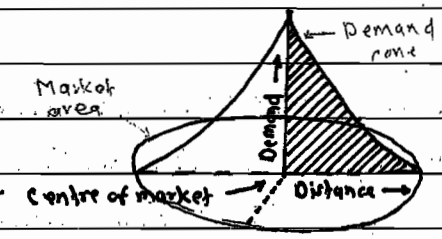


fig: Derivation of circular market area.

* **Statment :**

- There are many producers located on the plane. Each of them is equidistant from the other & their market areas are circular.

- The size of the market area is dependent on the number of producers The producers increas in number, market area become smaller and profits competed away.

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- The circles and producers leave in circular areas some places are unserved and they move closer thus hexagone are develops.
- Each product will represent a different sized market area i.e. the size hexagones varies.

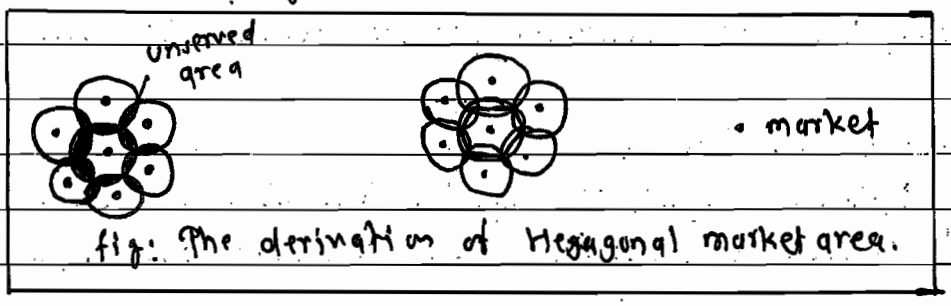


fig: The derivation of Hexagonal market area.

- Losch sought to find a spatial structure for both the producer and consumer.
- He was identified could be the centre for each of the 150 different hexagonal market areas.

- Losch arbitarilly chose just one production centre from the entire set of production points.
- He arranged hexgones so that this one centre was common to them all.
- He then, rotated hexagones around the central point and brought them to rest where the maximum number of hexagones coincided.

- 12 sectors thus emerged, arranged alternatively, so that six sector had many economic activities i.e. point of maximum demand and other six relatively few.
- The points of maximum demand will emerge as concentration of industry.

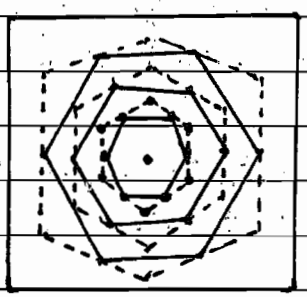


fig: Rotation hexagone around centre point.

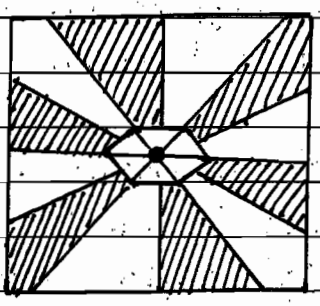


fig: Theoretical arragment of market areas & there derivation.

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+ Distance decay function - is not associated with a 'Transport system'.

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* **Criticisms:**

1. The theory is abstract in nature.
2. It has failed to take into accounts, the problem arising from locational interdependence of plants.
3. It overemphasizes demand.
4. Market for products do not occur in isolation as they overlap.
5. Losch calculation of market demand was too crude and ignored many of the difficulties.

Christiller - C.P.T.	Losch - Location model
(i) Christiller model based on Bavaria province of southern Germany.	(i) Losch sampling for all over Germany.
(ii) Concept based on consumer and sellers behaviour, transport & administrative service.	(ii) Losch consideration into 150 commodities and services developed over 40 network.
(iii) Christiller treated each function as having seprate range, threshold & hexagonal hinterland.	(iii) Losch concept less restrictive than that of christiller.

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Dec-2008
2005

Footloose Industries :

① " A manufacturing activity i.e. free to locate, where wants to and where transportation costs are minor element to total product cost is called footloose industries".

⑪ "These industries located anywhere, raw material are not wedded, such industries are footloose".

- In like manner, a footloose industries is not required to locate near its raw material or a power site".

• Example :
- Watch manufacturing, electronics manufacturing (T.V., Rad fan), Dying industries etc.
- It is assemble component parts, High technology, high level of information, inputs & brainpower.
- Some food processing, lightweight & access anywhere.

* Characteristics :

i. Light industries, which do not use raw material but component part.
ii. Their power required are not high.
iii. End product are small & often cheaper & easier to move.
iv. Non-polluting industries, which can be located near residential area.
v. Employs are small labour force.
vi. Accessibility, need to be near a road network.
vii. They are largely depend on component parts which can obtained any where

* Advantages :

① Locational advantages enjoyed footloose industries, they choose area of the greatest potential profit.
② Cheaper land value on the edge of city.
③ Accessibility to main road.
④ Pleasent environment.
⑤ Labour supply nearly residential areas.

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- Some industries near to market, such as bakaries, newspaper publishing firm and dairy product. Because their sole purpose is to provide their products with near immediacy.

- High technological industries are an ideal example of footloose industries.
e.g. - Computers, T.V., calculator, electronic game, washing-machine. etc.

'These operation are called 'ubiquitos industries' a close relation footloose firm.'

- "आपल्या उत्पादनाच्या बाजारपेठेच्या मागणी अनुरुप सोयी, प्रमाणात सुधारणा करणे आणि कुशल कुशलतेचा प्राप्त करण्याची क्षमता असणाऱ्या उद्योगांना 'स्वच्छंद उद्योग' (foot-loose industries) म्हणतात"

DATE

Resource Based Industries:

- Raw material are the basic requirment for manufacturing industries. These raw material are more important for heavy industries.

e.g. Engineering, metal goods etc.

- But with the expantion & development of means of transportation the role of raw material in the location of industries has almost lost its significance.

e.g. cotton textile in Liverpool (U.K.) and steel Industry (Japan) are established that fact are those countries sufficient capital and Technology.

DATE

- **Industrial Complex -**
  - 'Industrial complex is a large assemblage of manufacturing enterprises concentrated in a relatively restricted area form an industrial region.'

- **Industrial agglomeration -**
  'When two or more industrial complex forms a continious region over a large geographical area, they form industrial agglomeration'.
  ex - Osaka - Kobe metropolitan area (Japan).

- **WHO (world health organisation) -**
  मुख्यालय : जिनिव्हा (स्वित्झर्लंड)
  कार्यान्वित : 7 एप्रिल 1948 '7 एप्रिल' - जागतिक आरोग्य-दिन
- जागतिक आरोग्य संघटना : (W
  ① UNICEF : United Nations International children's Emergency fund
  ② CARE : Co-operative for Assistance & Relief Everywhere.
  ③ रेड क्रॉस : International Red cross.
  ④ FAO : Food & Agricultural organisation.
  ⑤ MCI : Medical council of India.

- जगात इंटरनेट्या बाबत सर्वात जास्त U.S.A. असून चीनचा दुसरा क्रमांक आहे. तर भारताचा 'नववा' क्रमांक आहे.

- **आय. टी. पार्क :**
  - १९९० च्या दरम्यान 'सॉफ्टवेअर तंत्रज्ञान पार्क' उभारण्यास प्रारंभ झाला.
  - भारतात मुंबई, बंगलुरू, चेन्नई, दिल्ली, हैदराबाद व पुण्यात I.T. पार्क आहेत.
- **भारतातील सिलिकॉन व्हॅली - पुणे.**
  - पुण्याची ओळख 'Infotech centre' अशी आहे.
  - C-DAC ने भारतात पहिला सुपर कॉम्प्युटर तयार केला.

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(1) GATT - (General Agreement on Tariffs and Trade) - 1 June 1948.
(2) EEC - (European Economic Community) - 1 June 1958.
(3) EFTA - (European Free Trade Organisation) 1960.
(4) OPEC - (Organisation of Petroleum Exporting Countries) 14. Nov. 1960. 'Bagdad'
(5) UNCTD - (United Nations Conference on Trade & Development) Dec. 1964.
(6) SAARC - (South Asian Association for Regional Co-operation).
(7) ASEAN - (Association of south East Asia Nations) - 1967
(8) NAFTA - (North American Free Trade Agreement) - 1988.
(9) WTO - (World Trade Organisation - 1 June. 1995.

- GATT -
  - सुरुवातीला 23 राष्ट्रे सहभागी (1 जाने 1948).
  - 1974 - 84 तर 1997 - 137 राष्ट्रे सहभागी
  - सदस्य राष्ट्रांची वर्षातून एकदा सर्वसाधारण सभा होते.
- डंकेल प्रस्ताव -
  - गॅटची आठवी परिषद 1986 मध्ये उरुग्वे येथे 'तीव्र मतभेद'.
  - गॅटचे डायरेक्टर 'ड्यूंकी आर्थर डंकेल' यांनी तडजोडीचा मसुदा तयार केला. त्याला 'डंकेल प्रस्ताव' असे म्हणतात.
- WTO -
  - 1 जानेवारी 1995 मध्ये GATT चे रुपांतर WTO मध्ये करण्यात आले.

उद्दिष्टे : (i) उत्पन्नात वाढ घडून आणणे (ii) पूर्ण रोजगार प्रस्थापित करणे
(iii) व्यापाराचा विकास करणे (iv) पर्यावरण संतुलनासाठी उपाययोजना आखणे.

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MODELS OF TRANSPORTATION AND TRANSPORT COSTS:

- The exchange of goods and services is a central feature of economic activity.
- The transport geography is concerned with the study of transport as a space adjusting technique.
- The transport of goods from areas of surplus to areas of deficiency increase their value.

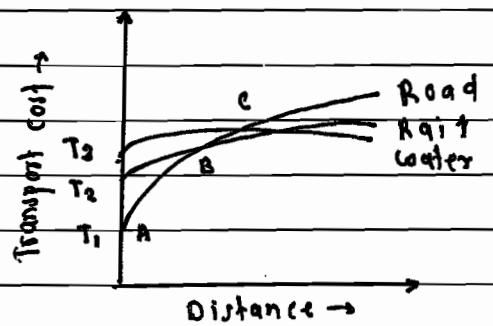
Example:

Iron ore commands a much higher value in 'Tokyo' than in Eastern India.

* Transport cost vary with a no. of reasons -
  1. Distance
  11. Type of terrain to be covered
  111. Type of carriers.
  1v. Type of compdity to be carried.
  V. Degree of competition from other carriers.

* Operating cost in Transport -

(1) mainly fuel cost and wages.
(2) cost of equipment involved.
(3) Indirect cost like insurance.



- Road transport is cheapest over short distance (A-B), rail over medium distance (B-C) and ocean transport long distance (beyond C)

But they may affected by local and some other factors.

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* The cost structure of different method of transport -

① The lowest rate are charged for non breakable, non-perishable commodities.
e.g- iorn ore, coal etc.

② Perishable goods needs special care & special arragment for its carriage.
e.g. milk, vegetables etc.

- In analysis of transportation network which of the follwing indices shows the highest centrality in the lowest value: Alpha Index.

- Taaffe's transportation model has a number of development phase: Four.

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ACCESSIBILITY :

- Geography is a spatial discipline concerned not only with the location of people and places but also, more important with the manner in which these interact.
- The concept of 'connectivity' considers the many pathways i.e. highways, air routes, sea-lanes, email & fax etc. that allow interaction betⁿ distant points.

Define :

① 'Accessibility is the concept that determine the efficiency of these pathways'.

② "It is measure of aggregate nearness, it is a direct expression of mobility either in terms of people, fright or information".

Example : The advent of the telephone dramatically increased the accessibility of users. In recent year cellular phones further increased accissibility.

- Travelling by automobile from suburban to the C.B.D. reflects variable accessibility; depending upon time of day.
These route rush during morning to 8 p.m.

Weather can affect accissibility -

- Blizzard and severe rainstorm will slow highway traffic, airport may be closed.
Here, again accessibility is diminished for a period of time.

Accessibility in Historical context -

- The movment in NewYork to pacific coast could take months. By contrast airport in New York City and arrive in San Francisco, for instance, in a matter of hours.
- Improvment in transportation technology 'bring place closer together' as the saying goes.

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Accessibility applied in social realm -

- During the era of 'apartheid' in south Africa, black south Africans were effectively excluded from access to sectors of the economy and social settings exclusive to whites.

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CONNECTIVITY:

'The directions of route linking pairs of places on indications of degree of internal connection in transport network'.

- More generally all tangible and intangible means of connection and communication betⁿ places.

Defⁿ: " Connectivity is a term applied to all of the possible ways in which people and places are connected."

Example -

In going to work or school, for the school student short walk across on several mile ride school bus in the city.

- People can easily speak with relatives in another state by telephone or through e-mail.

- It follows that there is direct relationship betⁿ the degree of connectivity across space and resultant measure accessibility.
- During the 'quantitative Revolution' numerical measures of connectivity were developed.
  The purpose of these measures was to determine the efficiency of a set of places.

- for Instance, two points (nodes) connected by one line (vertice) would be less efficient than having the two points connected by two lines.

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Rostow's Model:

- W. Rostow's proposed a five-stage model which tried to show how, over a period of many decades, nations develop from a traditional society to one of high mass consumption.

① **Tradition society -**

A traditional society contains a very high percentage of people engaged in agricultural and national wealth.
- Rostow's calls 'nonproductive' activities, such as the military and religion.

② **Precondition for Take-off -**

The influence of these well-educated leaders, the county starts to invest in new technology & infrastructure.
e.g. water supply & transportation.

③ **Take off:**

Take off industries achive technical advances and become productive. Rapid generated in a limited number of economic activities e.g. textiles & food products.

④ **The Drive to Maturity:**

Modern technology, diffuse to a wide variety of industries, which then experience rapid growth comparable to the take-off industries.
- Workers becomes more skilled and specilized.

⑤ **Age of mass consumption -**

The economy shifts from production of heavy industry, such as steel and energy, to consumer goods, like motor vehicles & refrigerators.

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High mass consumption	–	Durable consumer industries service industries
Drive to maturity	–	Growth to all sectors of the economy
The take off	–	Begining of one or more manufacturing industries
Preconditions for take-off	–	Export mining & cash cropping Development of roads & railways
Traditional society	–	Basic subsistance agriculture, craft industries

- more developed countries 4 or 5 stages and less developed countries have 3 stages.

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- Nature, scope, subject matter and recent trends.
- Pattern of world distribution, growth and density of population.
- Population policy issues.
- Pattern and Processes of Migration.
- Demographic Transition.
- Population resources region.

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- A Prologue to Population Geography – W. Zelinsky
- A Geography of population – G.T. Trewartha
- The Geography of life and Death – L.D. Stamp
- Population Geography – J.L. cleark
- Geography of Population – Beaju-Garnier.
- Principle of Population – Robert malthus

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POPULATION GEOGRAPHY :

- Geography of population one of the recent sprouts from the vernable trunk of science of geography in 1950's.
- G.T. Treawartha (1953) of the 'President of Geography association of U.S.A.' most important personality to elevate population studies.

The study of human population, their composition, growth distribution and migration movments with an emphasis on the last tw It is concerned with the study of demographic processes which affect the enviorment, but differs from demography in that it is concern with the spatial expresion of such processes.

* Defination :

1) John I. Clarke :-

Former chairman, Population Commition of International Geographical Union, His first text book on 'Population Geography' in 1965.

"Population geography concerned with the demostrating how spatial variations in distribution, composition, migration and growth are related to the spatial variations in the nature of places".

2) Zelinsky :

- In his book : 'A Prologue to Population Geography'.

"Population geography studies population phenomena in the context of space relation and agregate nature of places".

3) Beajeu - Garnier -

- In his book : 'Geography of Population'.

"Population geography concerned with the describe the demographic fact in their present enviormental context".

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* **Scope of Population Geography:**

- Population studies are not the exclusive domain of any single social sciences.
- It is the true that population geography not only relate to the demography but it is important from the also sociology, anthropology, economics and history etc.

① **Demographers** - have concerned themselves more with the statistic, of birth, death and marriage. Demography have often been considered as the quantitative study of human population.

② **Sociologists** - his greater concern with the studies relating social groups in their institutional organization.

③ **Anthropologist's** - It lies in three major problem of man:
(i) the evolution of man.
(ii) the ontogenic development of man.
(iii) the classification of human races.

④ **Economist** - It is only incidental and economic implications of any demographic pattern are the focus of such investigation.

⑤ **Historian** - attempting to analyse population, have been found to be chronological in their approch. Their main concern has been to trace population trend through time.

Demography:

"The interdisciplinary study of population especially birth rate, death rate, growth pattern, migration and related characteristics."

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* Subject matter of Population Geography :

1) Study of population distribution - in context of Region, continent, Nation etc.

2) Study of population density - factors influence of density, Types of density and characteristics of density.

3) Measurment of Population Growth - Birth Rate, Death Rate, factors influence of population growth, population growth theory.

4) Population composition - Age and sex structure, caste, Religion and Language etc.
① Demographich characteristics - age, sex, marritay status.
② Social - caste, race, religion, language, litracy etc.
③ Economic - workforce participation & educational participation rate.

5) Population change - factors affecting of population change, fertility, mortality and mobility : world distribution of population change.

6) Characteristics of population - Literacy, rural-urban, population, and urbanization.

7) Population and Resources Ratio - Optimum popln, over popln, and under population, and population resource region.

* Recent trend Population Geography in India :

Population Geography in India had late start 1960's.
- The initial framework of India's population geography was provided by doctoral work of 'Gosal (1956)' supervised by C. Trewartha.

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- The Department of Geography at the 'Punjab University Chandigarh' was the first in India, in early (1960's).
The first text book of 'population geography' by R.C. Chandana (1980)

- Some credit for the progress of population geography in India must be given to the 'Census of India'.
Indian census data encourage geographer to take up geographic analysis at micro and macro scale.

- The National Population Policy 2000 has empowered the village panchayat to establish maternity huts in each village to register each birth, death, marriage and migration.

- Atlases of SC and ST population are welcome addition to Indian population Geography.
Recently, trend toword fieldwork based on micro scale studies at least at doctoral level reasearch has been observed.

- Punjab, Chandigarh, Delhi universities arrange the conference in Population Geography.
National Association of Geographers of India (NAGI) also arrange verious conference.

- Department of Geography Punjab University, Chandigarh publication of research journal 'Population Geography'.

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Sources of Population Data :

a) Census :

A census has been defined as, "the total process of collecting, compilling and publishing demographic data pertaining at a perticular time, to all person in defined territory".

- Periodicity is an important charactristics of census.
- The 1st census of Iceland was in (1703), United state (1790), and Europe - Britain and France in (1801).
- The first synchronous (statistical) census in India was held in ('1872') complete census (1881)
- The census of India 2001, is the 'fourteenth' census in this continious series as reckoned from 1872 and sixth since independance. (2021 census - fifteen after independence seventh census.)

b) Surveys :

"A canvass of selected households in a village/urban centre with a view to collecting information on demographic attributes, socio-economic conditions etc. may be regarded as survey".

- Survey have been conducted such as fertility, mortality, morbidity, mobility, unemployment, health, education, welfare etc.
- In India, national sample survey organization was created in 1950.

c) Registration :

"The continuous, compulsary and legal recording of vital events, like births, deaths, marriages, divorces, annulments, separation and adoptations".

- The first central form of vital registration occured in 1836. Through the efforts of 'Dr. William Farr' it was made compulsary in 1874.
- In India, the registration of birth & deaths muncipilties in urban areas, and local revenue official in the rural areas.

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d) Miscellaneous / migration Record :

The population geographer do make use of migration reports, linguistic reports, estimates & projections.

- The responsibility of collecting vital population data from its member countries and reproducing and regrouping the same in a comparable form.

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DISTRIBUTION AND DENSITY OF POPULATION

Factors affecting on Population Distribution and Density :

a) Physical factors :

1) Relief and soil fertility - coastal plains, lowlands, river valleys are more elensly populated than rugged plain, plateau, Hill & mountain.
- People prefaire low lands are the suitable for agriculture.
* Example - Island of Java in Indonesia.

2) Climate -

Modrate temprature conditions with annual rainfall 50-80 cm, fevarable for human settlment. Extreme of climate like Hot and wet equatorial region, Hot desert like sahara & Arabia, cold polar region and snow covered mountain not fevarable for human settlment.

3) Natural vegetation :
- Dense forest like equatorial region are unfevarable for humans, because flowr are dumb and marshy.
- Tropical & temprate grassland have been developed for cultivation and human settlment.

4) water supply -
- It is essential for all human activities like Agriculture, Industrialization and animal husbandary.
- The region maximum water supply in river valley elense popln & Deseart region sparce population.

5) mineral Resources :
- Avalablity of valuable minerals resources attract human settlment even if the other factors are unfevarable
Example - Andies (copper), Alaska coil) & Australia Deasert (Gold).

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6) Accessibility :

- coastal areas more accessible than interior of continent. Nearly 3/4 popln is constructed within 100 km. of coast.

Example : Southern continents like - Africa, S. America & Australia.

b] Non Physical Factors :

1) Historical -

- The past population distribution influence present and future distributions.
- Historical speaking, the recency of discovery & settlment of the areas of human occupation goes a long way.

Example :- The contrast betn old world and new world with regard to present population.

2) Economic :

- Among agricultural socities certain high-yield food crops enable denser popln than other. In contrast, livestock economies are sparser populations.
- In highly industrialized region, commercialy activities region are densly populated.

3) Political -

- The emergence of political boundries, buffer-zone and the public policies with regard to popln movment and trade.

Example: boundry betn India and Pakistan in 1947 did generate redistribution of population.

4) Population Policies :

- The role of public policies & goverment policies in directing the distribution tendancies among population.
- The goverment policies with regard to trade connections with countries across the international borders.

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b) Technological Advancement -

- The technological innovations may make a human popln habitation possible in areas which formerly devoid of human.

Example : The extension of irrigation facilities have turned many deseart in to fertile farming areas.

c] Demographic factors :

The changes in the rate of natural increase distribution and density of population in the world take place through variation :

- 1) Natural increases
- 2) migration
- 3) fertility, mortality and mobility, which gives rise to regional differences in the magnitude of pressure being exerted by population.

d] Physical and social disasters :

- According to him :

- (i) Earthquake - San fancisco, Tokyo, Lisbon etc.
- (ii) Volcanic eruption
- (iii) Floods - Yellow river in china.
- (iv) Glacial advances
- (v) Droughts - 1972 in India.
- (vi) storm, epidimics and fire etc. forced transfer of population and repatriations constitute the social disasters.

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World Population Distribution:

The distribution of population is more 'locational' while the density is more 'proportional'.
- when one is dealing with distribution, the concern for the pattern spread of population and when one is dealing with density, the concern is more for some kind of man-land ratio.

* Measure of population distribution:-

1) Percentage distribution: The percentage of people living in the geographic areas of a given class has been computed.

2) Rank order - To the list of geographic areas of a given class in to Rank order, a further ranking from cencus to cencus.

3) The centre of popl?- In this regard have been the median point; mean point often is called the centre of population.

* Population Distribution Pattern:

The population of the world reached 7 billion mark in 2011.
(i) more developed region - (18.43%) including N. America, Europe, Japan, Australia, Newzeland and CIS-
(ii) Less developed region - (81.57%) including Africa, Latin America, Asia and oceana.

- Broadly, the world has been divided into two types of areas:

1) Ecumene:
"It is permanantly habitat areas, are called 'ecumene'.
- About 55-60% total area of continent could be ecumene.

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- About 3/4 of world popln was confined to four major clusters two of which were in Asia, one Europe and one N. America.

2) Non-ecumene Region:

- It is unhabited, intermittently inhabited or very sparsely inhabited parts are called non-ecumene region.
- The great Antartica & Greenland ice caps, Hot deserts, High mountains and dense forest.
- about 1/3 of the total land area on non-ecumene.

* Types of Population Distribution:

1) Lattitudewise Distribution:

- The world popln distribution was its unevenness and highly irregular spatial distribution.

(a) Northern Hemisphere: more than 90%

(i) 0° to 20° N - 10%.
(ii) 20° to 40° N - 50%
(iii) 40° to 60° N - 30%
(iv) 60° to 90° N - < 1%

(b) Southern Hemisphere: less than 10%.

0° to 90° S - < 10%

2) Altitudinal Distribution:

- The world 56.2% popln live between sea level to 200 mtr. and above which includes only 27.8% total land area.
- The vertical distribution of popln was highest in South Africa (644 m.) and lowest in Australia (95 m.).
- about 3/5 of the world popln lived within 500 mtr. from the sea level.

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3) Continentalwise distribution :

- Of these only 18.43% was confined more developed region and 81.57% less developed region.

continent	popln in billion (2007)	popln in %	
Asia	4.01	55.7	60.50
Africa	0.94	9.5	14.25
Europe	0.73	13.3	11.10
Latin America	0.56	7.5	8.60
North America	0.33	6.5	5.05
Russia	0.14	7.0	—
Oreania	0.03	0.5	0.50
Cences : 2007	6.625 billion	100 (2001)	100% (2007)

- Asia alone contributed more than half of world popln (4.01 billion) and Africa was contributed second largest popln.

cities * Most populous countries : (CIUEBPBMRJ)

(I) China with 1.44 billion inhabitants (2011) was the most populous country of the world.

(II) India with popln of 121 billion (2011) ranked second was followed by (17.5%)

(III) USA - 4.5%. (VIII) Bangladesh - 2.4%.

(IV) Indonesia - 3.4%. (VIII) Nigeria - 2.3%.

(V) Brazil - 2.8%. (IX) Russia - 2.0%.

(VI) Pakistan - 2.7%. (X) Japan - 1.9%.

were the ten top most populous countries of the world.

"India become only the 2nd country in the world after china to cross the one billion mark.

India accounts for 2.4% surface area of world (135.79 million) yet it supports and sustain 16.7% of world population."

Popln - 1.21 बिलि. - 2011

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Population distribution in India (2011):

- A perusal of popln distribution at district level revels that out of 593 district in the country.

1) Areas of High concentration:

- Each of these 12 districts had a popln of more than 5 m.
- The 12 districts, distributed sporadically in states like W. Bengal Maharashtra, Gujrat, Rajsthan etc.

2) Areas of mediam concentration:

- Also there were 187 districts in the country which had a popln of 2 to 5 m each.
- These district formed two belts: one is the Indo-Gangetic plain and other in the Penninsular India, south of M.P.

3) Areas of Low concentration:

- The district having population 1 to 2 m each, were 211 districts in number.
- They were spread in central belt of India running from Orissa to Rajsthan. In addition to Punjab, Haryana, Gujrat, NW Karanataka & SE Tamilnady.

4) Areas of very low concentration:

- In all 98 districts in the country had a popln 0.5 - 1.0 m each
- Such districts were located mainly in the hill regions of both NE and NW as well as tribal belt in India.
- It includes Arunachal, Sikkim, Mizoram, Himachal, NW Rajsthan & island union territories.

Census: 2011

Population; Persons - 1,21,01,93,422.

Males - 62,37,24,248

Females - 58,64,69,174.

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Population Density Pattern of World:

• Defination:

① 'The simple ratio betⁿ total population and total land area as expressed in terms of persons per unit of area.'

② 'The ratio betⁿ number of people and area.'

* Measures of Density:

1) Arithmatic Density: The ratio betⁿ total poplⁿ and total land area.

2) Nutritional / physiographic Density: 'It is ratio betⁿ total poplⁿ and total cultivated area.

3) Agricultural Density: 'It is expressed in terms of agricultural population per unit of cultivated area.'

4) Economic Density: 'The ratio betⁿ the requirment of a people and the resources made available to it by production in the areas it occupies'.

5) Room Density: 'The number of person per room' it is known as Room Density

* Charactaristics of world Density:

① 90% poplⁿ over 25% land area and only 10% poplⁿ over the 75% land area.

② Maximum density found in Asia. 30% land & 60% poplⁿ.

③ Australia and Newzeland 5% land area and 0.50% poplⁿ.

④ The ~~classmate~~ 1/2 population lives in East and South Asia (China, India Bangladesh, Pakistan, Japan, Korea & others

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(iv) World popln density (2009) - 47', Asia - (122), Europe (32) & Oceania (04). Africa (29), N. America (16), S. America (20).

(v) Singapur has rank 1st density (6773 person/sq.km.), Bangladesh (981), Mauritius (605) and Beljium (340).

(vi) Lower density - Australia (03), canada (03), Russia (08) & sudan (12)

(vii) Dense popln concentrate along tropic of capricorn along on world map and sparce popln along arctic circle.

a) **High Density Zone:** (more than 200 person/sq.km)

1) **Western and central Europe -**

- NW Europe high density populated part of the world.
- Netharland (399), Belgium (340), UK (248), Germany (281).
- Belgium, Great Britan, Germany 90% popln in urban area.
- Rhine basin (Germany) and Po basin (Italy) high density.

• **Reason:** (i) Industrial development.
(ii) Development of trade and transport.

2) **North East America:**

- East, NE area of U.S.A., St. Lawrance Basin, of canada.
- mississphi basin high density.

m Density

• **Reason:** (i) Development of technology & Industralization.
(ii) Highly urbanization.

3) **East and SE Asia:**

- china, Japan, India, Pakistan, srilanka, Bangladesh, Indonesia, Korea.
- Highest Bangladesh (981), Korea (475), Japan (338), India (334).

• **Reason** - (i) firtile land on river basin
(ii) monsoon climate
(iii) Irrigation facility.

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* Indonesia densely populated area - ~~Bali~~. Java

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a) Isolated areas : 'Sudan is mostly dense popl^n country in Africa.'

(i) Nile valley & Deltas, Rawanda (329), Mauritius (605).

(ii) S.E Brazil coast - & El-Salvador (319), Haiti (292)
Trinidad & Tobago (249)

(iii) South east coast of Australia.

- Reason - (i) fertile low land.
(ii) mineral resources.

b) Areas of medium Density : (10-200 person/sq.km).

- Tropical and temprate grassland region - praire, pampass, steper, Down grassland region.
- Central U.S.A., central china, central Latin America, mexico.
- Deccan plateau of India, Western Africa.
- mediterean sea region.

Reason - (i) subsistance agriculture & commercial grain farming.
(ii) Domestic animals & mechanised agricuture
(iii) climatic deficiencies & aboundance vegetation cover.

c) Areas of Low Density : (less than 10 person/sq.km).

- cold deseart, dry lands and hot-wet region of world.
- The ice caps : Antartica, Tundra, Greenland, Eurasia, Arctic and sub arctic cold deseart.
- The dry land - Sahara, Kalhari, Australian hot deasert.
- Equatorial rainforest region, & High altitude areas.

- Reason : (i) Ice cap covered unfertile soil.
(ii) Hot deasert water defficiency
(iii) Equatorial region femine & deases.

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Population Density in INDIA :

"India become 2nd populous country of world after china. India account 2.4% land surface of world and sustain 16.7% world population". (17.5%) 2011

- The avarage density of popln 382 person/sq.km. in 2011.
- Delhi has highest popln density (9340) (11297 (2011)) & Arunachal lowest (13) (17) 11

a) Areas of High Density : (more than 600 person/sq.km.)

- States : W. Bengal (903), Bihar (881), Kerala (819), U.P (690)
- Union territories : Delhi (9340), Chandigarh (7900), Pondicherry (2030), Lakshdwip (1895), & Daman & Diu (1413).
- Malbar coast & Tamilnadu, Mahanadi & Godavari delta.

• Reason : (i) agricultural economy (ii) Longest history of settlment. (iii) Suger & jute industries (iv) rice cultivation.

b) Areas of Medium Density : (200 - 600 person/sq.km.)

- States : Rajstan (165), M.P (196), Orisa (236), Gujrat (258), A.P. (277), Karanataka (276), Maharashtra (315) (365/2011), Punjab (484), Tamilnadu (480), Haryana (498) & Assam (340).
- Union territories - Dadra & Nagar Haveli 449 per km².

• Reason : (i) Handicapped agriculture (ii) Undulating topography. (iii) Paucity of irrigation (iv) unexplored resources.

c) Areas of Low Density : (less than 200 person/sq.km.)

- States : Arunachal (13) (17 → 2001), Mizoram (49), Sikkim (76), J & K (200), Chatisgarh (154), Uttarkhand (159).
- U.T. : Andaman & Nicobar (43).

• Reason : (i) rugged terrain (ii) limited availablity of agri. land. (iii) poor infrastructure (iv) limitation of economic development.

* An increase in popl⁹ at the rate of 2.1 % per annum will account for its getting doubled in : 28 years.

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* World Population Growth :

• Defⁿ: "Population growth refers to the change in number of people living in perticular area in specific time".

* measures of poplⁿ Growth :

1) Annual rate of increase -

'The absolute increase or decrease per annum, one of the most common measure of growth is the annual rate of increase'.

2) Natural increase rate -

'It is the difference between the crude birth and death rates'.

'Birth rate and death rate show the natural growth rate of poplⁿ'.

- World : Population, Historical Perspective (1810 - 2025)

Period	Population in(billion)	Time taken in(Years)
1810	1	~~120~~
1930	2	120
1960	3	30
1975	4	15
1988	5	13
1999	6	11
2011	7	12
2025 (estimated)	8.4	14
2050 (estimated)	8	-25

⊕ The world's poplⁿ was estimated to be around '8 million' at the advent of agricultur around 8000 B.C.

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(ii) The world popln continue grow very slowly for long period, world popln to have reached 800 million in mid of 18th century.

(iii) The popln started recording spectacular increases because industrial revolution, decline in mortality and widening gap betn birth rat and death rates.

(iv) The world more than 1 billion mark in 1808, the next billion was added in just 120 years (1928).
- The third billion added 32 years (1960), 4 billion came in to 19- the 5th billion reached in 1988. ie. just 13 years.

(v) The sixth billion added 12 oct. 1999 and 7th billion was added by 31 oct. 2011 was added period 11 and 12 respectively.
- The estimated 8 billion added was year in 2025 by period 14 year

01 51 81 011
23 - 36 - 68 - 121
2.1 1.9

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Population Growth in : INDIA

- India has had a very 'chequred demorgraphic' history.

* Stages of Population Growth :

1) Stagnant Popl^n : (1901 - 1921) -
- During this period Indias popl^n increased 236 to 249 million only.
- These period mortality is very high, because recurring, epidemics, famines, food-shortage war.
- In 1921 a recognised -ve growth rate -0.31, also called demographic divideation year.

2) Steadily increasing popl^n - (1921 - 1951) :
- During these period popl^n India increased 248 to 360 million, 112 million was added.
- Agricultural improvment, medical facilities to bringing down the mortality rate.
- The death rate remains down 47 to 27 in this period.

3) Rapidly Increasing popl^n - (1951 - 1981) :
- It has increased for 360 million to 685 million the growth rate 2% per annum.
- It remains steep mortality but fertility high, Death rate rapid from 27 to 16.
- Improving condition of food supply (Green & white revolution) medical facilities, and advanced technology.

4) Declining of popl^n growth rate - (1981 - 2011) -
- Both birth and death rate are declining trend in the post 1981 period.
- In this stage population policies, education are applied.
- It has increased for 685 million to the 1210 million @ annual rate 1.9% yrs

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Popln Decadal Growth Rate in India

Year	Decadal G.R %	Annual G.R.	Popln in crore
1901	-	-	~~23.60~~
1911	+5.75	0.56	28.84
minimum 1921	- 0.31	- 0.03	25.21
1931	+ 11.00	1.04	25.13
1941	+ 14.22	1.33	27.90
1951	+ 13.31	1.25	31.87
1961	+ 21.51	1.96	36.11
1971	+ 24.80	2.20	48.92
maximum 1981	+ 26.66	2.22	54.82 ~~60.33~~
1991	23.84	2.14	84.64
2001	21.34	1.95	102.87
2011	17.64	—	121.02

Popln Growth (2001-2011) -

Persons : 17.64 %

male : ~~17.19~~ %

Female : 18.12 %

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	State / UT Popl^n	% share in	State / UN. popl^n density	no. of person / sq.km
1.	U.P.	16.49	1. Delhi	11,297
2.	maharashtra	9.29	2. Chandigarh	9,252
3.	Bihar	8.58	3. Pondecherry	2,598
4.	West Bengal	7.55	4. Daman & Div.	2,169
5.	A.P.	7.00	5. Lakshdwip	2,013
6.	m.p.	6.00	6. Bihar	1,102
7.	Tamilnadu	5.96	7. West Bengal	1,029
8.	Rajsthan	5.67	8. Kerala	859
9.	Karanataka	5.05	9. U.P	828
10.	Gujrat	4.99	10. D&NH	698
11.	Orissa	3.47	11. Hariyana	573
12.	Kerala	2.76	12. Tamilnadu	555
13.	Jharkhand	2.72	13. Punjab	550
14.	Aassam	2.58	14. Jharkhand	514
15.	Punjab	2.29	15. Aassam	397
16.	Chattisgarh	2.11	16. Goa	394
17.	Hariyana	2.09	17. Maharashtra	365
18.	Delhi	1.38	18. Tripura	350
19.	J&K	1.04	19. Karanataka	319
20.	Uttarakhand	0.84	20. AP	308
21.	HP	0.57	21. Gujrat	308
22.	Tripura	0.30	22. Orissa	269
23.	meghalaya	0.24	23. m.p.	236
24.	manipur	0.22	24. Rajsthan	201
25.	nagaland	0.16	25. chattisgarh	189
26.	Goa	0.12	26. Uttarakhand	189
27.	Arunachal	0.11	27. Meghalaya	132
28.	Pondechery	0.10	28. J&K	124
29.	Mizoram	0.09	29. HP	123
30.	chattisgarh	0.09	30. manipur	121

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of person/ km.					
	21. Sikkim	0.05	31. Nagaland	119	
	22. Andaman & Nicobar	0.03	32. Sikkim	86	
	23. D & N.H	0.03	33. Mizoram	52	
	24. Daman & Div	0.02	34. A & N Islands	46	
	25. Lakhshdwip	0.01	35. Arunachal	17	

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- The growing trend in cross death rate in : Africa.
- Where the population is scattered - Cancer line.
- In which decade the growth rate of city population was maximum - 1971-81.
- The second largest populated continent of the world - Africa.
- The avarage density of popln in the forest region - 1 man per sq.km.
- Death rate in Europe was considerably reduced due to - Propernutrition.

17th (5.05) 2011

- North America fourth largest continent of world and 18% world popln live there.
- Europe occupies - 11% of world popln.

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POPULATION POLICY ISSUES

'The size of population, its growth rate, age / sex composition and pattern of migration are closely influenced by the policy of the respective government'.

- Each country has its own population policy. These policy range encouragir of high fertility of varying degree of discouragment.
- Some of the developed countries (Canada, Aus, USA, Japan, UK, France and Newzeland) are following the policy of slow growth also non as 'Pronatalism'.

* Objectives of Population Policies:

(i) To reduce the popln growth rate not necessarily to zero.
(ii) To stabilize the popln by acheving zero popln growth rate.
(iii) To achive negative rate of growth with a view to reducing the size of popln.

A) Policies Discouraging Popln Growth:

* The less developed countries are expreencing popln explosion.
* Some countries like china, India, Indonesia, Pakistan, S. Korea, Singapur, Tunisia, and Egypt.
* The less developed countries aimed at growth rate around 1%.

(I) China:

In 1970 Govt. of china adopted family size of 2 childrens. By 1980 the goal was changed only 'one child' per family.

- To achive numerous ways:

(i) marraige age women (24) & men (26).
(ii) Pre marilial sexual contact are uncommon.
(iii) free contraseptive & abortion (iv) Privacy is limited.

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2) India -

'Voluntary family planning' policy adopted in 1960's and 'tough sterilization' policy adopted in 1976-77.

method - (i) Placing health expert in village
(ii) Publicizing merit in small families.
(iii) offering financial reward to parent.

3)

3) Singapore:

- heavy financial penalties for parents who have had more than two childrens.
- The birth of IInd child parent who have been sterilized have been rewarded with free education & employment of child.

B) Policies encouraging popln Growth:

- 'In the developed countries, the growth of popln is either at the level of replacment or showing the trend of negative growth, such countries has these type policy:

* Regions of: Hungery, Romania, Germany, france, netherland, Denmark, sweden, Norway, finland, Italy, Austria, ~~Romania~~, Spain, Portugal, Russia, etc.

1) France - grant substantial payment and services to parents to help the child rearing.

2) Hungery & Romania - contraceptive are banned and abortions are permited on doctor's order.

3) Bulgeria, Russia, Hungery, Austria, Romania - Three children per family has become adopted goal.
- Parents subsidees, housing priorities, generious maternity leave.

present picture of popl

main a... institu... an adu...

discover family

classmate

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4) Russia - 'Mother Lenin Award' was introduced in 1970's. This award carrying a handsome cash, a car, a certificated used to mother who gave twelve children.

5) Germany - mothers are allowed one years leave and 80 % their salaries. Low intrest loans for home are available at the time of marriage and when each child is born.

6) Australia & NewZealand - The policies of these governments have been pro-natalist, and pro-immigration.

Population policy in INDIA:

- The Indian policy makers realized the importance of popln control as early as 1951-52, but a rigid policy was not adopted.
- In 1961-71 the popln growth rate was 2.5 %, which was the highest in any decade.
- At present, the popln growth rate has declined to about 1.9 % per annum.

1) First five Year Plan (1951-56) -

- During that time in India reduction of birth rate slightly but sharply decline death rate, that the pressure of popln in India.
- The plan for family limitation and poplation control should:
  - (a) Present an accurate picture of the factor contributing to the rapid popln increases.
  - (b) Discover suitable techniques of family planning.
  - (c) make advice on family planning of goverment hospitals and public agencies.
- The meagre provisions of Rs. 0.65 million for the family planning programmes.

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2) Second plan (1956-61)

- a voluntary sterilization popln policy was introduced.
- The family planning programme was an provided amount of 5 carore.
- This amount was utilized mainly to establish 1650 family planning centres in the different parts of the country.

3) Third plan (1961-66) -

- The creation of social climate in favour of small family norms, changes as increasing marriage age, education and continious reasearch and evalution.
- logistics were provided for family planning, which motivated about one million people.
- About Rs. 27 carore spent verious family planning programmes.
- About 1.5 million couples had accepted sterilization and about 1.39 million people covered other method such as I.U.C.D and convectional contraceptives.

4) Fourth plan (1969-74) -

- which refer to family planning as 'the kingpins of the plan' and to limitation of family as 'an essential and inescapable ingredient of development'.
- This plan time bound target reducing the birth rate from 3.9 % to 2.3 % by 1979.
- The outlay of this plan was raised Rs. 286 carore.
- The end of the plan 8.7 million covered under sterilization and 8 million couple covered by other method.

5) fifth plan (1974-79) -

- The introduction of element of compulsion, incentives and penalties and ligalisation for abortions.

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- The programme sought to integrate social services, including education and public health service.
- The outlay for family planning programme to Rs. 500 crore

500 crore

6) Sixth Plan (1980-85):

- A high priority in the socio-economic development plan.
- The strategy during the plan was to integrate health, family welfare and nutrition services at all levels.
- monetory incentives and full rebate in income tax for specified donations for welfare.
- The strict popln policy followed by Indira Gandhi goverment.

plan on health, welfare, nutrition, primary helth care, sub centre setup, rural area

7) Seventh and Eighth Plans (1985-95):

- A part from statistical targets, family planning programme more effective.

*Objectives: ① increasing mean age at marriage for female.
② Promoting 'two child' family.
③ Protecting 42% couple for 'contraceptives'.
④ promoting female literacy and employment programme.
⑤ providing popln education to all children in 11-15 age grou and programme.

- Despite all these measure and policyes, the economic development and rising standrd of living some of the people are not adequate to bring down the popln growth rate.

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Indian National Population Policy, 2000:

- The following national socio-demographic goals to be achived in each case by 2010 are formulated:

i) Address the unmet needs for basic reproductive and child health services, supplies and infrastructure.

ii) Make school education up to age 14 free and compulsary and reduce droupouts.

iii) Reduce infant mortality rate to below 30 per thousand live births.

iv) Promote delayed marriage for girls not earlier than age of 18 and preferably 20 yrs of age.

v) Achive 80 % institutional deliveries and 100 % deliveries by trained person.

vi) Achive 100 % regestration of births, deaths, marriage and pregnancies.

vii) Prevent the control of communicable diseases.

viii) Contain the spread of AIDS.

ix) Promote the small family norms of replacment level of 2.1.

x) converge social sector programme with family welfare programme so as to make family welfare movment a people's movment.

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Pattern and Processes of Migration

① 'The movment of people from place of origin to place of destination.'

⑪ Gosal - 'migration can not be considred a mere shift of people from one place of residance to another as it is most fundamental to the understanding of continiously changing space - relationship of an area.'

* Types of Migration :

- The phenomena of migration has often been classified into various types :

a) On the basis of motivation - 1) Economic migration
2) Social migration

b) On the basis of distance - 1) Short distance migration
2) Long distance migration.

c) On the basis of time - 1) Short term migration.
2) Long term migration.

d) On the basis of Area / space - 1) International migration
2) Internal migration

① International / External migration :

'The migrant move' across the international border, the migration is known as external migration'.

Emigrant - A person who leaves a homland to settle in another country. emigration (out-migration)

② Internal Migration :

'All those migration that take place within an area lying within the territorial jurisdiction of a country are, thus distinguished as internal migration.'

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Internal migration further classified in four types:

(i) Rural to Urban Migration:
- Rural to urban migration more pronounced in the less developed countries or developing countries.
- In less developed world both 'push' of 'rural areas' and 'pull' of 'urban areas' generate migratory tendancies among the people.
- Push factor in rural areas: poverty, unemployment, wages, lack of education, health & recreational facilities.
- Pull factor in urban area: employment opportunities, fixed wages and better socio-economic facilities.

(ii) Urban to Urban Migration:
- Inter-urban migration that takes place betⁿ more common in the highly urbanized countries of the world.
- Urban to urban migration, which is motivated economic factors.
- In developed countries migration governed by economic factor and developing countries commonly known as 'step migration'.

(iii) Rural to Rural Migration:
- In countries that are primarily agrarian, movment of people may take place from one rural area to another.
For Example - In India.
- Such migration which are directed towards areas exprencing development of irrigation, & relaimation of waste land.
- It is balance poplation - resource relationship.

(iv) Urban to Rural Migration:
- Such a movment takes place at the advanced stage of urbanization, it is generate over-congestion.
- It is met with more developed countries & less in developing countries.

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- Such residential migration is limited to short distance.
- In India many of retired personnel tend to settle in their native villages.

2) International migration:

'The migrant moves across the internation border, is known as external migration'.

① Europeans migration:

The Europeans overseas expansion of the 17th century exploiting the new world, while simeltenously high pressure of popln upon its dwindling resources.

- migration took place two different directions:
  - (a) Commercial production of North and South Americas from verginia to Brazil flourished.
  - (b) Large European migrate to south Africa, Australia and Newzelan

② Non-European migration:

- The labour demands of these newly discovered land, slave-trade From Africa to British and Dutch colonists.
- Western South Asia recieving foregin workers large scale recently In this group Saudi Arabia, Kuwait, Iraq etc.
- Southern Africa and Zimbabwe recieving neighbouring countries mine labours in short term.
- The third type migration, is concerned with refugees:
  e.g. Tibetan refugees who came in to India.
- In 1947 emergence of pakistan in the Indian sub-continent 15 million people move one part to another.

'Religious fanaticism' were caused by the 'international migration of popln' in Eurasia bet'n 'Greek & Turkey' in the late fourties after 'Second world war'.

- The push factor for international migration for: higher wages abroad.

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Determinants of Migration: (Causes) -

- factors controlling migration vary from area to area but also the significance of the same factor varies from person to person.
- With regard to the determinants of population:

i- Pull factor - are those that operate in areas of inmigration and attract the people of these areas.

ii- Push factor - are those that operate in areas of out-migration and compel the people to move to other areas.

a) Economic Determinants:

- the availablity good agricultural land.
- avalablity of employment opportunities.
  e.g. - Asian and African labours are migrate to U.S.A & European colonies of Australia & NewZeland.
  - workers are search in job for U.K., Japan, Germany etc.
- Transport network has increased interaction of migration.

b) Social Determinants:

- Social custom - females move from the place of their parents residence at the time of marriage.
- Religious freedom: Jews from Germany before the war and newly created Israel.
- The information through education, cultural contact, spatial interaction also widens the migration propensity spectrum.

c) Demographic Determinants -

- Age has been recognised important factor; young adults were more migratory than other groups.
- The rate of growth of popln that determines the extent of popln pressure in an area.
  e.g. European across the Atlantic ocean.

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d) Technology -

- Technologically inferior groups may be attracted to the areas of greate opportunities provided by more developed society.

for e.g. - After Industrial Revolution European emigrated U.S.A., Australia, New zeland etc.

e) Overpopulation :

- Rapid growth of popln in relatively poor resource regions may create a conditions of overpopulation.
- People migrated from the overpopulated regions in search of employm and better job opportunities.

e.g. - Each year, from India alone, about 3 lakh skilled and semi-skilled people emigrate.

f) Goverment Policy :

- Each goverment has foreign policy.
- The goverment policy of a particular country also favourable or adversely affects of popln migration.

e.g. - Russia, Aus, Brazil and Gulf countries to provide job of million of people.

g) (i) Diffusion of information - The availability of information through mass communication, education, and spatial interaction also increase the chances of popln migration.

(ii) General Rise the Level of Aspirations with the advancment in science and technology.

i) Wars :

- War have always involved upheavels, particularly in the regions where these have been fought.

e.g. - First and second world war.

Indo-Pakistan war in 1965 & 1971.

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Consequences of Migration:

- The process of migration has a direct bearing on the demography, society, economy and ecology of the place of origin and destination of the migrants.

1) Reallocation of Resources -
- The place of origin and place of destination of the migrants a qualitative and quantitative change.
- It leads to relocation human resources and natural resources.

2) Change in Demographic Characteristics:
- The absolute number of popln, the density of popln, sex ratio, fertility rate, age composition, literacy and occupation structure transformed in both places.
i.e. place of origin and destination of the migration.
- at the place of immigration, incress density of popln and more pressure on resources.

3) Change in Sex Ratio:
- The sex ratio at the place of destination drops as the male members are added, while the sex ratio at the place of origine increases.
e.g. High sex ratio in U.P and Himachal.

4) Economic Gains:
- There is more utilization of natural resources at the place of destination.
- The emigrants sent money back home to their families that brings prosperity to the popln of place of origin.

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5) Transformation of ethenic charactaristics :

- The physical and marital contacts of people belonging to two different ethnic group may change the biological charactaristics, of the migrants.

e.g. Interaction betⁿ Negroes and whites and Red Indians with european have resulted into to new ethenic groups like 'mulatto and 'Mestizo'.

6) Transformation of cultural values :

- The immigrant bring with them their language, religious and cultural values.
- Integration and amalgamation of people causes serious problem e.g : India - Pakistan and Bangladeshis.

7) Psychological consequences :

- people migrate from rural to urban areas, especially the big industrial and commercial cities, suffer from lack of proper residential accomodation.
- They also have to adopt to new dietary habits and timings of food.

e.g - water born diseases, psychological disorderd and loneliness are common among the migrant.

- At present global migration pattern indicates i.e. underdeveloped to developing to developed countries.
- major migration takes place in tertiary sector has IT, Biotechnology, education etc.

Mobility Transition Model of Migration - DATE

* **Ravenstin Laws**: 'First scholar to formulate the law of migration in 1889' which he derived from an analysis of inter-country movements within Britain in 19th century using census birth place data.

1. Migration and Distance -
- Large number of migrants move to a short distance only.
- Implied in this are : ① distance decay function and ② Preferance for large centres of commerce and industry among long distance migrant.

2) Migration by stages:
- The rapidly growing town in the gaps filled countryside up by migrants, from remote areas.
- Untill the attractive force of one of the rapidly growing cities makes it influence.

3. Streams and counter stream - Each main currents of migration produce a compensating counter current.

4. Rural - Urban Differential - The native of the towns have low degree of propensity to migrate in comparision to their counterparts in the countryside.

5. Prepoderance of Females - Among the short distance migrants, female appears to predominate.

6. Technology and Migration - The magnitude of migration increases with the advancment of technology.

7. Motives behind Migration - Economic motives have a primary importance among various factors governing magnitude of migration.

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Lee's Theory of Migration:

- He visulized the process of migration as the product of three different sets of factors : (i) place of origin (ii) the destination (iii) intervening obstacles.
- According to him, obsctacles will be subjective in natur and precived knowldge about the area of destination.

a) Hypothesis: relating to the volume of migration -

i) Diversity of area - volume of migration depend upon given teritorie variation. High degree of diversity among areas should result in high levels of migration.

ii) Diversity of people - There is homogeneity of people in terms of race, ethnic origin, education, income, tradition migration level shall be low in comparision to an area by heterogeneity.

iii) Intervening obstacles - The migration level has a direct relationsh with amount of intervening obstacles. Thus greater the obstacles lesser is the migration.

iv) Economy - During the period of economic expansion, the migration curve moves upword and during depressions, it suffers a downword

v) Time - Both volume and rate of migration tend to increase with time. migration is, thus, like sinning once done it is easier to do again.

vi) Status of country or area - The magnitude of migration is high in case of developed areas/country. On the contrary, less developed countries have least mobile population.

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Push = Pull - equal
Push > Pull - no migration
push < Pull - migration

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b) Hypothesis - with regard to stream of migration -

i) Well defined stream - migrants proceed along well-defined routes and to highly specified destination.

ii) Counter stream - for every major migration stream, a counter stream developes.

iii) Push factor - The push factors are more compelling than the attractions of pull factors.

iv) Efficency of migration - if the place of origin & destination are similar. In this case, persons moving in opposite directions shall cancel out each other.

v) Intervening obstacles - The efficency of migration stream will be high, if the intervening obstacles are ~~great~~ low.

vi) Economic condition - being high in prosperous times and low in times of depression.

* Characteristics of migrants :

① migration is selective. Not all people can move.
② migration responding to primiarly plus factor (pull) at destination tend to positively selective.
③ migrants responding to primiarly minus factor (push) at place of origin ten to negative selective.
④ Taking all migrants together, selection tend to bi-modal.
⑤ The degree of positive selection increase with difficulty in intervening obstacles.
⑥ The propensity to migrate is high at certain stages of the life-cycle.

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	Reasons of migration	% of Total in-migrant	% of male in-migrant	% of female in-migrant
1.	marriage	36.1	4.0	76.1
2.	Shifting of family	15.3	26.6	11.0
3.	Employment	8.8	27.0	1.8
4.	education	2.0	4.8	0.8
5.	Business	2.3	6.0	0.5
6.	other reasons	15.5	31.6	9.8

source: Census of India 1991, migration Table

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* Gravity model of migration:

- G.K. Zipf

- Zipf formulated the 'Gravity model' of migration.
- According to this model 'volume of migration is inversely praportional to the distance travelled by migrants.'
- The 'Gravity model' which demonstrates the relationship bet^{n} popl^{n} size, distance and migration.

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* Thomas Malthus (1766-1834):

The ideas of popln of the British economist. who put forward in his 'Essay on the Principle of population' (1798).

- He was developed argued that popln growth is a function of the growth of the food supply.
- 'If the food supply was increased then the popln would also grow.'

② He propounded the idea of popln, if unchecked, tends to increase at 'Geometrical Rate' (1, 2, 4, 8 .....)

① while food production increase only at on 'Arithmetical rate' (i.e. 1, 2, 3, 4 ....) over the same time interval.

Statments:

I) Population doubles once is every 25 years.

II) Population increase would result in misery and low standerd of living.

III) He says war, earthquake, & flood are some of the positive checks on popln growth.

IV) Celibacy, self control and late marriages are the preventive checks postulated by malthus.

- Today, 'Neo-malthusians belive that only through the limitations of births can the size of world popln be sufficiently controlled to make possible the elimination of misery and raising of the standerd of living.

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The Demogrphic Transition Theory:

- Demographic means 'study of population' and transition means 'change of population' in the pattern fertility, mortality and natural increases.

- The demographic transition theory originally given by W.S. Thompson (1929) and Frank W. Notestein (1945) who based their statment the trend of fertility, mortality being exprenced by Europe, America and Australia.

* There were three distinct parts of theory:
  ① descriptive - the simple description of the trends in mortality and fertility through time.
  ⑪ Theoratical - it is related to causal mechanism that create the pattern of trend in first part.
  ⑪ Predictive - The third predictive part obtained postulated as to what will happen in future.

- Broadly speaking, the theory postulates a particular pattern of demographic change from a high fertility and high mortality to a low fertility and low mortality.
- When a society progress from a largely rural, agrarian and illitrate society to a dominantly urban, industrial and literate society.

* Hypothesis:
① The decline mortality comes before the decline in fertility.
② The fertility evantually decline match mortality.
③ Socio-economic transformation of the society takes place simeltenously with its demographic transformation.

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- The demographic transition theory is characterized by following four stages:

a) **Stage I**: High and fluctuating birth and death rates, and slow popln growth- (Pre-Transition stage)
- The fertility is over 35 per thousand and the mortality rate is also high being more than 35 per thousand.
- It is pre-industrial and pre-modern stage, this stage mainly occurs in agrarian societies.
- This stage postulates stable and slowly growing population.
- About 200 yrs ago, all the countries of the world were at this stage.

b) **Stage II**: High birth rate and declining death rates and rapid popln growth- (Early Transition stage)
- This stage: gradual decline fertility of over 30 per thousand and sharply reduced mortality rate 15/thousand.
- The improvment in health and sanitation, condition result decline in mortality & fertility maintain.
- The process industralization, urbanization and modernization becomes prominent.
- Most of the developing countries are passing through these stage. The countries like India, Pakistan, Bangladesh, Nepal, Bhutan, Yemen, Kenya, Indonesia, malaysia.

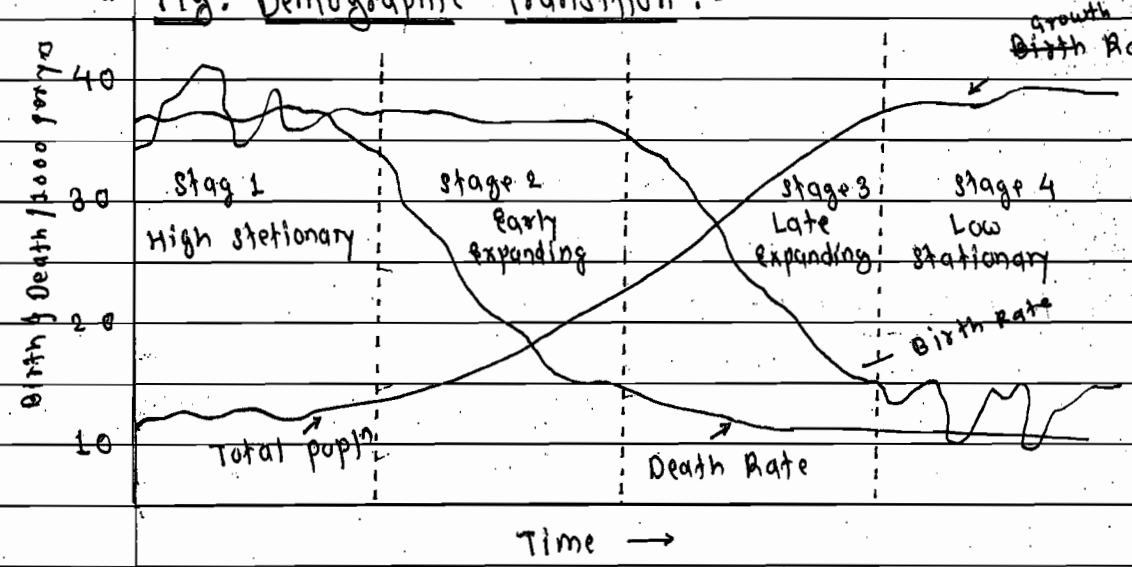
c) **Stage III**: Declining birth rates and low death rates, and declining rate of popln growth- (Late Transition)
- The late expanding phase is charactarised by a slowing growth rate of popln.
- The death rate stabilized at a slow level and the birth rate decline.
- The declined is associated with industrial society

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d) **Stage IV**-Birth and death rate approximetly equal, which in time will result in zero popln growth (Post Transition stage)

- The last stage in demographic both birth and death rates declines appreciably, the popln either stable or grows only slowely.
- The mortality is low and stable and fertility is low but fluctuating.
- Popln highly urbanized, the literacy & education level high, & degree of labour specillization high.
- Countries of Anglo-America, west European, Australia, New Reland, Singapore, Hong Kong & Japan are supposed to this stage.

* **Fig: Demographic Transition :-**



* **Criticism-**

(i) These transition stages time span are criticized.
(ii) These theory do not clearly match on all countries of world.
(iii) It incres the economic condition and urbanization to result decreas popln growth. These hypothesis are not considerd.
(iv) Only as economic and agricultural factors are consider, But some time political, socio-cultural also impact.
(v) The role of migration not included on these transition theory.

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- Which of the following is related to 'seven rule' of migration- Ravenstein.
- 'Intervening opportunities model' was proposed by- S.A. Stouffer.
- How many stages popln growth are involved in the demographic transition model- four.
- Which of the stage in demographic transition of population explosion- Early expanding.
- In the low stationary phase, birth rate is about- 12%.
- India is passing through in which of the following stage of demographic transition- Early Expanding.
- Which of the following regions are in the High stationary stage of demographic transition- Tropical Africa and South Asia.

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Population Resource Region

- The great difficulties involved in defining and measuring individually the factors of population and resources in region.

*Edward A. Ackerman (1970) - used three basic criteria for devising the world's scheme of popln resource ratio.
These included (i) Population factor (ii) Resource factor
(iii) Technology factor.

- Ackerman while using the three factors of popln, resources and technology put greater emphasis upon the factor of technology.
- Therefore, he arrived at the follwing five broad popln resource region of the world.

A) United States Type :

- Technology - source areas of low population - potential / resource ratio.
- These cover large territories that are well stocked potential resources.
- These region small to moderate population.
- The technology not only highly advanced, but also rapidly expanding.
- The society is well equipped with social and technological.
- Countries: U.S.A., Canada, Australia, Newzeland, Estern Russia and Argentina.
- about 100 to 150 yrs ago these countries were 'Brazilian Type' before there present status.

Technology-source
Resource - High
Popln - low

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B) **European Type:**

'Technology-source areas of high population or resource ratio'.

Technology-source popn-High resource-deficit

- The territories are small, the resources are limited and the population are larger.
- The favarable relationship betn population and resources.
- These region was more dependent upon the degree of international exchange of skill, technology, goods etc.
  e.g. - petroleum oil, foodstuffs, unskilled & semiskilled labour.
- **Countries:** Europe (U.K, France, Germany, Italy), Israel, Japan, and Soviet central Asia.
- China, India, N. Korea, Puerto Rico, Ghana etc. are still struggling hard to enter this category.

C) **Brazilian Type:**

'Technology - deficient areas of low population / resources ratio'.

Technology-deficient popn-low, resource-high

- The areas that are technology deficient but fairly stabilized size of population.
- In such areas, much larger population could be achived with the help of higher socio-economic development.
- **Regions** - (I) Indo-China Region (II) Tropical Africa (III) Latin America.
- The future entries to this group could be of oil rich countries of the world.

D) **Egyptian Type:**

'Technology - deficient areas of high population / resources ratio'.

- It refers to the lands that suffer from great imbalance of population and resources.

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- These areas are densely populated & popln rapidly growing.
- The main economy is agriculture e.g. food crops.
- The physical resources and capital resources are limited.
- The level of socio-economic development is low and people are conservative or negative attitude.
- All countries of the world have passed through this stage at one time or the other.
- However, such land are found in all continent of world. for example - Egypt, Algeria, Morocco, Tunisia in (Africa) Italy, Albania, Greece, Yugoslavia in southern (Europe.) Haiti, El salvador, Guatemala in (new world), China, India, Pakistan, Bangladesh, Korea, Nepal, Srilanka, in (Asia.)

E) Arctic Desert Type:

Technology - deficent areas possessing a few food producing resources.

- This population resource region little intrest among population geographey due to obvious reasons.
- These areas unhabited due to aridity, cold, remotness, or inhospitable terraine.
- There are maximum region no settlment, But some area small marginal groups.
- Region: Antartica, Greenland, N. America, Northern Eurasia and Deseart of Australia, Pantagonia, chili, SW Africa.

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Population and Resources

Resour popn

- Disparities in growth patterns responsible for creating an imbalance bet^n the popl^n and resources.
- The developed realm with the 25 % of the world's total popl^n enjoy about 85% share world's resources, while the less developed realm 15% of the world resources but has support to 75 % of the world's poplation.

25% popl^n = 85% resources
75% popl^n = 15% resources

a) **Optimum Population** -

'The perfect balance bet^n resources and population, however non-existent produces an equilibrium state which often called optimum population'.

- 'The optimum level is that size of population, which yields the highest quality of life'.
The quality of life means that: each inhabitant recives adequate amount of food, energy, water and air of high quality.
- It adequate medical care, recreational facilities, full employment, social harmoney, and family stability can be called 'optimum size' of population.
- The measurment of these size of popl^n extremly difficult.

Resource popln

2

b) **Overpopulation**:

'The carrying capacity of an area is exceeded by its population, the area is said to be overpopulated'.
Because the areas has more popl^n than what it can comfortably support.

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Resource-low popln-high

- Clarke distinguishes betn the absolute and relative overpopulation:

① Absolute overpopulation -

It is the living of standerd remains low even after the attainment of absolute limit of resource development.

② Relative overpopulation -

The present level of production is inadequate for the popln but greater production is feasible.

- Region of overpopulation in developed countries - Japan, U.K, Italy, NE U.S.A. and developing - China, India, Indonesia, Pak, Bangladesh etc

* Regional overpopulation causes:

i) rapid natural increase iii) uneven distribution of Resources.
iii) technology advancment iv) medical facilities.
v) agricultural development.

c) Underpopulation :

Resource-high popln-low

'The popln of an area is too small for full utilisation of the territory's resources, it is said to be a situation of underpopulation

- The state of underpopulation when the resources can support of area a larger existing popln without lowering standerd of living.
- The relative underpopln more common than the absolutey underpopulation.

① Absolute underpopln -

It is rare and can occur only in completly isolated societies where the degree of replacment of popln is less than unity.

② Relative underpopln -

'It occur due to insufficency of resouree development'.

- The phenomeng of underpopln caused by high mortality rate.
- Under popln Regions are: Australia, Newzeland, Prairies, Alaska, some African countries.

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- Who has tried to divide India in population Resource Region - P. Sengupta.

- Which of the following is not the feature of problamatic popln resources - Highly technical ability.

- Optimum population is calculated as per: man and his potentiality.

- The western part of china - under populated.

- 2011 Literacy in India : 74%
  male : 82%
  female : 65%

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POPULATION COMPOSITION

- Among the various components of population composition - sex, age and economic composition hold a prime place for popln geographers.

a) Sex Composition :

"The sex ratio is calculated is number of males per thousand females in a population is the most universal measures of sex composition."

$$\text{Sex Ratio} = \frac{Pf}{Pm} \times 1000$$

where,

Pm = numbers of males

Pf = number of females

- A distinction has also been made betn Primary, Secondary and Tertiary sex ratio.

(i) Primary sex ratio - denotes the ratio betn two sexes at the time of conception.

(ii) Secondary sex ratio - is the ratio between two sexes at the time of birth.

(iii) Tertiary sex ratio - refers to the ratio of the two sexes at the time of enumeration.

940 (India)

* **World Pattern of sex ratio** -

- There were 993 females for every thousand males in the world (1990).
- Among the various continents Europe, N. America, Africa were characterised by predominance of females.
- The continents of Latin America, Asia, Oceania suffered from the paucity of females.

1) **High sex ratio** -

Europe had the highest sex ratio of (1051) females per thousand males followed by North America (1059) and Africa (1017).

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Because...

i) U.S.S.R and Europe due to the large losses of males in the IInd world war.

ii) The high mortality in Africa may be due to hard life - the African males have inter-tribal conflicts.

iii) North American males may be associated with high rates of accidents involving more males than females.

2) Low Sex Ratio-

Asia, on the other hand, had the largest deficiency of females, as there were (960) females for every thousand males. In case of Oceania and Latin America the sex ratio of (983) and (995) respectively.

Asia - 960
Oceana - 983
L-America - 995

Because...

i) Asia a paucity of females relatively high mortality rate, neglect of females all ages, low status granted to them, the past practices of female infanticide - sati etc.

ii) Latin America and oceania deficency females because male selective immigration these countries.

* Sex Ratio in India; 2001-

The latest cencus of 2011, the sex ratio of India is 940 females per thousand males and 933 (2001).

i) Rural-Urban sex Ratio-

Rural areas (951) and urban (880) because more males moves rural to urban in search of job's.

ii) Religious sex ratio -

The sex ratio various religious groups in India - christains (986), - Hindu (930), Muslim (922) and - Shikh (860) females per thousand male.

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0-6 yrs sex ratio - 2001 - 927
2011 - 914

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i) Sex ratio higher than national avarage -

- There were 1058 females per thousand males in Kerala. 1084 (2011). It was followed by chattisgarh (989), Tamilnadu (987), Andhra (978), manipur (978), Karnataka (965), Goa (961), Jharkhand (941), and west Bengal (934) in this order.

Highest-Kerala lowest-Punjab

ii) Sex Ratio below national avarage -

- Haryana in the displayed lowest sex ratio of (861). Other states also Punjab (876), Sikkim (875), J & K (892), Arunachal (893), U.P (898).
- In there six states the sex ratio was below 900 females per thousand males.
- In rest of the states the sex ratio ranged betn 900 and 932 females per thousand males.

- Union Teritories - Pondichery in 2001 was (1001) highest, Lakshdweep (948), A & N (846), Delhi (821), D & N.H. (812), chandigarh (777) and lowest sex ratio Daman & Diu (710) and 618 (2011).

High-pondichery 1001-949.

Sex Ratio (1901-2001): # Sex Ratio (2011)

Years	Sex Ratio
1901	972
1911	964
1921	955
1931	950
1941	945
1951	946
1961	941
1971	930
1981	934
1991	927
2001	933
2011	940

* - 940 females per thousand males.
* Highest sex-ratio : Kerala (1084)
Pondechery (1034)
* Lowest sex-Ratio : D & Diu (615)
D & N.H (775)
Child sex Ratio - 914 female children.
(0-6 age group)
* Highest : Mizoram (971)
Meghalaya (970)
* Lowest : Haryana (971)
Punjab (970)

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b) **Age Composition: And it's Determinants -**

- There are three basic determinant of age composition include fertility, mortality and mobility.

i) **Fertility -**

The characterised by high birth rates display large praportion of young popln. e.g - Latin America, Africa & Asia.

- The Low fertility rate, the praportion of low young popln Europe, N. America etc

ii) **Morality -**

- The mortality low both the younger & older age group, it increase person in high age group for advanced countries.
- The morality decline lower to older age group, results increase younger age group for developing countries.

iii) **Migration -**

- The impact of migration upon age structure largely, because migration tend to age-selective.
- The working age group 15-30 are more mobile, the structure of two areas modified significantly.

iv) **wars -**

- The impact of wars is most pronounced on the age distributn as these take a heavy toll of young males.

* **Methods of Age Analysis:**

- Three different methods of analysing age composition have been used by popln geographers:

1) **Age Pyramid -**

- The age pyramid, which is more commonly known as age and sex pyramids.
- The age pyramids are constructed for depecting the age structure of a popln along their vertical axis.

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- The horizantal axis of such pyramids represents the total popln.
- If the horizantal axis represents males and females seprately, the pyramids is divided vertically in two halves, right side representing the females and left side representing the males.

2) Age Groups -

- The categorization of popln into various age groups permits regional comparision with the help of choropleth maps.
- Generally the popln is categorized into three broad age groups:
  - (i) the young (0-14)
  - (ii) the adults (15-59)
  - (iii) the old (60 and above.
- The social and economical implications of these three age groups and the geographical variations in their distribution are worthy of serious consideration.

3) Age Indices:

- The age composition can also be studided with the help of age indices.
- The calculations of such ratio hold significance for the purposes of manpower planning, growth of popln analysis, migration analysis etc.
- Such ratios are calculated namely -
  - (i) betn the aged and adults
  - (ii) betn the aged and the young
  - (iii) betn the young and the adults.
- The geographers in understanding the regional variations in these ratios.

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* World Pattern of Age Distribution:

- In 1980 the median age for the world's popln was estimated to be 22.4 years.
- The median for more developed regions was 31.4 years while less developed region was only 19.8 years.
- The median age lowest in the continent of Africa (17.3 yrs) and highest in Europe (33 years).

a) The Young - (<15)

- The world as a whole 35.6 per cent popln is below the age of 15 years.
- The corresponding figures for the more developed region 23% and developing region 40%.
- The wide variation betn ranging from less than 25 percent Europe, Africa nearly 50%, about 40% Asia & Latin America.
- There is direct correlation betn birth rate and proportion of young popln.
- These age group economically non-productive, these age group depend upon second age group.

b) The Adults: (15-59) -

- The upper limit is sometimes extended to 65.
- The adult age group is biologically the most reproductive, economically productive & demographically mobile.
- It support young age group & old age group.
- There are not wide regional variations in the world in the proportion of adults.
- The proportion of popln developed region 55.6% and less developed region 56.2%.

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- The world as a whole 58.6% popln is 15-64 years age group.
- The variation in Africa (51.2%), Asia (59.5%), Latin America (56.3%), Europe (64.7%), N. America (66.3%) and oceania 62.

c) **The old** - (60+ above):

- The world on an avarage 7% of its popln in the age 60+ age group
- The industrally developed countries are 16% popln and less developed countries are 6%.
- From among various continents - Europe (16%), N. America (12%) Oceania (10%), Latin America (6%), Asia (6%) & Africa (3%).
- In this age group also called 'senior citizens & elders'.
- This age group economically burdon on adult age group.

* **Age structure of India's:**

Age Groups	Percentage of population			
	Total	Rural	Urban	
0-14	39.35	37.17	30.6	347
15-59	56.98	54.87	62.36	780
60+	3.45	7.74	6.70	66
Dependancy Ratio	75.17	81.87	59.88	1293

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c) **Economic composition:**

"The proportion of population in to different economic activities is called as economic composition".

① **Economically active & non active population:-**

- The economicaly active popln is that part of manpower, which is actually engaged in the production of goods & services.
- Economically non-active popln is that part of manpower which is engaged in activities like household duties in their own house, retired person, student etc.

② **workers and non-workers:-**

- Any person whose main activity was participation in any economically productive work either by his physical and his mental activity was classified as worker.
- Thus, work involved not only actual work but also effective supervision and direction as a non-workers.

③ **Composition of worke force:**

i) Sex - The male participation rates are ubiquitously more than female participation rates almost all the world.

ii) Residance - The size of working force in rural areas is relatively large in compaire to urban area.

iii) Age - The age 15-60 years group consider as most active working group.

④ **Occupational Composition-**

"The proportion of active population under specific economic activities is known as occupational structure."

- The occupation of an individual refers to his trade, profession, type of work etc.

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* The 1971 Indian Census adopted the following industrial classification :

i) Cultivation,
ii) Agricultural labour,
iii) Livestock, forestry, fishing, hunting, plantations, orchards and allied activities.
iv) Mining and quarrying.
v) manufacturing, processing, servicing and repairs:
   (a) Household industry
   (b) Other than household industry.
vi) Construction
vii) Trade and commerce.
viii) Transport and storage
ix) Other services.

* The 1981 Census of India published its data about its workers into four main categories these are:

i) Cultivator
ii) Agricultural Labourers,
iii) Household industrial workers,
iv) other workers.

According to 2001 census;

1. Cultivators or Agricultural labours - 58.4 %.
2. Household industries labours - 04.07 %.
3. Agri. related industries labours - 37.52 %.
   99.98

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Rural-Urban Popl^{n} 2011:

Total : 121 crore

Urban : 87.7 crore (31.16 %)

Rural : 83.3 crore (68.84 %)

1. Tamilnadu - 48.50 %.
2. Kerala - 47.72 %.
3. Maharashtra - 45.28 %.
4. Gujrat - 42.58 %.

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POPULATION CHANGE

"Decrease or increase in the numer of inhabitant of a territory during a specific period of time".

- The population change may be +ve or -ve.

* Population geographer calculated popln growth rate in two types:

① Actual growth rate:

Such a growth rate calculated with the help of actual popln counts is known as actual rate of popln growth, it consider migration.

② Natural growth rate:

This natural rate of growth of popln at the begining of the dividing the difference betn birth and deaths of population.

Components of Population change:

There are mainly three components: Fertility, Mortality and Mobility.

1) Fertility and it's measures:

'Fertility refers to the 'occurance of birth and must not he mixed with fecundity'.

① Crude Birth Rate - (CBR)

'The number of births in a year per thousand mid year population'.

$$C.B.R. = \frac{Bl}{P} \times 1000$$

where,

Bl = live birth during a year.

P = estimated mid year popln.

② Fertility Ratio - (FR):

'The number of children below 5 yrs of age per thousand females of reproductive age group'.

$$FR = \frac{P_{0-4}}{P_{f\ 15-49}} \times 1000$$

where,

P_{0-4} = child of age.

$P_{f\ 15-49}$ = women for child bearing age.

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(iii) General fertility Rate (GFR) -

'The number of births in a year per thousand women of normal reproductive age'.

$$GFR = \frac{B1}{Pf\ 15\text{-}44} \times 1000$$

B1 - live birth in a year

Pf 15-44 - women normal reproductive age.

(iv) Age specific Birth Rate (ABR) -

'The number of births in a year to women of a given age group per thousand women that age group'.

$$ABR\ f_{20\text{-}24} = \frac{B_{20\text{-}24}}{Pf_{20\text{-}24}} \times 1000$$

where, $B_{20\text{-}24}$ = no. of births to women of a given age.

$Pf_{20\text{-}24}$ = stands for total female popln.

(v) Standerd Birth Rate (SBR) -

- The number of expected births for each specific age group can first calculate.
- The sum expected births for all age groups is to be divided by total population.
- And it is multiplyed by thousand so as to yield standerdised birth rate.

(vi) Total fertility Rate (TFR) -

'It is obtained by summing up the age specific birth rate & multiplying it by number of year in the age interval'.

$$TFR = 5 \times \Sigma \left[\frac{B_{15\text{-}19}}{Bf\ 15\text{-}19} \times 1000 \right]$$

(vi) Reproductive Replacment (RR) -

'female babies born per thousand of female popln in reproductive age group'.

$$RR = \frac{Bf}{Pf\ 15\text{-}44} \times 1000$$

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* **Determinants of fertility –**

1) Biological – (i) Race (ii) fecundity (iii) General Health.

2) Demographic – (i) Age structure (ii) Duration of marriage.
(iii) sex composition (iv) Degree of urbanization.

3) Social – (i) Religious background (ii) Level of education
(iii) Age at marriage.

4) Economic – -ve correlation betn income level and the family size.

* **World Pattern of Fertility –**

- The world avarage birth rate was estimated to be 22 per thousand. and Total fertility rate 2.8 children per women.
- The developed countries report one of the lowest birth rate and underdeveloped countries high birth rates.

1) High Fertility Region – (above 5) :

- Africa rank very high in the world (5.1) followed by west Asia, South Asia & Latin America.
- Africa (Egypt, Nigeria, Angola), Asia (Afganistan, Yemen) are above 5 TFR.

2)

2) Med Low Fertility Region (below 3) –

- As against whole Europe (1.4), N. America (2.0), S. America (2.5), Asia (2.6), Oceana (2.1)

- All the states in TFR (3-5) as medium fertility region.

* **Fertility in India :**

- India had a TFR of 3.1 children per women (2004).
- The first sign of fertility decline in 1971 in India.
- Goa has (14.3) ~~has~~ lowest CBR and Uttar pradesh most populase state (32.8) per thousand highest CBR. PAGE India.

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2) **Mortality and it's measures** –

"The permanent disapperance of all evidences of ~~life~~ life at any time after birth has taken place.".

① **Crude Death Rate** (CDR)–

'The number of deaths in a particular year per thousand of population'.

$$CDR = \frac{D}{P} \times 1000$$

where, D = Deaths in a year, P = mid-year popln for the year.

② **Mortality rates by age and sex** (DasR)–

'The number of deaths during a year of persons of a given age and sex per thousand that age and sex.

$$DasR = \frac{Das}{Pas} \times 1000$$

where, Das = number of death of specific age & specific sex during a year.
Pas = total popln of specific age & sex.

③ **Infant Mortality Rate** – (IMR):

'is calculated for connoting mortality among children of less than one year of age'.

$$IMR = \frac{Do}{B_l} \times 1000$$

where, Do = no. of deaths of children under one year of age.
B_l = number of leave births.

④ **Maternal Mortality Rate** – (MMR) :

"The number of females death due to maternity causes (pregenency, deliver or other maternity reason) per 'ten thousand' of live births".

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* Determinant of Mortality:

1) Demographic Determinant:
   - (i) Age structure - old age group high mortality.
   - (ii) sex composition - male mortality rate higher than female.
   - (iii) Urbanization - Urban area mortality higher than rural area.

2) Social Determinant:
   - (i) Prevalance of infanticide.
   - (ii) Widow remarriage
   - (iii) Adequency of medical facility.
   - (iv) Standard of living.

3) Economic Determinants:
   - (i) medical facilities
   - (ii) nutritional food.
   - (iii) Industrial socities high death rate as compair agriculture society.

4) Natural Hazards -
   (i) earthquake (ii) volcanoes (iii) landslide (iv) flood (v) drought.

* Mortality level of World:

- The crude death rate for world as a whole was 9.0 per thousand (2004).
- The developed countries death rate 9/1000 and less developed countries 8/1000.
- Africa was highest mortality rate 14/1000. Europe was 12/1000, North America (8), South America (6), Asia (7) and Oceania (7) per thousand.

2007 : B.R.-23.1 Natural Growth Rate - 15.7.
D.R. 7.4

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* **Mortality Rate in India :**

- The Indian mortality has transversed 40 per thousand at the begning of present century to around 8.5 in 2000.
- Mizoram (5.2) having a lowest mortality rate and Orisa (10.5) has highest mortality rates.
- mortality in below national avarage :- Mizoram, Kerala, manipur, Tripura, sikkim, J & K, W. Bengal, maharashtra,
- mortality is above national avarage - Orissa, U.P., M.P, chattisgarh, Aassam, Jharkhand, and Bihar.

3) **Mobility :**

- The third companent of popln change was 'migration'.
- The most advanced countries of the world it is not to collect direct data on migration.
- Wansch and Termote (1978) :- They have discussed the measures of migration at length in their book- 'Introduction to Demographic Analysis'.

cences 2011

Cencus 2011

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1.	देशाची लोकसंख्या - 121 कोटी.	- लोकसंख्या 17.5%
2.	लोकसंख्येत प्रथम राज्य	- U.P. 20 कोटी.
3.	लोकसंख्या वाढीचा वेग सर्वाधिक राज्य	- बिहार
4.	सर्वाधिक लोकसंख्या घनता राज्य	- दिल्ली (11,297)
5.	सर्वात कमी लोकसंख्या घनता राज्य	- अरुणाचल प्रदेश (17)
6.	भारताची लोकसंख्या घनता	- 382
7.	भारतात दर हजारी महिलांचे प्रमाण	- 940
8.	स्त्री-पुरुष प्रमाण सर्वाधिक राज्य	- केरळ (1084)
	केंद्रशासित प्रदेश	- पाँडेचरी (1038)
9.	स्त्री पुरुष प्रमाण सर्वात कमी राज्य.	- दमण-दीव (618) दमण (533)
10.	देशात साक्षरतेचे प्रमाण	- 74%
	महिला	- ~~74~~ 65%
	पुरुष	< 82%
11.	सर्वाधिक साक्षरतेचे राज्य	- केरळ (93%)
12.	सर्वात कमी साक्षरतेचे राज्य	- बिहार (63%)

1.	Total Rural Population	- 83.3 crore
2.	Total urban population	- 37.7 crore
3.	Rural - Urban popln ratio	- 68.84 : 31.16
4.	Birth Rate (2010)	- 22.1 / 1000 popln.
5.	Death Rate (2010)	- 7.2 / 1000 popln.
6.	TFR per women (2009)	- 2.6 / 1000 live birth.
7.	maternal mortality Rate	- 212 / lakh live birth
8.	Infant mortality Rate	- 47 per thousand.

Cartography -

Map as a tool in Geographical studies :

Types of maps : Techniques for the study of spatial patterns of distribution.

Single purpose and composite maps.

Choropleth, Isopleth, chorochromatic maps and pie diagrams.

Mapping of location specific data.

Accessibility and flow maps.

Remote sensing and GIS --

Remote sensing and computer application in mapping.

Digital mapping.

Geographic Information System (GIS) : Thematic maps.

Statistical Method -

Data source and type of data.

Statistical Diagram.

Study of frequency distribution and cumulative frequency.

Measures of central tendency.

Selection of class intervals for mapping.

Measure of dispersion and concentration.

Standard Deviation.

Lorenz curve.

Methods of measuring association among different attributes

Simple & multiple correlation.

Regression.

Techniques -

Measurment of spatial patterns of distribution.

Nearest - Neighbour analysis

Scaling technique, rank score, weighted score.

Sampling technique for geographical analysis.

1. India's I^st acurate map constructed - James Renel (1783)

1. Isopleth map (1737) - Filiph Buache - [illegible]
2. Hatures method's map - major Lehman
3. Spot Height map (1843) - ~~Steelar~~ Khristhopher packy
4. Colour / tint method map (1820 - steelar
5. Shading method map - Hans Kornad Gigger.

1. 'Germany mpep's - Steelar
2. France maps - Vidal-de-la-Blach / martin.
3. England maps - Philiphe & Bartholim.

* Cartography of India:

- In 1723 french cartographer 'Delisle' construct map of south India.
- India's I^st General sarveyer - Makenzie.
- James Rennel India's I^st acurate map constructed.
-
- Survey of India: centre - 'Dehradun'

sub-centre: Benglore, Hydrabad, Ahmadabad.

- 1857 [illegible]

metric mequsment techolgue:

1 cm = 500 m - large scale
1 cm = 1 km - medium scale
1 cm = 2.5 km. - small scale.

CARTOGRAPHY :

① "Cartography is the science and art of designing constructing and producing map. It is constructing with measurment and representing of the shape, size & other broad details of the earth surface in the past."

② "Cartography refers to the whole series of processes of map making from an actual survey of the ground to the printing of the map".

③ नकाशाशास्त्र हे सर्व प्रकारचे नकाशे व नकाशे तयार करण्याचे शास्त्र असून, त्यामध्ये नकाशाच्या मूळ सर्वेक्षणापासून ते अंतिम मुद्रणापर्यंतच्या सर्व प्रक्रियांचा समावेश होतो.

Map as a Tool in Geographical Studies :

① "A diagram, representing the world as a whole or part of it, drawn on flat surface with the help of projection and conventional signs and symbols is called a map".

② "A map may be defined as a convertional representation of the earth or part of it, on a flat pieace of paper".

③ "A selective, symbolised and generalised representation of the whole or part of the earth at a reduced scale".

Map representation is very essential for the understanding of geographer as it is more concerned about earth, its variations and inequalities surrounding it.

- However the amount of information to be represented on map depends on : ① Scale ② Projection
  ③ Conventional signs
  ④ Skill of the droughtsman.
  ⑤ Method of map making.

- The framework of the map is based on the way how the granticule i.e the longitudnal & latitudnal network prepared.

- Every symbol, sign represents a definite meaning, Earth can be mapped by a number of ways:-

(i) By actual survey with the help of instruments like chain, prismatic compass, planetable etc.

(ii) By photographs.

(iii) By freehand sketches and diagram.

(iv) By computer.

(v) By satellite and Remote sensing method.

* Importance -

* Photographs are the representative of a small portion of the earth. *

* The Remote sensing images give very detailed account of a region without much of distortion and are more accurate.

* Topographical survey map every point on the map bears a true relationship with the corresponding point of the ground.

TYPES OF MAPS :

The representation is drawn to a specific scale and map projection and shows distinctive aspects of the surface such as relief features, routes, settlments etc.

map may be classified with respect to:

i) Scale.

ii) purpose of content.

a) Types of maps based on scale:

Large scale maps are drawn to show small areas and on the other hand, small scale maps are drawn to show large areas.

1) Large scale maps -

Large scale maps further divided in to two types:

① Cadastral map -

territorial property

* The term 'cadastral' is derived from french word 'cadastre' meaning 'register of territorial property.

* These map drawn to register the demarcating boundrie of agricultural land, and plan of individual houses in urban areas.

* They are pripaired specially by goverment to realize revenue and tax.

* Scale :- 1:4000 villages & 1:2000 city plans.

* They are specially done by the govt. to realize revenue & tax.

② Topographical maps:

* They show general surface features in detail compassing both natural landscape and cultural landscape.

Topographical features showing

* These map show topographical details such as relief, drainage, agricultural land, forest, settlments, means of communication, schools, post & other services.

* In India 1:50,000 scale maps are generally prepaired.
1:20,000.

- Topographical map produced by: N.A.T.M.O.

2) Small scale maps:

Small scale maps are further divided in to two types:

① wall maps:

* These maps are generally drawn on large ~~scale~~ size

* In these maps the world as a whole or in hemisphere is distinctly represending.

* They map also be prepared for a continent, a country, large scale or small scale according to need.

* Their scale is smaller than that of topographical maps but larger than atlas maps.

(ii) Atlas / chorographical maps:

* Atlas maps are very small scale maps.

* These maps show only important peaks, important rivers, cheif towns, railway lines etc.

* These maps represent fairly large areas and present highly generalised picture of physical or cultural features.
- scale 1:1,000,000

b) Types of maps based on functions:

Maps based on their functions may be classified in to physical maps and cultural maps.

a) Physical maps:

Physical maps show natural features such as relief, geology, soils, drainage, elements of weather, climate and vegetation etc.

(i) Relief maps -

Relief maps show general topography of an area like mountains and valleys, plains, plateau and drainage.

(ii) Geological maps:

These maps are drawn to show geological structures, rock types etc.

(iii) Climatic maps:

These maps depict climatic regions of an area. Besides, maps are also drawn to show the distribution of temprature, rainfall, cloudness, relative humidity, direction and velocity of winds and other element of weather.

(iv) Soil maps:

maps are also drawn to show the distribution of different types of soils and their properties.

(v) Astronomical maps:

These maps show heavenly body or heavenly features.

2) Cultural maps:

Cultural map-show man-made features. Population, social, economic, and Political features showing:

(i) Political maps:

These map shows the administrative divisions of an area such as country, states or district. These maps facilitate the administrative machinary in planning and manegment of the concerned administrative unit.

(ii) Population maps:

The population maps are drawn to show the distribution, density and growth of popln, age & sex composition, religious, social and linguistic.

population maps serve the most important planning and development of an area.

iii) Economic maps :

Economic maps depict production and distribution of different types of crops and minerals, location of industries and markets, routes for trade and flow of commodities.

iv) Historical maps :

map showing historical events are called historical maps.

v) Social maps :

Social organisms, - tribes and races, their languages, religions etc. are depected on social maps.

Importance and Uses of maps :

① maps are tools of 'Geographers', but it also guide the traveller & tourist for their destination.

② The maps also important in the field of navey and airways. Toposheet are usefull to millietry operations.

③ maps are great source of information, It display natural and man-made features.

④ map provide detail information of landforms and other ground feature without seeing of area.

⑤ Recently it is used for advertiesment. They are drawn especially for showing the location of industries, production, centres etc.

⑥ maps used for measurment to determine distance, direction an area.

⑦ Businessmen, industrialists & managers of factories and workshops also need maps and charts.

⑧ Maps are useful for planning and conservation of natural resources

DISTRIBUTION MAPS

a) Qualitative areal distribution maps:

"The map which show the distribution by taking quality in to consideration is called qualitative areal distribution maps".
- It is showed by colour, shade and tint.

b) Quantitative areal distribution maps:

"The maps which show the variations in density of a quantity by symbol, such as dot, isopleth, squre is called quantitative areal distribution maps".

(I) Choropleth maps:

"The map which shows the variation in distribution with the help of ~~colour~~, and shade/lines is called as choropleth maps".

Use different shadings

- The lighter shade shows lower density and darker shade shows higher density.
e.g. Populatn Density map.

* Advantages:

(i) Ratio and Percentage effectively represented.

(ii) It is easy to draw as it is based on administrative unit.

(iii) Some time absolute number can also be shown by this method. "Different shading by horizantal, vertical and slanting lines or in check forms may be adopted to show variation of density of popln, location factor for industries, forest type etc."

* Disadvantages:

(i) At the boundry of two differently shades region, there is abrupt changes in density which may not always true.

(ii) wastland (forest, desert) disappear beneath the

'A form of thematic map representing classes of a features associated with areas by means of density shading'

* Use :
  (i) Population Density.
  (ii) Distribution of crop and Livestock.
  (iii) Percentage of area under wheat to the total cropped area.

(II) Dot maps :

"The map show the variation in distribution of quantities by dot of uniform size is called dot maps."

* The numbes of dot increase when data is large and less where the data or quantity is small.
* Generally only one object showing by dot method. But when two object shown an same map, dots may be shaded by different colour.

* Advantages :
  (i) Dot maps are easily understood.
  (ii) Dot map showing distribution from actual figures.
  (iii) Dot maps show variation in density very clearly and correctly.
  (iv) They are used for educational purposes because of their illustrative quality.

* Disadvantages :
  (i) In regions of high density where dots merge into one another, the counting of dots is almost impossible.
  (ii) This method can not be utilised for showing ration and percentage. can not show

* Use :
  (i) Distribution of cattle, area under crops, out-put of commodities and population density etc.
  (ii) Popln distribution is shown by multiple dot method of

(III) **Isopleth / Isoline / Isorithm maps :** - Isopleth maps are best suited for - Depecting changes which are relatively gradual.

(i) "The line which joint the place of equal value is called isopleth".

Greek word - iso means equal and plethron means measure.

(ii) "The maps on which quantities are represented by isopleth/line are called isopleth maps".

- These are mainly show the climatic data:

e.g: (i) Isobar (pressure) (ii) Isohyte (rainfall)
(iii) Isotherm (temprature) (iv) Isohel (sun-shine),
(v) Isoneph (cloudiness) (vi) Isosesmal (earthquake),
(vii) Isohaline (salinity) (viii) Isobath (depth) etc.

* **Advantages :** *Topographic contour maps are common type of isopleth maps.

(i) It depict distribution of quantities irrespective of the administrative divisim.

(ii) The distribution of a quantity by isopleth represented very effectively and it is more scientific than dot & chlopleth.

* **Disadvantages :**

(i) It is fail to give detail of distribution particularly when there are great variation in distribution.

(ii) It is not possible to depict / draw isopleth map if data is not available in respect of large no. of station.

* **Use :**

(i) Commanly use to showing the distribution of temp., rainfall and pressure.

(ii) Isopleth are also use to show percentage
e.g.: % of area under wheat to the total cropped area.

(IV) Diagramatic maps:

With the help of diagram showing distribution

"The maps on which distribution of quantity are shown by diagrams namely bar, square, circle, cube etc. are known as diagramatic maps."

* The choice of symbol depend on range of data:

(i) When range of data small (the difference between largest & smallest value is small) we make use bar.

(ii) When the range of data large we make use of two dimentional symbol namely square & graduaj circle.

(iii) When range is very large are use three dimentiunal symbol like cube & sphere.

* The praportion symbol are used in the folliwing categories of diagramatic maps:

a) Map showing unevenly & widely distributed quantities:

In some cases there are only a few stations where quantity occur or it is concentrate at a few widely seprated station with the result that we can not show the distribution by dot and isopleth. In such cases, proportion symbol use only.

Example - out put of iorn, popln of urban centre, generation of thermal, hydroelectricity power at different station.

(i) Bardiagram map - Generally verticle & the same width & their length praportion to quantity.

(ii) Graduated circle: when the difference betn the values of the quantities is too large then it used.

- The centre of each circle is placed at the point where data occur.

* Demerit :

① The map may not be easily measurable.

② Some of the letters may appear smaller than others e.g. - I showing iorn look smaller than 'C'.

* merit -

① many element showing together on one map.

(VII) **Pie Diagram :**

Pie diagram is a circle devided into sector, the area of each of which is proportional to the quantity represent."

It is also known as 'divided circle' or 'a pie graph'.

* It is commanly used for represent a quantity and its component.
* It is commonly used for represent a quantity and its component.
* The total of the component represent by circle & component by the sector of circle.
* It is very effective diagram
* It should be use only represent the percentage not absolute figure.

Example - State Hariyana (no. of villages 1971)

less than 500	500-999	1000-over	Total no. of villages.
2018	1909	2804	6731

① $\frac{360}{6731} \times 2018$ $= 107.9°$

② $\frac{360}{6731} \times 1909$ $= 102.1°$

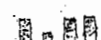
③ $\frac{360}{6731} \times 2804$ $= 150°$

chorographic Compage: "Alas maps which are drawn on a very small scale & give a more or less highly generalised picture are called chorographical compage."

(iii) Graduated sphere -

- occupies less space than circle.
- when data range to large then it is used.

b) map showing the distribution of a variable & it's component:

The distribution of a variable and it's component is shown by sub-divided graduated circle or by compound bar.  

(V) **Chorochromatic maps :-**

"Those maps in which different features or object shows by different shade and colour are called choro-chromatic maps."

Example: Forest - Green, Grassland - Yellow and Desert - Brown etc.

- It is also called 'colour of 'tint method'.
- It is also called 'Layering method'. which is used commanly in relief map to show the different elevation.

* The main defect (दोष) of this method is that it 'obliterate' all other feature.

(VI) **Choro-Sehematic maps:**

"The map which showing the distribution of different element with the help of initial letter is called choro-schematic maps."

Example - wheat by W, maize by M, Rice by R, coal by C, iorn by 'I', gold by 'G'. etc.

- "Cressay" has used this method in his chings Geographic foundation to show the distribution of minerals.

"Statistics may be defined as the collection, presentation, analysis & interpretation of data."

STATISTICAL METHOD

Statistics -

'Statistics refers to the statistical principles and methods used in collecting, analysing and interpretation of the data.'

* Statastical methods:

'Statistical methods are the techniques used for collections, summarisations, classification, analysis, comparision and interpretation of the huge and complex numerical data.'

* By their use, usefull deduction and inferences are drawn, and statistical laws are formulated. Though such laws are not perfect and completly exact, they are true only on the average or in the long run.

Data Sources And Types of Data:

Data: 'The collection of information and ideas' is called as data.

The collection of data is the basis or foundation of statistical invistigation. It is, therefore necessary to collect data very carefully.

* Types of statistical Data:

There are two types of statistical data:

a) Primary Data:

"The data which are collected for the first time by the collector or investigator for his own purpose or statistical enquiry from the sources of information is called primary data".

Isotropes - Potential Temprature Isogonic line - magnetic declination.
Isopachs - Cumulonimbus
Isohytes - Rainfall
Isohypses - Cloude base.

b) Secondary Data:

"The data which are collected by some one else and used by the investigator for his own purpose from published or unpublished sources is known as secondary data".

* For example -

The data collected by election office are primary for the office but secondary when used by other.

Sources of Data:

1) Primary Data Sources -

Among the primary sources of the demographic data are the cencus, the survey, the registrations etc.

(i) Cencus -

The population cencus is the most important source of data for demographers. In India first complete cencus of population was conducted in 1881. Since then it is being conducted at a regular interval of 10 years.

Under this cencus, the information are collected population number, their rural & urban distribution, their sex, age composition, literacy, religion and occupation etc.

(ii) Survey -

They are generally conducted to collect a variety of informations regarding fertility, mortality, morbidity, mobility, unemployment, health & education etc.

(iii) The Registration -

Under this category data Birth, death, marriage and divorce statistics are generally registered.

2) Secondary Data Sources:

The main sources are secondary data are:

(i) Published statistics:

This include official publications of governments, reports of enquiry committees and commissions, publications of trade associations, banks, publication of technical journals etc.

(ii) Unpublished statistics:

This include large amount of data collected by goverment ~~data~~ institutions or others which remain unpublished. This collected data can be put to use, if available.

Statistical Diagram:

"The representation of statistical data, or a geographic element in a highly abstract and convectionalised form by laying emphasis on one selected element"

* Importance -

(i) To compaire relating data to different period of time, & different region.

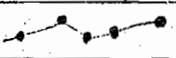
(ii) They also help us in a analytical thinking and investigation.

(iii) It is make quickly & make accurate comparision of data.

(iv) Statistical diagram may be show daily, monthly or annualy production of each and every commodity.

(v) They are most convencing and appealing ways for presenting statistical result.

1. One Dimentional - These include:

(i) Line diagram 

(ii) Bar Diagram - simple, compound & multiple bar diagram.

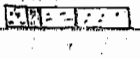
(iii) Pyramid Diagram - simple, super imposed and compound pyramid. 

(iv) water budget or rainfall dispersion diagram.

2. Two Dimesional - These include:

(i) Unit square diagram. 

(ii) Squre block diagram. 

(iii) Rectangular diagram - simple and divided rectangular diagram. 

(iv) Pie diagram.

Types of Toposheet		Standard contour interval in feet	Index no. of Indian Toposheet
(i) million	-	500	- 64
(ii) one-inch	-	50	- 64M/10
(iii) half-inch	-	100	- 64M/NE
(iv) quarter-inch	-	250	- 64M

3. Three Dimentional These include :
   (i) Spherical Diagram 
   (ii) Cube Diagram 
   (iii) Block Pole Diagram 

4. other - These include :
   (i) Star diagram. 
   (ii) triangular diagram. 
   (iii) scatter diagram. the other diagrams through which the cartographic representation can be made.

The statistical diagrams, however depends on the nature of data how they can be most suitably represented any one of the above methods.

* For examyle -
   (i) The percentage of coal production by different states in India can be most suitably shown in bar diagram.
   (ii) Land use pattern can be represented pie diagram.
   (iii) Production of different food grains of a particular year can be shown in a rectangular block diagram.

Pictorial Diagrams : सांख्यिकी चित्रांच्या आधारे सांख्यिकी आकडेवारी दर्शवली जाते, याला Pictorial Diagrams म्हणतात.

Cartogram : (नकाशाकृति) - देश वा प्रदेशाच्या संदर्भातील सांख्यिकी आकडेवारी दर्शविताना मूळ नकाशाच्या आकार-रेषांत: थोडा फरक करून तयार केलेल्या जाणाऱ्या आकृतीस Cartogram म्हणतात.

Types - (i) Rectangular cartograms.
   (ii) Value Area cartograms.
   (iii) flow Line cartograms.

* Use & Importance of statistical Technique in Geography:

i) To stabulate complex data systimatically & methodologicaly simplyfies.
ii) To identify, classify and extract inherant characteristics of phenomena.
iii) To present fact in definate format.
iv) To extract sample for large & unmanegable universe analysis with sample becomes valied for universe.
v) To study distribution, frequency, gradient & measures of in equaly, inhearant in factor for the data.
vi) To identify association, correlation & also combination of phenomena across the space & through time.
vii) To stimulate & built of spatial model.

Friquency Polygone:
"वर्गमालेखातील आयतांच्या माध्याचे मध्यबिंदू रेषाखंडानी जोडून मिळणाऱ्या बहुभुजाकृतीस, वारंवारिता बहुभुज म्हणतात."

Frequency curve - "वारंवारिता बहुभुजाच्या बाजू रेषाखंड असतात. त्यांचे कोपरे मोडून आपण जर त्याचा त्यांचे क्रोगपुज न बदलता वक्र काढला तर त्यास वारंवारिता वक्र असे म्हणतात."

- frequency polygons are also a good choice for displaying cumulative frequency distribution.

1. Bar or Pillar or Coloum :

- Representation of quantities by bars is the easiest and simplest types of diagrams.
- Bars shown by straight line or like pillar with uniform width.
- They may be vertical or horizontal and simple or Compound.

2. Blocks :

- Blocks may be either simple, giving two dimensional effect like rectangles and squares.
- They may be complex, producing three dimensional effect like cubical blocks - cylindrical, sphere, single etc.
- The volume of block is made commensurate to the quantity represented.

3. Star Diagrams -

- There is also known as direction diagram.
- The length of each ray is proportional to the quantity represented.
- Wind-rose provide common example of this type of diagram.
- The wind is calm may be shown by small circle in the centre.

4. Compound pyramid -

- Popl^n pyramid showing sex & age structure, growth and occupational structure are well familier.
- In the compound pyramids each tier may be sub-divided rural and urban population.
- Superimposed pyramid of popln - rural & urban, showing age and sex ratio may also be drawn.

5. Climography - 'G. Taylor'

- 'Climatological Diagrams' Koppen used the diagram to summrise variations in world climatic conditions.
- Interelation betⁿ three variables - Temprature, R. Humidity, monthly ~~rainfall~~.
- climograph showing only relative humidity and wet bulb temprature

6. Hythergraph - 'Griffith Taylor'

- These are also twelve sided fig. showing avarage monthly Temperature and rainfall conditions at a particular stations.
- The climatic character affecting the cultivation of crops like wheat, cotton, rice etc.

7. Ergograph -

- The graphical representation of statistical data to show relationship bet^n season, climate and crops.
- The cycle of plants growth closely corresponds to seasons.

8. Band graph -

- This is known as compound or aggregate line graph.
- It shows the trends of values in percentage or number or quantity in both the total and its parts by a series of lines drawns on the same frame vertical axis time and horizontal axis values.

9. Histogram - (~~आयामलेख~~)

'The ending class is stretched such that the height becomes lesser than that of previous group. such a diagram is known as a histogram'.

use c.f.

10. Ogive curve or Cumulative Frequency Curve -

'The class interval and c.f. are plotted on the graph against each other and a smooth curve drawn, this curve known as ogive or c.f. curve'. अर्थात् वारंवारिता के बजाए संचित वारंवारितेचा उपयोग. उक्त वक्र काढला जातो.

11. Isochrones - Spatial travel time diagram.

'These are lines showing placed located on equal travel time from a point'.

"दिलेली घटक निरीक्षणांचा वर्गीय क्रमाप्रकारे विस्कुरलेले आलेख, त्या घटकांचे निरीक्षणांचा वर्गीय क्रमाप्रकारे वितरण झालेले आहे त्या वितरणास वारंवारिता वितरण असे म्हणतात".

STUDY of FREQUENCY DISTRIBUTION AND CUMULATIVE FREQUENCY

Study of frequency Distribution :

"The summary table which arranges a large amount of information in a compact, systamatic form is known as frequency distribution".

- After collecting relevant statistical data, the process of classification is adopted and the data are presented in the form of frequency distribution.

Thus frequency distribution is simply a table in which data are grouped into different classes & the number of cases which fall in each class recorded.

* for example – The district of Karnataka have follwing percentage of employees to total population:

32.20, 48.15, 42.20, 36.10, 33.20, 39.70, 46.70, 43.05, 42.10, 40.10, 36.70, 42.40, 48.70, 41.10, 32.90, 39.90, 40.10, 39.70, 42.50.

Here the highest value is 48.70 & lowest value is 32.10 %.

- Talking a class interval of '2' the lengthy table can be tabulated in a much simple way where frequency can be shown –

% of workers to total popln	Tally mark	frequency
32-34	III	3
34-36	–	–
36-38	II	2
38-40	III	3
40-42	III	3
42-44	IIII	5
44-46	–	–
46-48	I	1
48-50	II	2

Cumulative Frequency -

"It is total number of observations less than or equal to a given value of the different classes."

* Whereas in the frequency distribution the frequencies shown against each class are those of the class only in cumulative frequency - The distribution of frequency of a particular class is obtained by adding to the frequency of that class all the frequencies of previous class.

adding frequency of first class & previous of all class.

So the cumulative frequency table is obtained from ordinary frequency table by adding the several frequencies.

- Obiviously the cumulative frequency of the last class is the sum of frequencies of all the classes.

* For Example -

% of worker's to total popln	frequency	cumulative frequency	~~पेक्षा कमी~~ ~~पेक्षा अधिक~~
32-34	3	3	19
34-36	-	3	16
36-38	2	5	16
38-40	3	8	14
40-42	3	11	11
42-44	5	16	8
44-46	-	16	3
46-48	1	17	3
48-50	2	19	2
	19		

"परिमाण वर्गापर्यंत वारंवारिता दुसऱ्या वर्गाच्या वारंवारितेत मिळविल्यात. ही बेरीज तिसऱ्या वर्गाच्या वारंवारितेत मिळवल्यात अशा रितीने मिळणाऱ्या वारंवारितेला संचयी वारंवारिता असे म्हणतात."

(I) पेक्षा कमी : वारंवारिता वरून खालती मिळवतात.

(II) पेक्षा अधिक : वारंवारिता खालून वर मिळवतात.

"The distribution which is to be analysed in various respects, needs such a value which can be taken as the base for the measurments. such a central value is known as the measure of location or central tendency."

Measure of Central Tendancy :

position of the point round which other observation.

"The statistical measure which gives an idea about the position of the point round which other observations cluster, is called measure of central Tendancy"

- The commonly used measure of central tendancy are: 1) Arithmatic mean or simple mean.
2) median.
3) mode.

1) Arithmatic mean - मध्य स्थाने कशाला म्हणतो?

'It is the sum of the values divided by their total number i.e. we obtain its value by adding together the sizes of all items & dividing this total by the number of items.

Formula - (i) Simple data -

$$\bar{X} = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{N}$$

OR $$\bar{X} = \frac{\Sigma x}{N}$$

सर्व घटकांच्या किमतींची बेरीज करून त्याला घटकांच्या संख्येने भागणे.

where, $\bar{X}$ = is the arithmatic mean
Σx = the sum of the values of all the variables.
N = number of observations.

(ii) Discrete Data -

If the numbers $x_1, x_2, x_3 \cdots$ occurs with frequencies $f_1, f_2, f_3 \cdots$ etc arithmatic mean given by:

$$\bar{X} = \frac{f_1 x_1 + f_2 x_2 + f_3 x_3 + \cdots + f_n x_n}{f_1 + f_2 + f_3 + \cdots + f_n} = \frac{\Sigma fx}{\Sigma f}$$

OR $$\bar{X} = \frac{\Sigma fx}{N}$$

उपयोग : दररोजचे व्यवहार उत्पादन, दर्जेदार उत्पादन, गर्दीव्यवस्थापन, कार्यक्षमता वाढवणे, मार्केटिंग उत्पन्न, मार्केट सर्व्हे etc

- Arithmatic mean is used computing the variance & standerd deviation of sample.

where,

$\bar{x}$ = arithmatic mean.

Σfx = is the total values of all the variables.

N = number of observations.

(iii) Continious Data -

$$\bar{x} = A + \left(\frac{\Sigma fu}{N}\right) \times c$$

where,

$\bar{x}$ = is the arithmatic mean

A = is the assumed value

Σfu = is the sum of the frequencies.

N = is the total frequency.

c = is the class interval.

(i) Median (मध्यमा) = $\frac{N+1}{2}$ - दिलेल्या आकडेवारीचे दोन भाग पाडते.

(ii) Quartiles (चतुर्थके) = $\left(\frac{N+1}{4}\right)$ - दिलेल्या आकडेवारीचे चार भाग पाडते.

(iii) Decciles (दशमके) = $\left(\frac{N+1}{10}\right)$ - दिलेल्या आकडेवारीचे दहा भाग पाडते.

(iv) Percentiles (शतमके) = $\left(\frac{N+1}{100}\right)$ - दिलेल्या आकडेवारीचे शंभर भाग पाडते.

Geometric mean: To use depict the growth of population in a country.

- मध्यकाचे विभाग हा असा काढितु जाते की, ज्याचे खालची 50% आणि वर 50% प्राप्तांक येतात.

① "It is that value of variate which lies mid-way

2) Median - when the variates are arrayed in order of magnitude."

(Singles divided into two equal parts)

② "The median is that value of the variables which divides the group in two equal parts, one part comprising all values greater and the other all values less than median".

③ "It is defined as a point not a score". - Gilford

Example: find the median of 88, 72, 83, 29, 80, 86, 48, 75, 69.

Solution: Arranging the given number in ascending order we get 29, 33, 48, 69, 72, 75, 80, 86, 88.

The median is the middle term i.e. 72

① Simple frequency Distribution -

first of all calculate the cumulative frequency corresponding to each value of variables. The value of the variable corresponding to be the

~~c.f. $\bar{x} = \frac{N+1}{2}$ if N is odd, and~~

~~if, N is odd~~

$\bar{x} = \frac{N}{2}$ if N is even is the median

where, N is total number of frequency.

(ii) Grouped frequency Distribution -

The cumulative frequency corresponding to each class boundry is the first calculated. The median is given by formula -

$$\bar{x} = L_1 + \left(\frac{N/2 - (\Sigma f)_1}{f \text{ median}}\right) \times c$$

where, $\bar{x}$ = median

L_1 = Lower class boundry of middle class.

N = number of atoms.

c = size of class interval.

f (med.) = frequency of median class.

(Σf) = Sum of the frequency of all classes lower

'In the grouped data the class having the maximum frequency is known as the modal class'.

3) **Mode**: Mode is that value of the variable which occurs most frequently and so with the maximum frequency. - যে মান সবচেয়ে বেশি বার পুনরাবৃত্তি করে তাকে mode বলে।

(i) **Individual series** -

When the series or observations are of individual nature, the mode can be located merely by inspection.

'The frequency which occurs maximum time, is the mode'.

* For example- 5, 7, 7, 7, 9, 8, 4, 7, 6, 10, 8, 6, 8.

where re-arranged - 4, 5, 6, 7, 7, 7, 7, 8, 8, 8, 9, 10

M = 7 because it occurs for or maximum number of times.

(ii) **Discrete series** -

Mode is located by using the method of grouping and thus is found at the point of maximum concentration.

So the cumulative frequency table is obtained from the ordinary frequency table by successively adding the several frequencies.

Obviously c.f. of the last class is the sum of frequency of all classes.

(iii) **Continious series** -

Two steps are followed in this case. First, the process of grouping is followed and by analysis table, the class group is located in which mode is located.

Then, the method of interpolation is applied to know the exact value of mode.

formula for interpolation mode is :

$$Mo = L + \left(\frac{(f_1 - f_0)}{(2f_1) - f_0 - f_2)} \right) \times h$$

where, m_o = mode

L = is the lower limit of the class.

f_1 = maximum frequency.

f_0 = frequency of preciding class.

f_2 = frequency of succeding class.

- At any station the avarage number of occurrence of fog, thunderstorms, or days with snowfall, wind direction etc. are most realistic in modal values.

In summary...

① mean is calculated by exact and fixed formula whereas median & mode are only approximate values.

② The mean values has advantages taking into consideration where as other not considerd.

③ This mean can be advantageously utilized due to mathematical property but the median & mode, Q.D. have disadvantage in this respect.

SELECTION OF CLASS INTERVAL FOR MAPPING

Class Interval :

'Upper class limit - Lower class limit.

The methods used for selecting class intervals would differ from the one in case of steadily increasing variable to increasing by leaps.

Some methods used for selecting class intervals -

a) Arithmatic Process -

It is sequence of numbers which increase or decrease by the same number/amount.

e.g. - 50, 100, 150, 200 or 25, 20, 15, 10, 5.

Then according to this method, every class has the same class-interval.

for example -

A state has 23 districts, The highest net irrigated area has 85.10 % and lowest value is 6.38.

The range is :

85.10 - 6.38 = 78.72 following six groups can be easily formed.

	Net irrigated area as % of net sown area.
① Low irrigation	5 - 20
② Low mediam irrigation	20 - 35
③ medium irrigation	35 - 50
④ High medium irrigation	50 - 65
⑤ High irrigation	65 - 80
⑥ very High irrigation	80 - 95

b) Geometric Progression:

'It is a sequence of numbers in which the ratio of each number of proceeding one does not alter'.

For example -

In a sequence showing the geometric progression as, 25, 50, 100, 200, 400.

This method is used when the range is very high. e.g - As per 1991 census density of popl^n in Jaisalmair & Calcutta district was 9 & 23, 699 person per sq. km. respectively.

LORENZ CURVE -

Max-O-Lorenz (1905)

'Lorenz curve is a graphical method of studying dispersion'.

* Use: (i) This curved is used to study the distribution of profits, wages, turnover etc.
(ii) The study of the degree of inequality in the distribution of income or wealth between two period of time.

* The technique of drawing the curve is as follows:

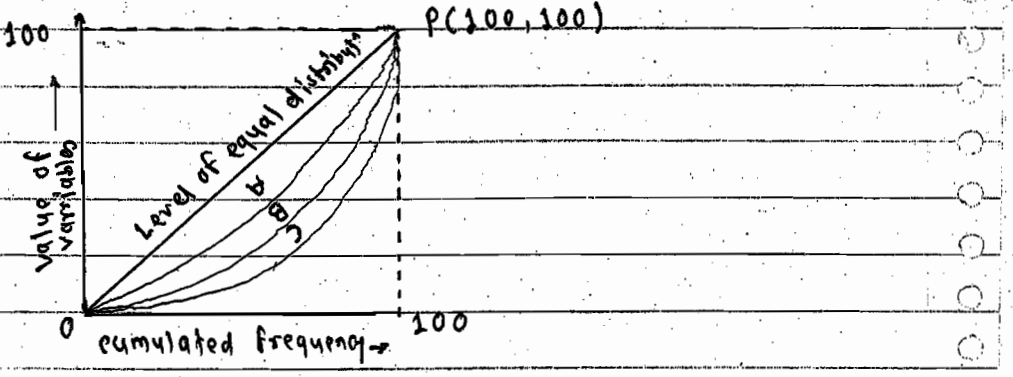
1) The size of the item (variable value) & the frequencies are both cumulated.

2) Along 'x-axis' represent frequencies (x) and along 'y-axis' represent values of variables (y).

3) Draw the diagonal line $y=x$ joining the origin $O(0,0)$ with the point $P(100,100)$.

4) The line OP makes an angle of 45° with x-axis and is called the line of equal distribution.

5) Plot the percentage of values and frequencies for given distribution & join these with smooth freehand.



For any given distribution the curve will never cross the line of equal distribution.

Methods of Measuring Association Among Different Attributes :

relationship betn surrounding phenomena & environment.

There always seems to be a relationship betn a phenomena and the enviorment surrounding it. Eg: Agricultural productivity depends on rainfall, quality of seeds, fertilizers, pesticides, goverment policies, demand & some other factors.

"The measurment of the nature and degree of relationship betn variables is called correlation and that between attributes is called association."

simple correlationship depict the relationship betn two varriables. for example - If we say agricultural productivity depends on irrigation. Then agricultural productivity is said to be the dependent variable and irrigation is said to be the independant variable. 'Correlation may be positive or negative.'

depen. vari. dependent on irrigation.

- **classification according to Attributes :**

classification according to attributes is of two types - simple & manifold.

(a) **simple classification -**

A given popln is divided in to two parts, the one part showing presence & the other showing absence of the attributes.

(i) **Presence -** The presence attributes showing Roman Capital letters A, B, C, D etc. and is termed positive attributes.

(ii) **Absence -** The Greek letters α (alpha), β (Beta), γ (gamma) etc. are used to represent absence of attributes and termed negative attributes.

(iii) Manifold Classification :

There are a number of attributes or more than two classes and subclasses.
for e.g - Profession teaching, buisness, service, agriculture.

* Types of Association :

There can be three kinds of association bet^n attributes - Positive association, negative association and independence.

(i) Independent -

If the actual observation is equal to the expectation, the attributes said to be independent.

(ii) Positive association -

If actual observation is more than the expectation the attribute are positive association.

(iii) Negative association -

If actual observation is lower than the expectation the attributes are -ve' association.

- દોન પ્રકાર સંબંધ અને ગુણધર્મમાં પારસ્પરિક સાહચર્ય (Association) એને કહેવાય.
- ગુણધર્મ (Attribute) એવા દા પરિભાષિક શબ્દ વાપરવામાં, એવા સ્થળે આવા ગુણધર્મ કે જે માપવા જેવા નહી પણ વિશેષતા દર્શાવે છે: કે નહી તે નિશ્ચિતપણે કહેવા જોઈ.
દા.ત. સ્ત્રી-પુરુષ, સાક્ષર-નિરક્ષર, વિવાહિત - અવિવાહિત, સદોષ-નિર્દોષ વગેરે.

'દોન પ્રકારોમાં સંબંધમાં કિંવા પરસ્પરાવલંબનમાં સાહચર્ય કહેવાય. તેજ દોન લક્ષણોમાં સંબંધમાં કિંવા પરસ્પરાવલંબનમાં સાહચર્ય (Association) કહેવાય.
દા.ત. કારકુનો પેદા ન થવા વાપરવું.

* Youle's Coefficent of Association :

$$Q = \frac{D - S}{D + S}$$

where, D = દોન્હી લક્ષણો અસ્તિત્વમાં હોય એવા X દોન્હી લક્ષણો અસ્તિત્વમાં ન હોય એવા
S = પહેલું લક્ષણ અસ્તિત્વમાં હોય અને બીજું લક્ષણ અસ્તિત્વમાં ન હોય એવા X બીજું લક્ષણ અસ્તિત્વમાં હોય અને પહેલું લક્ષણ અસ્તિત્વમાં ન હોય એવા.

* Measures of Dispersion and Concentration:

Def^n – "The degree to which numerical data tend to spread about an avarage value is called as Variation or Dispersion of data".

With the help of these values the distance of the varities from the central value are assessed generally there are two types of measure of dispersion:

(i) Absolute – which assumes the units of the distribution.

(ii) Relative – which is numerical expression having no-unit.

1) Absolute measures of Dispersion –

(a) Range – "It is the simplest measure of dispersion. It is the difference betn the biggest value and the smallest value of the items of the distribution".

For example – To

To express the general condition prevaling at a station weather being recorded. The range may be daily monthly & annual.

Range = $X_{max} - X_{min}$

= 83 − 20 = 63 ✓

'सर्वात मोठी किंमत व सर्वात लहान किंमत यांच्यातील फरकाला विस्तार म्हणतात'.

Coefficent of Range = $\frac{X_{max} - X_{min}}{X_{max} + X_{min}}$

(b) Mean Deviation –

'It is the mean of the departure of varient from the central value taking all positive value'.

$$M.D = \frac{|X_1 - \bar{X}| + (X_2 - \bar{X}) + (X_i - \bar{X}) + \cdots + (X_n - \bar{X})}{N}$$

प्रत्येक घटकाच्या किंमतीच्या सांख्यिकीय मध्यापासूनच्या विशेष अंतरांच्या बेरजेला घटकांच्या संख्येने भागले असता येणाऱ्या सरासरी विचलन (M.D) असे म्हणतात.

$$M.D = \frac{\sum_{i=1}^{n} |(x_i - \bar{x})|}{N} \quad \text{or} \quad \frac{\sum |dx|}{N}$$

where, M.D = mean Deviation

$\bar{x}$ = is the mean value

x_i = is the ith value.

x_n = is the nth value.

N = is total number of observations.

(c) Quartile Deviation –

It is given by

$$Q.D = \frac{Q_3 - Q_1}{2}$$

where, Q.D = Quartile Deviation.

Q_1 & Q_3 = have their usual meanings.

'यहिले 25% घरहु व दोवरहे 25% घरक हो उक्त मध्यमा 50% घरकोया विकास दोतना व मध्यमा दोनहे आयतान. यादि Q.D. कुहे हिसाब.'

2) Relative Measure of Dispersion –

'There are the measures expressed in terms of ratio, percentage and coefficents and are widely used in geographical studies.

It can be used in the cases where percentage departure from the rainfall or say percentage variation in production, etc. are required.

Land use, demographic structure.

- In order to obtain coefficent, the difference of two quartiles is divided by the sum of the two quartiles.

$$\text{Coefficent of Q.D.} = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

- The more frequently used co-efficient of variation, correlation, regression etc.

' खरकांच्या किंमतीचे गणितमध्यापासून सरासरी काढून त्या फरकांच्या वर्गांची बेरीज करणे व त्या बेरजेस खरकांच्या संख्येने भागून, भागाकाराच्या वर्गमुळाला प्रमाण विचलन असे म्हणतात.

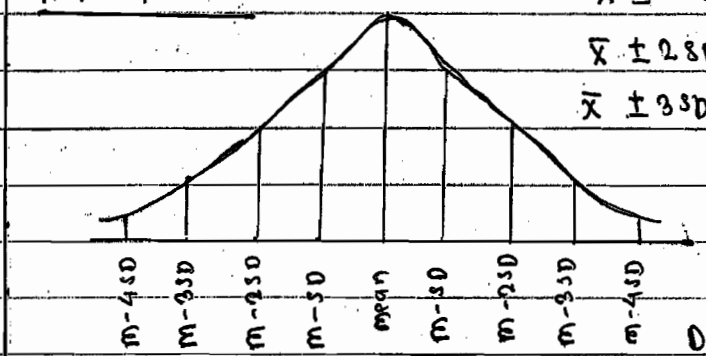
- प्रमाण विचलन (SD) म्हणजे विस्तृत कमी व प्रमाण विचलन अधिक म्हणजे ~~विकलन अधिक असे म्हणता येईल~~.

Standard Deviation :

"In this we first find out the sum of the squares of the deviations from the mean and then divide it by the number of observation. The resultant is called the variance and its positive square root is defined as the standard Deviation".

- S.D is measure of dispersion value in the data set.
- The normal curve which is very widely used in statistics, has some very important properties which are follows :-

normal curve



$\bar{x} \pm$ S.D covers 68.27% observatn.
$\bar{x} \pm 2$SD covers 95.45% observatn.
$\bar{x} \pm 3$SD covers 99.73% observatn.

Deviation from mean are '-ve' as well as 'tve' such that summetion becomes zero.

(i) In a normal distribution, the values of the mean, the median & mode are identical.

(ii) The curve is symmetrically distributed around the value of the $\bar{x}$.

(iii) In a normal observations, a large proportionat of observations are concentrated around the mean.

(iv) The two tails of the normal curve while approching the x-axis never meet it i.e. they are asymptotic to the x-axis.

For ungrouped data,

$$\text{Standard Deviation } (\sigma) = \sqrt{\frac{\Sigma (x-\bar{x})^2}{N}}$$

- This value helps in ascertaining the distance of a particular variate from mean in terms of S.D.
- It most frequently used in the studies of the functional classificatn

skewness = $3(\bar{x} - \text{median})$

Coefficient of Variation :-

'It can be defined as the standard Deviation expressed as the percentage of arithmetic mean.'

In these case, we take the help of some relative measures of dispersion. The most commonly used measure of relative dispersion is coefficient of variation (c.v.) which can be given by -

$$C.V = \frac{S.D}{\text{mean}} \times 100 \quad \text{or} \quad C.V = \frac{\sigma}{\bar{x}} \times 100 \text{ or } = \frac{s}{\bar{x}}(100)$$

- In any distribution it is the ratio of the s.d. (σ) and mean ($\bar{x}$), expressed as percentage, and has no unit.
- Higher the co-efficient of variation, more scattered is the nature of distribution.

- पुमाणा विचलनाने सामग्रीतील किंमती साधारणमानापासून (mean) किती दूर आहेत, त्या किंमतीत किती विषमता (variability) आहे हे मोजता आले तरी दोन वारंवारिता वितरणांची तुलना करताना त्याचा उपयोग होत नाही.
- तुलनेसाठी पुमाण विचलनावरून विचलनाचा शेकडा दाखवतात.
- विषमतांचा शेकडा (c.v.) म्हणजे पुमाणविचलनाचे (S.D.) गणितमध्यापेक्षा (mean) शेकडा पुमाण.

$$\text{विषमतांचा शेकडा (c.v)} = \frac{\text{पुमाण विचलन (SD)}}{\text{गणितमध्य (mean)}} \times 100$$

(1) विषमतांचा शेकडा (c.v) अधिक म्हणजे विषमता (variability) अधिक व विषमतांचा शेकडा कमी म्हणजे विषमता कमी.

(2) दोन वितरणांतील विषमतांची तुलना करण्यासाठी विषमतांचा शेकडा उपयोगात आणतात.

June 05

'Correlation means the dependance of one variable over the other i.e. how two or more phenomena are related'.

- 'दोन किंवा अधिक चलांमधले असणाऱ्या सहसंबंधाचे अस्तित्व ठरविणे, त्याची दिशा ठरविणे व त्याचे सामर्थ्य कळणे म्हणजे सहसंबंध (correlation) होय.

Coefficient of correlation :

A causal relationship between the two characteristics exists. when one of them may logically be considered as the cause of other.

The factor which is supposed to be the cause is known as the independent variable and the one which is supposed to be the effect is known as the dependent variable.

① +ve correlation - If an increase in the independent variable also tends to cause an increase in the dependent variable, the correlation said to be positive.

for example - irrigation & fertilizers are positively correlated.

② -ve correlation - On the other hand, if an increase in the value of the dependent variable the correlation said to be negative.

for example - Urban employment & poverty. As the urban employment decreases, poverty is bound to increases with it.

Measurment of Linear correlation - 'Karl Pearson's'

'Karl Pearson' has suggested a more precise quantitative measurment of the degree and direction of linear correlation.

According to him Correlation coefficient 'r' will be...

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

- Properties of 'r' as follows -

① If the sign of r is positive the variable 'x' and 'y' are positively related and

if the sign of 'r' is -ve, they are negatively correlated.

(ii) The value of 'r' varies bet" -1 to +1. The value of +1 or -1 indicates a perfect positive or perfect negative correlation.

As the extent of correlation decreases the value of 'r' approches zero.

- If it nearer to -1 it is said to bear perfect -ve correlation, if nearer to +1, a perfect positive correlation. and if it is '0', then there is no correlation.

- कार्ल पिअरसनने सुचविलेला सहसंबंध शोधण्या हा सहसंबंधाचा correlation अभ्यास करण्यासाठी सर्वात अधिक उपयोगात आणला जातो.
- या पद्धतीने सहसंबंध काढण्यासाठ हात मोजणे येणे.
- या मध्येच्या चिन्हावरुन सहसंबंध हा आहे की नाही हे समजते, व किमतीवरुन हा आहे की कमी ते समजते.

- कार्ल पिअरसनचा सहसंबंध गुणांक -

$$r = \frac{(\Sigma xy) \text{ या गुणाकाराची बेरीज}}{\sqrt{(\Sigma x^2) \text{ वेरीज} \times (\Sigma y^2) \text{ वेरीज}}} \quad \text{or} \quad r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times y^2}}$$

- r ची किमत येणारी +1 व -1 च्या मध्ये असणे.
जर, $r = \pm 1$ असेल तर चलांत पूर्ण हा सहसंबंध असतो, व
जर, $r = -1$ असेल तर चलांत पूर्ण नाही सहसंबंध असतो.
जर $r = 0$ असेल तर चलांत कोणताही सहसंबंध नसतो.

- Purpose/use — सहसंबंधाचा अभ्यास करणे कोणासाठी आवश्यक आहे.

उदाहरण: मुलांची उंची व वजन, लोकांचे वय व रक्तदाब, उत्पन्न व आत्महत्या, उत्पन्न व गुन्हेगारी अशा विविधांची कमी अधिक प्रमाणात सहसंबंध आढळतो.

weight height employment criminal
Example

REGRESSION

'To examine the relationship betⁿ one dependent & one independent variable'.

"The average relationship between two or more variables in terms of the original units of the data".

re: 2 or more variables

- In regression there are two types of variables.

① Dependent variable -

The variable whose value is influenced or is to predicted.

② Independent variable -

The variable which influences the values or is used for prediction.

Objective - Association betⁿ Dependent & Independent variable

* Lines of Regressions -

① Line of regression of 'y' on 'x' is the line which gives the best estimate for the value of 'y' for any specified values of 'x'.

② Similarly, line of regression of 'x' on 'y' is the line which gives the best estimate for the value of 'x' for any specified value of 'y'.

In any distribution the line of best fit is known as regression line.

* Regression Equations :

They help in estimating from a given value of one variable the average corresponding value of the other.

- There are two regression lines and there will be two regression equations x on y and y on x.

dep - dependent
weight - independent

Regression equation x on y -

$$x = a + by$$

Regression equation y on x -

$$y = a + bx$$

example : a medical researcher might want to use body weight (independent variables) to predict most appropriate does for a new

• **Applications :**

① Regression lines are being increasingly used in urban studies. e.g. popⁿ increase (dependent) also pollution increase (independent)

② It's use in physiographic analysis and industrial geography.

③ Isopleth maps of residuals from regression are prepared to give the pictures of deviations from the expected values.

④ The regression statistics can be used to predict the dependent variables, when the independents variable is known.

⑤ Significance of regression co-efficient in bivariate analysis is studied by using the 't' test'

* objective : Association betⁿ Dependent & Independent variable.

① - Yet another example r = +1 ② - Yet another example r = -1

③ - Yet another example r = + ④ - Yet another example r = -

⑤ - Yet another example r = + ⑥ - Yet another example r = -

⑦ - Yet another example r = 0

• **Scatter Diagram:**

'The diagram obtained by plotting any frequency distribution provided that the points remains independent, i.e. not joined together by any curve, no matter the points are congested or scattered unsymetrically.

- scatter group are essential for showing natural grouping.

• **Chisquare (χ^2) Method :**

'This test is based on the comparison of the differences betⁿ the observed results & the theoratical results given in the χ^2 test'.

Aa

SCALING TECHNIQUES

single element not reflect characteristic

It has been observed that no single variable is sufficient enough to reflect all the complex characteristics. So a composite picture from a large number of choosen variables has to be worked out, which is called 'Composite Index'.

But in such case the composite index are highly sensitive to the units of measurment of original variables.

For Example - To show statewise transport development.

(i) The number of railway stations per 100 sq.km.

(ii) The avarage capacity of the transaction in tonnes for a certain year.

variation in tonnage > stations

In this case the number of stations would be very small in comparision to the yearly tonnage per station. The variation in tonnage also expected to be much higher than the number of stations.

But the problem of this type of weightage is that the two variables have different scales of measurment. So it is necessary to eliminate the biasness of scale before evolving any system of weightage.

There are number of methods for scaling, which are:

a) Ranking score method - Spearman's

In this method we rank the observations and their rank become new variables. But in this method some points which can affect the results are as follows;

-'To find co-efficient correlation of two variables, the ascending or decending values of their observat" are arranged in their

i) The rank variable is discrete and has no dimension.

ii) The value of two consecutive ranks do not have an equal amount of difference in their original values.

iii) Mean, standard deviation and coefficient of variations of all the variables after ranking become equal.

iv) The larger the number of variables, the smaller will be the distortion in composite index due to ranking.

⑥ Weighted Score -

"The biasness of scale is eliminated the main problem remains infront of planners is to assign weights to them."

- The weight are generally two types:

1) Subjective weightage system -

ability of the person

is purely arbitary and depends upon the ability of the person to determine the weights. The advantages of this method is that it being the simple saves labours and expedits the work.

2) Mathematical weightage system -

It is minimizes the subjectivity. Here a system is evolved through theoritical framework of the problem and its mathematical logic.

Measurment of spatial Patterns of Distribution

spatial association & distribution

Nearest Neighbour Analysis : - clark & Evans

"It is most popular statistical analysis concerning spatial association and distribution." It was formerly introduced in by "P. Hertz" but its systematic used was initiated by "clark" and "Evans" two American plant ecologist.

* **Use** : ① It is a technique that enables geographers to to make simple objective comparision bet^n distributions ex-distributions of settlment.

② The analysis in values a comparision between the observed spacing of a set of points and the spacing that might be expected in a random distribution pattern.

* The formula is -

$$RN = 2d_o\sqrt{n/A}$$

where,

RN = is the nearest neighbour value.

d_o = is the mean distance (distance bet^n each point & its nearest neighbour).

n = is the total number of points in the pattern

A = is the area over which the points are distributed.

'out of the huge popln, if a limited selectn of items or cases is made, it is called sample'.
e.g. a limited selection of pebbles on the sea beach, will be sufficient making generlizatn abouth the pebbles on that coast.

Sampling Techniques for Geographical Analysis:

Samples - are devices for learning about large masses by observing few individuals.

Techniques of sampling -

'The methods of sampling which ensure better representation of the popln under different situations'.

Defn - "The method by which a sample is drawn out of a given popln are called Technique of sampling".

Method of Sampling:

① Simple Random Sampling -

It is a method of drawing the sample in which every member of the popln has equal chance of being selected in the sample. This method is useful only when the members of the popln are fairly homogeneous.

every member ↑ popln equal chance

② Areal Random Sampling -

Areal random sampling is slightly different from the ordinary random sampling. By using a random numbers, a set of points may be selected as random sample of all the points. The areas around the sample points may be considered as sample areas.

random no.'s set ↑ points.

③ Systematic Sampling -

- It is known as 'quasi-random', many times a random sample does not have the good coverage of the area of study. A systematic sampling selects the population at regular intervals.

for example - every 9th name of an electoral list, every 10th household, every alternate grid intersect - will yield the systematic sampling.

- A regular pattern of selection is made instead of choosing each individual, regardless

pre obj

selection ↓ regular intervals

④ Stratified Sampling -

When the popln is composed of highly varied observations, random sample may not work. for example -, for a family planning survey one has to select urban as well as rural household.

So a blanced representation may be ensured by dividing the popln into two sets of urban and rural households and then drawing a random sample of appropriate size from each set. This type of sampling is called stratified sampling.

- when the popln is heterogeneous with respect to variables under enquiry and can be divided in to relatively homogenous groups and subgroups a stratified sampling techniques can be adopted.

e.g: The popln of a village in to 10,000 and on the basis of income variables, it is divisible in to 10 groups.

- stratified random sampling is widely used in agricultural, industrial, and applied geographical researches.

⑤ Multistage Sampling:

- when the required sampling unit is reached through stages, it is called multistage sampling.

for example - If 1000 families are to be selected for a land tenancy or socio-economic survey for a meso or micro region.

* Applications of Sampling Techniques:

① Sampling techniques are of great utility for researches, dealing with the socio-economic problems of the society.

② These are working in the fields of evolution of landforms, climatology, hydrosphere etc.

save time, efforts and cost and give fairly reliable results.

④ These techniques have a significant role in the formulatⁿ of hypothesis, decision making, simulation and forecasting.

⑤ Sampling can save time and money, results have relatively faster speed, more accurate measurment etc.

ⓐ गणती पद्धत (Census method) -

'शाळीसमधील प्रत्येक घटकांकून व घटकांबाबत माहिती जमा करण्याच्या पद्धतीला 'गणती पद्धती' म्हणतात'.

उदा: ①महाराष्ट्रातील सर्व प्राथमिक शिक्षकांचा समूह.
② सर्व पाच लाख कोतमजुरांचा समूह.

ⓑ नमुना पद्धत (sampling method) -

'संपूर्ण शास्त्रीयेवजी जर शास्त्रीतील काही निवडक घटकांकून व घटकांबाबत माहिती जमा केली तर त्या पद्धतीला नमुना पद्धती म्हणतात'.

उदा: महाराष्ट्रातील प्राथमिक शिक्षकांपैकी काही प्राथमिक शिक्षकांचा नमुना घेणे.

उपयोग -
① नमुन्यावरून शास्त्रिघटकाचे अनुमान करणे.
② शास्त्रिघटकातले सहीक नमुन्यावरून तपासणे.

फायदे: ① वेळेची बचत ② खर्चाची बचत ③ अधिक अचूकता
④ माहितीची विश्वसनीयता अधिक असते.
⑤ काही बाबतीत गणती पद्धती अशक्य ठरते.

मर्यादा: ① पूर्वग्रह दूषितपणे लक्षात येत नाही.
② चुकीचे मोठे परिणाम होतात.
③ सामाजिक शास्त्रातील मर्यादित उपयोग.

तत्त्व: ① संख्याशास्त्रीय नियमितपणाचे तत्त्व (Regularity)
② मोठ्या संख्येचे नियमाचे तत्त्व (Large numbers)

number of units and equal chance

- या पद्धतीत कोणत्या घटकांचा समावेश नमुन्यात करावयाचा व कोणत्या घटकांचा करावयाचा नाही हे संशोधकाच्या मनावर अवलंबून नसते.
- प्रत्येक घटकांची नमुन्यात निवडले जाण्याची संभाव्यता समान राहते.

* पद्धती - ① लॉटरी पद्धत
② यादृच्छिक संख्या सारणी पद्धत.

- प्रत्येक घटकाची नमुन्यात निवड होते, संशोधकाच्या अभिवृत्तीचा परिणाम निवडीवर होत नाही.

2) Systematic Sampling : (व्यवस्थाबद्ध नमुना) – 'quasi random technique'

the point of interval

- निवड विशिष्ट नियमानुसार, क्रमांकानुसार व विशिष्ट अंतरानुसार होत असते.
- सर्व घटकांना क्रमांक देऊन पहिला घटक यादृच्छिकपणे निवडावा व त्यानंतर ठराविक अंतराने घटक निवडावेत.

उदा: रस्त्या कोपऱ्यांपैकी एक दवाखाना कोपऱ्यांची निवड करावयाची असल्यास 7, 17, 27, 37, 47, 57 असा क्रमांकाची निवड करावी.

- यादी अद्यय अक्षरानुसार तयार केली उपयुक्त ठरते.

3) Stratified Random Sampling : (स्तरित यादृच्छिक नमुना)

heterogeneous

- जेव्हा शहरी वेगवेगळ्या गटांत विभागलेली असते त्यावेळी साध्या यादृच्छिक निवडीमध्ये प्रत्येक गटास योग्य ते प्रतिनिधित्व मिळेलच असे सांगता येत नाही.
- जेव्हा शहरी बहुजिनसी (Heterogeneous) / स्तरात (strata) विभागलेली असते तेव्हा प्रत्येक ~~घटकांतील~~ स्तरांतील घटकांना योग्य प्रतिनिधित्व मिळविण्यासाठी.
- प्रत्येक स्तरांतील घटकांना त्या त्या वर्गातील घटकांच्या संख्येच्या प्रमाणात नमुन्यात प्रतिनिधित्व दिले जाते.

उदा: एका शिक्षणातील पदवीधर बेकारांचा अभ्यास – प्रथम स्त्री-पुरुष वेगवेगळे, त्यानंतर ग्रामीण-नागरी उपवर्ग, उपवर्गांची - कला, वाणिज्य, विज्ञान शाखांतील पदवीधर असे गट पाडता येतील.

- Representation of the Universe is best done by stratified random sampling.

- Sten-de-Geer's - diagram is used to represent rural and urban population.
- Rotameter - used for measuring distance on maps.
- Planimeter / ~~Photograph~~ - used for measuring areas on maps.
- Pantograph - used for reduction of maps.
- Ediograph - used for measuring volumes.

4) Multistage / cluster sampling : (बहुपदी / पुंजा पद्धती) -

- जर शहरी आकाराने मोठी असेल व विस्तृत भूप्रदेशावर विखुरलेली असेल तर बहुपदी नमुना पद्धती वापरली जाते.
- नमुना निवड अनेक स्थितीतून अनेक पायऱ्यांनी केली जाते.
- मूळ क्षेत्राचे लहान लहान भाग पाडून काही भाग निवडतात.
- दोनपेक्षा पायरीवर काही छोटी-छोटी क्षेत्रे किंवा पुंज निवडतात, स्तरण या पद्धतीला पुंज नमुना (cluster method) असे म्हणतात.

उदा : महाराष्ट्रातील प्राथमिक शिक्षकांच्या आर्थिक समस्यांचा अभ्यास.
प्रथम महाराष्ट्राची जिल्हावार विभागणी, काही जिल्हे निवडू, निवडलेल्या जिल्ह्यांची तालुक्यात विभागणी, काही तालुके निवडू, निवडलेल्या तालुक्यांची शेऽयांत व शहरात विभागणी, व त्यातील शहरे व शेऽयांची निवड करू.

5) Quata sampling -

In quota sampling, the popln is first segmented into mutually exclusive subgroups, just as in startified sampling.
- Then judgment is used to select the subjects or units from each segment based on a specified proportion.
e.g - an interviewer may be told to sample 200 females & 300 males betⁿ the age of 45 to 60.

Pressure - Barometer
wind - Anemometer
Temprature - Thermometer
Rainfall - Rainguage
Humidity -
visibility -
Cloudiness

- **Planimeter** - J. Amsler.

'It is a handy but delicate instrument used for the determinat of areas from maps'.

- **Theodolite** -

- Theodolite is an instrument used in surveying for measuring angular distances in both the verticle and horizantal planes.
- It is normally mounted on a tripod and must be levelled before use.
- It consits of telescope that can be rotated in both the horizantal and the verticle planes.
- It is extremely accurate and all readings are made by means of verniers or micrometers. ⇒ ① Adj. the line of collimation
- It is used for triangulation surveys. ② Adjustment of plate level.
③ Adj. of the horizantal axis
④ Adj. of the verticle axis.

- **Pantograph** -

An instrument used in map enlargment or reduction.

- **Clinometer** -

Measures angles and slopes on ground. It is based on the principle of a pendulum swinging across a graduated arc or of a sighting-tube with a spirit level and an adjustable verticle leaf marked with degrees above & below the horizantal.

- **Form Lines** - 'The interpolated contours'

A form line is a line drawn on a map where there is in sufficient information available to enable a contour to be construct.
- It is not instrumently surveyed and is intended merley to give an impression of the terrain.

- **Digital Mapping / Digital Cartography -**

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'This is the process by which a collection of data in compailed and formated into virtual image.

- The primary function of this technology is to produce maps that give accurate representations of a particular area, detailing major road arteries & other point of interests.
- It is found in Google Earth, the main use of these maps is with the G.P.S. system or GPS satellite networking.
- Digital mapping is fast, accurate & have the capability to used as input in GIS, GPS & IT based industry.

- **Computer Mapping:** computer mapping is used to convert paper or analogue map into digital map through the process of digitization, with the help of software Arc GIS, ERDAS, Map Info.

Dec. 05

Thematic Map:

'A thematic map is a type of map or chart especially designed to show a particular theme connected with a specific geographic area'.

- These maps: 'can portray physical, social, political, cultural, economic, sociological, agricultural or any other aspects of a city, region, nation or continents'.

*Purposes:

(i) They provide specific information about particular locations.
(ii) They provide general information about spatial pattern.
(iii) They can be used to compare pattern one two or more maps.

Example: maps of demographic data such as popln density.

LOREN'Z CURVE:

studying disparities in concentration

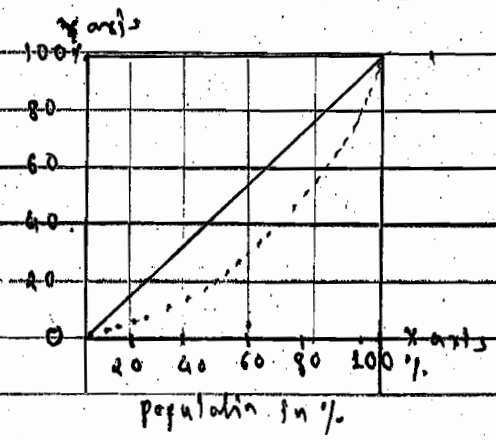
- काही थोड्या लोकांच्या हातात फार मोठ्या प्रमाणात संपत्ती, जमीन, सत्ता एकवटलेली असते. आर्थिक क्षेत्रातील या प्रकारचे असंतुलन अभ्यासण्यासाठी लॉरेंझ वक्राचा उपयोग होतो.
- लॉरेंझ वक्राने हे असंतुलन किती प्रमाणात आहे हे आलेख रूपाने समजते.

- **Drawing:**
  - (i) प्रथम घटकांच्या किमतींची व त्यांच्या वारंवारितेची संचित (Cumulative) मांडणी करतात.
  - (ii) नंतर घटकांच्या पुरेशा संचित किमतींची एकूण किमतीशी शेकडेवारी काढतात.
  - (iii) त्याचप्रमाणे संचित वारंवारितेची एकूण वारंवारितेशी शेकडेवारी काढतात.
  - (iv) घटकांची शेकडेवारी - X अक्षावर व वारंवारितेची शेकडेवारी - Y अक्षावर.
  - (v) हे बिंदू आलेख वक्राने जोडतात. यास लॉरेंझ वक्र असे म्हणतात.

- **Interpretation:**

- लॉरेंझ वक्र समान वितरण रेषेच्या जवळ असेल तर वितरणातील असमानता कमी व दूर असेल तर असमानता अधिक.
- सामान्यपणे लॉरेंझ वक्र समान वितरण रेषेच्या खाली असतो.

- **Importance/Use –**
  - (i) संपत्तीचे वितरण (ii) क्रयाचे वितरण
  - (iii) औद्योगिक उत्पादनाचे वितरण (iv) परीक्षा गुणांचे वितरण.
  - (v) आर्थिक व सामाजिक प्रश्नांचा अभ्यास करण्यासाठी.



- These methods are used for identifying regions with variation in levels of development.

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* Soil formation and composition :

- मृदेमध्ये आढळणारे विविध घटक - पाणी व हवा (25%), खनिज द्रव्ये (45%) & सेंद्रिय द्रव्ये - (5%)

- Chernozom soil - low quantity of minerals & Regur soil : High quantity of minrals.

- Def^n : "Soil may be defined as the thin surface layer of earth formed by the break layer of the earth formed by the breaking down of the rocks in various ways & by various purpose".

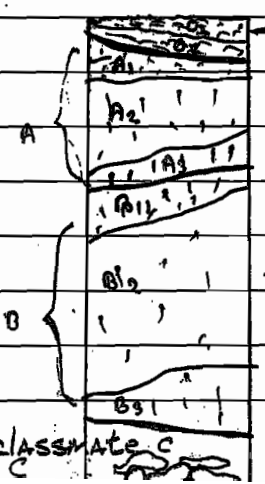
* Functions of the soil -

① वनस्पती बीज उगवण्यासाठी व वाढवण्यासाठी साधन मृदा.
② वाढत्या वनस्पतीस मृदा पोषणास आधार देते.
③ वनस्पतीच्या मुळांना पाणी पुरविणे.
④ N₂, Fe, Iorn असलेल्या खनिजद्रव्ये मृदा पुरविते.
⑤ असंख्य जिवांचा मृदा ही आवास (Habitat) आहे.

* factors of soil formation -

① Relief
② Climate
③ Parent Rock
④ Time
⑤ Biotic factors.

* Verticle Soil Profile :



- organic minerals
- Podolized horizon.

* Soil type ascending order of thickness A horizon :
① Chernozem soil
② Chestnut soil
③ Alluvial soil
④ Laterite soil.

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* Soil classification :

અ) પ્રાકૃતિક ગુણધર્મોનુસાર :
1) રંગ - કાળી, તાંબડી, રાખોડી, તપકિરી, પિવળી.
2) પોત - (i) વાલુકા (Sand) - 2 - 0.05 mm.
(ii) Silt : 0.05 - 0.002 mm.
(iii) clay : < 0.002 mm.

બ) રાસાયણિક ગુણધર્મોનુસાર
અ) (i) અમ્લધર્મી
(ii) આમ્લધર્મી
(iii) ક્ષારિય
(iv) અક્ષારિય
2) (i) પેડાલ્ફર - ઍલ્યુમીનો, ફેરસ. Aluminium & iorn oxide
(ii) પેડોકલ્સ - ચેરસ્નટ, ચેનોઝમ - carbonate.

ક) ઉત્પત્તિ પ્રદેશાનુસાર -
1) ક્ષરિત કટિબંધીય : (i) ટુંડ્રા (ii) લેટરાઈટ.
2) સમશીતોષ્ણ : (i) ચેનોઝમ (ii) ચેસ્ટનટ (iii) પ્રેઅરી
3) ગુણાકૃતિબંધીય : (i) લૅટેરાઇટ (ii) લાલ.
4) ઠંડા : (i) પર્વતીય (ii) ટિકાગ્રી (iii) calcareous.

ડ) નિર્મિતિનુસાર (સ્થાન) :
1) સ્થાનિક મૃદા
2) આંતર વિભાગીય મૃદા
3) અવિભાગીય મૃદા.

ઈ) નિર્મિતી કાલાનુસાર :
1) નવમૃદા (અવિકસીત)
2) પુનિમૃદા (વિકસીત)

• **Polypedon** –
'A soil column extending down from the surface to reach a lower limit in regolith or bedrock is known as polypedon'

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Clay < colloids < silt < sand.

Core and peripheri model – Theodore Shultz.

	Types of soil	pH values
i)	Agricultural soils	pH 8 – 8.5
ii)	Extremely Acidic soils	pH 5 – 8
iii)	Neutral Soils	pH 7
iv)	Extremely Alkaline soils	pH 4 – 4.5

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World soil classification:

a] Group 1 :

- Soils with well developed horizons or with fully weathered minerals.
- Resulting from long-continued adjustment to prevailing soil temprature & soil water conditions.

1) Oxisols -

- Very old highly weathered soils of low lattitude.
- subsurface horizone of accumulation of mineral oxides & very low base status.

2) Ultisols -

- Soils of equatorial, tropical & subtropical latitude zones.
- with a subsurface horizon of clay accumulation and low base status.

3) Vertisols -

- Soils of subtropical & tropical zones with high clay content & high base status.
- Vertisols develop deep, wide cracks when dry, & the soil blocks formed by cracking move with respect to each other.

4) Alfisols -

- soils of humid & subhumid climates with a subsurface horizon of clay accumulatn & high base status.
- Alfisols range from equatorial to subarctic latitude zones.

5) Spodosols -

- Soils of cold, moist climates, with a well developed B horizon of illuviatn & low base status.

6) Mollisols -

- Soils of semiarid & subhumid midlatitude grassland.
- with a dark, humus-rich epipedon & very high base status.

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7) Aridisols -
- soils of dry climates, low in organic matter.
- often having subsurface horizons of accumulation of carbonate minerals & soluble salts.

b] Group II:
'soils of a large proportion of organic matter'.
Histosols - soils with thick upper layer very rich in organic matter.

c] Group III:
soils with poorly developed horizons or no horizons, and capable of further mineral alteration.

⑨ Entisols -
soils lacking horizons usually because their parent material has accumulated only recently.

⑩ Inceptisols:
soils with weakly developed horizons, having minerals capable of further alteration by weathering process.

⑪ Andisols -
soils with weakly developed horizons, having a high proportion of glassy volcanic parent material produced by erupting volcanoes.