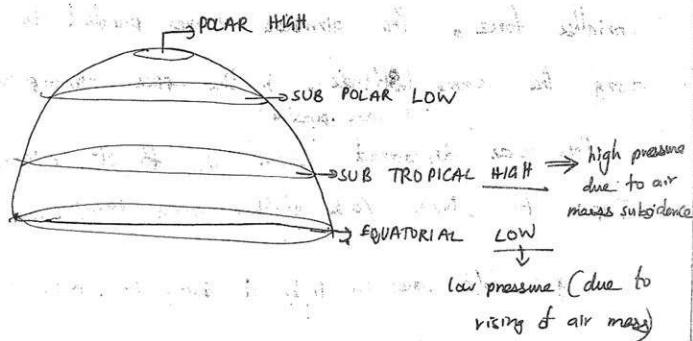


22/07/12

## CLIMATOLOGY

V.P. GATHAM, IAS  
① *Set Back*



Isobar  $\rightarrow$  Places having equal pressure

- Winds (air mass) moves from High Pressure areas to Low Pressure.
- Winds are perpendicular to isobars (cannot move to other side).

$\rightarrow$  Cyclone rotates anticlockwise in N'hemisphere. Why?

Coriolis force deflects winds to right - but ~~sometimes~~.  
 Pressure gradient acts in the opposite direction. When the  
 pressure gradient is ~~more~~ stronger than Coriolis, it  
 overcomes Coriolis and the winds rotate to the  
 left, in ANTICLOCKWISE DIRECTION. This rotation of  
 winds is CYCLONE  $\rightarrow$  CAN  $\Rightarrow$  Cyclone in Anticlockwise in North.

Jetstreams (Rossby waves or upper atmospheric or geostrophic wind)

When the pressure gradient is equal to the coriolis force, the air mass moves parallel to the isobars, along the same latitude, in the upper atmosphere  $\Rightarrow$  JETSTREAMS  
 $\Downarrow$  (same pressure)

This was discovered when US jets returned from Japan to New York after WWII atomic bombing.

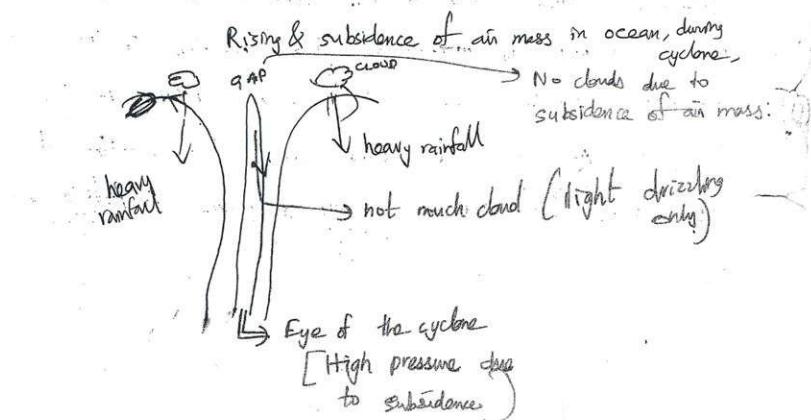
e.g. - Cold waves in N. Delhi during winter  $\Rightarrow$  due to jetstreams

$\Rightarrow$  Higher the temperature, lower the pressure.

In India, Why cyclones form during winter?

Cyclones are formed due to Low Pressure areas <sup>in seas</sup>. But only during winter (Oct-Nov), the sea (Bay of Bengal) has a higher temp than land. Because ~~sea~~ is cooled slower than land.

This higher temp in sea causes air mass to rise.



⇒ Frontal & Back portions of the cyclone <sup>(3)</sup> has causes very little RAINFALL.

→ The eye of the cyclone (centre portion) produces very little rainfall..

N.E. trade does not bring rainfall to certain EAST PARTS of continent due to presence of ~~water~~ land in the N.E. side.  
(eg:- W.Bengal (India) due to China, Somalia, Ethiopia (Africa) due to red sea).

### ENERGY SOURCE OF CYCLONE

Latent heat of evaporation provides the energy for rotation of cyclone. The cyclone never itself moves, it just rotates at the same position.

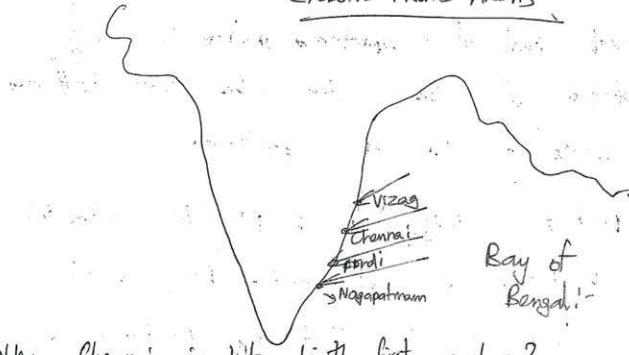
N.E. trade winds tend to push the cyclone in Bay of Bengal towards the east coast. But, the high pressure in land (due to cooled land) provides some resistance to the entry of cyclone. Anyhow, N.E. trade brings the cyclone to the coast. Once the cyclone reaches the coast, it loses its source of energy (latent heat of evaporation) as there is no moisture over land. It brings rainfall only by its frontal portion, since it breaks down after entering land. Sometimes, when the entire portion of cyclone manages to enter, we can experience absence of rain for some time due to eye of cyclone, i.e. b/w heavy & continuous showers <sup>frontal</sup>.

Tropical cyclones  $\Rightarrow$  carried by Trade winds  $0^{\circ} - 45^{\circ}$   
 Temperate cyclones  $\Rightarrow$  Carried by Westerlies  $45^{\circ} - 60^{\circ}$

$\Rightarrow$  In tropical areas, only EAST COAST gets rainfall. Why?

Tropical areas are influenced by TRADE WINDS. So, they cross the sea at the ~~are~~  $\Rightarrow$  carried towards EAST COAST.

### CYCLONE PRONE AREAS



Why Chennai is hit by the first cyclone?

Chennai is the most urbanized area on the east coast. So, it has highest temp. (due to anthropogenic heating) and hence has lowest pressure on east coast. So, the first cyclone attacks CHENNAI first.

### Orissa (1999 floods)

Orissa is on the east coast. But it is NOT usually affected by cyclone because N.E. trades

reaching Orissa are from land (NE India, China) ⑤

~~NOT~~ But in 1999, two to three cyclones had already brought rainfall to most of the east coast (Chennai, Vizag, Pondicherry, Nagapattinam) & hence most of the east coast was cool & hence high pressure. So, the cyclones, unable to reach these places took a trajectory towards Orissa. As it progressed, it gained high energy (due to vapourisation) and high speed and it produced DEVASTATING FLOODS IN ORISSA.

Tropical cyclones  $\Rightarrow$  heavy & continuous rainfall for 2-3 days, with a slight clear sky for 2-3 hrs  $\Rightarrow$  due to EYE.

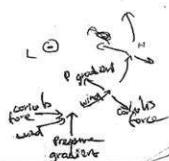
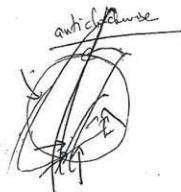
ROTATION OF CYCLONE  $\Rightarrow$  due to Coriolis & pressure gradient.  
anticyclonic in N Hemi (source of energy: latent heat of evaporation).

MOVEMENT OF CYCLONE  $\Rightarrow$  due to Trade winds.

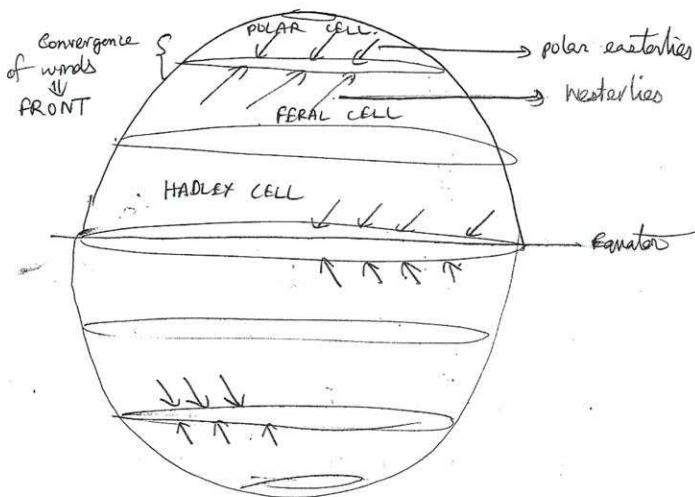
Low atmospheric pressure

area in sea  $\Rightarrow$  storm  $\Rightarrow$  cyclone  $\Rightarrow$  cyclone crosses coast.

Rotation of cyclone



## TEMPERATE CYCLONES



Climatological FRONT:  $\Rightarrow$  Convergence of winds!

Sub-polar & Equator are the two FRONTS

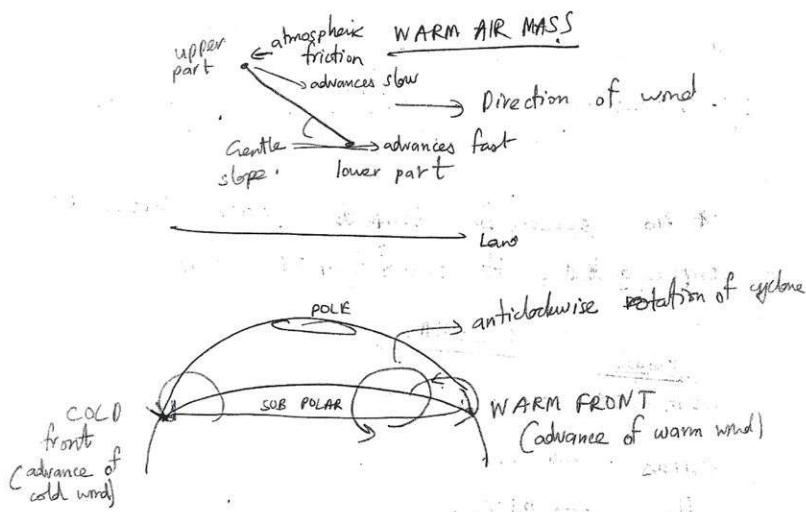
sub polar FRONT  $\Rightarrow$  convergence of WINDS  
of different nature [cold polar easterlies &  
warm NESTERLIES]

Some points of convergence have a higher  
temperature gradient (high diff-blw temp of warm &  
cold winds) than other places on the same sub-polar latitude.

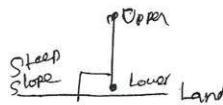
WARM AIR MASS  $\Rightarrow$  friction is ~~is~~ slightly above the land. ⑦

COLD AIR MASS:  $\Rightarrow$  it is close to land (due to heavier weight)

Warm air mass has a gentle slope. The upper part of warm wind faces friction of atmosphere but the lower part has no friction. So, the lower part advances slightly faster than the ~~upper~~ upper part.



COLD WIND  $\Rightarrow$  pretty close to the ground. So, it experiences no atmospheric friction. So, both upper & lower parts advance simultaneously.



### Advance of warm wind

Warm wind, being gentle, only slightly gentle rises the air mass as it advances. So, it produces only slight rainfall without much thunderstorm.

### Advance of cold wind

Cold wind, being steep, rapidly rises the air mass as it advances. So, it produces heavy rainfall, with HEAVY TURBULENCE & THUNDERFALL.

Every ~~far~~ TEMPERATE CYCLONE has both WARM & COLD WINDS. So, ~~tropical~~ cyclone has both light & heavy rainfall.  
↳ warm air mass      ↳ cold mass

\* No season for temperate cyclones. Whenever there's a temperature gradient, it produces temperate cyclones.

### CLOUDS

clouds  
cumulus → bulky, dark cloud.

cirrus → high and dry.

alto → middle.

stratus → layered. (at a low height).

nimbus → rainfall.

Clouds  $\Rightarrow$  semi-solid.

⑨

Clouds are hanging in the atmosphere by the force of rising air masses. When the cloud becomes too heavy, it pours down as rain.

### Cloudbursting

Intense cooling of land  $\rightarrow$  no rising air mass to hold the cloud  $\Rightarrow$  falls & bursts.

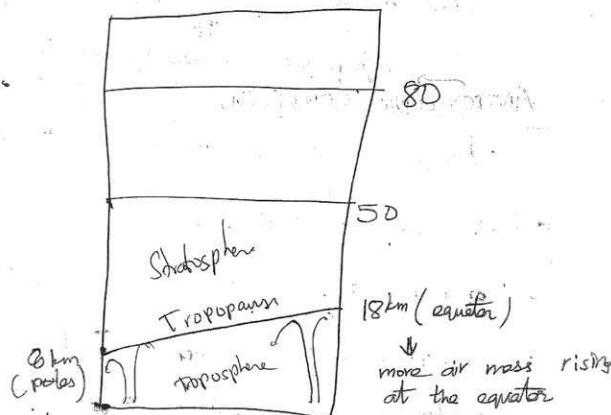
e.g.: Kullu, Himachal

### Hailstorm (Organic cooling) [in mountain]

Intense heating of land  $\rightarrow$  bulky heavy cloud  $\Rightarrow$  cannot dissolve into droplets  $\Rightarrow$  falls as due to bulk hailstorm.

TORNADO  $\rightarrow$  a cyclone that originates in land & flows

over land. (Texas, Oklahoma, Nebraska, Kansas, Nebraska)



→ In winter & night, more air mass subsidence <sup>in poles</sup> reduces the thickness of troposphere and stratosphere and ozone diffuses into troposphere. This causes irritation to nose (during inhaling), beyond a particular limit.



### Relative Humidity

→ 75%. rel. humidity implies the air mass holds 75%. water vapour & can take in 25% more water vapour.

### Absolute humidity:

gram weight of water vapour per Volume of air.  
→ varies for the same amt of water vapour, for contracted & expanded air.

### Specific humidity

weight of water vapour / weight of air.

→ a high pressure surrounded by several closely spaced low pressure ridges.

### ANTICYCLONIC CONDITION

- Places where the air mass SUBSIDES.

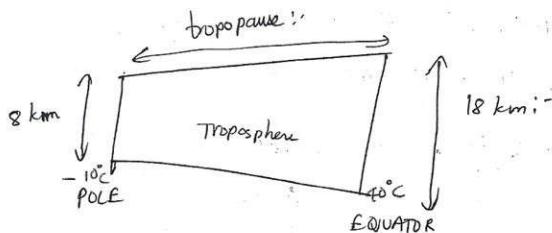
1. East coast of tropical cyclones:

2. Leeward sides of mountains in orographic rainfall.

3. Sub-tropical regions receiving rain from.

Anticyclone  $\Rightarrow$  rotates clockwise in northern direction.

→ As we move from equator to poles along tropopause, temperature increases. (11)



•  $-6^{\circ}\text{C} / 1\text{ km}$  decrease in temp., as we move up the troposphere.

• Thickness of troposphere at pole = 8 km.

$$\begin{aligned}\text{Temp. of tropopause at pole} &= -10^{\circ}\text{C} + (-6^{\circ}\text{C} \times 8) \\ &= -58^{\circ}\text{C}\end{aligned}$$

Thickness of troposphere in equator = 18 km.

$$\begin{aligned}\text{Temp. of tropopause} &= 40^{\circ}\text{C} + (-6^{\circ}\text{C} \times 18) \\ &= 40 + (-108) \\ &= -68^{\circ}\text{C};\end{aligned}$$

Temp. of equator is lower than at poles, in TROPOAUSE.

⇒ The thin troposphere in poles is the main reason why ozone holes are formed in the poles first.

The CFCs reach the stratosphere in the poles easily.

20/07/12

## GEOMORPHOLOGY

### Glacial landforms

- Movement of ice along with rocks & stones
- Ice itself is not an eroding agent.
- The rocks & stones carried by ice are potential erosion agents.
  - Abrasion → eroding, shearing, scratching the rocks
  - Plucking → freezing the cracks, dragging & separating individual blocks
- Glaciers are very powerful erosion agents.

#### Distribution.

e.g.: - Glacial erosion has created the Great Lakes of USA (Superior to Ontario), Great Bear to Winnipeg (Canada) and several lakes in Finland.

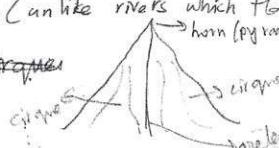
## EROSIONAL LANDFORMS

### U-shaped valleys

Glacier converts V-shaped valleys to U-shaped valleys for their smooth flow.

### Cirque (arm chair like topography):

As the glacier slides (unlike rivers which flow)  
it creates cirques.



### Arcades

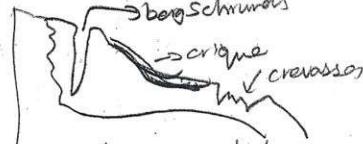
Cirques are formed all around the mountain. The gaps b/w cirques → Arcad.

## Pyramidal peaks or Horns

(13)

Cirques all around the mt - create peaks called

PYRAMIDAL PEAKS -



### Bergschrund

At the head of the glacier, ~~the~~ where it leaves the snowfield, a deep VERTICAL CRACK OPENS UP called BERGSCHRUND. These are major obstacles to climbers  $\downarrow$  very dangerous.

Hanging ~~waterfall~~ valleys  $\rightarrow$  After the ice ~~too~~ of a tributary valley is gone melts, its valley is called hanging valley :-

Waterfalls in summer. Frozen in winter to form a Hanging waterfall  $\rightarrow$  (tributary glacier):

### Nunatak:

A high peak surrounded by snow fields - look like a glacial ISLAND.

### Crag & tail topography

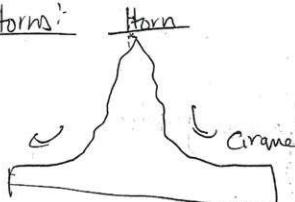
Glacier's upslope is steep & ~~so~~ downslope is gentle

paternoster lakes  $\rightarrow$  depressions at the base of cliffs.

### Roche moutonnée:



### Horns:



Depositional landforms (MORAINES)  $\Rightarrow$  Scratched rock particles that are imbibed in the glacier

When glacier melts, the rocks & sediments carried by it are deposited.

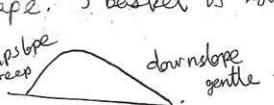
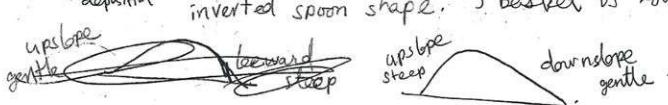
These depositional features of glacial till are ridge-like and called Moraines:-

Terminal moraines, (end moraines)  $\Rightarrow$  end of glacier

Lateral moraines

Medial moraines  $\Rightarrow$  b/w two glaciers

Drumlins:  $\rightarrow$  similar to (erosional ~~Ridge~~, ~~valley~~)  $\rightarrow$  deposition inverted spoon shape.  $\rightarrow$  basket of eggs topography



### Glacio-fluvial deposits:-

When glacier have melted

Boulder  $\rightarrow$  mixture of debris  $\Rightarrow$  rock, angular boulders - pebbles - clay, fine rock flour

Eskers:

long, narrow ridge of SAND & GRAVEL

at ground moraines. Roads are laid on Eskers

Outwash:

Water (from melted glacier) wash the terminal moraines & deposits to form a plain called OUTWASH

Kettles If the outwash plain has ~~windations~~ (ridges & depressions), the water stagnates forming a kettle lake

Actions of glacier  $\Rightarrow$  Quarrying, Plucking -

## Uses of Geomorphology (as a civil servant) (15)

- Construction of dams (by studying pattern of erosion)
- Town planning (by studying slope patterns) & Landscaping
- ~~Rail~~ Transport (structure of soil & rocks)
- Managing natural hazards (Predicting & adopting preventive measures of natural hazards)
- Wars (study of terrains of battlefield)
- To determine depth of mining & regions of minerals.

Earthquakes can't be prevented but managed:

### Pre-disaster mgmt.

- No dams in earthquake-prone areas
- Identifying earthquake-prone areas (convergent zones)
- Earthquake wave absorbing buildings
- No heavy materials for buildings
- Alternate transport means

### DISASTER MGMT.

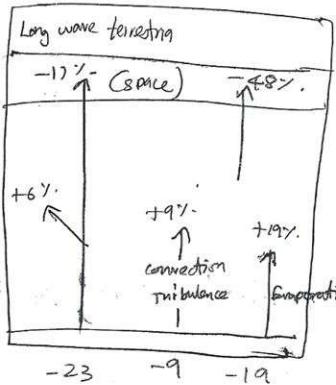
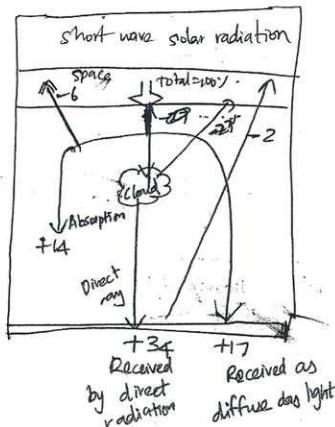
- Mock trials for earthquake mgmt
- Providing adequate training & instructing ppl
- Stock of food supplies, distribution to ppl by proper supply lines
- Resettlement & rehab areas
-

28/01/12

## Heat Budget of the Earth (15m open ended)

A delicate balance between the incoming short wave solar radiation and outgoing long wave terrestrial radiation.

### Vertical heat budget



### Vertical heat budget

### Operating mechanisms

Scattering, diffusion, direct radiation, absorption, cloud reflection, absorption by earth, absorption by atmosphere.

Horizontal Terrestrial reradiation, evaporation, convection, turbulence.

### Horizontal heat budget

Tropical & equator receives more insolation than the sub-polar & poles. This difference in heat is redistributed by rising air mass and winds. The winds redistribute

& satisfies horizontal heat budget (conduction, horizontal transfer of heat)  
Permanent or planetary winds

Don't miss up minute details (numeric data) reg. the absorption.

(17)

### SIGNIFICANCE OF HEAT BUDGET

- If there is no ~~delicate~~ <sup>horizontal</sup> heat budget, there surplus insolation at the tropics & <sup>equator</sup> poles result in increased temperature and deficit insolation at poles will continuously decrease the temperature.

It will result in complete ice-covered poles throughout the year & hotter climate in tropics throughout - The temp.

- The vertical heat budget of the earth is essential for keeping the overall avg. temperature of the earth constant. If it did not exist, the incoming solar radiation will continue to heat up the earth and earth will become progressively warmer making it unfit for the survival of any organism. All the living organisms owe their survival to the heat budget balance.

- The horizontal heat budget is one of the important causes for the change in seasons. The horizontal redistribution of heat is one of the main causes for change in seasons.

- There would be NO winds if a horizontal heat budget did not exist. Rising, subsiding, convergence & divergence of air mass is attributed

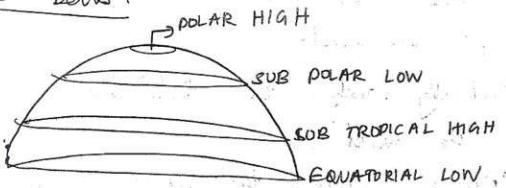
to Nature's redistribution mechanism & it tends to restore it to equilibrium. Thus ~~wind~~ movement of air mass horizontally along the land is essential for the main ~~cause~~ <sup>source</sup> of rainfall in several regions of the world.

- Ocean current movement is due to heat budget. The ocean currents move from warm areas to cold areas to maintain equilibrium of pressure.
- UV rays may enter the earth if there was no prevailing heat budget mechanism.

Heat budget is the main cause for air mass rising, condensation and cloud formation. It is the cause of rainfall.

But, this delicate balance of the earth is disturbed by anthropological activities such as greenhouse gas emission (which causes ozone depletion) and deforestation. If this harmful trend is not arrested at the earliest, it will result in destruction of

## → Pressure belts:



(19)

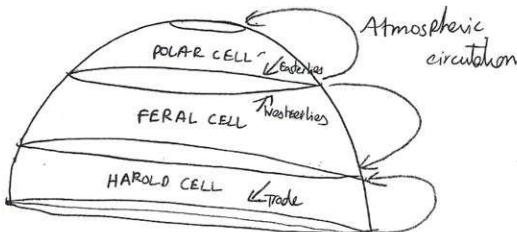
## Equatorial low

- $5^{\circ}\text{N}$  to  $5^{\circ}\text{S}$ .
- Doldrums → unstable
- ~~Source~~ of all rising air mass
- Low pressure
- Rising air mass → condenses → cloud formation
- Dense cloud, high temp, heavy rainfall.

- Discuss the basis for origin of pressure belts of the world.
- Critically analyse the distribution of pressure belts in the world.
- Critically evaluate the impact of pressure belts of the world.

# STABLE → ~~sinking~~ subsiding air mass (HIGH pressure)  
 UNSTABLE → rising air mass (LOW.)

- Discuss the origin of planetary winds / atmospheric circulation  
 or significance  
 / stable & unstable regions.



Planetary winds. → Trade, westerlies, easterlies.

### PRESSURE:-

The weight of a column of atmospheric air per unit area,  $\frac{\text{earth's atm. pressure}}{\text{1038 mb (millibars)}}$

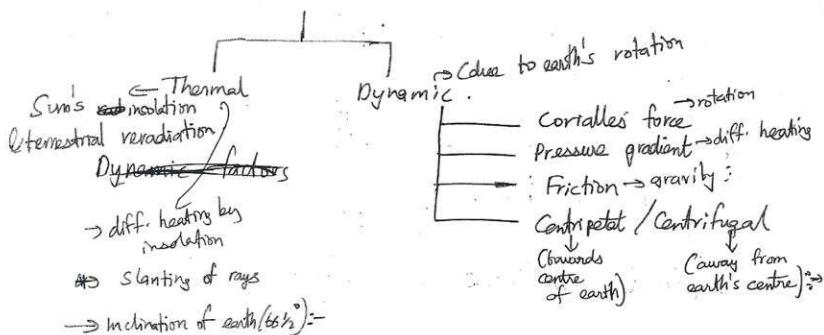
### Pressure belt

If the ~~pressure~~ atmospheric pressure is ~~homogeneous~~ widespread over a ~~particular~~ area, then it is called a pressure belt.

## → Factors of pressure belt

(21)

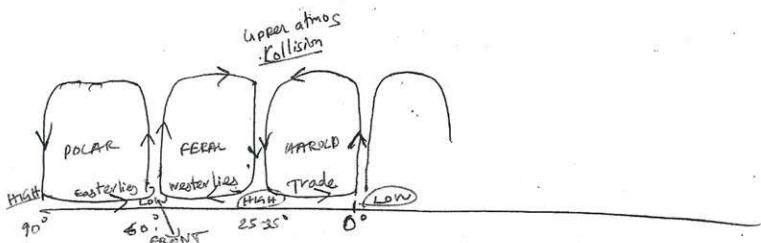
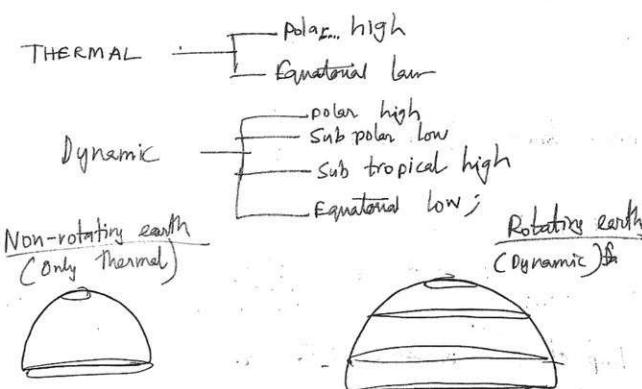
### Factors for pressure belts:



### ORIGIN OF PRESSURE BELTS

For each pressure belt Mechanism → 90% ; Description of pressure belt → 10% ;

⇒ Explain the origin  
In the mechanism, ~~mention~~ attributing factors (men. above)



### Conclusion

Thus, the simple pressure belt which would have been created by thermal effects alone has been made a bit more sophisticated by the effects & forces caused by rotation of earth. These varied pressure belts have resulted in various planetary winds.

→ Origin & significance of planetary winds:-

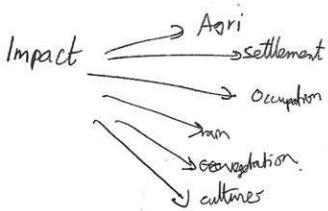
Same as pressure belts

Mention more about the ground level winds and the forces acting on them (coriolis, pressure grad, friction) :-

→ Upper atmos. circulation

Emphasise more on upper atmos.  
(centrifugal/petal, rising, subsidence)

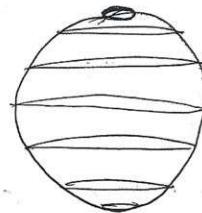
→ Impact of pressure belts ~~on~~



→ Critically analyse the distribution of pressure belts in the world.

(23)

- 7 pressure belts
- Due to subsidence & rise & winds



• Only equatorial pressure belt is contiguous.

#### SPATIAL VARIATION

- In the same hemisphere, there is huge difference in pressure due to land & ocean.

#### HEMISPHERE VARIATION

- Variation of pressure belts in N. & S. hemispheres

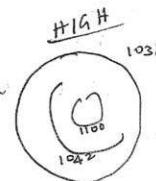
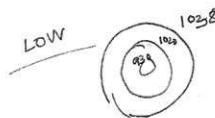
↓  
summer      ↓  
winter

#### SEASONAL VARIATION

##### SHIFTING OF PRESSURE BELTS

Summer solstice → northward shift of pressure belts

winter solstice → southward



## PLANETARY WINDS

Global horizontal movements of air mass in large scale.

### FACTORS

#### Non-rotating

→ perpendicular to isobars.

→ Don't write full mech. Start from convergence or divergence on the land.

### Origin of Trade winds

Distribution → map ↗

### Origin of westerlies

### Origin of eastlies

### Significance

Trade wind → rainfall decreases from west to east.

western side → Tropical desert.

- Navigation
- Wind movement → Ocean currents.
- Identifying regions of permanent planetary winds → windmills can be planted.

04/08/12

classmate

(25)

→ Atmospheric circulation:-

In both land windy & upper atmosphere windy.

→ TYPES, MODES & DISTRIBUTION OF PRECIPITATION

→ Precipitation:-

Anything which falls either in solid or liquid form after condensation.

Forms of precipitation:- 1) Rainfall, 2) snow, 3) hailstorms 4) Sleet  
5) Drizzle

Types of precipitation:- 1) Convective precipitation

2) Orographic ppt. 3) Frontal ppt.

Convective ppt. (Characteristics)

- 1) In high insolation regions.
- 2) high humidity
- 3) Afternoon rainfall
- 4) Association with season (increases in summer).
- 5) short duration rainfall, but heavy intense.
- 6) heavy turbulence, thunderstorms.
- 7) high cumulo nimbus cloud.

Orographic

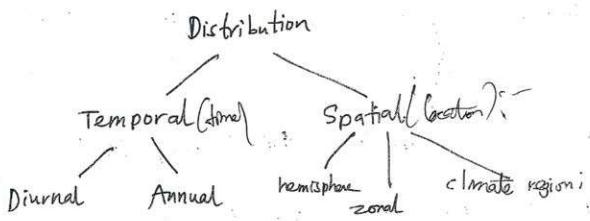
Airmass faces a mountain, ascends, cools adiabatically and condensation (cloud).

- 1) Increases with increasing height, starts decreasing after a certain height.
- 2) Cumulus cloud in windward side, nimbus or stratus cloud in leeward side.
- 3) More rainfall in windward side, less or no rainfall in leeward side.

4) Not associated with season.

Frontal cyclone  
or front → meeting pt. of air mass of opposite physical properties.  
Tropical → meeting pt. of air mass of same phys. properties.  
Frontal cyclone → meeting pt. of ~~warm & cold~~ air mass.

### Distribution



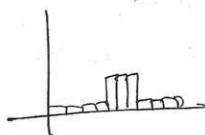
Though the world on an avg. receives same

### Annual

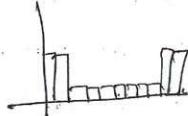
No variation  
(~~rainfall throughout~~ one year)



Summer rainfall  
(monsoon)



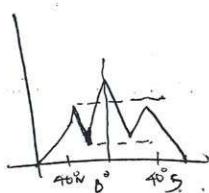
Winter rainfall  
(Mediterranean)



### Diurnal

Equator → only evening rainfall;

### Hemispherical



Variation in hemispherical Though avg. rainfall in both the hemispheres are same, it shows regional variance.

~~Subpolar~~ Subpolar → more rain in Northern than Southern Hemisphere  
Tropical → less rain in Northern than Southern Hemisphere

In the equator regions, northern hemisphere receives more rainfall than the S-hemisphere because the ITCZ (Inter Tropic Convergence zone) is in N-hemisphere for more time in a yr.

In the mid latitude, the rainfall in N-hemi is lesser than the S-hemi ~~because~~ but is compensated by higher sub-polar rainfall in N-hemi.  
But, in both hemispheres, rainfall decreases from equator to poles.

Both the hemispheres record almost the same avg. annual rainfall.

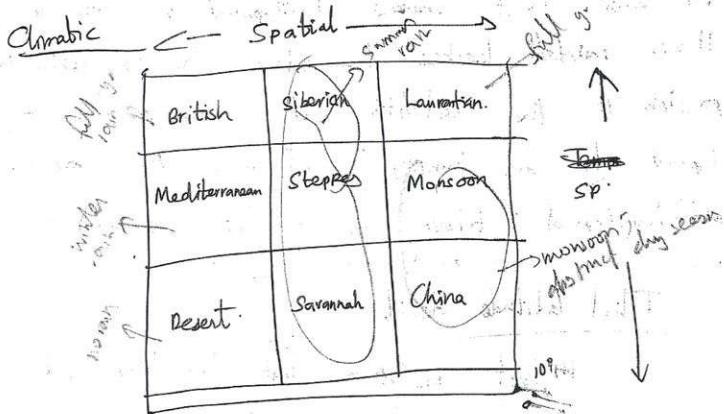
### Zonal

1) Zone of high rainfall  $\Rightarrow$  equatorial zone (mechanism).

2) Zone of moderate rainfall  $\Rightarrow$  temperate

3) Zone of no rainfall  $\Rightarrow$  tropical desert.

### Chronic



Precipitation distribution

15 m  $\Rightarrow$  draw only chequered board & explain both temporal & spatial with it.

60 m  $\Rightarrow$  Write as in note. Dist  $\begin{cases} \text{Temp} \\ \text{Spatial} \end{cases}$

Another way  $\Rightarrow$  draw climatological

$\rightarrow$  development of a region & its rainfall distribution goes hand in hand. Discuss.

The rainfall varies to a great extent in diff from one region to another, depending on its latitude, spatial & temporal distribution:-

Equatorial region:-

High insulation & high humidity causes daily heavy rainfall throughout the yr. Due to more sunlight & high rainfall, there is heavy dense vegetation with high trees. So, it is mostly dense forests.

The dense forest makes development of infra difficult.

Heavy rainfall leaches the soil. So, no agriculture possible in the lateritic soil. The ppl have to depend only on hunting & gathering. They are mostly underdeveloped tribes are in this region.

High prevalence of epidemic diseases reduces longevity.

Mid latitude desert

Highest insulation but dry trade winds

carrying little moisture. So, only dry and winds <sup>(29)</sup>  
& no or little rainfall. Makes vegetation impossible.

Only xerophytic plants. Pl. are mostly nomads  
moving from place to place for water & food, in search of  
oasis. No permanent source of income. The rugged  
conditions

#### ~~Mediterranean~~

#### Grasslands (Savannah, steppes)

Savannah grasslands  $\Rightarrow$  only summer rainfall.  
Some trees due to very little rainfall. Rainfall mostly  
supports grass. Wildlife sanctuaries of the world.  
All cat families. Wildlife rehabilitation makes human  
settlement difficult. During arid times, pop migrates  
to other regions.

Steppes  $\Rightarrow$  mid latitude ( $40^{\circ}$ - $50^{\circ}$ ). Moderate rainfall.  
Supports only grass - wheat, maize & corn. Large  
farm lands & ranches. ~~food factories~~ bread baskets of the world.  
Associated industries like cattle rearing, dairying,  
meat packing develop. Large farm-sector employment.

#### ~~Monsoon~~

#### Monsoon & China

Heavy summer rainfall. Assists Paddy cultivation  
during rainfall period. Rice producers of the world.  
Export of rice makes them develop.

### Mediterranean &

peculiar Only winter rainfall. Dry, warm summers & cool, moist winters. One of the most forest climates in the world. Conducive for long hours of work. Most scientific inventions from this climate as it allows long hours of till. Tourism related activities ~~even~~ form a good part of GDP.

### Sub-polar regions

Snowfall prevents cultivation. Mostly snow-covered. Ppl have to retire at homes for a major part of the year. So, no major economic activity during this passive period.

### British

Rainfall throughout the year allows extensive mechanised cultivation for most part of the year. Most of the ppl are farmers

### Rainfall in dpt.

- 1) vegetation
- 2) agriculture
- 3) weather & associated diseases
- 4) occupation
- 5) Wildlife
- 6) Tourism

Development & rainfall go hand in hand. Discuss : (3)

\* Not necessarily we have to support, we can also give divergent opinion.

\* What is development?

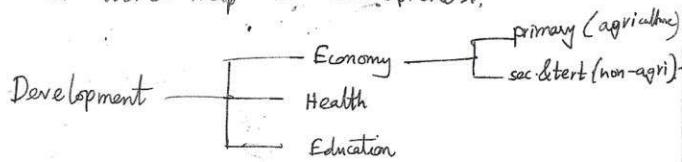
Is the statement a paradox?

|            |   | High rain             | Low rain |
|------------|---|-----------------------|----------|
| High depl. | China, U.S., Europe...<br>Kenya                 | W. Asia<br>Tamil Nadu |          |
| Low depl.  | Equator<br>Assam, Bihar countries.<br>Rajasthan | Saharan<br>countries. |          |

→ paradox:-

Draw a map for world dis of rainfall..

Draw a world map for development..



### Local winds

Microscale (limited geographical) movement of ~~wind~~ air mass. from one region to another, to balance the pressure difference.

1. Differential heating of land & water..

Sea breeze, Land breeze.

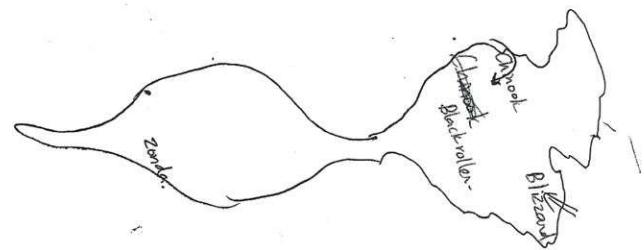
↓  
dry.  
& mechanism

↓  
dry.  
& mechanism

↓  
dry.  
& mechanism

2. Altitude difference  
→ mist formation; grape & tea cultivation..

Valley breeze →  
mountain breeze →  
↓  
dry.  
& mechanism



## Cold winds Local winds

(33)

1. Blizzard  $\Rightarrow$  snow bringing winds in Canada  
 $\downarrow$  (can cause intense cold  
cold, polar, snow blizzard)  
 $\rightarrow$  Montreal, Quebec, Dor, Hawa)
2. Chinook  $\Rightarrow$  ~~Rocky~~ rises & subsides in the Rockies.  
Once chinook subsides <sup>on leeward side</sup>, temp. increases and it melts the snow (Snow eater), thus favouring cultivation.
3. Black roller  $\Rightarrow$  in the Great plains of N America  
 $\downarrow$  Harmattan  $\rightarrow$  Harmattan
4. Santa Anna  $\rightarrow$  dry, warm wind  $\rightarrow$  Plains of USA
5. Papa gaya  $\Rightarrow$  Mexico...
6. Zonda  $\rightarrow$  Argentina:  $\rightarrow$  dry, warm wind!
7. Berg (mountain wind)  $\rightarrow$  Africa.
8. Harmattan (Doctor)  $\Rightarrow$  Ghana, Nigeria:  
 $\downarrow$  dry wind from desert <sup>strong</sup>; warm, dry, dust-laden winds.  
It reduces the high humidity in these equatorial regions  
bringing relief to this pol. So, it is called doctor.
9. Sirocco  $\Rightarrow$  from Sahara to Italy:-  
 $\rightarrow$  Picks up moisture from Mediterranean sea &  
brings blood red colour rainfall in Italy. damage to fruit crops.  
 $\hookrightarrow$  due to red sandy dust it carries from Sahara.
10. Foehn  $\Rightarrow$  Alps to Germany  
 $\rightarrow$  Chinook
11. Buran  $\Rightarrow$  from Siberia  
 $\downarrow$  blizzard.

12. Kara - barren  
 ↗ Kara sea  
 ↙ Harmattan
13. Loo  $\Rightarrow$  dust winds in N India  
 obstructs sight; blocks navigation.  
 blocks incoming sunlight, reduces temperature.  
 slight drizzle, all sand settles down.  
 reduces sugar yield of sugarcane ..
14. Nor'wester  $\Rightarrow$  Bengal region, New Zealand  
 ↗ Harmattan
15. Brick-fielder  $\Rightarrow$  Centre Australia.
16. Southerly buster  $\Rightarrow$  Australia :-
17. Mistral  $\Rightarrow$  severe cold wind  
 along Rhine & Rhone river -

Local winds  $\rightarrow$  Study from 'Sandna'

Sandna  
Refn:-

- ~~Sea breeze~~  
~~NW~~  
 1) Diff. heat of land & sea  
 2) Altitude difference:

Economic significance of each local wind:-

Map of distribution

Local winds :- open ended  $\Rightarrow$  Mechanism  $\Rightarrow$  50%  
 significance of local  $\Rightarrow$  50%.

Significance of local winds  $\Rightarrow$  10%  $\Rightarrow$  mechanism  
 90%  $\Rightarrow$  economic significance

## Buys Ballot law (pressure)

(35)

If you stand with your back to the wind, ~~the~~  
 in northern hemisphere there is high  
 pressure to ~~the~~ <sup>your</sup> right & ~~low~~ <sup>low</sup> pressure to your left.  
 (this causes anti-clockwise (high to low) rotation of cyclone in N.hemi.)

## Ferrell's law (direction of coriolis force).

If one stands with your back to the wind, ~~the~~ in  
 Northern hemisphere, the wind is deflected to your right  
 and in Southern hemi it is deflected to your left.

## Jetsream

## JETSSTREAMS

Narrow, meandering, swift-flowing, upper atmospheric  
 geostrophic wind which encircles the entire globe.  
 $\downarrow$  parallel to isobars  
 (balances centrifugal & pressure gradient)

### Properties

- 1) Narrow, west to east.
- 2) Thousands of km in length, 600 km width, 4-5 km depth.
- 3) Wavy & meandering path.
- 4) Seasonal change in wind velocity  $\rightarrow$  fast in winter ~~in summer~~.
- 5) Originates in poles and at  $20^{\circ}$  lat.
- 6) Expands at winter till  $20^{\circ}$ , in summer only at poles.
- 7) Circumpolar - originates around poles.

- Stages of jetsream. (Index cycle)
  - meandering of jetsream towards equator
  - pressure gradient shifts from north-south direction to east-west direction.
- Rossby waves :- pressure gradient
- Jetsreams are RARELY formed near the equator.

→ Types of jetstreams

1. Polar front
2. Polar night
3. Subtropical westerly
4. Tropical easterly
- 5) Local ...

→ Significance

→ Winter rainfall in J&K. → (supports apple & crops)

→ Cold waves in N. India - (very destructive)

→ In summer, jetstreams move to North of Himalaya.  
(Withdrawal of westerly jetstream)  
Since it leaves the N. India, it leaves a vacuum.

So, S.W. monsoon rushes to fill this vacuum.  
(Withdrawal of westerly jetstream - ITCZ in north India).

→ Temperate cyclones & jetstreams are highly linked.

→ Causes horizontal convergence & horizontal divergence  
in the upper troposphere.  
forms <sup>upper air</sup> ANTI CYCLONE      forms <sup>upper air</sup> CYCLONE

→ Affects the movement of aeroplanes.

→ Transports pollutants throughout the world (by vertical movement b/w tropo & stratosphere)  
(distributes pollutants from industrialised areas to all regions of the world).

A more understanding of the jetstream will reveal changes in surface weather phenomena -

→ Easterly jetstream over peninsular India (during SW monsoon) → brings rain bearing storms.

→ Westerly jetstreams in N.W. India → Western disturbances  
winter rainfall → rabi crops  
snowfall in the mountains → melting in summer  
source for perennial rivers.

## Air Mass

(37)

Large body of air ~~which~~ which has uniform temperature & humidity horizontally.

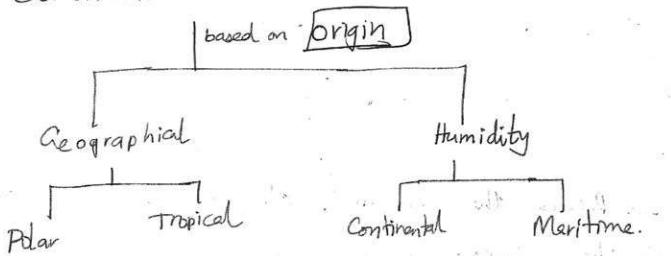
Area of ORIGIN of air mass:- Area of SUBSIDENCE of air mass.

(Pole & Tropic).

### Conditions for origin of air mass

1. Extensive & homogeneous earth's surface. (plain relief).
2. No convergence of air, only divergence in the ground floor.
3. Stable atmospheric conditions.
4. Either only land or only water. No mixture of land & water.

### Classification of Air mass based on origin

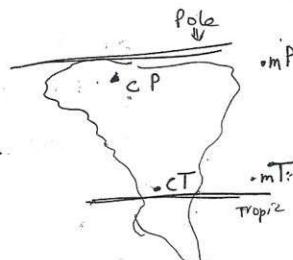


cP → continental Polar

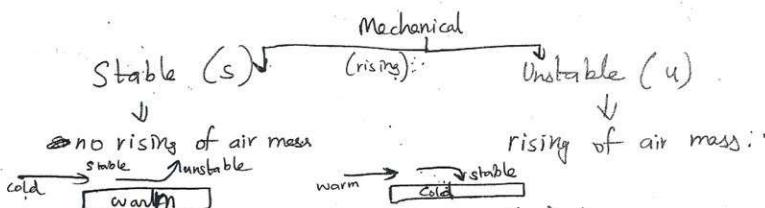
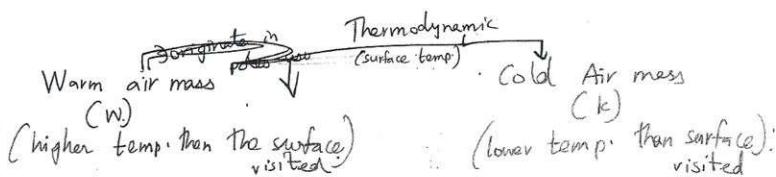
mP → maritime Polar

cT → continental Tropical

mT → maritime Tropical.



Thermodynamic classification (based on place over which it moves.)



Initially, when a cold ( $k$ ) air mass moves over a warm region, the heat of the surface is not sufficient to rise it. So, it is stable ( $ks$ ). Once, it over such a warm surface for some distance, it is heated up & rises ( $ku$ ):

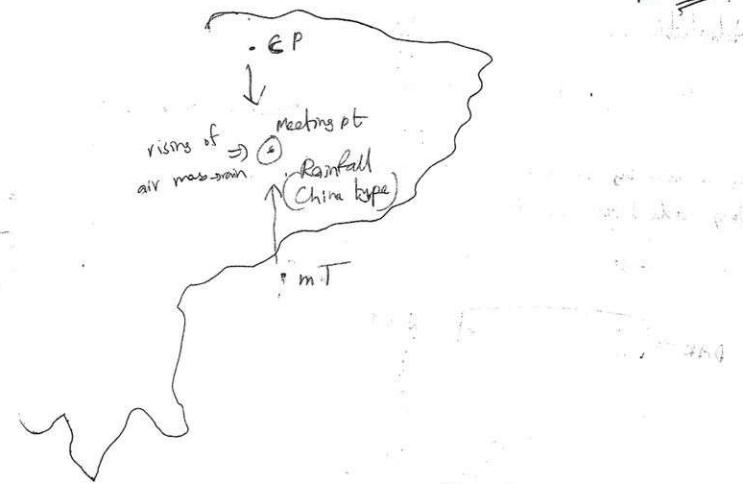
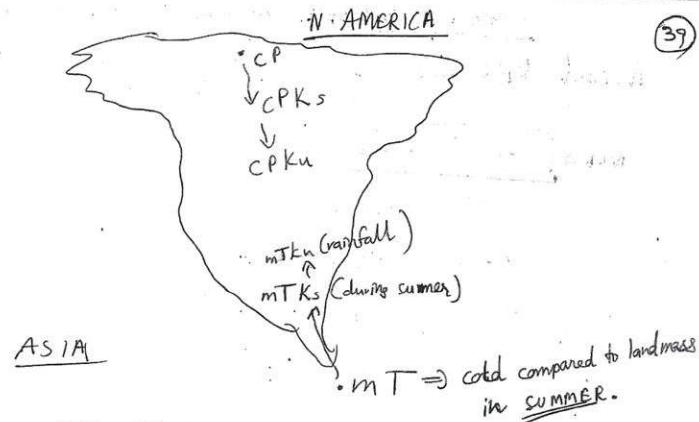
→ Discuss the origin & classification of air masses and its impact on any one region.

→ Defn:-

→ Origin ⇒ conditions for origin

→ Classification → [Geographic, humidity  
Thermodynamic, mechanical]

→ Significance.



### Significance of Air Masses

- Determines the weather of a region.
- Stability & instability of airmass plays a major role in rainfall.
- A permanent subsidence of an mass over a region causes aridity & desertification.

### STABLE & UNSTABLE REGIONS OF THE WORLD

Normal lapse rate  $\Rightarrow$  decrease of temp. with increasing altitude  
 (NLR)

$$\text{NLR} \rightarrow -6.5^{\circ}\text{C} / \text{km}$$

$$-6.5^{\circ}\text{C} / 1000\text{m}$$

$$-0.65^{\circ}\text{C} / 100\text{m}$$

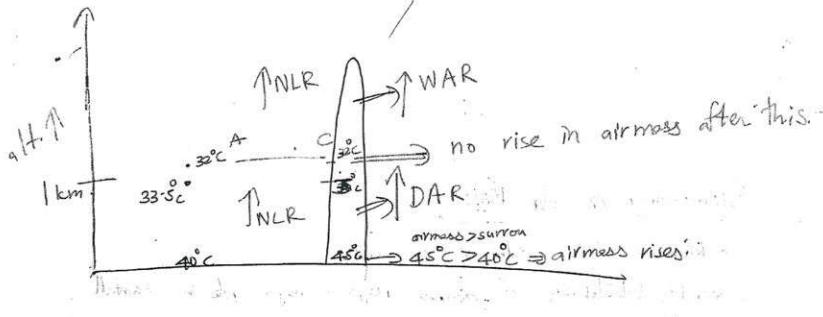
It's an avg. lapse rate. Not same at all places.

Adiabatic  $\rightarrow$  No heat transfer to outside the system.

Vertical air mass is adiabatic  $\Rightarrow$  It does not transfer heat to the surroundings. Change of temp. of ascending or descending air mass by expansion or contraction, without exchanging heat with surroundings.

Dry adiabatic rate  $\Rightarrow$  decrease of temperature with increasing alt. of an air mass, with increasing altitude.

$$\text{DAR} \rightarrow -10^{\circ}\text{C} / \text{km} \rightarrow \text{constant!}$$



$$\bullet \text{ DAR} \Rightarrow \text{NLR} \\ (10^{\circ}\text{C}/\text{km}) > (6.5^{\circ}\text{C}/\text{km}) \Rightarrow \text{STABLE}$$

DAR > NLR } absolutely stable  
 WAR > NLR }

Endothermic  $\Rightarrow$  absorbs heat  
eg:- evaporation:-

(+) ✓

Exothermic  $\Rightarrow$  release of heat eg:- condensation

At AC, temp. of air mass = temp. of surr.

$\Rightarrow$  so, no rising of air mass.

But, at this point C, the ~~rising~~ air mass releases energy in the form of condensation & hence it ~~still~~ continues to rise by this energy release. This <sup>energy (heat) release reduces the rate of decrease</sup> ~~reduction in temp. of rising~~ of temp. of air mass, with altitude, after its starts condensation and is called WAR (Wet Adiabatic Rate).

~~WAR < NLR~~

WAR  $<$  DAR

This release of energy causes instability :-

WAR  $\Rightarrow -5^{\circ}\text{C/km}$

~~NLR~~

DAR  $<$  NLR  $\Rightarrow$  UNSTABLE

NLR & WAR are varying phenomena. DAR is constant at all places.

### Solar eclipse

S      M      E  
Sun light is blocked by earth -

### Lunar eclipse

S      E      M

The moonlight (which is actually sunlight reflected by moon) is blocked by earth -

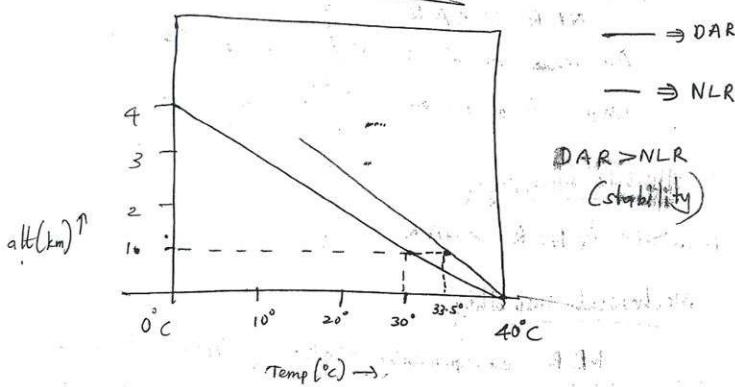
The earth can see only ONE side of the moon, because of almost simultaneous & equal rotation & revolution of the earth.

New moon? full moon?

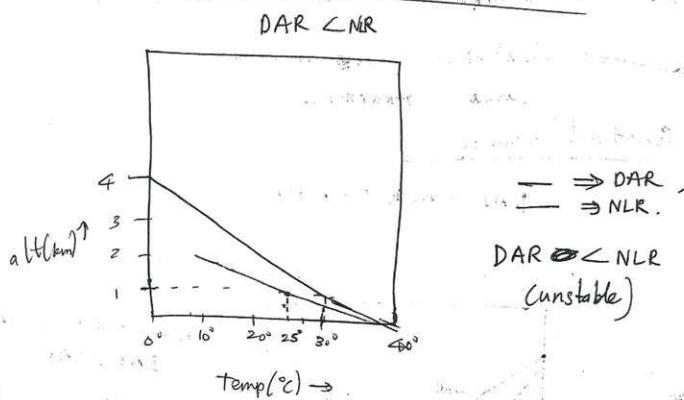
Why is sea water salty?

0 to 81/2

### DAR vs. NLR graph (STABLE STATE) (Q3)



### DAR vs. NLR graph (UNSTABLE)



Stable :-

~~AIR~~ DAR > NLR.

Air mass becomes colder than surrounding air at a certain height & starts to descend (as it is heavier).

ABSOLUTE STABILITY  $\Rightarrow$  WAR > NLR even at CONDENSATION POINT. further vertical motion of air is stopped.

## Instability

$NLR > DAR$

Air mass is at a higher temp. than the surrounding air, becomes lighter and ascends.

### Absolute instability

$NLR > DAR \& NLR > WAR$

### Mechanical instability

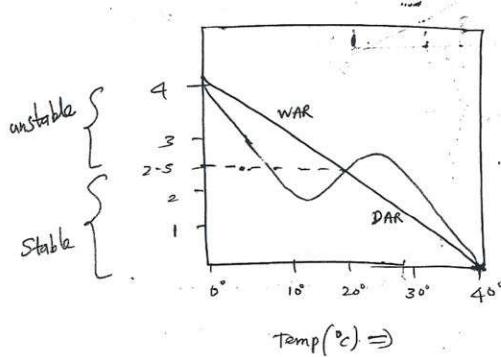
$NLR$  exceptionally high. Upper layers of atmosphere become exceptionally cold & denser than underlying layers. Cold & upper dense upper layers descend.

$\Rightarrow$  ~~so the underlying air mass rises~~

Causes TORNADOES.

### Conditional instability

$DAR > NLR > WAR$



$h < 2.5 \text{ km} \Rightarrow \text{STABLE}$   
 $DAR > NAR$

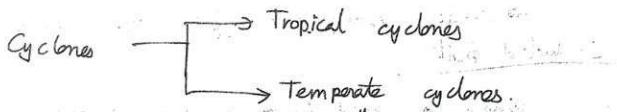
$h > 2.5 \text{ km} \Rightarrow \text{UNSTABLE}$   
 $NLR > WAR$

$\longrightarrow \Rightarrow NLR$

## Cyclone

(45)

Centres of low pressure surrounded by closed isobars having increasing pressure outward and rotates in anticyclonic in northern hemisphere and cyclonic in Southern hemisphere.



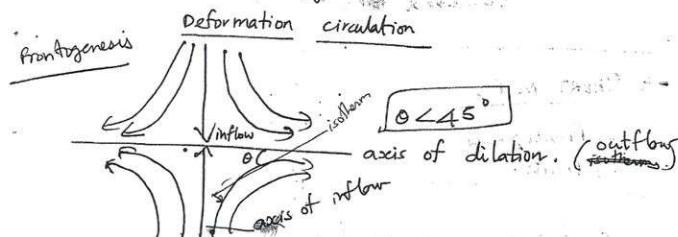
FRONT frontal in nature.

convergence of contrasting air masses.

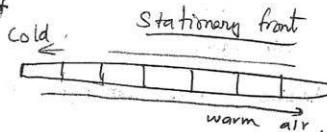
FRONT ⇒ A sloping boundary between two opposing air masses with different characteristics (temp, humidity, density).

Frontogenesis ⇒ origin & creation of new fronts

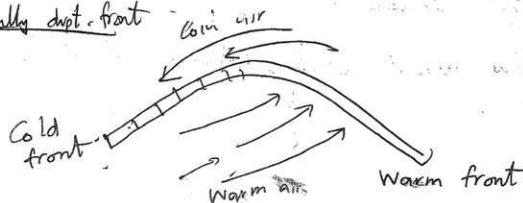
↓ deformation circulation is most favourable for frontogenesis



Formation



Fully dev. front



Warm front → high temp., high relative humidity.

→ warm, light air. (low density)

→ gently sloping frontal surface ( $1:400$ )

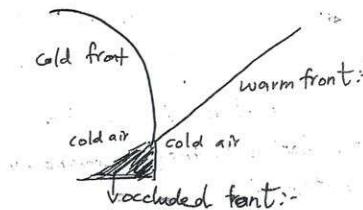
Cold front → low temp., low rel. humidity  
→ dense heavy rain fall with thunderstorm  $\Rightarrow$  gentle, long duration rain

→ steep frontal surface ( $1:50$ ):-

→ dense heavy rain with thunderstorm.

Occluded front

When a cold front overtakes a warm front & warm front is completely displaced from the ground surface. It denotes a fully formed frontal condition.



#### ⇒ SHORT NOTES

→ Frontogenesis

→ fronts.

#### ⇒ Conditions for frontogenesis

→ convergence of air masses

→ high temp. difference b/w converging air masses.

→ deformation circulation.

→ Angle b/w axis of outflow & isotherms.  $< 45^\circ$ .

## FRONT → short notes

(47)

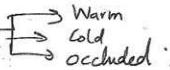
Front  $\Rightarrow$  defn.

frontogenesis  $\Rightarrow$  defn.

deformation circulation  $\Rightarrow$  diag.  
deformation

conditions for front creation.

Types of front



Major frontal zones of the world.

Significance  $\rightarrow$  temperate cyclones.

### Major frontal zones



### Temperate cyclone

1.  $\Rightarrow$  Zone  $\Rightarrow$   $45^\circ$  to  $60^\circ$

2. Origin  $\Rightarrow$  Frontal in nature

3. Shape: variable (dependent on char. of air masses & convergence)

4. Size: - covers  $1500$  -  $3000$  km  
Large size

5. Speed: -  $150$  to  $300$  kmph  
(due to ~~large~~ size)

6. Two types (warm/cold) of air mass involved.

### Tropical cyclone

"  $10^\circ$  to  $25^\circ$

Thermal in origin  
(diff. heat of land & sea).  
Low depression in seas.

Mostly circular in shape.  
Only one air mass is involved.

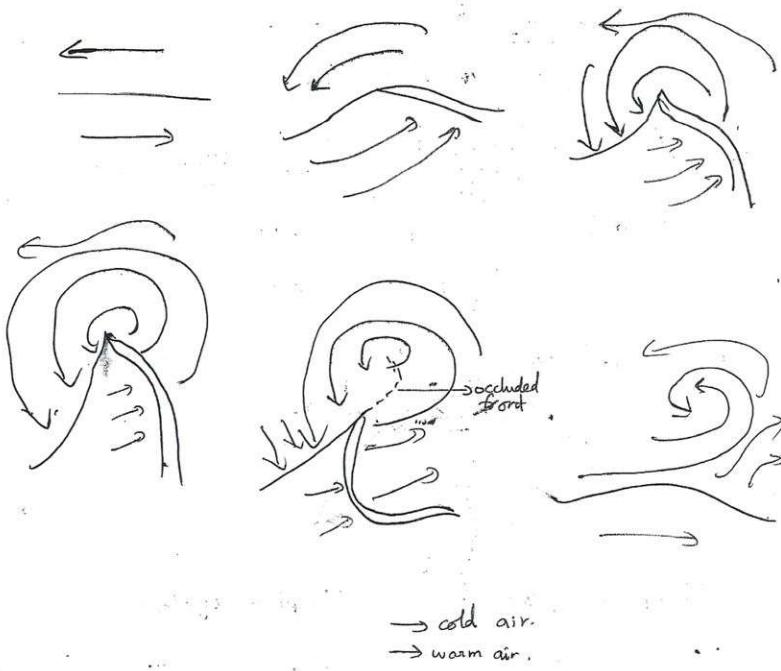
Size: - covers  $150$  -  $300$  km

Small size

Speed: -  $180$  to  $400$  kmph (due to ~~large~~ size)  
fierce & destructive (as: ~~none~~ naked)

Only one type of air mass.

### Temperate cyclone



### Conditions for origin of tropical cyclone

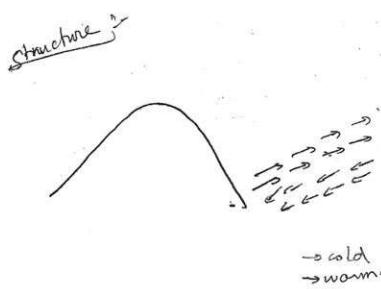
- 1) Temp. of oceans  $> 27^{\circ}\text{C}$ .
- 2) High value of Coriolis force (at  $0^{\circ}$  latitude  $= 0$ ;  $\therefore$  no tropical cyclone at equator).
- 3) Continuous supply of MOISTURE, since the energy for movement is provided by LATENT HEAT OF EVAPORATION.
- 4) There should be anticyclonic circulation at a height of 9000 m to 15000 m (upper atmosphere).

## Zone of tropical cyclones

(49)

### Structure

#### Temperate



Cold front: heavy rain

Warm front: gentle rain.

#### Weather

1. Gentle, long duration rain, nimbus cloud.  
(warm front)

2. WARM SECTOR  $\Rightarrow$  no rain  
high temp.

3. COLD FRONT  $\Rightarrow$  heavy dense rain  
cumulus nimbus cloud.

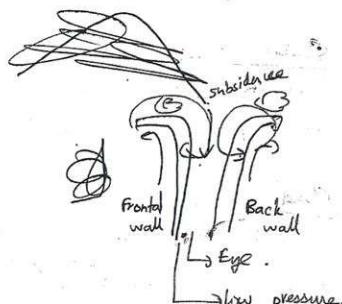
4. COLD SECTOR  $\Rightarrow$  no rain  
low temp.

#### Wind direction

1. Continuous shift of wind direction

~~warm front cold wind~~  
 S.E.  $\rightarrow$  S.  $\rightarrow$  S.W.  $\rightarrow$  ~~cold front~~  
~~(warm)~~  $\rightarrow$  W  $\rightarrow$  N.W.  $\rightarrow$  N.E.  
 $\rightarrow$  ~~warm wind~~  
 $\rightarrow$  ~~anticyclonic~~  
 $\rightarrow$  ~~(~~

#### Tropical



Frontal & back : Heavy rain.

Eye : - no rain:-

Frontal wall  $\Rightarrow$  continuous  
heavy rain

Eye  $\Rightarrow$  No rain, clear sky.

Back wall  $\Rightarrow$  continuous heavy  
rain! -

in case it reaches the  
land --

Constant wind direction.

(

Coast affected:-

West coast of continent  
(under the influence of WESTERLIES)

East coast of the continent  
(Trade winds);

Distribution

Draw a world map showing the distribution of  
temperate & tropical cyclones.

Origin

Both on land or water,  
wherever a front is formed.

Originates only in water.

It is a depression in sea.  
(constant supply of water vapour necessary)

Season

Both ~~any~~ seasons (since it does  
not depend on diff. heating of ocean)

Only in ~~summer~~ (when ocean  
is warmer than land) ↓ low pressure.

Cloud

Various types of cloud:  
↳ (due to diff. types of air masses)  
Nimbus > cumulonimbus.

Only cumulonimbus cloud.  
↳ (only 1 type of air mass).

Frequency of occurrence

~~Very frequent~~ Less frequent.

Very frequent. (many  
cyclones attack TV in a single week)

Damage caused

Not much damage.

Heavy damage (due to  
high velocity & high freq. of occurrence)

Rising of air mass

• Oblique (slanting)

• Vertical.

• Does not need  
anticyclonic condition.

Associated with an anticyclonic  
condition (subsidence on the edge)

# Global Climate change

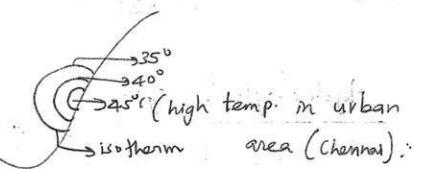
(51)

Urban heat island  $\Rightarrow$  concrete jungles

↑  
Presence of high temperature in an urban area

Compared to the surrounding rural areas.

→ Roads  $\Rightarrow$  (black tar)  $\rightarrow$  act as black bodies  $\Rightarrow$  absorb a lot  
Heat budget in Arctic of heat)  
IPCC report says all ice cover will melt in 2100. This will decrease the  
albedo by  $ie (2\%)$ , thus increasing global temperature. now almost  
the entire White sea has melted



Temp.

→ Large emissions of  $CO_2$  by vehicles & factories.

More  $CO_2 \Rightarrow$  greenhouse gas. More trapping of sunlight.

Higher temp. IPCC report  $\Rightarrow$  With every  $1^{\circ}C$  increase in temp,

Rainfall  $\rightarrow$  there'll be a 10% heavier rainfall extremes in tropics, causing floods.  
→ Due to the increasing temperature, more air

mass rises and these URBAN HEAT islands get HEAVIER rainfall compared to other regions on the same latitude. Moreover, the tropical cyclones attack these heat islands first (due to low pressure).

Wind  
→ Wind will form more eddies (closed whirlpools & turbulences  $\Rightarrow$  cannot flow freely due to obstruction  
↓ building

Pollution  
→ Since wind cannot move freely out of the city, the pollutants trapped within the city,

### Humidity

→ Higher humidity due to high respiration from densely populated settlements, more water usage by man.

### Water run off

→ HEAVY RUNOFF → since no "free land to penetrate underground So, water table level goes down. Has to be maintained by river water harvesting

Health → HEAT STRESS & other health hazards are

HIGH.

heat wave

e.g.: Delhi:-

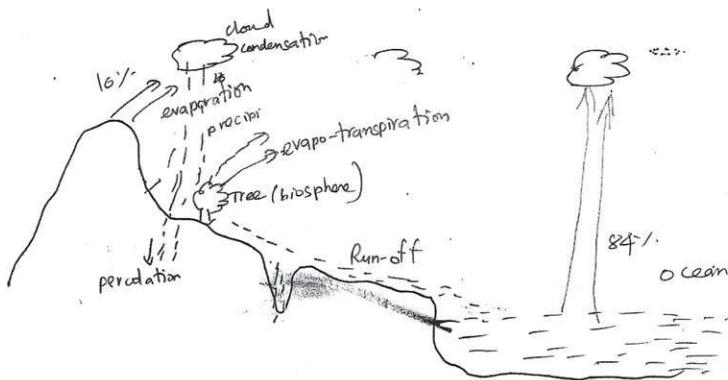
e.g.: Madras eye

(Chennai - @ summer)

## Hydrological cycle

Change in geographical position and physical state of water between lithosphere, hydrosphere, atmosphere and biosphere.

Hydrological cycle  $\Rightarrow$  evaporation  $\rightarrow$  condensation  $\rightarrow$  precipitation  
transpiration  $\downarrow$  run-off, percolation



Total evaporation  $\rightarrow$  [ 84% from ocean  
16% land ]

# Man's interference in hydrological cycle ..

(53)

## Short notes

⇒ Hydrological cycle & man's interference in it.

1. Dams (percolation) 2. Concrete jungles 3. Deforestation (trans-evap.) ↓ 4. Encroachment of rivers. (run-off)

## APPLIED CLIMATOLOGY

### 1. Disaster management

Floods, cyclones, drought, hurricanes.

5. Encroachment of lakes  
6. Depletion of water table  
7. Seeding of clouds  
8. Sand mining (soil erosion)  
run off (wind erosion)

Prediction of time & source of origin, type, velocity of cyclones.

### 2. Agriculture

→ Type of crop (amt & density of rain)

→ Time of sowing (by predicting time of rain)

→ Scheduling of irrigation

→ Pest mgmt. (type of pest depends on climatic conditions)

→ Wind speed & direction.

### 3. Urban planning

→ Drainage (average rainfall, density of rain, percolation of soil).

→ Construction of buildings (by a knowledge of wind direction, sunlight)

→ Settlements in mountainous landscape (mountain & valley breeze)

### 4. Navigation

→ Ship movement (wind direction).

→ Flight & train (prediction fog, mist, smog)

↳ jetstreams

→ Satellite launch.

→ Jet movement in stratosphere (to avoid air packets collision).  
(height of clouds → stratosphere varies).

→

### Dairy sector

• Milk production fluctuates with seasons (summer less milk).

• Storage of milk (depends on weather).

• Diseases affecting cattle.

### Health mgmt-

→ Occurrence of diseases depends on climate:-

(hot-wet equator → malaria ; summer - Madras eye).

→ Administering of OPV. (in winter).

→ Spread of diseases can be controlled by a good understanding of wind & weather patterns. rainy season → cholera  
↳ in case of air-borne disease (TB)

### Power production

→ Solar power ⇒ amt. of insolation, duration, variation of sunlight, annual & diurnal range.

→ Wind power ⇒ nature & direction of wind, seasonal winds

### Fishing

→ ~~depends~~ Fishing in sea not possible in stormy conditions.

→ wind direction determines current movement & hence fish movement.

## Industries

Brick industry → operates mainly in summer months & closed down during monsoon

Match box industry.

Salt [high intense insulation reqd.  $T_{0.50}$ ]

Film related industries (cinema) → requires humid sea breeze.

## Inflation & economy

coasted climate (Chennai, Los Angeles, Mumbai)

Drought → CPI increases, due to food inflation.

Success & failure of monsoon.

Commodity trading. Indian Budget → Gamble of monsoon, raw materials for eco-based industries (sugar)

## Culture of ppl.

- Food habits.

- Dress worn (cotton ⇒ senator; fur ⇒ Siberian; wool)

- Type of house (igloo ⇒ Polar; flat roof in Rajasthan; shaped roof in Kerala)

- Festival occurrence (honest fest, sowing festival)

## Tourism

- Time of visit of a tourist spot

- Climate (warm & pleasant ⇒ Mediterranean climate)

- Types of dress to be worn while visiting a tourist spot

## Reference websites:-

- 4x4 report ⇒ A report by GoI -

↓  
4 sectors  
↓  
4 regions

- UNFCCC ⇒ read reports on climatic change (accelerated by human activity)

Rainfall :-

| Throughout | Summer            | Snow throughout         |
|------------|-------------------|-------------------------|
| Winter     | summer            | pseudo monsoon (summer) |
| No         | Summer (but less) | Summer                  |
| throughout |                   |                         |

Natural vegetation

Lichens

| Poplar   | spruce & larch        | Maple              |
|----------|-----------------------|--------------------|
| Olive    |                       | Verbena<br>Mullein |
| Cactus   | Acacia, bottle, babur |                    |
| Hardwood |                       |                    |

Tribes

Eskimos, Lapps, Inuits

|                              |                             |              |
|------------------------------|-----------------------------|--------------|
|                              | Koryaz<br>Kalmaks<br>Kazaks |              |
| Abarigines,<br>Iglo Bedouins | Bushman<br>Masai            | Bodos        |
|                              | Pygmies, Amazon             | head-hunters |

## Agriculture Occupation

(57)

| Hunting & whaling.                                 |  |  |
|--|--|--|
| mixed farm,<br>dairy, market garden<br>Saw milling | Lumbering                                  | Fishing  |
| orchards,<br>vineyard                              | Extensive &<br>mechanised<br>agriculture - | Rice, fish,<br>sericulture                     |
| Normadism  | Nomadic<br>& pastoralist                   | Shifting<br>cultivation,<br>settled agri.      |
| Hunting & gathering                                |  | Plantation<br>(Rubber, coffee, tea,<br>cocoa). |

## Crops

|        |                            |   |
|--------|----------------------------|---|
|        | Oat, barley,<br>potato     |   |
| Grapes | Wheat,<br>corn<br>soyabean | Maize,<br>corn                                |
|        | "                          | Rice, sugarcane,<br>wheat, groundnut<br>pulse |

## Wild life (Animals)

|  |  |                  |
|--|--|------------------|
| Reindeer, musk ox, polar bear, penguin |  |                  |
| Domesticated<br>animals                |  |                  |
| Lions, pigs                            |  |                  |
| Camel, horse                           | Crocodile, zebra,<br>elephant, tiger,<br>lion, cheetah | Elephant, monkey |
| Chimpanzee, Anaconda, Snakes           |  |                  |

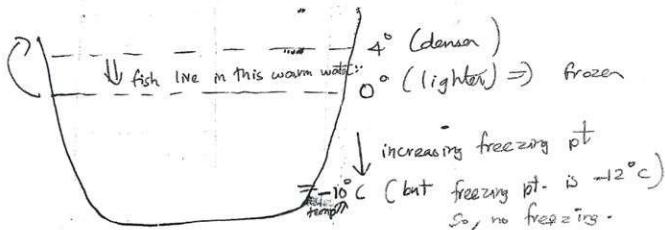
## Diseases

|                            |  |  |
|----------------------------|--|--|
| Mad cow disease<br>(AIDS), |  |  |
| Heat stroke.               |  |  |
| Malaria, ebola             |  |  |

Sea water is salty. Why?

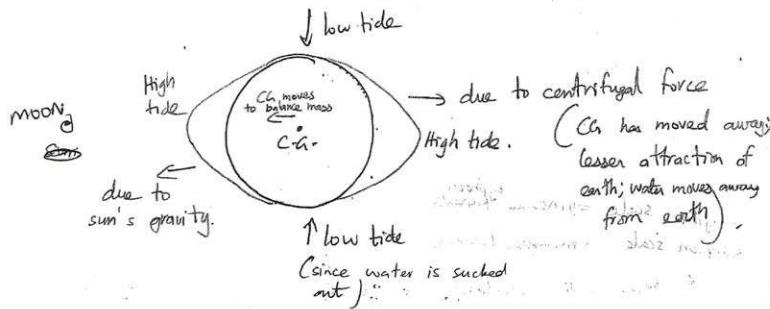
Rivers carry equal amount of sodium & calcium. So, it does not taste salty. But, on reaching the sea, the sea organisms in the shallow seas consume a lot of calcium for shell construction. This leaves only sodium in the sea, making it salty.

Sea water ~~first~~ freezes on the surface. Fish lives in the sea even under frozen conditions.



## Tides

(59)



S E M  $\Rightarrow$  full moon

same line; diff. angle  $\Rightarrow$  ~~full moon~~

SEM  $\Rightarrow$  lunar eclipse  
same line; same angle  $\Rightarrow$  S  $\Rightarrow$  E (M)

no light  
from moon

SME  $\Rightarrow$  solar eclipse  
same line; same angle  $\Rightarrow$  S  $\Rightarrow$  M

sun's ray blocked

SME  $\Rightarrow$  new moon  
same line; diff. angle  $\Rightarrow$  S  $\Rightarrow$  E

moon's light on  
the side

$\rightarrow$  Large oceans rotate clockwise in north hemisphere,

anticlockwise in S-hemisphere -

$\rightarrow$  Air mass & small water bodies  $\Rightarrow$  rotate anticlockwise  
in N-hemisphere & clockwise in S-hem.

$\rightarrow$  TORNADO  $\Rightarrow$  a cyclone on land (no moisture)  
no rain  $\Rightarrow$  heavy damage.

$\rightarrow$  WATER SPOUT  $\Rightarrow$  intense cyclone within ocean (tornado in ocean)

water stands like a pillar in mid-ocean.

Bathometry  $\Rightarrow$  to explore ocean beds

Anemometer  $\Rightarrow$  speed of wind

Barometer  $\Rightarrow$  pressure

Thermometer

$\rightarrow$  mercury (in hot conditions)

$\rightarrow$  alcohol (in polar areas)

Fujita scale  $\Rightarrow$  measure by phone

Simpson scale  $\Rightarrow$  measure hurricane

$\downarrow$  it has low freezing pt  
(sub-zeroes)

\* Work out climatology questions in prelim G+S (10-15 yrs).

### GLOBAL CLIMATE CHANGE - CONTEMPORARY ISSUES

- Doha conference 2012

- world's only binding protocol on climate change  $\Rightarrow$  Kyoto protocol  $\Rightarrow$  commitment period has ended

$\rightarrow$  (Hot air) The quota of greenhouse gas emissions (as given by Kyoto protocol)  
NOT used by a country & which can be traded to other countries  $\Rightarrow$

Carbon credit

? lack of funding (Adaptation fund) due to economic recession

$\downarrow$  through tax on COM trade

. No agreement on 2<sup>nd</sup> commitment period for Kyoto protocol

. Temp to raise by 5°C by 2100 rather than UNFCCC target of 2°C by 2100.

11/08/12

## Koepffler's classification

(units: temp  $\rightarrow$   $^{\circ}\text{C}$ ; rainfall  $\rightarrow$  cm)

(b)

1. Vegetation

2. Temperature

3. Seasonal dist of rainfall

4. Latitude

5. Altitude

### Vegetation

Megatherm  $\rightarrow$  big leaf, more greenish (tropical rain forest)

Mesotherm  $\rightarrow$  medium-sized leaf (mid lat-temp forest).

Microtherm  $\rightarrow$  very small leaf (British, Laurentian, Siberian) coniferous forests

Xerophytes  $\rightarrow$  no leaf; modified (desertic)

Hekkistotherm  $\rightarrow$  snow-covered areas (polar)

### Climate classification based on vegetation

#### megatherm

[A] Humid tropical climate  $\Rightarrow$  rainfall throughout the yr, hot & humid, no winters, temp always  $> 18^{\circ}\text{C}$ .

xerophytic [B]  $\Rightarrow$  semi-arid & desertic, evaporation exceeds precipitation.

mesotherm [C]  $\Rightarrow$  warm mesothermal (WARM TEMPERATE)  $\Rightarrow$  warm temp, no mild winters, avg temp (-3 $^{\circ}\text{C}$  to 18 $^{\circ}\text{C}$ ) winter ~~summer~~.

#### mesotherm

[D] Humid microtherm  $\rightarrow$  cold forest area, -3 $^{\circ}\text{C}$  to 10 $^{\circ}\text{C}$ .

#### hekkistotherm

[E] ~~F~~ polar climate  $\rightarrow$  permanent snow cover, summerless.

Based on seasonal distribution of rainfall.

f → rainfall throughout the yr.

m → monsoon (short dry season).

w → winter DRY; summer rainfall

s → summer DRY; winter rainfall

n → minimum fog; g → shortest season preceding ppt. i → diff. of temp b/w warmest & coldest month < sc.

### Latiitudinal variation

h → (hot) avg temp  $> 18^{\circ}\text{C}$  [low latitude]

k → (cold) avg temp  $< 18^{\circ}\text{C}$  [high latitude].

### Altitude

H → highland climate (high altitude) with SNOW.

### Symbols

Note! - All formulae, measurements are in cm.

| Primary | secondary | tertiary | DESCRIPTION.  | $  \sin H = 2.54 \text{ cm.}$ |
|---------|-----------|----------|---|-------------------------------|
| A       |           |          | Any temp. of. coldest month $> 18^{\circ}\text{C}$ . (HUMID TROPICAL)                     |                               |
|         | f         |          | Every month precipitation $\geq 6 \text{ cm.}$  |                               |
|         | m         |          | Short dry season - ppt. in driest month $< 6 \text{ cm.}, \text{ but } > 10 - R/25$       |                               |
|         | w         |          | winter dry - ppt. in driest month $< 10 - R/25$<br>At least one month $< 6 \text{ cm.}$   |                               |
|         | s         |          | summer dry - Rarest climate in the world.<br>(eg: mediterranean, chennai coast).          |                               |
| B       |           |          | evaporation $>$ ppt. $R \leq (2T + 0.2)$ $\rightarrow$ when $70\%$ or more in warm months |                               |
|         |           |          | $R \leq (2T + 1.4)$ $\rightarrow$ when no month $> 70\%$ rain                             |                               |
|         |           |          | $R \leq 2T \rightarrow 70\%$ or more in cold months                                       |                               |
|         | s         |          | steppes climate (semi-arid)   |                               |
|         | w         |          | desert climate (arid)   |                               |
|         | s         | h        | savannah  |                               |
|         | s         | k        | Temp grassland (steppes)  |                               |
|         | w         | h        | Hot desert  |                               |
|         | w         | k        | cold desert   |                               |

|     | EF  | ET        |   |
|-----|-----|-----------|---|
| CF  | Dw  | Df        | rain scummer<br>snowfall winter<br>throughout<br>63 |
| Cs  | BSk | Cw        | (BWK)   |
| BWh | BSk | Aw        |   |
| Am  |     | rare = As |   |
| AF  |     |           |   |

| F | 2° - 3°       | Description:  |
|---|---------------|---|
| C |               | Avg temp of coldest month $< 13^{\circ}\text{C}$ , but $> 3^{\circ}\text{C}$ .      |
| W |               | ' summer ppt. $> 10 \times$ winter ppt.   |
| S |               | winter ppt. $> 3 \times$ summer ppt.  |
| F |               | when above both criteria are not fulfilled.<br>→ no dry season                      |
|   |               | temp of coldest month $< 3^{\circ}\text{C}$ ; min 4 months $> 10^{\circ}\text{C}$ . |
| a | → warm summer | warmest month $> 22^{\circ}\text{C}$ , at least 4 months $> 10^{\circ}\text{C}$ .   |
| b | → cool summer | No month $> 22^{\circ}\text{C}$ , at least 4 months $> 10^{\circ}\text{C}$ .        |
| c |               | 1 to 3 months $> 10^{\circ}\text{C}$  |

|   | P | 20° | 3° |  |
|---|---|-----|----|--|
| D |   |     |    | Avg temp. of coldest month $< -3^{\circ}\text{C}$ ; Avg. temp. of warmest month $> 10^{\circ}\text{C}$ . |
| W |   |     |    | same as C.   |
| S |   |     |    | "  |
| f |   |     |    | "  |
| a |   |     |    | "  |
| b |   |     |    | "  |
| c |   |     |    | "  |
| d |   |     |    | Avg temp. of coldest month $< -38^{\circ}\text{C}$ .   |
| E |   |     |    | Avg. temp. of warmest month $< 10^{\circ}\text{C}$ .   |
| T |   |     |    | (Tundra) Avg. temp. of warmest month $0^{\circ}\text{C} < T \leq 10^{\circ}\text{C}$ .<br>true summer    |
| F |   |     |    | (Frost) Avg. temp. of warmest month $< 0^{\circ}\text{C}$ .<br>Plan ice cap $\rightarrow$ Permanent ice  |
| H |   |     |    | High altitude.<br>(Highland with snowy areas)  |

## Merits of Koeppen's

(65)

- Quantitative in nature → numerical values of temp. & ppt.
- used to delineate boundaries of diff. climatic conditions.
- He brought out the importance of effective ppt. (amt. of ppt available to plants, i.e. ppt - evaporation).
- He recognised the association b/w vegetation types & climatic zones.
- His scheme is simple, generalized & descriptive.

## CRITICISM

- undue significance to mean values of temp. & ppt.
- neglected other weather elements (ppt. intensity, amount of cloudiness, no. of rainy days, diurnal temp. range, winds).
- ignored the causative factors of climate.
- did NOT include the characteristics of air masses.
- use of alphabets & formulae makes it difficult to memorize.

| $1^{\circ}$ | $2^{\circ}$ | $3^{\circ}$ | Description  |
|-------------|-------------|-------------|--|
| <b>A</b>    |             |             | <p>Avg. Temp <math>&gt; 18^{\circ}\text{C}</math>.<br/>     All months ppt. <math>&gt; 6\text{ cm}</math>.<br/> <u>short dry season</u> <math>6 - \frac{1}{25} &lt; \text{ppt} &lt; 6\text{ cm}</math>.</p> <p>winter dry ; driest month rain <math>&lt; 10 - \frac{1}{25}</math></p> <p>summer dry . Rarest climate .</p>   |
| <b>B</b>    |             |             | <p>70% rain in summer <math>R &lt; 2T + 28</math></p> <p>No months 70% rain <math>R &lt; 2T + 4</math></p> <p>70% rain in winter <math>R &lt; 2T</math></p> <p>s steppes climate</p> <p>w desert climate</p> <p>s <del>sh</del> h Savannah (tropical grassland)</p> <p>s k Steppes (temp. grassland)</p> <p>w h HOT desert</p> <p>w k cold desert ;</p>  |
| <b>C</b>    |             |             | <p>Avg temp. of warmest <math>&lt; 18^{\circ}\text{C}</math> ; Avg temp. of coldest <math>&gt; -3^{\circ}\text{C}</math>.</p> <p><del>s</del> w summer rain <math>&gt; 10 \times</math> winter rain</p> <p>s winter rain <math>&gt; 3 \times</math> summer rain ; rare climate.<br/>     if neither of the above 2 satisfied.</p> <p>a Warm <math>&gt; 22^{\circ}\text{C}</math> ; At least 4 cold months <math>&gt; 10^{\circ}\text{C}</math>.</p> <p>b <del>No</del> No month <math>&gt; 22^{\circ}\text{C}</math> ; At least 4 cold months <math>&gt; 10^{\circ}\text{C}</math>.</p> <p>c 1-3 months <math>&gt; 10^{\circ}\text{C}</math> .</p> |
| <b>D</b>    |             |             | <p>Avg. warm <math>&lt; 10^{\circ}\text{C}</math> ; Avg. cold <math>&gt; -3^{\circ}\text{C}</math>.</p>  |

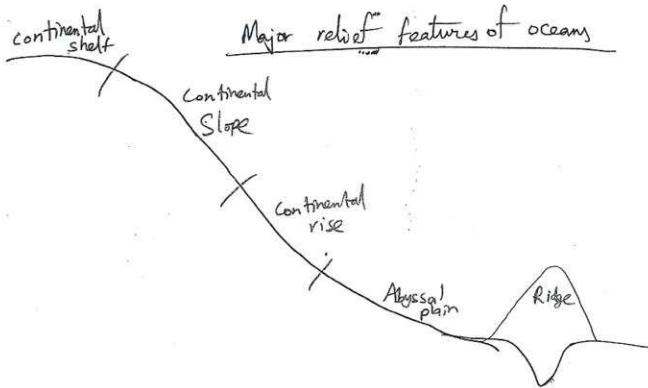
(67)

|   |   |   |  |
|---|---|---|--|
| D |   |   |  |
|   | W | same as [C]   |  |
|   | S | "   |  |
|   | f | "   |  |
|   | a | "   |  |
|   | b | "   |  |
|   | c | "   |  |
|   | d | At least one coldest month $< -38^{\circ}\text{C}$                                  |  |
| E |   |   |  |
|   | T | Tundra <del>forest</del> ( Warmest ; $0^{\circ}\text{C} < T < 10^{\circ}\text{C}$ ) |  |
|   | F | Frost ( Warmest $T < 0^{\circ}\text{C}$ )   |  |

| EF   |     |  |
|------|-----|--|
| ET   |     |  |
| CF   | Dw  | DF                                     |
| CS   | Bsk | Cw<br><i>(Bnk)</i>                     |
| Bwh. | Bsh | Asw<br>Am ( <i>Ap</i> )<br><i>drav</i> |
|      | Af  |  |

17/08/02

## OCEANOGRAPHY



### Minor relief features of ocean

- Trenches
- Canyons
- Grayots
- Sea mount
- Reef

#### Trench

- Deepest points in oceans.
- Usually parallel to the coast.
- Convergence <sup>because</sup> <sub>of</sub> plates, results in a V-shaped valley → trench.
- feature of Pacific ocean : absent in Atlantic Ocean  
(Convergent zone)                          ↓  
  (Divergent zone).

#### Canyon

- Perpendicular to coast  
    ↓ because
- Erosion by rivers on the continental shelf after it joins the sea.

~~Seamount~~ Seamount

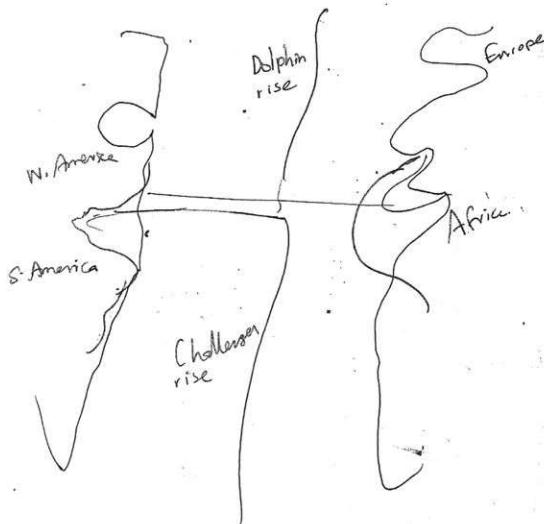
(69)

- Isolated, elevated hills ( $> 1000\text{m}$ ) with sharp peak.

~~Guyot~~ Guyot

- A ~~sea-mount~~ with a flat top (instead of sharp peak)

Reef



Mid Atlantic Ridge

northern portion  $\Rightarrow$  DOLPHIN RISE.

southern portion  $\Rightarrow$  CHALLENGER RISE.

Telegraphic plateau } north  
Myville <sup>Thompson</sup> Rise

Walvis ridge  $\Rightarrow$  towards Africa } south

## FRACTURES

Gibbs fracture ( $40^{\circ}$  N)

Oceanographer fracture ( $32^{\circ}$  N)

Atlantis fracture ( $30^{\circ}$  N)

Kame fracture ( $25^{\circ}$  N)

Wema fracture ( $10^{\circ}$  N)

Romanche fracture  $0^{\circ}$  Divides N. & S. Atlantic ridges

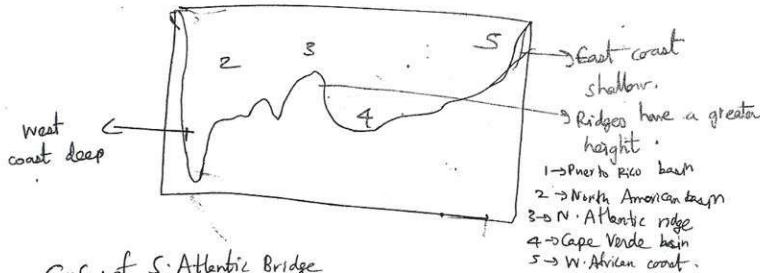
↳ (near equator)

↓

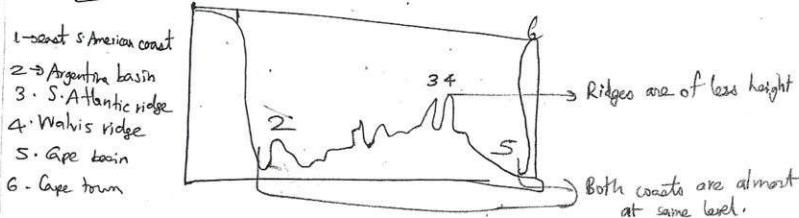
Dolphin rise

Challenger.

## C-S. of N. Atlantic ridge

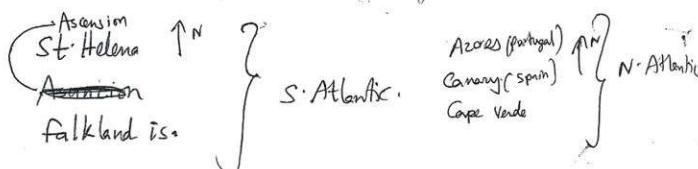


## C-S. of S. Atlantic Ridge



Bermuda triangle  $\rightarrow$  Bermuda, Haiti (Port au Prince), Florida (Miami)..

Almost all island in S. Atlantic ocean belongs to U.K -



Brazil → Continental shelf is narrow. (narrowest → Cape São de Roque) (71)

It widens from Brazil towards <sup>south</sup> & continental shelf is very wide at Antarctic. (from Estua Blanca to Antarctic)

It widens from Brazil towards <sup>north</sup> & greatest at the Caribbean (<sup>so only</sup> islands due to shallow depth). (Lesser & Greater Antilles).

It again becomes narrower till New York. Again starts widening towards north. ↳

Newfoundland ⇒ wide shelf ⇒ Gran Bank ⇒ fishing ground.  
↳ fishes found at a shallow depth.

→ Wide continental shelf, in the northernmost part of N-Atlantic ⇒ that is why Greenland, Iceland.

W. v. Thompson ⇒ b/w Iceland & Scotland; Telegraphic plateau → south of Greenland & Iceland.

Wide continental shelf at Europe & Asia.

↓  
Norwegian Sea, North Sea

↓  
Herring pond of the world.

### Ocean bottom topography (Continued)

→

→ Major relief

→ Minor relief

→ Analysis of continental shelf.

→ Ocean basins

1. Labrador 2. Puerto Rico 3. Spanish 4. Cape Verde 5. Guinea 6. Angola 7. Argentine

contd ...

Ocean deeps in Atlantic. (Trenches)

1. Puerto Rico deep 2. Columbia deep 3. Vema deep 4. Romanche deep.

Marginal seas

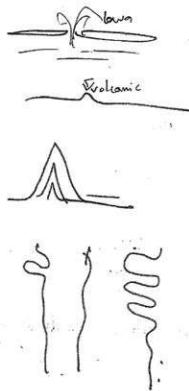
1. Mediterranean sea 2. Caribbean Sea 3. Gulf of Mexico.

~~Mid At~~

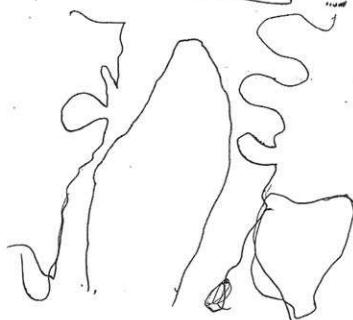
## Oceanic ridge (or Mid Atlantic ridge)

→ What is oceanic ridge.

→ Origin:

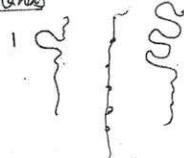


→ Ocean bottom topography



→ Analysis of continental shelf ⇒ where increases decreases why?

→ Islands

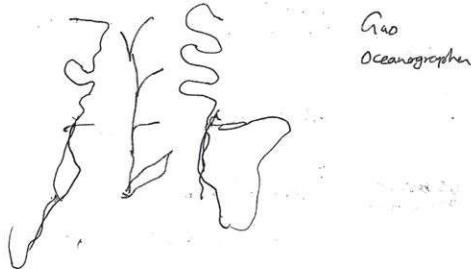


Islands ⇒ Azores, Canary, Cape Verde, ⇒ N. Atlan.  
Ascension, St. Helena, ⇒ S. Atlan.

All islands are located either on the ridge  
or continental shelf.

→ Fracture zones

(T3)

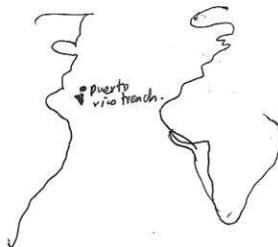


Gao  
Oceanographer

→ Trenches

Not such trenches, because no convergence

Only one trench :- Puerto Rico TRENCH



N. Atlantic ridge

→ High height of ridges

→ West coast is deeper than east coast shallow

S. Atlantic ridge

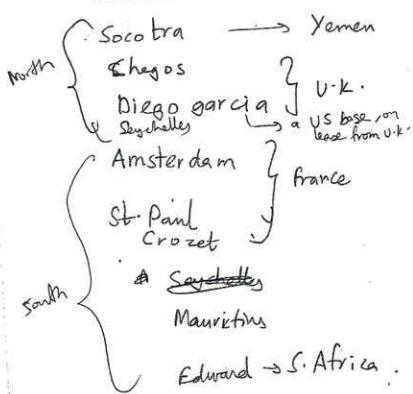
- Avg. height of ridge is lesser than N. Atlantic

- Both coasts gentle slope

Ocean bottom is a repository of various mineral resources, biodiversity ~~is~~ rich areas & fishing grounds.  
Understanding is very imp.

## INDIAN OCEAN

### Islands (N to S)



All islands in Indian ocean are on the mid-ocean ridge.

### BIG ISLANDS

Sri Lanka, Madagascar (Madagascar)

Usually, N-Indian ocean → U.K.  
S-Indian ocean → France.

### Ridges

Socotra - Chagos ridge.

Chagos ridge. ⇒ (W. India ⇒ Lakshadweep).

Seychelles ridge.

Chagos - St. Paul ridge.

NINETY EAST RIDGE → extension of Himalayas in the ocean.

Trench → Java trench (Indonesia).

### CONTINENTAL SHELF IN INDIAN OCEAN

#### Africa

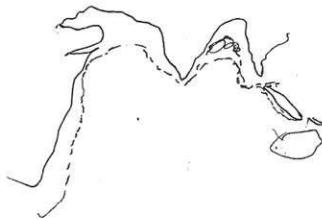
Western Indian ocean { N-Africa to Somalia ⇒ shelf width decreases.  
→ Gulf of Aden (least width)

Somalia to S-Africa ⇒ shelf width increases:-

Eastern Indian ocean { Arabian Sea, Bay of Bengal ⇒ wide continental shelf.

Indonesia region → no continental shelf  
→ only trench (JAVA trench or Sunda trench)  
→ convergent zone

- (75)
- No sea mounts/gigas
  - Coral reef → Andaman & Nicobar; Lakshadweep  
fringing reefs on east; barrier reefs on west
  - No fracture zones, only branches



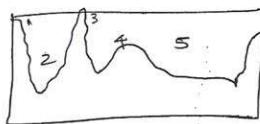
- East coast shallow; west coast deep.

(ii)

So, more islands in the east coast.

- No classification of N & S. Indian Ocean, because N-Indian ocean is landlocked. Only consider S-Indian ocean -  
(Gulf of Aden, Gulf of Oman, Arabian Sea, Bay of Bengal)

Draw graph (S. Indian ocean)



- 1 → Madagascan coast
- 2 → Reunion
- 3 → Mid-ocean ridge
- 4 → S. Paul ridge
- 5 → Indian-Aus basin (Coastal basin)

~~Draw diagram for Marginal seas~~

- Marginal seas
- Less no. of marginal seas compared to Pacific & Atlantic
  - 1. Red sea 2. Gulf of Oman 3. Bay of Bengal 4. Arabian sea

Ocean basins

- 1. Oman basin 2. Arabian basin 3. Somali basin
- 4. Mauritius basin 5. Mascarene basin 6. Agulhas-Natal basin.

11/08/12

## MODELS & SYSTEMS

→ Majid Hussain

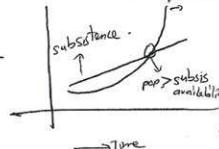
### Malthusian Theory (1786)

Malthus → British economist ⇒ 'POPULATION BOMB.'

- (1) → The power of the earth to produce subsistence is far less than power of the population growth.
- (2) → World population growing in A Geometric progression (GP)  
Food Production growing in Arithmetic progression (AP)

- (3) → Every 25<sup>th</sup> yr, population doubles.

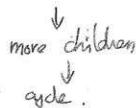
Reasons for population growth.



i) Sexual passion.

ii) Availability of subsistence.  
resources to sustain the population.

Passion for sex → early marriage → more reproductive period



Available subsistence → food & resource a variable  
(good reproductive health, property)  
↓  
sexual relation more resource to take care of children  
less CR, IMR  
↓  
more children  
↓  
population growth overcomes subsistence.

- (4) If we DO NOT apply preventive checks, then the positive checks will start to operate.

(77)

- Preventive checks  $\rightarrow$  moral restraint,  
 $\rightarrow$  No early ~~late~~ marriage, spaced birth, limited no. of children
- Positive checks  $\rightarrow$  famine, competition for resources  
 $\uparrow \downarrow \downarrow$   
 food crisis war crime

### Criticism

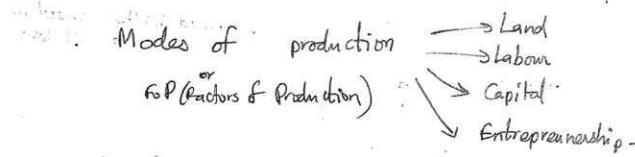
- 1) No vision about contraceptive measures, by technological advancement.
- 2) Religious in nature  $\rightarrow$  Being a catholic, he does not advocate contraception.
- 3) ~~\*\*~~ That the population doubles in 25 yrs, is arbitrary.
- 4) Sexual desire for sex is a biological phenomenon, whereas desire for children is a social phenomenon. He fails to distinguish these two.
- 5) This theory is NOT universally applicable.  
 (can't be applied in Arabia, where religion dominates).
- 6) He could not envisage the scientific developments in agri, which ~~will~~ had later led to a huge jump in food production.

### SIGNIFICANCE

- First to introduce the awareness about population explosion & its vagaries.

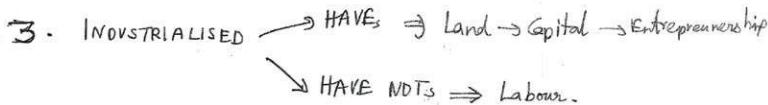
- $\rightarrow$  Very doomsday in approach. No effective <sup>practical</sup> solution suggested.

Marx → German intellectual.



- Marx made a historical interpretation of modes of production. ('historical dialectism')

- 1. Hunting & gathering → Socialist society; No private property  
Primitive communism.
- 2. Settled agriculture → land clearance, domesticated animals  
First private property.  
Resources were high; so everybody had access to resources & private property.



HAVEs multiplied their own resources. (increased their land, capital & entrepreneurial skills).

HAVE NOTS multiplied their resources → Labour → population. More children are his only old-age insurance. More population → more labour → less wages per labour → further increase population → cycle.  
HAVEs reduced their population → less children → to prevent DILUTION of their resources.

HAVE NOTS enjoyed their leisure → no ~~use~~ resources to concentrate on during leisure → so more population -

HAVES started exploiting.  $\Rightarrow$  low wages, hire & fire, unsafe working conditions (79)

They established institutions to protect them from the HAVE-NOTS.  $\downarrow$  law & order, police, estate;

### Change of population growth with modes of production

Hunting, gathering  $\rightarrow$  have to carry their children on their back. So, no further children until the first child learns to walk. So, automatic control. LESS population growth.

Settled agriculture  $\rightarrow$  settled home; no need to carry children. ~~children~~ Cap b/w pregnancies DECREASE. MORE population growth. Moreover, settled homes increased the intimacy of relationship  $\Rightarrow$  so, more children.

Industrialised  $\Rightarrow$  Capitalists BUSY managing their resources. No <sup>leisure</sup> time. No population growth.

### Moral Solution

Change the capitalist society to a communist society, to decrease population. HAVE-NOTS will have resources to manage, less leisure, prefer NOT to dilute resources  $\Rightarrow$  LESS population growth.

### Criticism

1) 'Wages' is an economic phenomenon, not a demographic phenomenon (for e.g. In India, though population is growing, wages are increasing yr by yr).

2) Distribution of resources equally will severely affect the ability to organise MEGA PROJECTS.

3) Distribution of resources will be a disincentive to ppl who work hard & want to earn more.

## 18/08/12 Bottom topography of Pacific ocean

→ Approach is no mid ridge; so inst. of approaching over the whole ocean (shelf, islands, ridge), approach as diff. parts of the sea.

### N. W Pacific

- <sup>continental-ocean convergence</sup>  
Continental shelves
- Convergence zone → so no continental shelf → no marginal sea
- Trenches → due to convergence  
Guatemala, California trench
- Continental shelf widens towards Alaska ⇒

### N.W Pacific

- Ridge → S. Honshu ridge → <sup>oceanic convergence</sup> Japan sea - Pacific
- A lot of trenches → Kuril trench, Japan trench, Mariana trench, Mindanao trench.  
↓  
Deepest trench.

C. Shelf <sup>too</sup>: Though convergence place, b/w the island arcs and the mainland, continental shelf is present ⇒ so

marginal seas ⇒ S. China Sea, Japan Sea, Sea of Okhotsk,  
(b/w China & Philippines) ↓ (b/w Russia & Japan)

- Deepest part of the ocean.
- Islands ⇒ Philippines, a part of Indonesia, some S.E. Asian arcs & festoons → Japan arch, Philippines, Kuril, Sakhalin countries.

### S. W Pacific

contains a lot of islands → made of coral reefs or sea mounts, guyots. (mostly coral reef) Great Barrier Reef (east coast of Aus.)

scattered Islands → Micronesia, Polynesia, Melanesia

Ridge → Lord Howe ridge (b/w N.Z & Aus.)

Trench  $\rightarrow$  Tonga <sup>trench</sup> & Kermadec trench  $\Rightarrow$  steepest trench. (81)

Coral reef  $\rightarrow$  Great Barrier Reef

Mangal seas  $\rightarrow$  Tasmania sea, Java sea, coral sea, Timor sea.

### S.E. Pacific

- Ridge  $\Rightarrow$  East Pacific ridge (Albatross ridge)  
S.E. Pacific Plateau,

Cold ridge.

Juan Fernandez ridge (Along Chile coast).

Challenger fracture  $\Rightarrow$  towards southern tip of S. America.

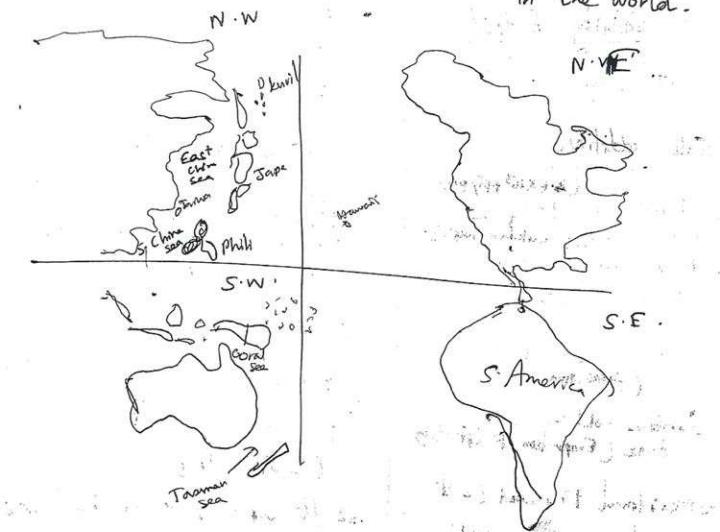
- Most no. of islands.

- No continental shelf due to convergence (continent-ocean  $\Rightarrow$  Andes)

Chilean Is -

continental seabed is.  $\Rightarrow$  Juan Fernandez, Ambrosio, Fehiz

- Trench  $\Rightarrow$  Peru-Chile-Peruvian trench  $\Rightarrow$  longest trench in the world.



$\rightarrow$  Largest ocean in the world.

$\rightarrow$  Most variety b/w diff. parts of same ocean.

$\rightarrow$  Absence of clear-cut ridges.

$\rightarrow$  Most no. of islands.

$\rightarrow$  Variety of land features  $\rightarrow$  coral reef, geyser, sea mounts.

$\rightarrow$  World's deepest & longest trenches.

- Salinity of water
- Average salinity = 35‰.
- Salinity → Amt. of dissolved salt (in gms) per kg. ~~of water~~ (Measured in parts per thousand → ppt or ‰)
  - Normal salinity of ocean → 35‰ so salinity

- Brackish water ⇒ Salinity < 24.7‰.  
⇒ 24.7‰ ⇒ ocean (saline) water

Isohyde  $\rightarrow$  Places receiving the same amt. of rainfall

Isohaline  $\rightarrow$  Places having the same salinity  
 $\downarrow$   
salt (halide)

### Salinity Budget

Salt  $\Rightarrow$  not only Na, but also Cl, Mg, Ca.

| Salt addition   | Salt removal  |
|---|---|
| $(2.6 \times 10^6 \text{ ppt/yr})$                      |   |
| → Addition by river water<br>Calcium sulfate            | → Human consumption (salt extraction).                    |
| → Dead marine organisms & their excreta                 | → Reverse osmosis   |
| → Wind carries salt from land.<br>(Advection)           | → Phyto & Zoo plankton consumption                        |
| → Surface moisture flux (Evaporation - precipitation)   | → Sea breeze carries away salt.                           |
| → Meridional transport (salt carried by ocean currents) | → Percolation of salt into water table<br>(Sedimentation) |
|   | → Salt exclusion during ice formation                     |

Percolation  $\rightarrow$  vertical movement

Seepage  $\rightarrow$  horizontal movement

## Significance

- Imp. for marine organisms (eg:- Ca<sup>2+</sup> is essential for shell forming organisms)
- buoyancy (due to density → floats → ship navigation).
- salinity affects sp. heat capacity of water → evaporation → ppt. in arid areas
- salinity → ocean currents; salinity → freezing pt. of water → polar ice sheet

## factors affecting salinity

- 1)  $\rightarrow$  Black sea (15%) low salinity → due to Danube, Dniester, Dnieper  
 Influx of fresh water → rivers deglaciation, rainfall.

- 2) Temperature → evaporation. ↑ 35% at 5°N  
 ↓ 37% at 20°N → subtropical high P. cloudless sky

- 3) Ocean current → Gulf of Mexico (37%) due to Gulf Stream  
 warm current → high evap. → high salinity ↑  
 N. Atlantic drift increases salinity of NW Europe coast

- 4) Winds → cold current → low evap. → low salinity  
 Labrador current → N.W. Atlantic (33%)  
 Oyashio current → N.W. Pacific (31%)

0° to 30° ⇒ trade winds → flow from east to west

so, more salinity on the western part of ocean (to the east of the continent).  
 low salinity on eastern ocean (to the west of the continent).

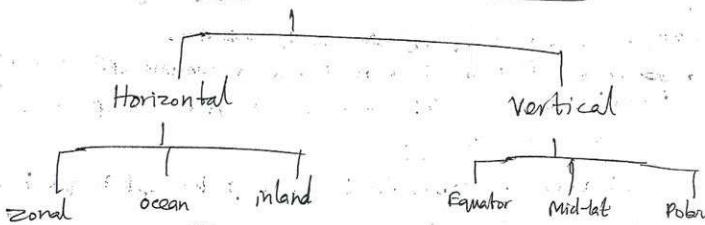
30° to 60° ⇒ Westerlies → west to east

so, more salinity on eastern part of ocean (west coast of continent)

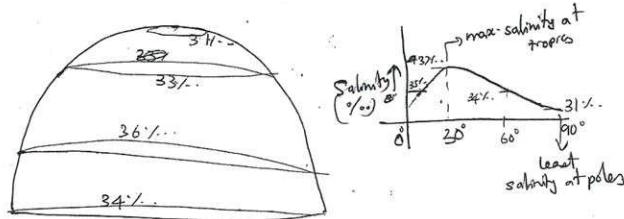
- 5) Mid-Atlantic ridge → prevents mixing of water on two sides of the ocean. But mid-Atlantic Ridge has several holes, through which mixing is possible through seeping.

| Salt                              | Percentage |
|-----------------------------------|------------|
| 1. NaCl                           | → 77.8%    |
| 2. MgCl <sub>2</sub>              | → 10.4%    |
| 3. MgSO <sub>4</sub>              | → 4.7%     |
| 4. CaSO <sub>4</sub>              | → 3.6%     |
| 5. K <sub>2</sub> SO <sub>4</sub> | → 2.5%     |
| 6. CaCO <sub>3</sub>              | → 0.3%     |
| 7. MgSO <sub>4</sub>              | → 0.2%     |

## Salinity distribution



## Zonal distribution



Equator  $\Rightarrow$  low salinity (in spite of high temperature)

Reasons for low salinity:  
• High rainfall

• Influx of river water from Amazon, Congo, Ganges, Brahmaputra, Irrawaddy.

## Mid-latitude

### HIGHEST SALINITY

- Reasons:
- Subsidence of air mass (Anticyclonic condition)
  - High insolation, due to clear sky, increased evaporation.
  - Not much addition of freshwater by rivers.  
Anticy

## Subpolar

### LOW SALINITY

Reasons, Low temp.

- High rainfall (cyclonic)
- Freshwater by ~~Nile~~ Danube, Rhine
- meltwater from tropic cold current.

## POLAR

(85)

- Lowest salinity.

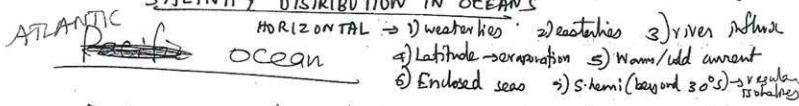
Reasons

- Alternate freezing & ~~thawing~~ melting expels the salt -
- Large influx of fresh water due to melting of glaciers.

Closely spaced isohalines  $\Rightarrow$  high salinity gradient

$\downarrow$   
fast change in salinity.

### SALINITY DISTRIBUTION IN OCEANS



0° to 30°  $\Rightarrow$  low salinity in eastern margin  $\rightarrow$  African coast ;  
 Salinity increases towards western side of ocean  $\rightarrow$  (since trade winds carry highly saline water from east to west)

30° to 60°  $\Rightarrow$  Westerlies / low salinity in .  $\rightarrow$  also due to warm current (wif)

Salinity increases towards eastern side of ocean  $\Rightarrow$  North Sea, British Coast  
 high salinity (34‰) despite high latitude ( $55^{\circ}\text{N}$ )  $\rightarrow$  due to saline water from N Atlantic Drift (warm current) & westerlies.  
 $\rightarrow$  A big loop is formed in Central Atlantic ocean due to gyral formation (rotation of ocean current).

- Salinity high in Caribbean  $\Rightarrow$  more
  - LANDLOCKED SEAS  $\rightarrow$  Mediterranean (40‰)  $\rightarrow$  high evaporation
  - Baltic sea (15‰)  $\rightarrow$  high influx of freshwater.
- Mouth of Amazon ( $15\%$ )  $\Rightarrow$  N.W. South American coast mouth of St Lawrence  $\rightarrow$  31‰.  $\downarrow$   
 Rhine  $\rightarrow$  32‰.  $\rightarrow$  less salinity.
- Isohalines in S American coast never touch Africa due to the effect of cold current in Africa.  $\rightarrow$  low salinity.
- Beyond  $40^{\circ}\text{s}$ , there is regular horizontal isohalines due to the absence of land.
- Though ridges are present, NO salinity divide as there are openings in the ridges which allow inter-mixing of water.

## Indian ocean

- Salinity divide  $\Rightarrow$  A vertical isolalne  $\Rightarrow$  due to the effect of a mid-ridge -  
prevents inter-mixing of water on two sides, creating a salinity divide.
- High salinity in Bay of Bengal & Arabian Sea  
(41%)  
due to land locked nature & dry weather (middle east  $\rightarrow$  deserts)
- But, salinity of Arabian sea  $>$  Bay of Bengal  
(35%)  $\downarrow$  (30%)  
less influx of freshwater than Bay of Bengal;  
more arid climate (monsoon winds)  
from Arabia  
high salinity from Red sea
- Salinity of Arabian Sea  
and reflux of Ganges, Brahmaputra, Irrawaddy
- Loop formation  $\Rightarrow$  S. Indian ocean (near Aust. coast)  
 $\uparrow$   
due to change in direction of ocean current in Indian Ocean, absence of loops in N. Indian ocean.

## Pacific ocean

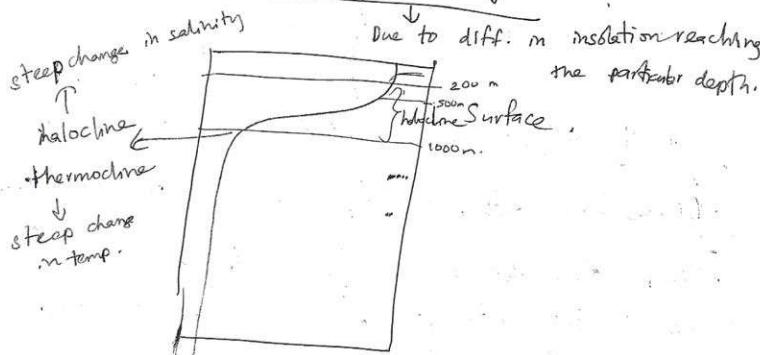
- High irregularities in salinity due to presence of several islands.
  - Huge variation due to big area.
- Loop formation both in N. Pacific & S. Pacific.
- $0^\circ$  to  $30^\circ \Rightarrow$  salinity increases towards western part of ocean  
(due to trade winds) as Gulf of California has salinity 34%.
- $30^\circ$  to  $60^\circ \Rightarrow$  " " " eastern part of ocean  
(due to westerlies)
- No ridge  $\rightarrow$  no salinity divide.
- Low salinity in river mouths  $\Rightarrow$  Yangtze river mouth (33.1%)  
Yellow river (Yangtze) mouth (30%).
- Salinity low in N.W. Pacific (Okhotsk sea  $\rightarrow$  31%), Manchuria  $\rightarrow$  34%  
due to influence of melt water & Oyashio cold current from poles.

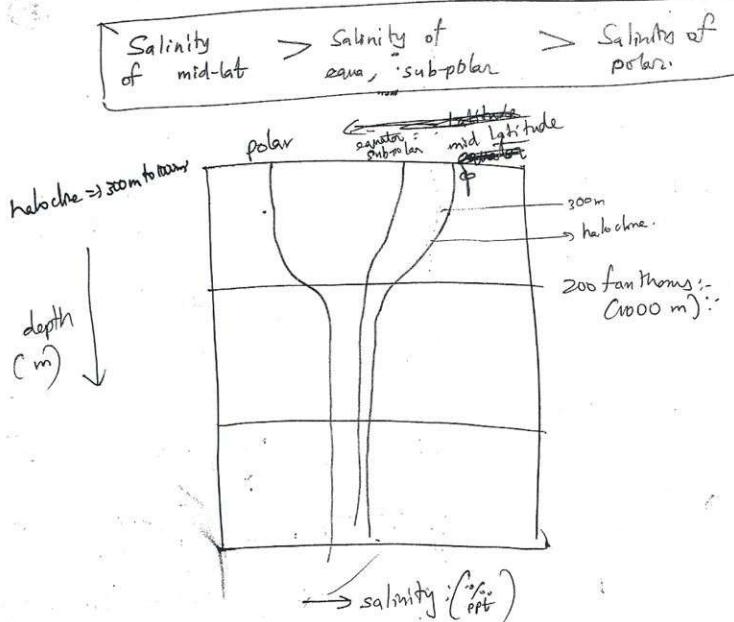
## Inland seas

(87)

- Salinity also depends on presence or absence of outlets with ocean.
- Presence of outlet  $\Rightarrow$  Mediterranean sea  $\rightarrow$  high salinity due to evaporation.  
↓  
exchange of water salinity b/w inland sea & ocean.
- ↓  
so, comparatively less salinity.
- Inland seas with no outlet
- Absence of outlet  $\Rightarrow$  Dead sea, Lake Van, Great salt lake  
288‰ ~~220‰~~ 330‰  $\rightarrow$  Isr-Jordan, Turkey, 220‰  
no salinity exchange  $\downarrow$  highest salinity in the world  
However, Black sea has low salinity due to influx of Danube (freshwater)  
so, all salt conc. within the inland sea  
↓  
less salinity (in high altitude due to glacial & river water) more salinity (from low latitude due to high evaporation)

## Vertical distribution of salinity:





- In polar regions, the surface is less saline due to deglaciation & ~~but too~~ salt expulsion from the surfaces; also due to glacial meltwater.
- After a certain depth, salt content increases.

- Critically analyse the salinity distribution in the world. (15 m or 30 m)
- Discuss how salt budget is maintained in the ocean. (12 m)
  - Temp. alone does not increase salinity of the ocean. With ref. to this statement, explain the factors influencing the dist. of salinity. (15 m)

If, 15m Critically analyse salinity dis.

→ Land locked  $\Rightarrow$  salinity high

→ Mid-oceanic ridges  $\Rightarrow$  salinity divide

→ Loop (ocean current)

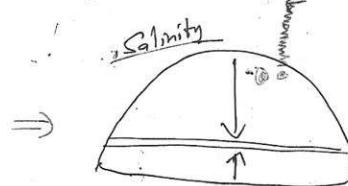
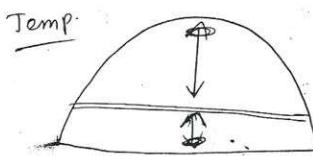
→ wind influence

→ vertical dist.

DO NOT go deep into the various oceans

Temp. alone does not increase salinity?

In case of a statement-type ques. first explain the statement - support or negate it & then go with the flow.



There is a correlation.

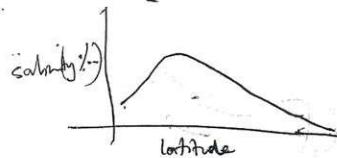
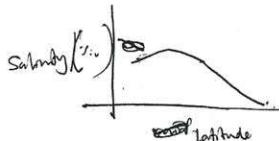
But, it is not the only deciding factor.

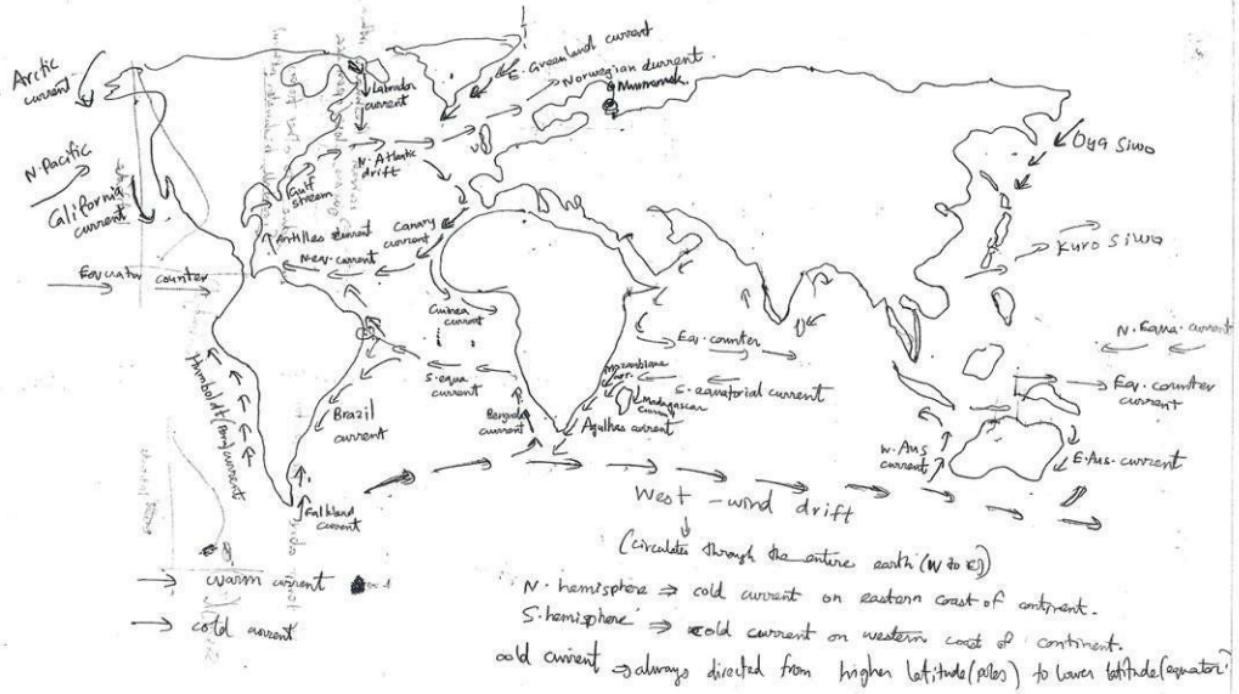
for ex:-  
Equator does not have as much salinity as dictated by the temp.

Other factors  $\Rightarrow$  rainfall, freshwater inflow, glaciers, close/open sea, ocean current, ridge.

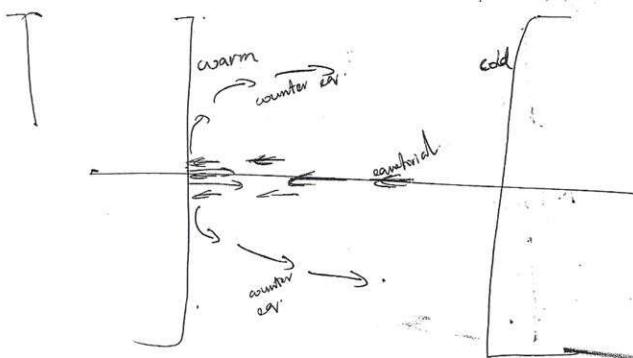
If temp. alone is the factor

but due to other factors  
(rainfall, freshwater inflow)





(91)



Earth rotates from west to east → due to inertia, the ocean current moves from east to west

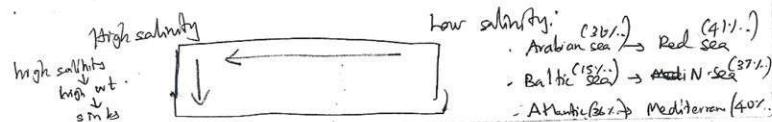
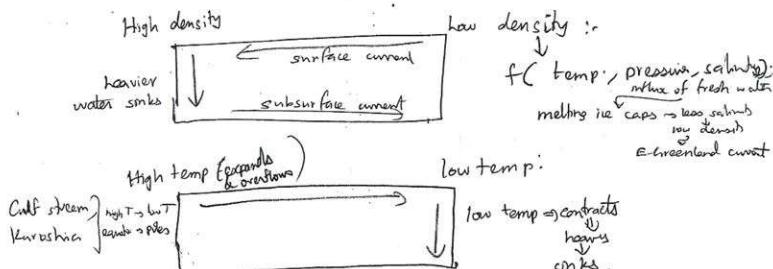
Equatorial curr.  $\Rightarrow$  due to earth's rotation & influence  
of trade winds

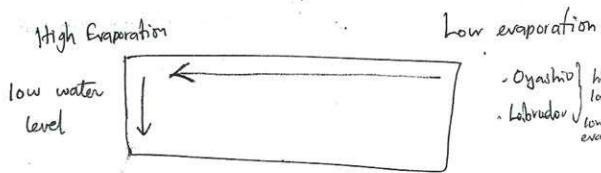
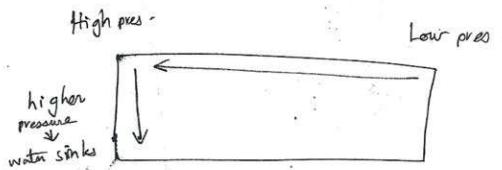
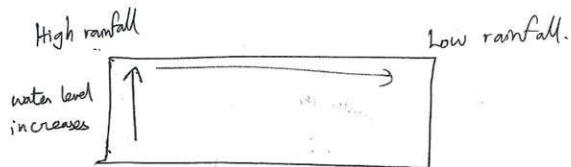
Counter equatorial current  $\Rightarrow$  on hitting the continent  
west to east. moves in the oppsite

Equatorial current on hitting continents splits in N. & S.  
clockwise. ant'clockwise.

### Factors affecting ocean current

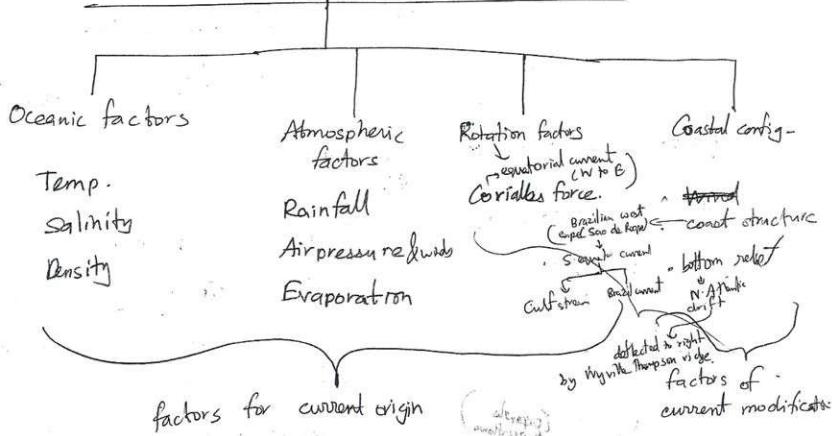
Oceanic factors  $\rightarrow$  Density, temperature, salinity.





- Oyashio } high latitude  $\rightarrow$  low
- Labrador } low  $\rightarrow$  high evap. evap.

### Factors responsible for ocean currents



- Current  $\rightarrow$  has a definite direction & greater velocity. (93)
- Stream  $\rightarrow$  Speed is increased (more than a current)
- Drift  $\rightarrow$  Does not have definite direction; dictated by wind.

### Speed

Stream  $>$  Current  $>$  drift

- Meeting pt. of cold & warm currents  $\Rightarrow$  large amt. of phytoplankton & zooplankton available  $\Rightarrow$  food material for fishes  $\rightarrow$  fishing industry.

Cold current  $\rightarrow$  food material available. for fish.

Warm current  $\rightarrow$  not enough food. for fish.

### El Nino & Southern Oscillation

\* important mechanism & effects  
 El Nino,  
 El Nino Modoki;  
 dipoles in Indian ocean

- In some extraordinary yrs., the Humboldt current (a cold current) on the Peruvian coast is replaced by El Nino (warm current).

This reduces the available food for fish  $\Rightarrow$

Anchovies fishes on Peruvian coast die without food

Guano bird dependent on Anchovies fish dies  $\rightarrow$  Guano from its droppings(excreta)

fertilizers production decreases  $\rightarrow$  economy suffers

- The El Nino(warm current)'s effect is carried throughout the world by the West-wind drift. This is called southern oscillation.

- El Nino has a detrimental drought effect in India (S.W monsoon  $\Rightarrow$  no rain) & floods on China.

## Impacts of ocean current

1. Fishing ground  $\rightarrow$  meeting pt. of warm & cold current

USA Canada  $\Rightarrow$  Grand Bank

$\downarrow$   
Meeting of Gulf stream & Labrador current,  
 $\downarrow$  warm cold

Japan  $\Rightarrow$  meeting pt. of Kuro Siwo & Oya Siwo.  
 $\downarrow$  warm cold

### 2. Climatic alterations.

warm current  $\rightarrow$  brings more rainfall to the coast.

N-Atlantic drift keeps Britain warmer than other

(warm current)

places in the same latitude. (Canada).

(warm water) is carried

Norwegian current keeps the Russian port

$\downarrow$  warm

Murmansk on the Arctic coast ice-free throughout  
the year.

### 3. Navigation

Direction of ocean current  $\rightarrow$  fuel efficiency.

Meeting pt. of warm & cold  $\Rightarrow$  meeting of

warm & cold  $\Rightarrow$  winds  $\Rightarrow$  cold warm air mass rises,

cold air settles at the bottom  $\rightarrow$  mist formation

(Cirrus cloud)

$\downarrow$   
T'ITATTC (Grand bank)

$\downarrow$   
Meeting of cold Labrador  
current & warm Gulf stream.

Salinity distribution.

Fish movement

## Desertification

(95)

Cold current  $\Rightarrow$  subsidence of air mass  $\Rightarrow$  no rainfall.

All deserts are backed by cold current.

Atacama  $\Rightarrow$  Humboldt current

Patagonia  $\Rightarrow$  Falkland currents.

W. Australia  $\Rightarrow$  W. Aus current

Sonoran, Mojave  $\Rightarrow$  California current.

~~Sahara~~  $\rightarrow$  Canary current.

## Cyclones

Cyclone  $\rightarrow$  low pressure warm current  $\rightarrow$  rainy climate :-

Cold current  $\Rightarrow$  high pressure  $\rightarrow$  no cyclone :-

## Delta formation

Amazon, Parana-Paraguay  $\Rightarrow$  no delta formation  $\Rightarrow$  only estuaries.

deposited silt is carried away by the warm current.

## Heat budget

- west wind oscillation ...  
- equatorial current ...

## Pollution spreading

Oil spills in an ocean are carried throughout the world

## Sea weeds

Circular formation (loop)  $\rightarrow$  all dust acc. in the centre

$\rightarrow$  Sea-weeds (Sargassum) grow well.  
eg:- Sargasso sea.

## Coral reef

$\rightarrow$  found on the eastern coast of the continent.

$\rightarrow$  Coral reef  $\rightarrow$  need warm temperature  $\rightarrow$  so warm current reqd.

## Energy production

- Non-conventional renewable new energy from rotation of turbines by ocean currents.

OTEC → Ocean Thermal Energy Conversion;

## EL Nino

- Impact on monsoon.

- Causes coral bleaching.

## Malthusian theory

1. Poverty & misery  $\Rightarrow$  natural inevitabilities
2. Solution  $\rightarrow$  preventive & positive checks
3. Economically driven theory
4. Formal in approach.  
(Arithmetical progr., mathematical calc.)
5. Dedicated population theory.
6. Factors for population growth
  - 1) Desire for sex
  - 2) Availability of subsistence
7. Period of doubling  
 $- 25$  yrs.

8. Population leads to poverty.

9. Wider applicability

10. Supported capitalism.

Similarities

- $\rightarrow$  Failed to realize religious factors of pop. growth.  
(Opp. of many religious consider children the gifts of God & hence avoid use of contraceptives).
- $\rightarrow$  Failed to envisage the tech. devt. & contraceptive methods.
- $\rightarrow$  Failed to take in local factors  
(In India, population growth was mainly due to the desire for a male child.)

## Marxian theory

(27)

- Poverty & misery  $\Rightarrow$  gifts of capitalism.

- $\rightarrow$  solution  $\Rightarrow$  distribution of resources. (change in mode of production).
- Politically driven theory.
- Based on observations (informed).
- By-product of his economic & political theory.
- Factors of population growth
  - Need to produce surplus labour.

- Period of doubling  
 $\downarrow$   
varying with various societies (depend on occupation pattern).

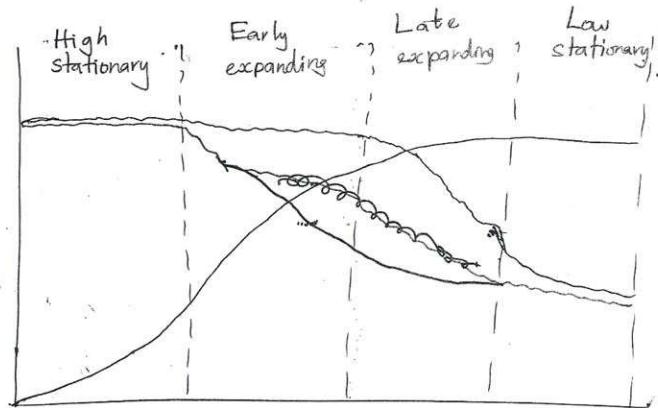
Poverty leads to population growth.

Constraint only to certain sections of society.

Supported communism.

## Demographic transition theory

Thompson & Notestein.



— birth rate

— death rate

|     |          |  |                         |                               |
|-----|----------|--|-------------------------|-------------------------------|
| I   | Agrarian | $\Rightarrow$ High stationary $\Rightarrow$ High                               | High epidemics          | <del>stable</del> slow growth |
| II  |          | $\Rightarrow$ Early expanding $\Rightarrow$ High<br>(mortality induced)        | $\downarrow$            | Increased at<br>a high rate   |
| III |          | $\Rightarrow$ Late expanding $\Rightarrow$ $\downarrow$<br>(fertility induced) | low                     | Increased at<br>a lower rate  |
| IV  |          | $\Rightarrow$ Low stationary $\Rightarrow$ Low                                 | Low                     | slow growth                   |
| V   |          |  | Birth rate = Death rate | zero growth                   |

When a country or a region develops from an agrarian society to an industrialised modern society, a particular direction of demographic transition occurs — from high fertility, high mortality to low fertility, low mortality.

I stage

• Pre-modern, pre-indus.  $\Rightarrow$  no tech. innovation.

• Agrarian societies

- No rudimentary instruments used - wasteful production; less life expectancy.
- Long period of breast-feed & nomadism will put preventive checks on pop. growth.

• High death rate due to epidemics.

• Large family considered an asset

II stage

$\rightarrow$  eg:- India, Kenya, Indonesia, Pak., Bdesh.

• Introduction of medical facilities.

• Industrialisation.

• New societies (from feudal to ~~an~~ organised form of govt.).

• Death rate reduced drastically

• In the late second stage  $\Rightarrow$  slow decline in birth rate, steep decline in death rate.

• No longer, large families are assets?

~~etc etc~~

III stage

• entrepreneurship.

• Luxurious goods consumption.

• more conc. on consumer goods.

• Birth rate reduced <sup>drastically</sup>  $\Rightarrow$  increased awareness of

contraceptives.  $\rightarrow$  eg:- China, Brazil,

~~etc etc~~

IV stage

• Highly specialised society.

• Consumerism : demand-driven

• Boom in tertiary sector.

• Birth rate & death rate match each other.

• Population will become stabilised.

• Abundance of tech. know-how; labour specialization.

eg:- Anglo-America.



→ Population is a self-adjusting phenomenon, as the society gradually matures.

→ Economic & social devt and class mobility is

|       | I                         | II   | III               | IV                      |
|-------|---------------------------|--|-------------------|-------------------------|
| world | Certain African countries | India, Pak, B'desh                                     | China, Brazil     | Scandinavia, U.S., U.K. |
| India | Tribal communities        | BIMARU<br>Bihar, M.P., Rajasthan, U.P.<br>(CAG states) | Karnataka, Andhra | TN, Kerala              |

### Significance

- A proper understanding & analysis of the stage of population growth of a particular region will help in deciding on the type of policy measures in that region. For e.g.: for a region in stage I, it is essential to introduce medical facilities to choke the high mortality rate. For a region in stage II, it will be suitable to spread education about contraception.

### Merits

(P)

- First theory to relate dpt. & population.

- Supported by statistics (birth rate & death rate figures).

### Criticism:

- West Asia → Economic dpt. ~~has~~ did not bring down the population growth. Religious factor not considered.

- China → has jumped the II stage in a short time by autocratic & suppressive measures → One Child policy

- ~~No~~ An important factor → Migration — is not included.

- France, Germany ⇒ gone beyond stage IV

- What after stage IV? Is it a cycle? No mention.

- France, Aus ⇒ still an agrarian country but population growth has stabilised. So, stages of pop. does not entirely depend on the type of occupation.

- U.S.A. ⇒ born in the II stage.

So, all stages not applicable to the entire globe.

- Sequential dpt. of stages may be disturbed by a sudden war or a natural calamity.

Though, this theory is widely applicable.

- Mainly based on empirical observations of ~~the~~ in the West. Does not take into acc. the socio-economic factors of east.

19/08/12

## Thornthwaite's classification

1931 classification (all formulae use temp. in °F & rain in inches)

→ He accepted vegetation as a basis, but not directly.

→ He took temperature as a factor, but not abs. values.

He introduced

→ Precipitation efficiency → Amt. of pot. that is available for the growth of vegetation.  
~~percolates through the soil~~

→ Thermal efficiency ⇒ positive deviation of mean temp from freezing pt.  
pt. off. index ( $P/E$ )

To calculate these, he used Humidity Province

and Thermal efficiency index ( $T/E$ ).

$$P/E \text{ ratio} = \frac{\text{Total rainfall (monthly)}}{\text{Total evaporation (monthly)}}$$

$$P/E \text{ monthly ratio} = 11.5(rt - 10)^{10/9}$$

$$P/E \text{ index} = \sum P/E \text{ (monthly)}$$

r → rainfall (monthly) (in inches)

t → temp. in fahrenheit. (monthly)

Based on P/E indices, he classified HUMIDITY

PROVINCES.

### Humidity provinces (5)

| Humidity province | Vegetation          | P/E index - Annual |
|-------------------|---------------------|--------------------|
| A → wet           | Tropical rainforest | 128+               |
| B → humid         | Sub-tropical        | 64-127             |
| C → semi-humid    | Tropical grassland  | 32-53              |
| D → semi-arid     | steppe              | 16-31              |
| E → arid.         | Desert vegetation   | < 16               |

## Thermal provinces (6)

Based on T/E (index), he classified thermal province.

$$T/E^{\text{C monthly}} = (t - 32) / 4 \quad (t \rightarrow \text{monthly temp (fahrenheit)})$$

$\uparrow$  freezing degree  $T/E (\text{annual}) = \sum T/E (\text{monthly})$

$\uparrow$  freezing degree  $T/E (\text{annual}) = \sum T/E (\text{monthly})$

A' → Tropical (Megatherm)      128+

B' → Meso-thermal      64-127

C' → Micro-thermal      32-63

D' → Taiga      16-31

E' → Tundra      0-15

F' → frost      < 0

## Seasonal distribution of rainfall. (4 categories).

r → rainfall in all season

s → summer dry

w → winter dry

d → dry in all seasons.

Combining humidity, thermal provinces & seasonal dist. of rainfall, he made  $5 \times 6 \times 4$  classifications theoretically, but only 32 are practically applied.

### Criticism

- Large data reqd. for calc. P/E & T/E.
- Very diff. to memorise, due to a lot of symbols
- This classification needs a lot of calculation & skilled persons.
- Large no. of climate types.
- Failed to give relation of temp. & ppt. with wind, ocean current, etc.

1948 classification (all formulae use temp. in  $^{\circ}\text{C}$ )  
 & rain in (cm)

Introduced 2 more variables

- i) Potential evapotranspiration (PET) (loss of water from plants & soil)  
 ii) Soil moisture index (ability of soil to retain water).

$$\frac{\text{PET}}{\text{cm}} = 1.6 \left( \frac{10t}{i} \right)^{\alpha} \rightarrow \text{monthly}$$

$t \rightarrow$  monthly temp. ( $^{\circ}\text{C}$ )

$$i \rightarrow \text{sum of } (\sum t) \left( \frac{1.514}{5} \right)$$

$\alpha \rightarrow$  complex fn. of  $i$

Soil moisture index

$$Im = (10S - 60D) / PET \rightarrow \text{monthly}$$

$S \rightarrow$  monthly water surplus

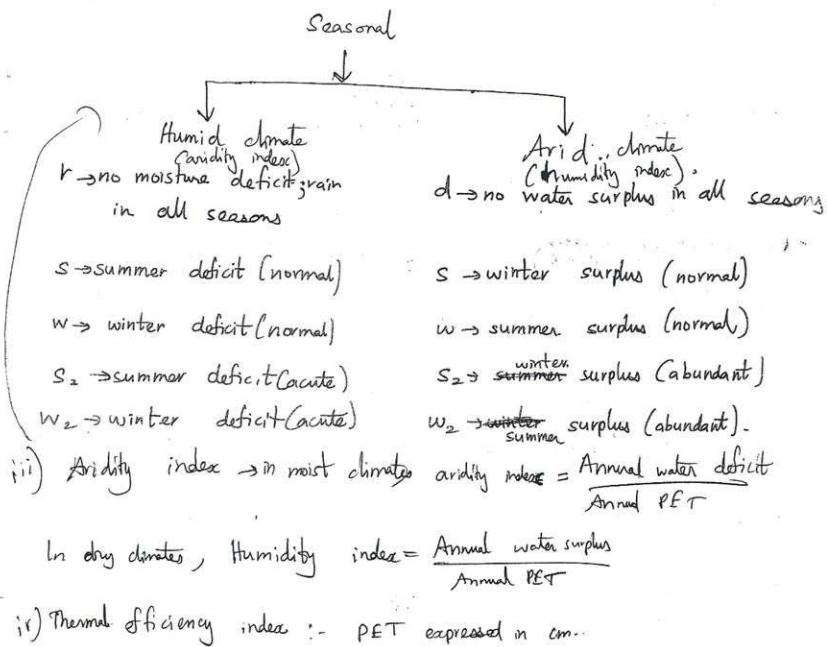
$D \rightarrow$  monthly water deficit.

### New humidity & thermal provinces:-

| Moisture index | Humidity province | Thermal province |
|----------------|-------------------|------------------|
| $\geq 100$     | Per humid         | Megatherm        |
| 20-100         | Humid             | Mesotherm        |
| 0-20           | Moist subhumid    | Microtherm       |
| -33-0          | Dry subhumid      | Tundra           |
| -67 to (-34)   | Semi arid         | Frost            |
| -100 to (-68)  | Arid              |                  |

## Seasonal variation of Effective moisture

(105)



- Critical appraisal of Thornthwaite (30m)
- Comparative analysis of Thornthwaite's 1931 & 1948 classification.
- Koppen's has more applicability than Thornthwaite's.
- For climate change, read 4x report of GoI, b and UNFCCC report & Science exp. website

### Koeppen

- Directly considered veg. as a basis.
- Abs. values of temp. & rainfall.
- Evaporation not given weightage (except in 187)
- No mention of transpiration.
- Globally & general applicable. (popular among climatologists, meteorologists, geographers, botanists).
- Split weightage to altitude & latitude.
- Climatic zones perfectly coincide with veg. zones.
- Relatively less no. of zones.
- Simple & less no. of formulae. Computation & data collection easy.
- Considered rainfall as such.
- B  $\Rightarrow$  semi-arid, arid.

### Thornthwaite

Only considered as a veg. indirectly, through evapotranspiration.

Values sub. to give certain indices, which are used for classification. Evaporation considered a major factor. Transpiration is included in 1948 class.

Can be used only at research level. (popular only among botanists & geom.) No mention of altitude & latitude initially, but only later included.

No coincidence except in N. America.

3 times more climatic zones.

Complicated formulae.

Calc. effective rainfall through P/E, PET, soil moisture index.

B  $\rightarrow$  Mesotherm.

### Similarities.

1. Both used symbols & formulae.
2. Both recognised the role of vegetation.
3. Rainfall & temp. are major factors, in both classification.
4. Both used quantitative values for delineation of climates.

## Similarities.

- 1) Both recognised vegetation, only indirectly -
- 2) Both appreciated evaporation as a major factor.
- 3) Both classified humidity & thermal provinces.
- 4) Both did NOT take into account causative factors.
- 5) Both are very complex schemes.

## Difference

1931

1948

1. Variables :-  $H/E, T/E$  $PET, hm$ 

2. Only evaporation

Evaporation, transpiration,  
soil retention

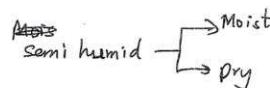
3.

Can be used by  
agri. scientists for  
irrigation scheduling

4. 5 humidity, 6 thermal provinces.

6 humidity, 5 thermal  
provinces.

5) Only one semi-humid.



6) Both tundra &amp; taiga included.

No mention of taiga.

7) Considered only N America.

Considered the entire world.

→ Critical appraisal of Thornthwaite's.

Give this intro

indirect vegetation  
effective rainfall through P/E, T/E,  
modified in 1948 through PET, soil mois. index,  
to include the effect of veg. (trans.) & run-off (retention cap. of soil).  
used values of temp. & rainfall in certain formulae  
for classification.  
first to intro concepts such as Th. eff., pot. eff.

→ Now elaborate on the adv. & disadv. of Thornthwaite,  
comparing its advan. over Koepen's shortcomings..

→ Comparative analysis of Koepen's & Thornthwaite's.

- Both similarities & diff.
- Use the pts. in the table.
- Elaborate by explaining what are thermal  
humidity provinces.

Explain Thermal off., pot. eff., soil retention.

- Give formulae for T/E, P/E, PET, lm. & elaborate on  
the data read., the range of these indices.
- Give the applicability of.

→ Koepen's more applicable than Thornthwaite -

⇒ 5 lines; esp. abt Koepen & Thornthwaite.  
Matching of climatic zones with veg. makes for

easy class.

Use of abs. values make even or common.

## OCEANOGRAPHY

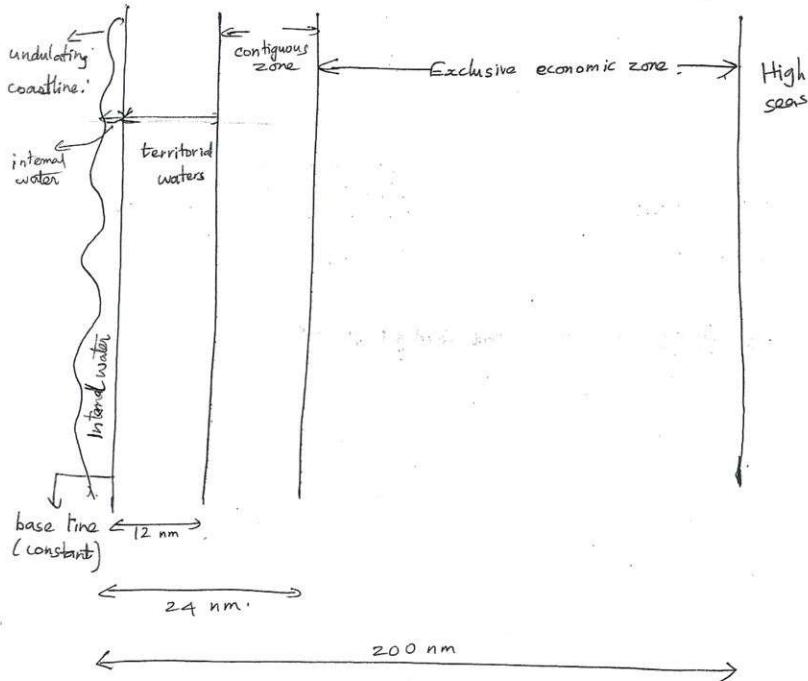
(109)

### Law of Seas.

→ U.S. has NOT ratified. India is a party.

UNCLOS → UN Convention on Law of Seas.

ISBA → Int'l. Sea Bed Authority.



Horizontal distance → measured in Nautical miles (1 naut mil = 1.86 km).

Vertical distance → measured in fathoms (1 fathom = 6 ft.).

Blue water policy → <sup>aircraft carriers, submarines,</sup> <sub>high seas adjacent</sub> expedition in <sup>another country's</sup> territorial waters

Green water policy → expedition in <sup>another country's</sup> EEZ.

Brown water policy → expedition in <sup>another country's</sup> rivers.   
 own territorial waters, mainly rivers & inland seas

→ similar to one country's land mass shelf ; state govt. has jurisdiction  
→ Territorial water ⇒ complete security

National constitution applies.

• Also called 'marginal sea' or 'marine belt'.

- 0-12 nm from base line.
- No other country can enter the territorial waters of a country without its permission.
- However, there is a narrow HIGH SEA PASSAGE even in territorial waters for: port accessibility & free trade & transit.
- Coastal nation has COMPLETE SOVEREIGNTY over its territorial waters.

→ Contiguous zone ⇒ under central govt.'s jurisdiction

- 12 nm to 24 nm from base line.
- Concerned nation has rights of custom duties, fiscal, strategic, defence, immigration & sanitary (marine pollution) regulations in the territorial & contiguous zones, and it also has the right to PUNISH concerned parties for infringement of these regulations.

→ Economic Exclusive Economic Zones (EEZ).

- 24 nm to 200 nm from BASE LINE.  
India has an EEZ of 200 nm.
- Concerned coastal state has exclusive rights over <sup>mining, oil, gas, etc.</sup> exploitation, conservation & mgmt. of mineral resources of seabed deposits, ocean floor (crust), marine water energy, WATER & MARINE ORGANISMS within this EEZ. (MINING, FISHING, laying cables, navigation of ships, flying of aeroplanes of OTHER STATES).
- But, in the EEZ outside territorial waters is open for

Disputes in maritime  $\Rightarrow$  due to overlap of maritime boundaries  
(in closely located coastal countries).

- Kuril islands  $\rightarrow$  Russia & Japan.
- Paracel is. & Spratly is. (South China Sea)  $\rightarrow$  China, Taiwan, Philippines, Vietnam, Indonesia, Malaysia.
- S. India  $\rightarrow$  Lakshadweep; fishermen's struggle;
- Falkland is  $\rightarrow$  Argentina & Britain.
- Diaoyu (Senkaku is.)  $\rightarrow$  China & Japan.

### Disad. for land-locked countries.

- But, the coastal countries near land-locked countries ~~are~~ are supposed to charge low transit fee for them (e.g. India gives free port access to Nepal)
- Nowadays, land-locked countries are also demanding for drilling rights in oceans.

### Mgmt. of High Seas

- Disputes over law governing high seas.

Sea bed  $\Rightarrow$  upto 200 n.m. or edge of continental margin, with a limit of 350 n.m. from baseline or 100 n.m. from 2000m isobath.  
Sometimes, continental shelf of a coastal nation extends far beyond their EEZ. So, they are demanding ISBA for rights over these maritime regions.

$\rightarrow$  Russia's continental shelf extending in the Siberian part of Arctic ocean.

$\rightarrow$  Malaysia's continental shelf extending into S. China Sea.

### Marine Pollution

Oil spills even in one's own territorial waters spreads to the entire HIGHLIGHTS: HIGH SEAS. Who's responsible for the cost of cleaning this?  $\rightarrow$  Cu, Co, Mn, Ni; cannot be found on Indian land.

PMN  $\rightarrow$  Poly Metallic Nodules  $\rightarrow$  minerals in ocean deposits that

take the form of nodules (rounded deposits). INDIA is the first country to obtain rights for exploiting PMN. (pioneer investor) by UNCLOS III.

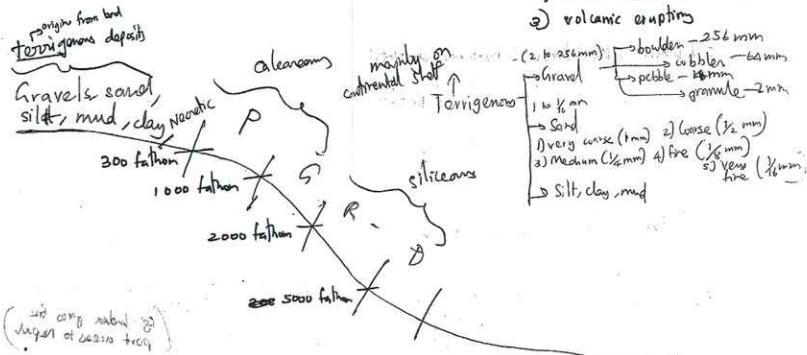
## Ocean Deposits

Thin blanket like deposits that are found on the ocean floor.

Source of marine deposits  $\rightarrow$  1) continental rocks  $\rightarrow$  weathering;

2) marine organisms  $\rightarrow$  decomposition

3) volcanic eruptions



Blue mud, Green mud, red mud,

Pelagic deposits,  $\rightarrow$  derived from algae and in the form of liquid ooze.

Pteropod, globigerina, diatom, radiolarian, red clay.

### Terrigenous

Blue mud  $\rightarrow$  iron sulphide.  
35%  $\text{CaCO}_3$

Green mud  $\rightarrow$  potassium silicate, clay, calcite, cal. carbonate.  
56%  $\text{CaCO}_3$

Red mud  $\rightarrow$  iron oxide.  
32%  $\text{CaCO}_3$

MUD  $\Rightarrow$  finer than clay:

$\rightarrow$  Non continental app.  
Neoteric (calcareous shells)  
of marine organisms

$\hookrightarrow$  Pelagic deposits

(oozes)  
(liquid form)  
Calcareous ooze  $\rightarrow$  calcium

Pteropod

Globigerina.

Pteropod  
Globigerina  
Organic  
Radiolarian  
Diatom.

clayey fulus

Pteropod  $\Rightarrow$  mainly Atlantic;

- formed of MOLLUSCS.

• Mollusc  $\Rightarrow$  soft-bodied, shelled animals.

intake Ca from sea water for shell formation.  
• high Ca content  $\rightarrow$  so, not found deep  $\rightarrow$  since Ca is soluble & cannot exist at a depth.

• When they die, they deposit

3000-1000 fathoms on Mid Atlantic ridge - Canary, Azores

Pacific, Mediterranean, Indian ocean, Azores, Canary,

Globigerina

Azores,  
Antilles,  
Gulf of Mexico

• shells of foraminifera.

• Formed of germs  $\Rightarrow$  also globigerina.

• found in abundance in all oceans.

2000-4000 fathoms.

Silica  
Siliceous  $\left\{ \begin{array}{l} \text{radiolarian} \\ \downarrow \\ \text{mainly SPONGES} \rightarrow \text{benthic animals} \end{array} \right.$

Radiolarian  $\rightarrow$  mainly Pacific.

• formed by shells of radiolaria & foraminifera.

• dirty grey powder.

• More silica; small  $\text{CaCO}_3$ .

• Lime content decreases with increasing depth.

- 2000-5000 fathoms.

• Pacific ocean.

Diatom  $\Rightarrow$  HIGH LATITUDES

• microscopically plants.

• Phytoplankton  $\Rightarrow$  food for fish (this is why cold currents from pole are very good for fish).

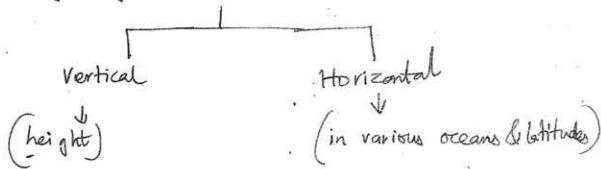
• Occur mainly in high latitudes.

• N Pacific, Alaska to Japan belt, Antarctica.

Inorganic materials  $\Rightarrow$  dolomite, iron,  $\text{MnO}_2$ , barite, amorphous Silica.

REED CLAY:  $\Rightarrow$  abundant in all oceans.  
 $\rightarrow$  Inorganic  $\rightarrow$  silicate of aluminum, iron oxide.  
 $\rightarrow$  Reductive materials;  $40^\circ \text{N}$  to  $40^\circ \text{S}$  in Atlantic

⇒ Critically analyse distribution of ocean deposits.



- OCEAN RESOURCES
- Fisheries → nutrition support
    - Pelagic (surface; school-forming)
    - Demersal (deep sea)
  - Oil
    - offshore oil fields
  - Minerals
  - Poly Metallic Nodules → now endangered species.
    - sea cucumber, sea horse, pipe fishes
    - spirulina
    - Astar - agar
  - Medicines
  - Carbon sequestration ( $\frac{1}{3}$  of  $\text{CO}_2$  is absorbed by Oceans)
  - Pearls → from oysters ...
  - Salt
  - Water (by reverse osmosis).
    - most obvious being power w/ energy
      - Tidal & wave
    - more than 32 phyla, 10 m species.
  - Bio-diversity,
  - Over-fishing (esp. in deep seas)
    - Deep sea fishes (cat. depth  $> 400\text{m}$ ) are usually slow-growing (late breeding, demersal). That makes them vulnerable to overfishing.
    - EU has recently halved the quota allowed for deep-sea fishing.
    - Intl. Council for Exploration of sea.

→ Ocean resource is the last resort to human. Discuss  
pearl cultivation  
Fishing.

(15)

Overfishing may lead to the depletion & even extinction of certain species of fish. The govt. is taking measures to prevent fishing, esp during breeding seasons. Extinction of <sup>certain kind</sup> fish may lead to a complete breakdown in the <sup>aquatic</sup> food chain.

#### Mining

With only minimum exploration of oceans so far, we are unaware of the quantity of both abiotic & biotic resources available in ocean floor. Without the proper knowledge, human exploitations in oceans may lead to denudation of whatever resources are in oceans, if they are present in minimal quantities. Mining wastes may disturb the delicate ecosystem & biosphere in oceans.

#### Whaling

Though various steps have been taken to prevent whaling, it is very difficult to control such marine exploitation. Though whaling is banned, it is still allowed for scientific research purposes. Many countries like Japan exploit these provisions for whales for food.

#### Aquaculture

Introduction & rearing of new types of ~~fish~~ fishes may adversely affect the delicate ecosystem of ~~the~~ seas. Moreover, fishes like to travel freely (both horizontally & vertically) and do not like man-made boundaries.

## Ocean ranching

Ocean power(tidal/wave)

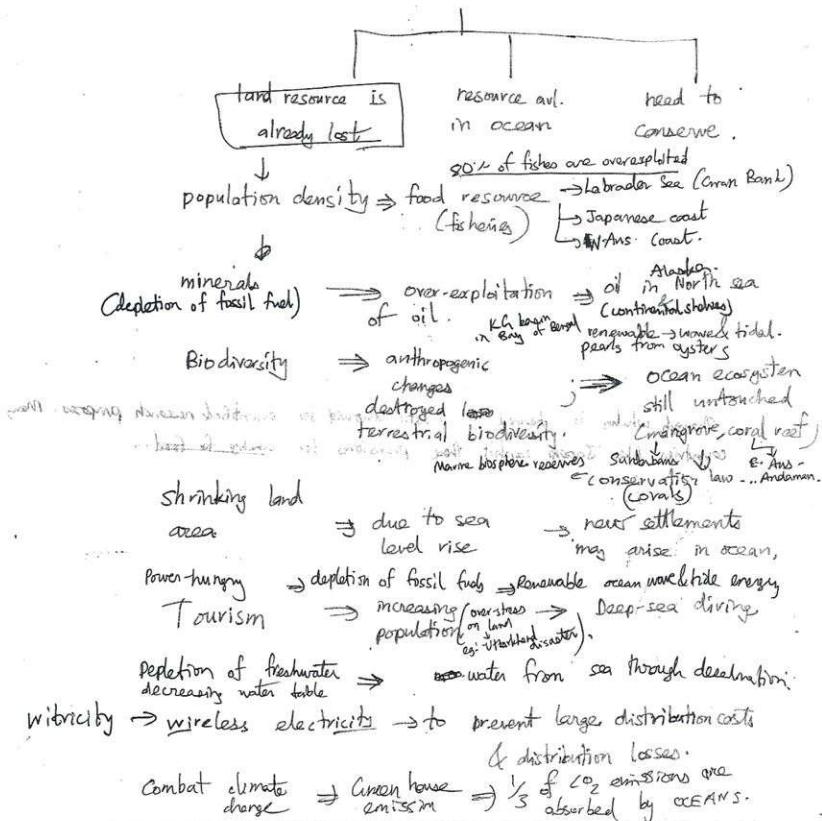
Ocean water (desalination)

## Deep sea diving

A recently introduced tourist activity. An increase in this hobby may introduce a never-before human artificial interference to the deep sea organisms.

Theme of 11<sup>m</sup> (GDP to GDP by 2050) : Conserving marine & coastal ecosystems

→ Ocean resources is the last resource to human. Issues.



~~South~~ Africa

(117)

S-Africa

Orange river → Augrabies falls.

Grasslands → Velds' → High Veld.

Mountains ⇒ Berg ⇒ Drakensberg, Swartberg, -

R. Limpopo → Mozambique, S.A., Zimbabwe

Kalahari desert { Okavanga swamps ⇒ largest inland swamp in the world.  
Swamps usually occur in coasts.

Makgadikgadi Salt pan ⇒ high evaporation

↓  
salt sol. on the surface

Zambezi river → Victoria falls

↓  
Kariba lake → Kariba dam.

→ Cobora Bassa dam.

Black mountains → Mithumba mt.

Muchinga mountains

Mt. Kilimanjaro → Kenya →  
↳ highest peak in Africa

Great African rift valley. — Kiow  
Edward  
Albert

Turkana  
Tana

Great lake region F

Niger river → tributary Benue  
↓  
→ drains in Gulf of Guinea.

Jos Plateau → Nigeria  
↓  
Rich in tin.

Atlas mountains → N.W. Africa  
↓  
Highest pk ⇒ Mt. Toubkal.

#### Laws on Marine Pollution

1973 → MARPOL Convention → most imp. convention on pollution by ships. It is called 'Intl. Convention for Prevention of Pollution by ships'.

1978 → The 1973 convention was amended. So, it is called MARPOL (73/78).

• Indian Merchant shipping Act, 1958 gives effect to the Intl-Convention for Prevention of pollution of Seas by Oil (1954).

• MARPOL 73/78 ~~one of~~ is the most imp. intl- marine environ. convention. It concerns with prevention of pollution by oil, bulk chemicals, dangerous goods, sewage, garbage, atmos. pollution of ships.

IndiaLargest states

Rajasthan

Madhya Pradesh

Maharashtra

Andhra Pradesh.

Land of Gods → Uttarakhand (<sup>more pilgrimages</sup>:- Haridwar, Rishikesh, Gangotri)

God's own country → Kerala

↓  
all beauties of

Tourism  
Incredible India → <sup>Tagline</sup> Aditi Dev Bhav.

Tropic of Cancer → 8 states.

↓  
Gujarat, M.P.

Closest capital to Tropic of Cancer

Ranchi

Bhopal

Gandhi Nagar

Aizawl

States sharing boundary with only

1 other Indian state → Sikkim (W.B.) & Meghalaya (Assam)

State with the longest coastline

Gujarat

The country with which India shares max. boundary

↓  
B'desh

States with no int'l. boundary (neither maritime or land).

↓  
M.P., Chhattisgarh, Jharkhand, Haryana.

State which shares max. no. of boundaries with other states

↓  
U.P. (8 states)

Smallest state → Goa

\* Smallest population → Sikkim

~~Axes~~ Youngest state → Jharkhand? (check)

Jurisdiction of Lakshadweep → Cochin high court

" " " Andaman & Nicobar → Calcutta high court

④ Territory of Ind. with 4 dist. but which do not share boundary with each other ⇒ Pondicherry

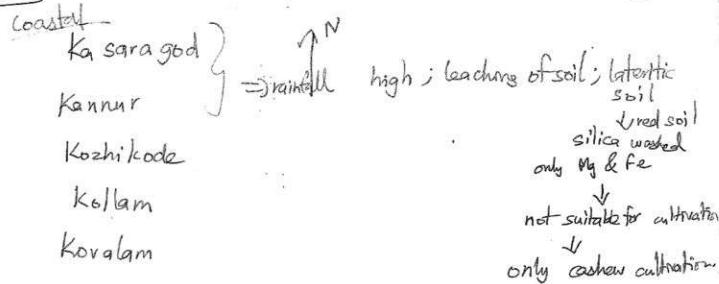
Pondy, Mahe, Yanam, Karaikal.

• Chicken neck of India → Siliguri corridor

(Sikkim - WB - & Assam border)

## Kerala

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Vembanad lake  $\Rightarrow$  lagoon

Ernakulam (Cochin)

Alappuzha  $\rightarrow$  Venice of the East

Kottayam

Kuttanad  $\Rightarrow$  low (below mean sea level)  $\Rightarrow$  Paddy cultivation.

Kumarakom

Thrissur  $\rightarrow$  cultural capital of Kerala.

Dalakhal  $\rightarrow$  TN border.

Vegetation:

WYNAAD  $\rightarrow$  mountainous region (W. ghats)

~~on~~ junction of Kerala, Karnataka, TN

Kasaragod, Kannur, Kozhikode  $\Rightarrow$  lateritic soil (rich in iron)

$\downarrow$   
tiles (Q.B) (bez of iron content hard)

Vembanad famous lagoon  
(Kottayam, Alappuzha, Ernakulam)  $\rightarrow$  Tourism

Kochi (Ernakulam  $\rightarrow$  NH 47 (A)  $\rightarrow$  smallest NH of India)

Trivandrum → capital of Kerala.

↓  
VSSC (Vikram Sarabhai Space Centre), Trivandrum equatorial rocket launch station.

Kollam, Kozhikode → monazite <sup>cont</sup> (Thorium ore)

Coir industry ⇒ coconuts ⇒ from kottayam to Trivandrum.

Kerala → one side highlands; one side lowland;

heavy rain ⇒ water logging.

→ So, pop. settlement linearly on highlands.

↳ so high population density.

→ Mountainous area → rubber plantation.

→ paddy cultivation → paddy that survives in water.

→ Land of spices → pepper, cardamom

↓  
100% spice market  
(Spices Board of India)

Cardamom hills.

→ TOURISM.

→ Rob model for health system.

→ Universal PDS.

→ Highest literacy rate.

→ Highest HDI

→ Highest sex ratio (more than 1000 females per male)

→ Matrarchial society (mother based) (123)

→ Linear settlement (along the roads.)  
↳ Hig

→ First Communist (non-Congress) govt. in India → EMS Namboodiripad (1952)

→ Gulf syndrome (almost all families will have persons in Gulf countries esp. in Malabar region).

→ Malabar → Muslims. (Moplah Muslims).

→ Beautiful houses (even in villages).

→ Ayurvedic medicine (Kottakkal Ayurvedic Vaidhya Shala)

→ High unemployment -

→ Highest consumption of alcohol.

→ I'

→ Ecological areas → Periyar, reserve, Anamalai, Wynad, Nembanad.

→ Dance → Kathakali, Mohiniyattam.

→ Martial art → Kalari.

→ S.W. Monsoon → onset in Indian mainland (June 1<sup>st</sup> week)  
Kerala.

• Heavy rainfall.

• Tropical forests →

Religion → Majority Hindus, lot of Muslims & Christians.

Muslims → N. Kerala (Malabar)

Christian → South of Calicut.

Jews → Mattancherry

- Highest p.k. → Anaimudi (in Anaimalai, W Ghats)  
(on Kerala-TN border);
- Palghat pass → wide gap in W Ghats.
- No major river → many small rivers.
- Kerala has a tradition of tolerance and a harmonious existence of Hindus, Muslims & Christians

Famous Personalities

Atul Gore / Gopal Krishna → director, film-maker.

Lifetime Achievement award.

M.N. Nambiar

M.G.R

} Kerala origin.

Festival → Onam → marks the visit of mythical king

↓ MAHABALI from the 'netherworld'.  
Poottalam

Kerala has produced several top notch bureaucrats.

Krishna Menon → first foreign secretary

Shiv Sankar Menon → National Security Advisor.

## Heat budget

1. Vertical budget

2. Horizontal bud.

mechanisms

3. Diffusion,

radiation

4. Significance.

(2)

## PRESSURE BELT

1. Defn: Atmos. press.

2. Rotating; non-rotating

3. Diff. pressure belts

4. Var. Intra-belt variation

5. Temporal (seasonal) var.

→ Continental, mar. time.

6. Significance.

cheesened board

## Cyclones

1. ~~low~~ front, warm  
cold air mass

2. Tropical & temp. cyclones

3. Condition for frontogenesis

4. Deformation waves

5. Places

6. Diff. b/w trop & temp. cyclone

## Atmos. circulation

1. Non rotating; only

2. Other forces rotating

3. 3 cells → Ferrel, Hadley, polar.

chees board

## Planetary wind.

1) Non rotating; rotating

2) 3 winds

3)

chees board

## Jetstreams.

1) G. Adm.

2) Condition for formation

3) Index cycle

4) Significance

Rainy waves

## Local winds

1) Mt. & valley breeze

2) Sea land breeze

3) Local winds

4) Sig.

## Climatic class

### Stability

1. NLR, DAR, WAR

2. Also & relative stability & instability

3. Impact.

4. Stable & unstable zone

## Airmass

1. Adm.

2. Conditions for formation

## Köppen

→ vegetation

→ abs. temp. & ppt.

→  $T = R - \frac{R}{45}$

→  $R < 2T + 28$

→ A, B, C, D, E.

→ f, m, s, w, S, W, b, H

→ a, b, c, d, e.

## Thermohalite

1931

$$N/E = 11.5 (r-t-10)^{1/2}$$

$$T/E = (-32)4$$

$$1948 \quad PET = 1.6 \left( \frac{t}{10} \right)^4$$

$$\text{Lat } \delta = \pm 1.514$$

25/08/12

## OCEANOGRAPHY

### Tides & waves

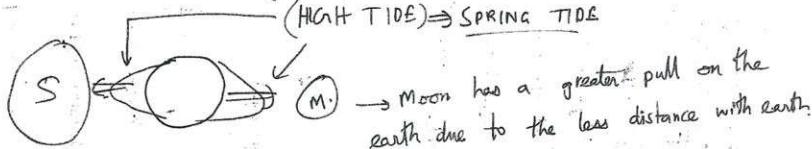
#### Tides

1. Vertical movement of sea water
2. Due to gravitational pull of sun & moon & earth
3. Tides are periodic
4. Not frequent occurs with intervals.

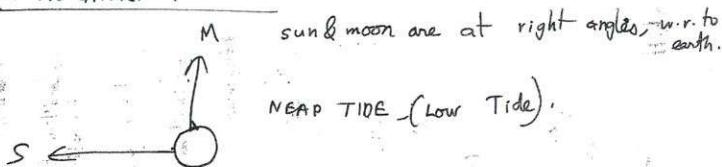
#### Tide

Due to gravitational interaction of sun, earth & moon.

Syzygy  $\Rightarrow$  When sun, earth & moon are in the same line (NOT necessarily in the same angle). (SEM or SME position).



#### QUADRATURE POSITION



#### Wave

- 1) Circulatory
- 2) Translatory
- 3) Breakers  $\rightarrow$  plunge, spill, surge.

5. Tides → common in coastal area.
- Waves occur in inland and coastal oceans.
6. Tide ⇒ a weak erosional agent.
- Wave is a strong erosional agent due to its frequency.
7. Tide ⇒ high potential before for power.
- COASTAL CONFIG. does not dictate the waves. It is vice versa.
8. Tide ⇒ also caused due to COASTAL CONFIG.

### Significance of tides

- Useful in navigation (eg:- Kolkata port, Shanghai port).
- Intrusion of sea water into land at the time of tide results in salination of groundwater & surface water and also causes damage to livelihood & properties.
- High tide affects the formation of deltas.

Bay of Fundy → highest tide in the world.  
 ↳ (north of New York).

Southampton → 4 tides per day. (due to coastal config.)  
 ↳ usually, 2 tides/day.

## Tidal theories

1) Progressive wave theory

2) Equilibrium wave theory

3) Stationary wave theory

## Coral Reefs & Atolls

→  $\frac{1}{4}$  of earth's surface.

Coral reefs & Atolls are formed due to deposition & acc. of skeletons of lime secreting organisms called coral polyps.  $\downarrow$  calcareous shells

b/w  $25^{\circ}N$  to  $25^{\circ}S$  latitudes.

Symbiotic relationship b/w coral polyps & Zoo Xanthellae.

Coral Reefs  $\Rightarrow$  highly sensitive & significant ecosystems

$\downarrow$  called 'RAIN FOREST' of oceans

beoz

Coral reefs provide a habitat to a diverse variety of organisms. (About 1,00,000 species reside in coral reefs).

$\Rightarrow$  Conditions for growth of coral polyps

1) Corals are very temp. sensitive. Need mean temp. of  $27^{\circ}C$ . (tropical oceans).

This is why corals are found only in the eastern side of continent (Great Barrier Reef (Aus)).

Western side of continent experiences cold current, so temp. is very less.

2) Corals live only in SHALLOW WATERS ( $\frac{up\%}{200-350\text{ft}}$ ).  
Bcoz, sunlight &  $O_2$  is important for its growth.

3) Clean sediment-free water is reqd. for its growth. (129)

If sediments are there, then the sediment may plug the narrower mouth and cause its death.

This is why corals do not occur ~~near~~ <sup>very near to</sup> coast, because run-off from land ~~is~~ brings sediments.

4) Freshwater is injurious to corals.

This is also why corals DO NOT grow along coast since rivers may bring freshwater to sea.

Bioz:- freshwater does NOT bring food for coral growth.

∴ There is a discontinuity of corals at places where rivers join the sea.

5) Very saline water is also injurious.

Salinity of 27% to 30% is ideal.

Because highly saline water contains less  $\text{CaCO}_3$ , which the corals need for their growth.

6) Extensive submarine platforms are reqd. ~~below~~

The corals use these platforms as a base to grow. The corals, therefore, act as barriers to ships entering the coast.

In Sydney, Brisbane ports, ships can ONLY enter the coast at places where the rivers join the sea. (Since corals do not grow here).

#### SIGNIFICANCE OF CORALS

1) Shield humans from Tsunamis & ~~severe~~ hurricanes. ( $30\%$  of ocean biodiversity &  $20\%$  of fish catch)

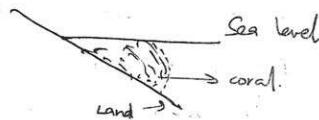
2) shelter more than 1 million fishes & marine organisms  $\rightarrow$  biodiversity

3) Host the oysters, which produce costly pearls (e.g.- Pearl of Manhar).

4) Richest & most sensitive ecosystem  $\rightarrow$  an indicator of the health of the ocean.

## Types of coral reef

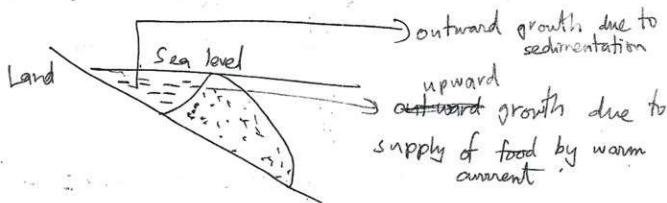
### 1) Fringing reef:



seaward slope is steep & landward slope is gentle.

### 2 Barrier reef

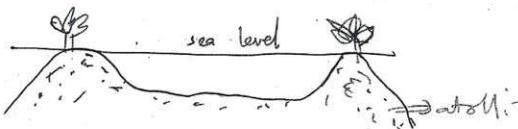
- Parallel to coast.
- Largest reefs, highest & widest.
- broken at many places, at riverine areas.



### 3. Atoll.

- A ring of narrow corals of horseshoe shape.
- Crowned with palm trees.
- Found around an is.

(last page for the diagram)



## Theory of formation of atolls

(13)

- 1) Subsidence theory  $\Rightarrow$  DARWIN.  
Darwin  $\rightarrow$  Fringe, barrier & atoll are sea stages of evolution.  
How corals, which can only grow in shallow waters, could go to greater depths? Darwin  $\rightarrow$

1. Fringing reef grows upward to get food, ~~form~~ barrier reefs.

2. After that the land ~~on~~ which corals grew SUBSIDED, taking corals to greater depths,  $\Rightarrow$   
 $\downarrow$  bcoz of tectonic movement.

3. As the land  $\xrightarrow{\text{(marine platform)}}$  subsides, the corals grow upward vigorously for food & to get them out of deep water.

4. The growth is more vigorous outward from the coast.  
This forms barrier reefs.

5. The subsidence of land is only gradual.  
Sedimentation along coast prevents corals from growing near to the coast. Here a lagoon is formed.

Evidences  $\rightarrow$  stationary landforms would NOT have cliffs.

1. Absence  $\xrightarrow{\text{presence}}$  of cliffs along coast of coral reefs indicates that there is SUBSIDENCE.

2. SEDIMENTATION in the lagoon is compensated by gradual subsidence of land. This permanency of lagoon indicates continuous subsidence.

3. No atolls are found in uplifted beaches.

(where land  $\xrightarrow{\text{old beach}}$  is emerging  
 $\downarrow$   
NOT  $\downarrow$  subsiding)

(4) Thickness of coral reef increases downward.  
This shows that these corals at great depth were formed very early, when they were actually in shallow waters (before subsidence).

5) Steep slopes of is. having atolls indicates subsidence, since steep slope is found only in upper part of is.

### Criticism

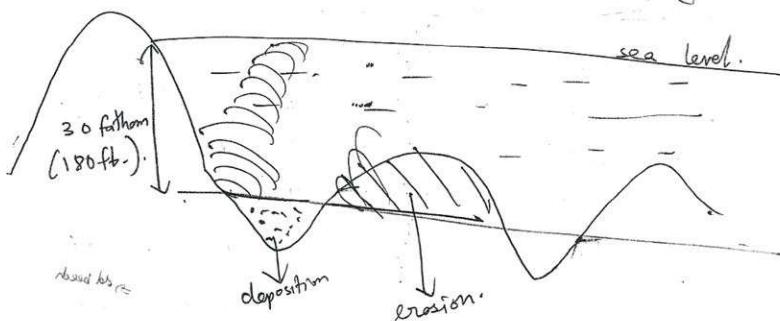
If fringing, barrier & atolls were taken to be sequential stages of evolution, how do all these three occur at the same level in the same is.?

If subsidence was the phenomenon, all coral reefs must have subsided totally by now.

Stand-still theory  $\Rightarrow$  Murray

$\hookrightarrow$  father of modern Oceanography

- Non-subsidence of land. Land is stand-still  
 $\downarrow$   
stationary.



Permissible depth of coral  $\rightarrow$  180 ft (30 fathoms)

(133)

1. This depth is attained either by marine deposition or erosion.
2. Once the permissible depth is obtained, the corals <sup>are</sup> formed.
3. Lagoons are formed near coast (b/w coast & barrier) because of dissolution of dead corals.

#### Criticism

1. No explanation for atoll formation.
2. A limit of 30 fathoms for deposition & erosion can NOT be accepted.
3. Erosion & deposition CANNOT occur at the same place of ocean.
4. Corals were found even below 30 fathoms.
5. If land is stationary, the lagoon would have been eventually filled with sediments.
6. Dead corals DO NOT dissolve. They also form pelagic deposits.

## Glacial control theory → DALX

Daly was convinced that all coral reefs were formed during Pleistocene Ice Age.

Start of Pleistocene → degl.  
- ~~Glaciation~~ → sea level decreased by 33 fathoms & temp. of marine water decreased.  
Due to low temp. (freezing pt.)  
So corals died. (low temp; great depth)

End of Pleistocene

- Deglaciation → sea level increased & temp. also raised.  
(Due to increase of temp.).

Shallow depth of platforms; high temp.  
corals started growing.  
of uniform depth  
Lagoons were formed due to uniform lowering of sea level during Pleistocene Ice Age.

1. Sea level decreased <sup>wave-cut</sup> platform created. Corals formed.
2. Sea level increased. Corals started growing upward.
3. Narrow ~~coral~~ platform → fringing reefs
4. Wide platform → ~~Atolls~~ Barrier reef.
5. Isolated wave-eroded i.e. → Atolls.

Coral  
Criticism

1. Corals are formed even beyond 23-38 fathoms.

(135)

Most accepted theory → Darwin theory

↓  
Supported by 'Davis' theory of geographic cycle.

Why coral atolls are found only on one side of is.?

Even along the same coast, one side may have submerged more than the other side. ~~is.~~

OPEN-ENDED 'Coral reef.'

→ Defn. of coral reef

→ Conditions

→ Distribution

→ Stages of coral reef (types ⇒ fringing, barrier, atoll).

→ Why coral reef is a significant ecosystem?

→ How corals can be preserved?

Conditions for coral reef formation.

→ Defn. of coral reef

→ Elaborate each condition with critical explanation & substantiate it with the existing dist. of corals.

→ Significance ⇒ need to preserve.

Darwin Theory

→ Defn.

→ stages

Coral bleaching → e.g.: most of the oysters in Gulf of Mannar, 90% of corals in Falk strait have been destroyed.

- There is a symbiotic relationship b/w Coral polyps & Zoo Xanthophores.

• Bleaching → Whitening of coral reefs ⇒ it leads to the death of Zoo Xanthophores (a colouring agent)  
GOVT MEASURES 1) Anti-poaching 2) Good marine sanitation 3) Artificial substratum for regeneration of corals (Indian govt. has done this in 10 islands in Gulf of Mannar).

1. El Nino, carried by west wind drift, bleaches corals all over the world.
- Cultivation of an invasive alien seaweed → Gracilaria alvarezii for commercial purposes It fully colonises the sea bed blocking the entry of sunlight to corals & chokes them to death.
2. Due to certain diseases  
- bacterial. → invasive soft corals with high fecundity (rapid reproduction)  
Snowflake coral,
3. Anthropogenic activities
  - a) Dumping of radioactive wastes ⇒ leads to increase of temp ⇒ death of corals  
Collection of corals for ornamental purposes.
  - b) Domestic sewage from coastal areas
  - c) Global climatic change. (Greenhouse effect → increase of overall temp. They eat the corals)  
Storm damage, crown of thorn fish → depleted 40% of Great Barrier reef.
  - d) Developmental activities in oceans  
(Gulf of Mannar ⇒ Sethu Samudram project)

Red Sea ⇒

- e) Oil spills → changes viscosity & property of ocean water causes

f) OCEAN ACIDIFICATION → Ocean is a natural carbon sink. When the segregated carbon level increases, it acidifies ocean.

# Tamil Nadu

(137)

Capital :- Chennai

↓  
Chennappa Naikanur.

1639 ⇒ Madras ⇒ Francis Day

↓  
Famous Institutes Fort St. George ⇒ Assembly, Secretariat - Integral Coach Factory (ICF) ⇒ Perambur

CLRI → Adyar.

OTA (off

NIOT (National Instt. of Ocean Tech.)

National Biodiversity Authority.

Tourist places

Mahabalipuram ⇒ Shore temples, Pancha Pandava Rathas.

Marina Beach ⇒ 2<sup>nd</sup> longest beach (13 km.)

First CM of Madras Province → Omandhiran.

Theelamuthu Nadarasan Maligai ⇒ imolated during Anti-Hindi protests -

Attack by 'Emden' - a German Cruiser.

1967 ⇒ non-Congress rule (DMK)

Anti-Hindi agitations

Modern Theatre ⇒ Salai (Sundaram)

Self-respect movement ⇒ E.V.R. Periyar.

↳ Social reform

opposed Brahminism,  
NOT Brahmins.

Madras ⇒ Medical capital of India.

COIMBATORE  $\rightarrow$  Manchester of South India.

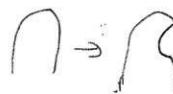
- black cotton soil.
- auto sports & diesel engine  $\Rightarrow$  Narain Karthikeyan.
- Salim Ali Inst. of Ornithology  
"bird man of India"  $\Rightarrow$  Father of ornithology in India.
- Coimbatore  $\rightarrow$  receives rainfall during N.E. & S.W. monsoons  
  - ↓  
(like Kanchipuram)
  - but overall rainfall  $\rightarrow$  deficient,
- Sugarcane breeding research inst.  
  - ↓  
flower of sugarcane  $\rightarrow$  sorghum
  - Coimbatore & Lucknow are the two places where sugarcane flowering is very active.
- Siruvani water  $\rightarrow$  second tastiest water in the world.  
  - ↓  
first  $\Rightarrow$  Nile.
- OOTY  $\Rightarrow$  Kundha hydel electric project  
  - ↓  
largest HEP in TN.
- Indian Photofilm instt  $\Rightarrow$  Ooty.
- $\rightarrow$  Coonoor  $\Rightarrow$  Vaccine production  $\rightarrow$  Pasteur instt.  
  - ↓  
esp. for Rabies.

## Madurai

(139)

- Capital of 1<sup>st</sup> & 3<sup>rd</sup> Sangam period. ⇒ PANDYA rule.
- Jasmine city ;
- Sleepless city of T.N.
- On the banks of VAIGAI RIVER.
- Temple city of TN ⇒ famous 'Meenakshi temple'.

## Tirunelveli

- Tamirabarani river → perennial river;
- Lord Shiva → 
- Paalayamkottai → historical jail of TN.  
↳ OXFORD of TN.
- Paalayamkottai & Tirunelveli ⇒ Twin cities.
- Geographical Indicator ⇒ Halwa.
- 'Maancholai fight' ⇒ black incident of TN.
- K K NNP      Tourist place ⇒

## Tuticorin

- Pearl city ; Salt city.
- SPIC. (Southern)
- H.Q. - for Sethu Samudram Project.
- Heavy water plants.
- Keodankulam Nuclear Power Project. V.O.C ⇒ Swadeshi movement.

## Tirunelveli

- Maniyatchi ⇒ Vaanjithan ⇒ first to kill a Dist Magistrate (Collector) ⇒ Lord Haas in India.
- Largest windfarms in India ⇒ Tirunelveli to Kanyakumari, Tirunelveli, Muppandal, Kattankulam.

## Kanyakumari (cap.: Nagercoil)

- S. most part of India mainland. ( $8^{\circ}4'N$ )
- Vivekananda rock. ; 133 ft. Tiruvalluvar statue.
- Gandhi museum.
- part of erstwhile Travancore princedom.
- Sansamam - trijunction of Bay of Bengal, Arabian sea, Indian Ocean.

## Tanjore

- Brahadiswara temple  $\rightarrow$  Raja Raja Cholan.  
arch. marvel
- Largest Shiva linga.
- Kaveri river.
- Granary of TN  $\Rightarrow$  Rice cultivation (deltaic alluvium; irrigation canals)
- Sarfoji Saraswati Mahal library  $\Rightarrow$  one of the two  
most significant libraries in India. The other is  
Kathabakshi lib.  $\Rightarrow$  Puthna.
- Geographic indicators  $\rightarrow$  Veena, dancing doll.
- Kallanai Dam  $\rightarrow$  Kavikkoil Chozhen  
Sarfoji rulers  $\rightarrow$  patronised Bharatatyam.

## Trichy

- Rock temple.
- Kaveri river  $\rightarrow$  Sri Ranganathaswamy temple  
 $\downarrow$   
highest kopura of TN.
- Kollidam  $\rightarrow$  Kaveri makes distributary (Coleroon)
- Tiruchi  $\Rightarrow$  centre part of TN.

### Salem

(141)

- Steel industry (mainly from scrap)
- A ⇒ Aluminium
- L ⇒ Limestone
- E ⇒ Electricity (Mettur hydel & thermal power project)
- M ⇒ Mango ('Malkava')
- Tapioca -
- Salem → once the theatre (box-office) capital of TN.
- Lorry workers, borewell -
- Large no. of AIDS patients,  
Female foeticide.

### Namakkal

- Egg city.

~~TNPL~~

### Karur

- TNPL.
- Textile industry.

### Erode

- Turmeric market.
- EVR Periyar
- Bandipur → biosphere reserve.

### Nilgiri

↓ First biosphere reserve in India.

### Gulf of M

## Rameshwaram

- Ram + Es hwaran .
- Pamban bridge  $\Rightarrow$  Rameshwaram to Thalai Mannam .
- Adam's bridge  $\Rightarrow$  Ram Sethu
  - $\downarrow$
  - Limestone deposits
- Sethu Samudram Project.

DONGAL FESTIVAL  $\Rightarrow$  'Harvest festival' of TN.

'Thoda' tribes  $\rightarrow$  Milgiri

$\hookrightarrow$  polyandry; (since they believe to be descendants of Paandavas)

Badiga tribes.

DANCE  $\rightarrow$  Bharat Natyam . (famous dancers  $\rightarrow$  Padma Subramanian)

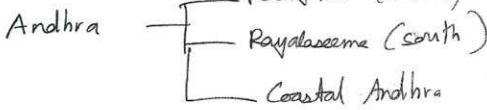
## Folk dances

- 1) Karagaattam
- 2) Poi kaal kuthirai
- 3) Oyibatam

## Writers (novelists - modern writers)

J. Krishnamurthy (కృష్ణమర్త్య) , Jayakanthan (ஜைகாந்தன்) , Anupitha (அனுபிதா) , T. Janakiraman (தி. ஜாங்கிரமன்)

26/01/12  
Andhra Pradesh



• Tirupati  $\Rightarrow$  one of world's ~~largest~~ richest temples -

Lord Venkateswara .

• Kaala hasthi  $\Rightarrow$  foothill of Tirupathi :

G-I of Tirupathi  $\Rightarrow$  'Ladoo':

• Puducherry → Lagoon

↓  
Sriharikota is.

Satish Dhawan Space Centre → rocket launching station.

Nellore → rice cultivation.

Ongole → cattle breed.

Anantapur → chilly;  
↳ red chilly (pungent nature)...

Rajamundry → Tobacco cultivation

↳ Tobacco research instt.

Vijayawada → located on 'Krishna river'

Kolleru lake → wetland → bird sanctuary.

Machilipatnam (Masulipatnam) → first British factory  
↓ in S. India.

Important port for Dutch, British.

Kakinada → imp. port during British rule.

Vishakhapatnam / Vizag

• Ship building (Hindustan Shipbuilding Ltd.)

• Port

• ISPART Nigam Ltd. → Vizag iron & steel plant.  
↳ (iron & steel co.)

SRIKAKULAM → haematite / mining mafia

↓  
forest area granite

Almost not under govt. control.

KOTTAGUNDAM → sponge iron production

RAMAGUNDAM → Thermal power plant ~

Hyderabad & Secunderabad → separated by Hussain Sagar lake.

→ Twin cities of South India,

↓  
H.Q. of South Central Railways.

ICRISAT → Int'l. Crop Research Instt. of semi-Arid Tropics.

- DNA finger printing
- Tsunami warning centre → INCOIS.
- Sardar Vallabhbhai Patel IPS training academy..
- Ramoji film city.
- MUSHTI river → Confluence of Hyderabad.
- NALSA

HAL

Heavy water  
Printing press

Char Minar

- Library → SALARJAN MUSEUM  
↳ national importance
- Golconda fort.
- IIT coaching
- famous for 'Hyderabadi Dum Biryani'
- Hyderabad founded by Nizam ul Mulk

↓  
Last Nizam → Osman Ali Khan → anti-Razakar movement.

voluntary revolutionaries

Hyderabad brought into Indian Union by Police Action → Operation Lightning.  
Osmania University.

Hyderabad — predominantly a Muslim area.

WARANAL → imp. railway station  
infamous for farmer suicide.

(145)

Hyderabad & Warangal → Telangana region

Mahbunagar → Naxalite

Anantapur → largest dist. of Andhra

Puttaparthi → Sai Baba.

Kadappa → Stone (బలురు శాసు)

Chittoor → National Centre for Atmospheric study (ISRO).

Puttur → A.P - TN border ⇒ plaster of paris ⇒ వంపు (పెట్లు).  
పెట్లు

Thummanapalli → Uranium

Gold → Ramagiri, Yeppamarai.

Nizam Sagar Dam → Godavari

Godavari → 'Oakshin Ganga' (Ganga of the South).  
grainy of South India.

Peninsular India → made of Careiss & granite.

↓ Volatilization

Red soil

Good for tobacco & groundnut cultivation

Coastal Andhra → alluvial soil.  
(Gujarat & Andhra).

Andhra → spicy food → Gingra pickle → made of Gingra & spinach.

TRIBE → Chenchu tribe → famous for \* lambadi?

SRI SAILAM

- Famous Shiva temple (biggest NARASIMHA in the world)
- National park

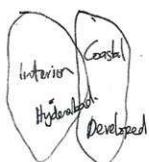
## Famous leaders of Andhra.

- Potti Sri Ramulu → died in a hunger strike (during 1950s) for a separate ~~ANDHRA~~ on a linguistic basis.
- I VENKAIYAH → gave final shape to our NATIONAL FLAG design.
- MG Ranga → 1924 ⇒ All India Kisan Sabha Movement.  
(That is why, Andhra's agri, <sup>university</sup> ~~rest~~ is called MG Ranga Agri university.)
- NT Rama Rao → Actor-turned - CM.  
↳ <sup>↓</sup> Actor in Karuna movie.

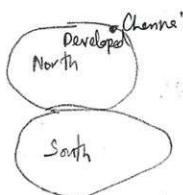
DANCE → Kuchipudi

## Regional disparities

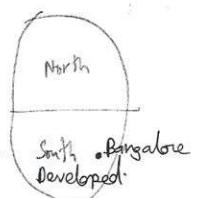
### Andhra



### TN



### Karnataka



### Tamil Nadu

#### Agri

M.S. Swaminathan → Agri-scientist

C. Subramaniam → Agri minister, GoI

Srinivasan → Agri Secretary, GoI

triple 'S'.

} during  
Green  
Revolution.

Kalkan ⇒ education min. during Kamraj regime in TN

- Initiated several infra. projects

- Died in a Govt. hospital

## KARNATAKA

(147)

Capital :- Bangalore.

→ BELGAUM → (bordering Maharashtra).

↓  
1924 Congress session → President Gandhiji  
Leather industry:

NH 4 → Hubli (Vijaya Nagar empire)  
↓  
Railway headquarters.

### MINING

Chitradurga → iron ore mining  
Tumakuru

## BANGALORE

- Silicon valley of India, electronic city.
- Hub of Indian IT industry.
- Bangalore → a word for 'outsourcing'
- Cool climate (bcoz of high alt. from sea level) → Garden city of India, wide roads
- Well planned city,
- Manipal university..
- National Instt - for Mental Health & Neural Sciences - recently given greater autonomy by NIMHANS bill, Min. of Health & Family welfare (NIMHANS)

produces quality PSYCHIATRISTS.

• IISCE → Indian Instt. of Sciences Bangalore.  
↓  
B EML → Bharat Earth Movers Ltd.

supplies tanks, trucks & heavy vehicles to Indian Army.  
recently TATRA truck scandal.

• BEL → Bharat Electronics Ltd.

↓  
manufactures EVMs (Electronic Voting Machines).

• PARKS → Kappan park, Lal Bagh..

HASSAN → MCF (Master Control Facility)  
2<sup>nd</sup> MCF to come up at Bhopal.

Mangalore → port  
Tulu people  
"Rai" belt.

Udupi → Krishna temple

Shravana Bela Gola → Gomateshwara temple.

Jog falls → highest waterfall in India  
on Sharavati river.

National parks  
DANDELI NATIONAL PARK, Bandipur national park.  
(Tiger)  
Nagarhole (Tiger), Bannerghatta, Ranganthetta (Bird sanctuaries).

Karwar → India's Naval ship building yard.

↓  
northernmost coast of Karnataka.  
Operation 'Sea bird'.

### MYSORE

- NECC → National Egg Coordination Commission.
- Sandalwood → G.I. → Mysore Sandal Soap.
- famous for Incense sticks.
- Mysore palace ; Vrindavan gardens

Famous river → Kaveri → Krishna Raja Sagara dam.

originates in Madhikeri (or) Gangadhar (Gomti nadi)

Badravati dam → Vishweshwary ga

his bday is celebrated as India's Firemen Day.

## MINERALS

(149)

Gold  $\rightarrow$  Kolar gold mines. (but amt. of gold extracted from ore is very low so, it is almost closed).

Manganese  $\rightarrow$  Belgaum.

Cost of extraction  $\rightarrow$  high.

Iron ore  $\rightarrow$  Kudremukh, Shimoga & Bellary.

$\rightarrow$  (transported through pipeline to Mangalore port)

Bedaravati iron & steel plant  $\rightarrow$  India's 2nd iron & steel plant

(1<sup>st</sup> Tata  $\rightarrow$  Jamshedpur)

- Baba Budan Hills

\* Coorg

Chickmaglur  $\rightarrow$  known for COFFEE

India Gandhi's MP constituency..

Karnataka  $\rightarrow$  Maha Nadu / Mal Eelan

$\downarrow$   
Gently sloping nature of Karnataka.

Mandhia dist.  $\Rightarrow$  place where 'Kaveri' water is opened to TN.

Gen K.M. Cariappa  $\rightarrow$  India's 1<sup>st</sup> Field Marshall.  
 $\downarrow$  from Coorg

Coorg  $\rightarrow$  ppl can have gun without license.

Karnataka tourism  $\rightarrow$  one country ; many worlds!

Spl. tourism train  $\rightarrow$  Golden chariot?

Hospet, Hampi  $\rightarrow$  Vijayanagar Empire

$\hookleftarrow$  temple ..

'Bellary'

Soil  $\rightarrow$  Red lateritic soil ; Crops  $\Rightarrow$  Ragi, Coffee, Onion

Famous historian - 'Rama Chandra Guha':

Trinity of Carnatic Music  $\Rightarrow$  Bangalore, Mangalore, Chennai

## Significance of glaciers

(177)

- 1. Leaching of soil → no support to vegetation;
- 2. Outwash plains → boulder clay alluvium → most fertile agri. eg: - MIDWEST ~~USA~~ USA plains.
- 3. Lakes formed due to glaciers → Inland waterways  
eg: - Great Lakes of N. America
- 4. ~~Hydroelectric~~ Hanging valleys → Hydroelectric energy.  
eg: - Swiss, Canada
- 5. Eskers → sand & gravel for construction
- 6. Snow-cover → tourism → skiing, sight seeing.  
eg: - French, Italian Alps.
- 7. Cutting by glaciers → natural routeways across mountains
- 8. Strategic high points → Siachen
- 9. Avalanche → death & destruction
- 10. Source of perennial rivers → Ganges, Indus, Yamuna etc.

→ Critically examine the concept of geomorphic cycle and discuss the views of Davis & Penck.

### Geomorphic cycle

The period of time during which an uplifted landmass undergoes its transformation through the process of land sculpture ending in a low featureless plain (peneplane) is called Geographical cycle.

This cyclic 'nature of earth history' was first propounded by James Hutton. He stated that

- i) There is no vestige to the beginning.
- ii) No prospect of an end.
- iii) Present is key to the past.

It led to the theory of Uniformitarianism

"All the same physical processes and laws that operate today, operated throughout the geologic time, although not necessarily with the same intensity as now."

Sequential changes of landforms are due to endogenetic forces and exogenetic forces. While the endogenetic forces create vertical irregularities, the exogenetic forces try to remove these vertical irregularities to form a low featureless plain.

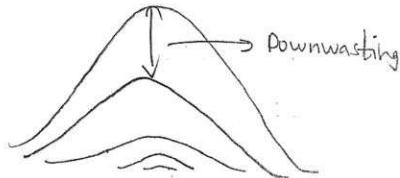
Two of the most famous theories of geomorphic cycles of erosion are by i) Davis & ii) Penck.

### Aim:

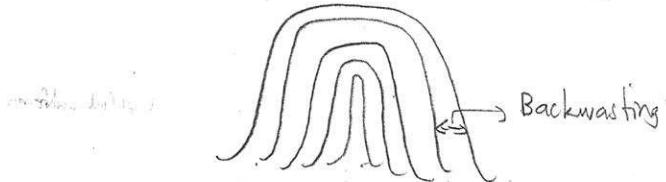
Davis theory tried to provide a basis for a systematic description and <sup>show it originated</sup> genetic classification of landforms; Whereas Penck brought out a morphological analysis of landforms.

### Basis of the theory

Davis believed that erosion decreased the gradient of the slopes by a process called DOWNWASTING. The summit of the peak was eroded gradually.



Penck believed that all slopes were made of straight slope segments and they underwent parallel retreat by BACKWASTING. The rate of retreat was proportional to the gradient of the slope.



### Factors affecting landform

Davis gave a trio of factors affecting landform <sup>agents of erosion</sup> <sub>stages - youth, prime or old</sub>. But, he eventually ignored the other two factors and gave them

importance to time - time dependent model.

(153)

Penck pleaded for a time-independent model.

He stated that landform was a result of the rate and phase of degradation and rate and phase of upliftment.

### Cyclical theory

According to Davis, erosion followed upliftment and resulted in a sequential degradation of landform in a hypothetical crustally stable landmass. But, in nature, wherever there is uplift, there will be erosion and they will be simultaneous. Moreover, there are no areas with indefinite crustal stability. Single cycle of erosion.

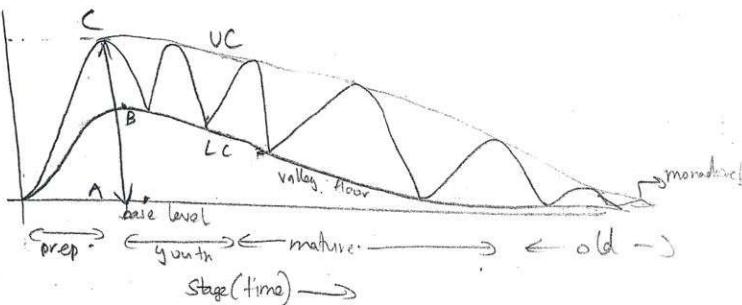
Penck realised that both erosion & upliftment are simultaneous but differ only in their rate. He also took into account the crustal movements of earth. But, his concept of continuous crustal movement (but this was accepted only after the advent of plate tectonics) was heavily criticised. This throws the possibility of second cycle of erosion & polyyclic landforms.

Davis was of the view that upliftment was a sudden & rapid process and erosion there is no erosion during upliftment. But, tectonic studies have shown that upliftment is an exceedingly slow process.

Penck's view on upliftment was more logical. He said upliftment was first slow, then accelerated uplift, then accelerated degradation (waving), then slow degradation (waning).

## Stages of development

Davis



AC  $\rightarrow$  initial abs. relief ; BC  $\rightarrow$  initial

UC  $\rightarrow$  summit curve ; LC  $\rightarrow$  valley curve;

Davis classified his cycle into 4 stages.

### Preparatory stage

This is a stage of sudden & rapid upliftment.

No erosion exists. So, both the absolute relief and relative relief increases.

### YOUTH STAGE:-

Due to the steep slope, kinetic energy & transporting capacity of streams are high and hence vertical erosion is prominent causing valley deepening. So, relative relief increases.

Since there ~~is no~~ <sup>rate of</sup> uplift ~~is~~ <sup>not lighter than</sup> erosion, abs. relief ~~also increases~~ is constant.

### MATURE STAGE:-

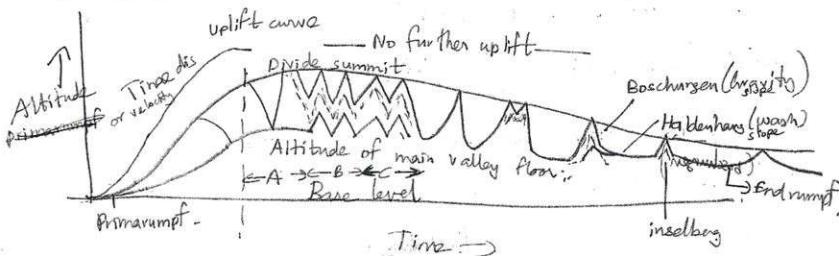
The reduction in gradient reduces vertical erosion (valley deepening) and causes horizontal (lateral) erosion, thus eroding the summits. Therefore ~~it is~~ decrease of relative & abs. relief.

COLD STAGE:

(155)

Entropy of streams is very high. There is almost no valley deepening but there is horizontal erosion causing erosion of summits. So, the abs & relative reliefs are decreased and brought to ground level with isolated hills called MONADNOCKS standing.

Penck



There is no preparatory stage.

WAXING (ACCELERATE) RATE OF DVPT:

The rate of upliftment is initially slow & then rises rapidly. Since the rate of uplift is far greater than erosion, abs. relief increases. Vertical erosion is more dominant than erosion of slope summits. So, relative relief also increases;

UNIFORM DVPT.

Phase (A): Rate of uplift is still higher than lateral erosion of summits. So, abs. relief increases. But, the erosion of summits is equal to valley deepening. So, relative relief is constant.

Phase (D): Rate of uplift matches the erosion of summits. So, abs. relief is constant. Valley deepening rate & summit erosion rate are equal. So, relative relief is constant.

Phase @ :- Upliftment stops completely. So, absolute relief decreases due to summit erosion. Due to equal rates of vertical erosion & summit erosion, relative relief is constant.

### WANING DEVELOPMENT:

• There is no upliftment. The rate of valley deepening reduces. The summit erosion dominates. So, both absolute and relative relief decreases.

The upper slopes usually are steep and are called (Böschungen) gravity slopes, while the lower slopes are gentle and called wash slopes (Abdachungen).

### Language:

• Davis theory is in 'English' and it is very lucid and expressive. It can be applied to all landforms. It has incorporated various views like 'base level', 'gradient of streams' and 'profile of equilibrium' and follows Hutton's cyclical theory of Nature. It has been widely accepted and adopted though its time-dependent & static cycles are criticised.

Penck removed the time dependency and concentrated on structure and it helped to create concept of 'rejuvenated or polygenic landforms'. But his obscure terminology, German language and incomplete work have made understanding his theory difficult. His theory is applicable only to Alpine landforms.

→ Highlight the geomorphic features essentially found in topographies under second cycle of erosion. (157)

Second cycle of erosion occurs when there is a topographic discordance due to some changes like

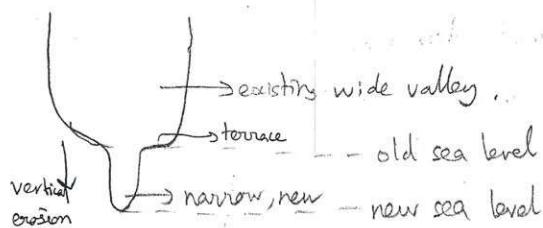
- i) Glaciation or deglaciation
- ii) Increase or decrease in sea level
- iii) Tectonic upliftment of landmass
- iv) Hydrological changes.

These disturbances increase the period of the cycle of erosion by rejuvenation (~~due to older land form converted to young stage~~). These are also called polycyclic as there is more than one cycle of erosion.

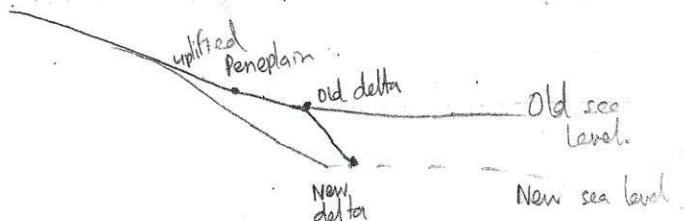
Some of the polycyclic or rejuvenated landforms are:-

### 1) Valley in valley topography.

When there is a sudden decrease in sea level or increase in speed of stream, it causes further vertical erosion producing a narrow, deep valley under the existing wide, shallow valley. The new narrow, deep valley contains a pair of terraces above it, indicating the end of the old valley.



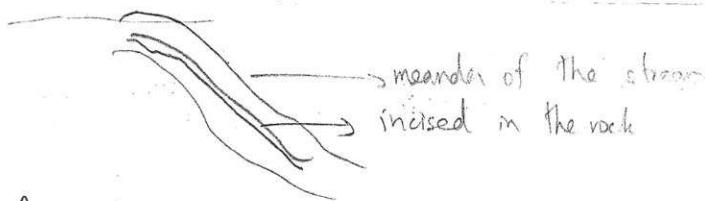
## 2) Uplifted peneplain



When sea level decreases, a new delta is formed at a lesser height in accordance with the sea level. As the existing peneplain is at a higher level than this newly formed plain, it looks uplifted.

## 3) Incised meanders:

Streams come down steep slopes with high velocity. Due to this high kinetic energy, most of the weight of the stream is concentrated in the channel bottom (middle) vertically eroding the rocks & producing incised meanders.

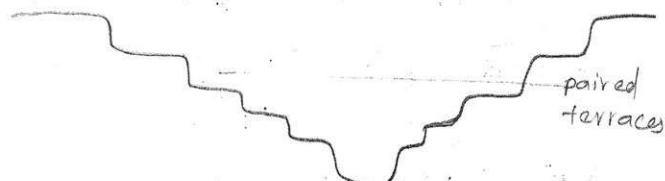


## 4) Paired terraces:

Terraces are valley in valley topographies - In case of multiple sea level changes, each of the old sea level is denoted by a terrace. If two

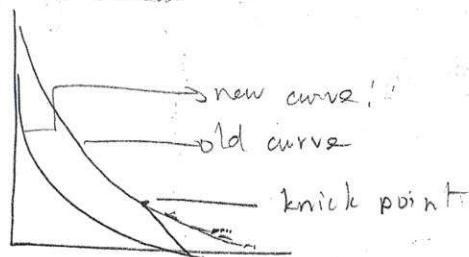
(159)

terraces are present at the same elevation, then they are paired terraces. They occur in areas of sudden decrease in sea level. Parallelism of terraces denote that they belong to the same period.



### 5) Knick points.

When the smooth longitudinal profile of a river is disturbed by tectonic or hydrological changes, a discontinuity in the profile called **Knick point** is formed.



(break of slope)

→ Explain the sequential devt. of landforms associated with coastal areas

Landforms in coastal areas are formed by the action of waves. The actions of waves are

- i) Corrasion :- erosion of a steep rocky cliff by waves' action.
- ii) Attrition :- particles carried by the waves collide with each other and are ground to finer particles.
- iii) Hydraulic action :- water may enter into cracks or debs and when they come out, the compressed air explodes breaking the rocks.
- iv) SOLVENT ACTION :- Dissolves  $\text{CaCO}_3$  in limestone beaches.

Landforms of erosion (in rocky cliffs) (in submerg. coast)

Youth stage:-

Cliffs & Wave-cut terraces

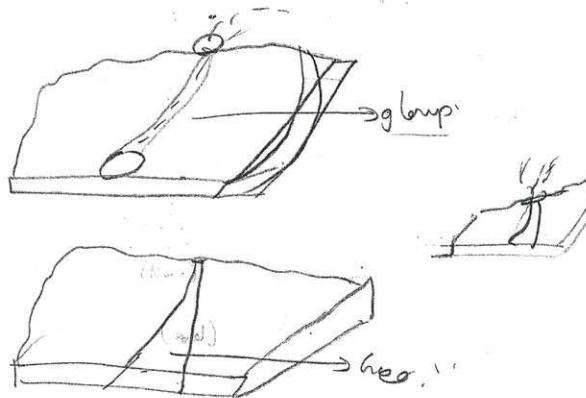
Steep rocky cliffs stand in the land adjoining the sea.



The waves by their constant corrosive action erode the cliffs and the cliffs recede resulting in wave-cut platforms. The eroded material is deposited as wave-built platforms.

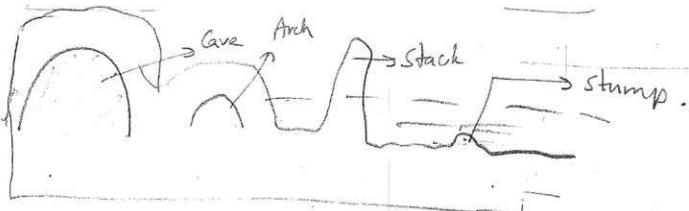


The cliffs are further eroded. Water enters into the cracks in the rocks through long shafts called goups. By hydraulic action, it results in the weakening of rocks & it breaks down forming a deep cleft called GEOES.



### Caves, arches, stack & stumps

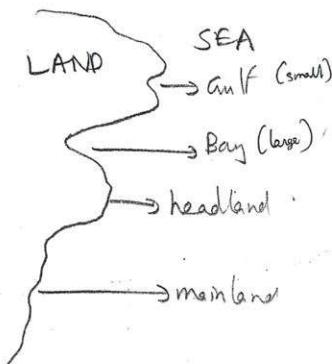
Hydraulic action & corrosion may produce deep hollow space in rocks called CAVES. Two caves join together to form arch. Sometimes, only one upstanding portion is left uneroded. This is stack. When the stack is submerged, it is called a stump.



## Landforms in low-sedimentary coast (emerging coast)

### Bays, gulf

Sometimes, due to differential erosion, the some part of mainland is protruded into the sea as headland. Water enters into the mainland. This inlet is called bay, if it is large and gulf if it is small.

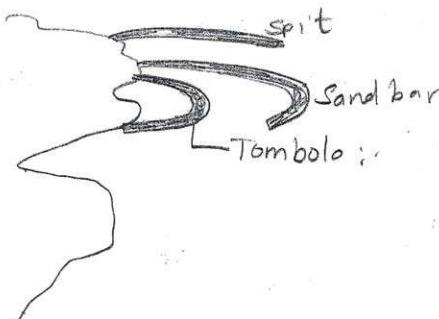


## Landforms due to deposition

Spit, sand bars, tombola, sand barriers!

Wave breakers due to their churning action deposit sand and shingles (pebbles) in the coastal sea. These shingles connecting the land with the sea are called SPITS. Due to wave action, this gets curved towards the coast. This is SAND BAR. If the sand bar emerges from the sea, it is called

SAND BARRIER. If the sand-bar connects two landmasses, it is called TOMBOLA. (163)



### Beeches

Attrition by waves deposit fine sand on the coast. These form sandy beaches. If pebbles are deposited, it is called a shingle beach.

### Marine dunes

The sand deposited by winds and accumulated along the coastline is carried by offshore as sand dunes along

### Mature stage:

Deposition & erosion become equal. The sand bars and tombolos are destroyed. The coast is plain.

### Old stage:

This is a theoretical or hypothetical stage, since this stage doesn't occur due to either submergence or emergence.

## → Karst landforms

Karst landforms are made up of limestone (calcite) rocks or mixed with little magnesium (dolomite).

In such areas, the solvent and precipitation action of surface and ground water are high.

### Distribution

Karst landforms are found in NW Yugoslavia (Karst district), Kentucky in USA, Yucatan peninsula in Mexico, south of Great Victoria desert in Australia and Pennines in Britain.

### Conditions for necessary for Karst landforms

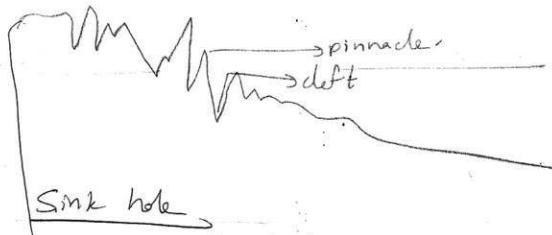
- The limestone rocks must be thick and well jointed. They shouldn't be porous but only the joints should be permeable. They should be present near the surface of earth and plenty of rainfall should be available for solvent action. Then it must be wide in area and depth and must have folds or fractures for water stagnation & action.

### Landforms in Karst region:

#### i) Erosional Landforms.

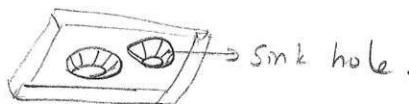
##### Lappies

Lappies are irregularities on the limestone surface due to differential solvent action of water.



### Sink hole

Small, funnel-shaped holes formed initially at the top of the limestone surface.



### Swallow hole

Beneath the surface, the sink holes widen and form large swallow holes.

### Dolines

Dolines are collapse sinks (like quick sand).

### Uvalas (sink valley)

Uvalas are sink valleys. swallow holes combine with dolines to form uvalas.



### Pojies

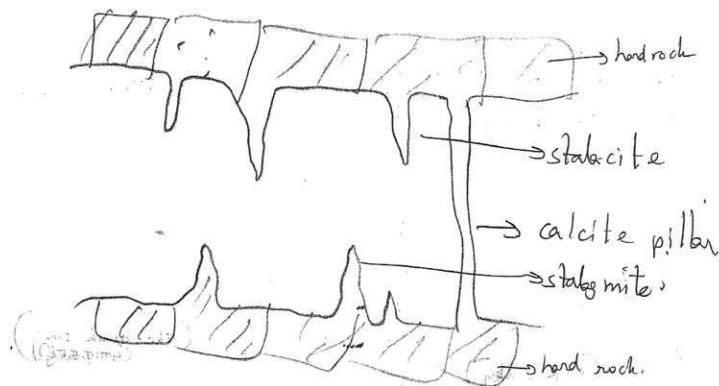
Several uvalas combine to form large depressions called pojies.

## Dissolution

### Caves

When alternating limestones and hard rocks are found, water enters & dissolves the limestone layer leaving hard rocks intact. This results in a hollow space between hard rocks called caves. If both ends are open, it is called a tunnel.

### Landforms of deposition



Hanging icicle like limestone rocks with tapering ends are called stalactites.

When a limestone rock protrudes upward, it is called a stalagmite.

Stalactite and stalagmite join to form a calcite pillar (connection b/w two layers).

### Significance

Not luxuriant vegetation due to absence of surface drainage and thin soil. Only short grass grows. So sheep rearing is practised. Sparse population.

exists. Due to  $\text{CaCO}_3$  availability, cement (167)  
industry thrives. But building a house here  
is not easy due to the weak limestone bed.  
Only lead is the mineral found in veins of  
limestone rocks.

→ Discuss the evolution & characteristics of  
Glacial landforms:-

A large mass of moving ice is called a  
glacier. Pure ice is not in itself an eroding agent.  
The rocks & boulders along with the ice cause two  
types of eroding action.

1) **PLUCKING** → The glacier freezes the rocks at  
the fracture, drags and pulls off with it individual  
blocks, resulting in a rugged terrain.

2) **ABRASION** → The glacier scratches, shears and  
erodes, as it moves through resulting in the smoothening.

### Erosional landforms

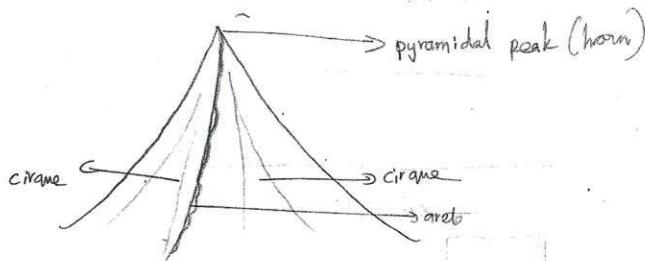
Cirque: ~~cirques & tarn~~:

When a glacier starts flowing from the head  
valley, it plucks the steep back-wall of the  
head valley and as it flows downstream, by the  
action of abrasion, it erodes and deepens the  
lower ends of the valley producing a DEPRESSION.  
This results in a HORSE-SHOE or ARM CHAIR

topography called CIRQUE. At the base, it may form a lake called TARN.

### Aretes :-

When a mountain is surrounded by two or more cirques, a knife-edged ridge is formed between these cirques called ARETE.

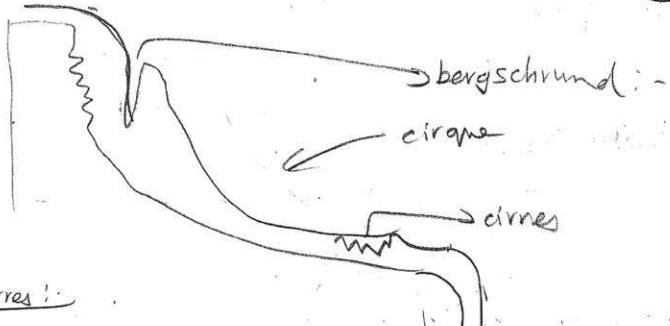


### Pyramidal peak (horn)

When two or more cirques surround a mountain, the peak looks sharp & pyramidal. It is called HORN. If the peak stands aloft the icy cirques like an island, it is a NUNATAK.

### Bergschlund

As the glacier leaves the ~~head~~ valley-head, it produces a deep crack called BERGSCHLUND, which is exposed when the ice melts. It is a narrow deep ridge and is very dangerous to climbers. It is exposed in summer when all ice flows downstream and there is no replacing ice to fill the bergschlund.



### Cirques:

These are cracks made by the glacier when it encounters a bend downstream.

### V-shaped valley:

When the glacier comes down the valley, it is joined & fed by several other glaciers (just like tributaries). This glacier as it moves down the valley erodes the valley laterally by abrasion and removes any undulations in its path forming a smooth V-shaped valley.

### Hanging valley:

In summer, the tributary glacier being small melts. The valley over which these glaciers ran, seems like a HANGING VALLEY. excellent potential of hydroelectric power.

### Roche moutain

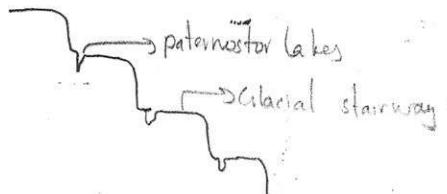


The uphill is smooth & gentle due to the abrasive action of glacier. While it falls down,

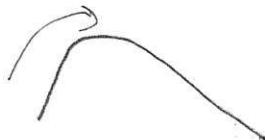
it plucks the back-wall of the mountain producing a rugged & steep down-slope.

### Glacial Stair case

Sometimes due to continuous hard rocks on its way, the glacier forms a staircase structure. Near the <sup>b/w, 2 consecutive stairs</sup> ~~steep end~~, it produces a narrow depression. This depression when filled with water is called paternoster lakes.



### Crag & tail



The up-slope is steep while leeward slope is gentle.

### DEPOSITIONAL LANDFORMS

#### Moraines

Moraines are rocks & boulders <sup>gathered</sup> that are eroded by glaciers by abrasion and imbibed in them and carried by the glacier.

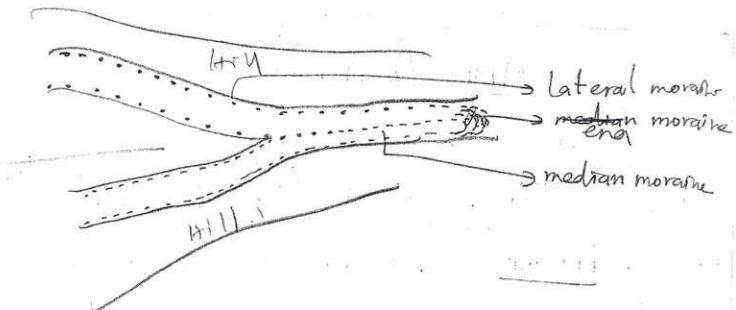
Lateral moraine → The moraines are usually imbibed in the sides of the glaciers.

Median Moraine → When two glaciers join, the lateral

moraines are moved to the centre part of the glacier and are called median moraines.

### Terminal (end) moraine

When the glaciers reach downstream, the moraines are deposited at the end in snout shape.



### Drumlin: (deposition) version of crescent)

Drumlin is a depositional feature in which boulders or clay are deposited in such a way that it has a steep upslope & gentle downslope. It looks like an inverted spoon. It is placed diagonally to form 'BASKET or fan' topography.



inverted spoon

### Eskers

Eskers are long, narrow ridges of stones and gravel deposited by the glacier when it melts. Roads Eskers are the best place to lay roads on glaciers. These stones are used for construction purposes.

## Outwash plains

In summer - glacier melts : The stream carries away all ~~as~~ the fine deposits and deposits it in a low-featureless plain called <sup>most fertile plains</sup> outwash plain.

When there are undulations in this plain, water may get stored  $\rightarrow$  KETTLE LAKES.

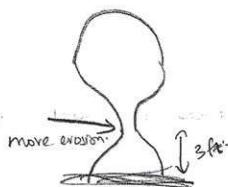
## ARID LANDFORMS

Arid, desertic landforms are mostly affected by the effect of wind. Wind erodes in 3 ways.

- 1) DEFLATION  $\rightarrow$  The wind may carry away the sand from a particular place forming a depression. This is called deflation.
- 2) ABRASION  $\xrightarrow{\text{similar to corrosion of waves}}$  The sand particles carried by the wind may collide with a rock and erode it heavily by sand-blasting.
- 3) ATTRITION  $\rightarrow$  The sand & other debris when carried by wind collide with each other & are ground to fine particles.

## Erosional landforms

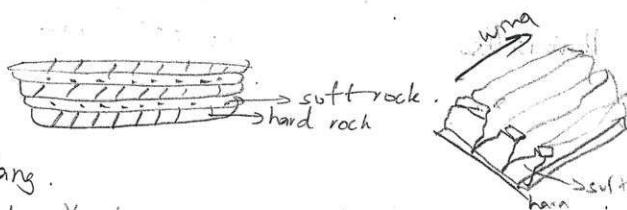
- 1) Mushroom or pedestal rocks:-



This is because of differential abrasion (17) of wind, the centre portion of the rock is eroded greatly. These rocks with slender filaments are called Mushroom Rocks.

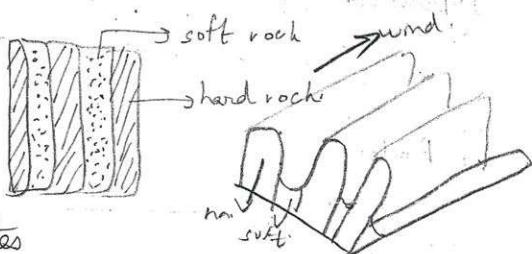
## 2) Zengen

Alternating horizontal strata of soft rock and hard rocks are placed one above the other. In such cases, the soft rocks are eroded more than the hard rocks:



## 3) Yardang.

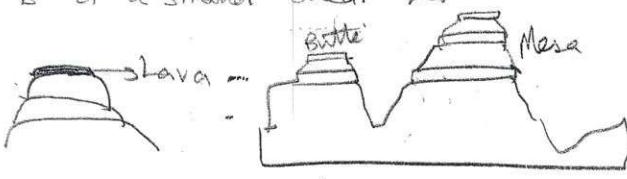
In Yardangs, set longit vertical strips of hard and soft rocks are found adjacent to one another.



## 4) Mesas & Buttes

### A table

A high land with a table-like top with lava on the top is called MESA, when it is of a large area and a BUTTE when it is of a smaller area.



## Inselbergs

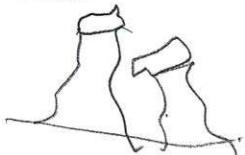


Isolated hill-like rocks formed in the old stage of geographic cycle are called inselbergs.

They have steep gravity slopes

e.g.- Ares rock in Australia.

## Dense islettes



## Deflation hollows

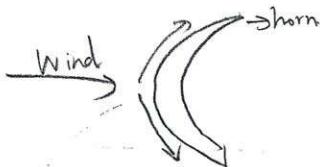
dases:-

## Depositional landforms

Mostly, the depositional landforms in deserts are dunes.

### i) Barchans:

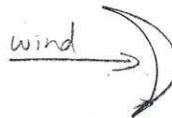
It is a crescent-shaped sand-dune formed with its <sup>(Choms)</sup> wings hooked ~~along~~ from the direction of wind. This is because of relatively hard material on the centre of the dunes and the wind splits equally forming the wings of BARCHAN.



## Parabola

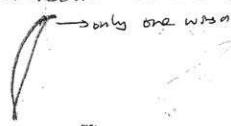
(175)

A parabolic shaped sand dune but with its wings pointed opposite to the direction of wind.



## Seif

Seif is a parabolic dune with a single wing.



## Longitudinal dunes

The longitudinal dunes are those in which sand in the wind <sup>path</sup> direction is carried away & settled on either side. These form long, narrow, rocky corridors with sand on either side. These are formed in areas of scanty sand.

These are the routes taken for navigation in deserts.

e.g.: Silk route (China to West Asia)



## Transverse dunes

The sand dunes are arranged perpendicular to the direction of wind. In these places, there is large availability of sand.



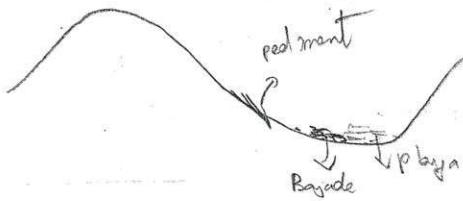
## Loess

The fine sand particles formed by ATTRITION are carried to far away places by the wind and deposited as fine sand. This is called LOESS.

e.g.: - Igwindi, Ogadon.

## Fluvial deposits landforms (due to water action)

- 1) Pediment  $\rightarrow$  eroded footplain
- 2) Bayad  $\rightarrow$  depositional footplain
- 3) Playa  $\rightarrow$  depressions (temporary lakes)



## Distribution

~~Sub~~ Saharan Africa, Great Sandy desert (Aus), Sonoran, Mojave (to N. America)