

# Geomorphology

**Earth's Interior**

**Earth Movements**

**Tectonics**

**Tectonics and  
Orogeny**

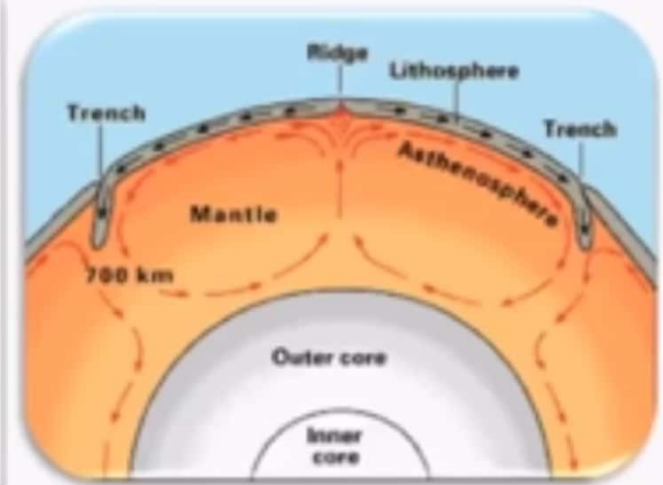
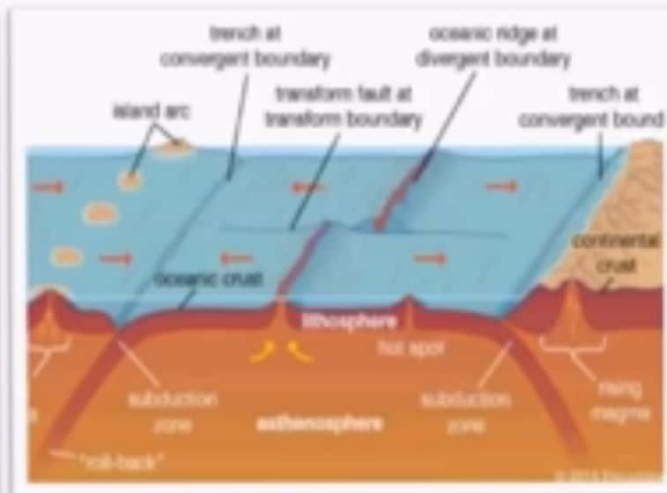
**Continental Drift**

**See Floor  
Spreading**

**Plate Tectonics**

## Important theories

- ❑ Continental Drift Theory (CDT)
- ❑ Convectional Current Theory (CCT)
- ❑ Sea Floor Spreading Theory (SFST)
- ❑ Plate Tectonics (PT)
- ❑ Polar wandering (Similar to CDT)



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# Continental drift Theory

By Alfred Wegener ; German Climatologist

Postulated in 1912, Published in 1922



Subhodeep Das





# Historical Perspective

Francis Bacon (1620) :



Similarity between opposite coast of Atlantic Ocean.

Jigsaw puzzle



## ...Historical Perspective

Antonio Snider (1858) :

Introduced – Idea of Drifting of Continent.

- Suggested – **Coal** seams of **N. America** and **Europe** are tropical in origin

- Said- these continents ; once joined together.

They split apart and move away.



# ...Historical Perspective

Edward Suess :

First coined the term – **Gondwanaland** – for all southern continents.

Also credited ;

**SiAL** (Lighter **continental** crust).

**SIMA** (Heavier **oceanic** crust).

... in **late Nineteenth century**.

Wegener believed his concept.





## ...Historical Perspective

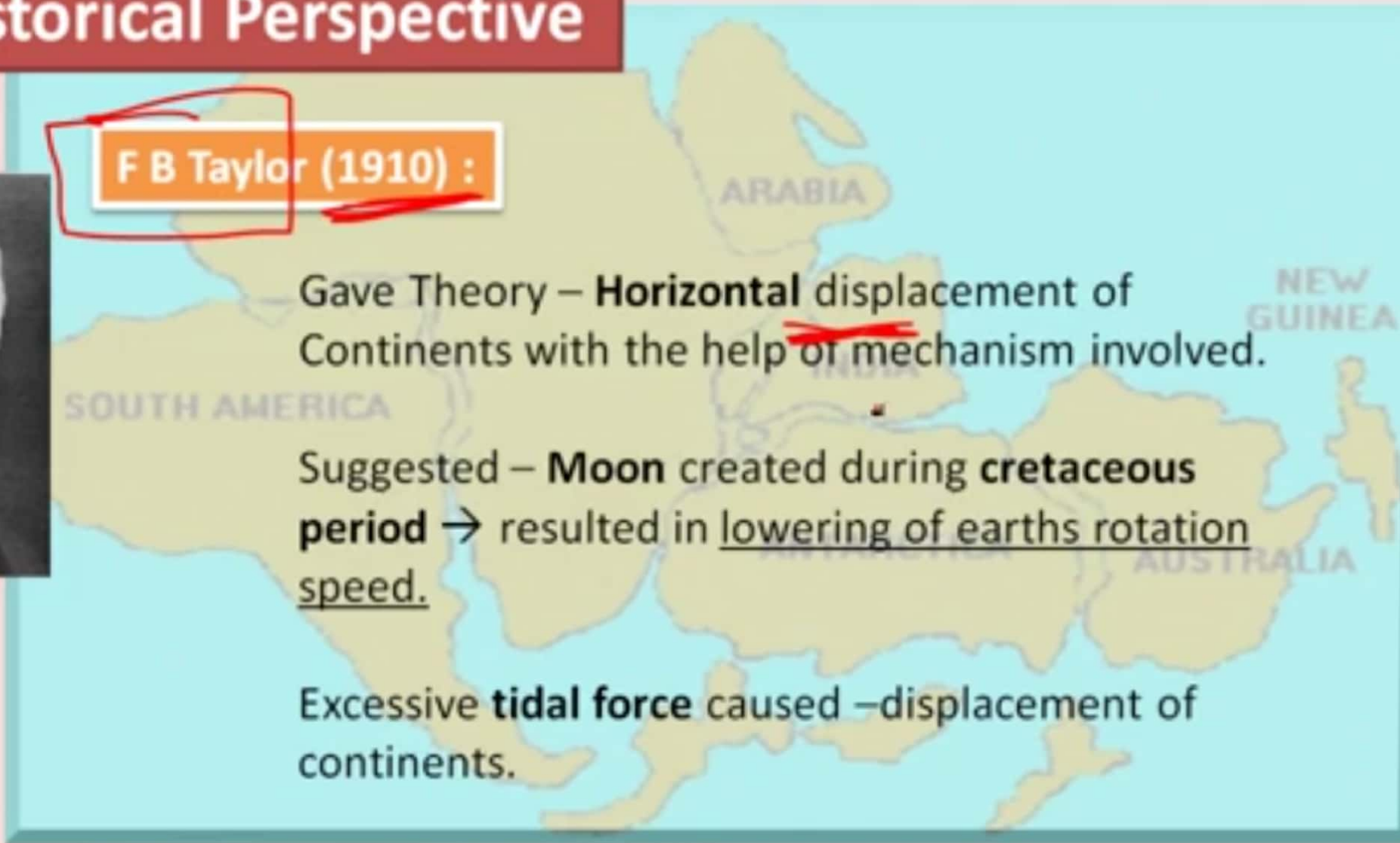
F B Taylor (1910) :



Gave Theory – **Horizontal** displacement of Continents with the help of ~~mechanism~~ involved.

Suggested – **Moon** created during **cretaceous period** → resulted in lowering of earths rotation speed.

Excessive **tidal force** caused –displacement of continents.





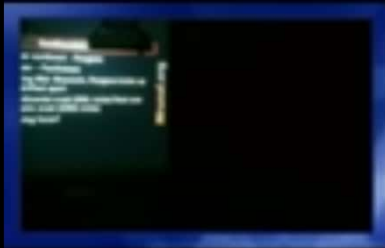
## Continental drift theory

- ❑ Super continent - Pangaea
- ❑ Ocean - Panthalasa

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## Continental drift theory

- ❑ Super continent - Pangaea
- ❑ Ocean - Panthalasa
- ❑ During Mid- Mesozoic, Pangaea broke up and drifted apart
- ❑ Continental crust (SIAL rocks) float over Oceanic crust (SIMA rocks)
- ❑ Driving force?

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**KIDS  
DISCOVER**

# The Continental Drift Theory

## Piecing It All Together

**Tectonics**



**PERMIAN**

250 million  
years ago

The Atlantic and Indian oceans did not exist, and all the continents were configured into the universal landmass of Pangaea. The land was surrounded by one global ocean, called Panthalassa.



**TRIASSIC**

200 million  
years ago

The breakup of Pangaea began. Rifts formed, splitting West Gondwana from East Gondwana. India separated from Antarctica. Laurasia split from South America and Africa.

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Two hundred and fifty million years ago, the land masses of Earth were clustered into one supercontinent called Pangaea. As millions of years passed, Pangaea broke apart, and large pieces of land slowly moved away to form the continents as we know them today.



**JURASSIC**

145 million years ago

Seafloor spreading further opened the central North Atlantic and Indian oceans. At the end of the period, a new rift split South America from Africa.



**Tectonics**



**PRESENT DAY**

New Zealand is split from Australia's east coast. The North and South Atlantic oceans are more open. Africa is slightly north, and India is joined with Asia.



**CRETACEOUS**

65 million years ago

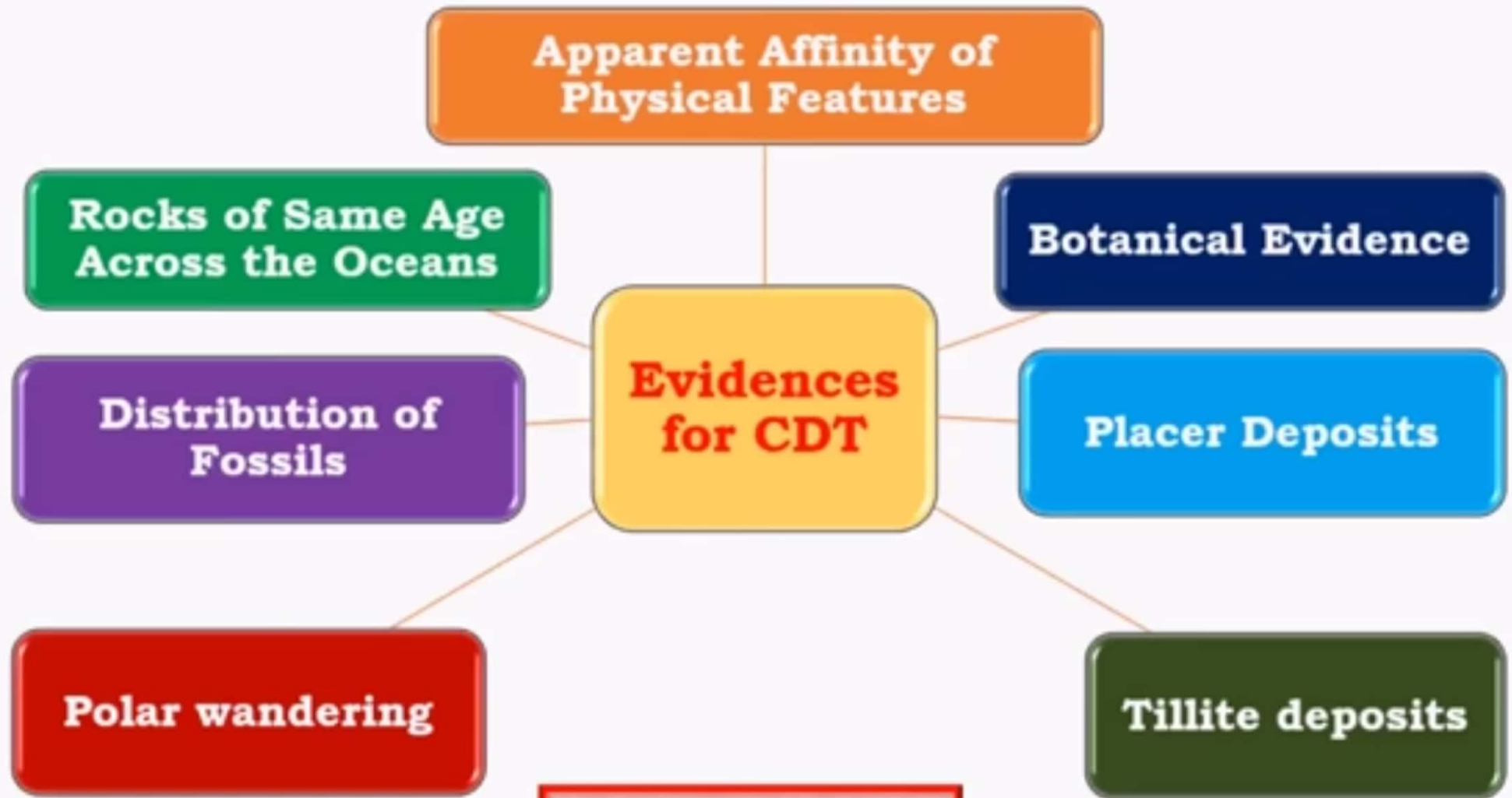
The movement continued. Madagascar drifted away from Africa, which continued its move north. The northward drift of India continued, and Australia split from Antarctica.

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**Timeline**

- Mesozoic Era (225-70 m)
  - ❖ Triassic Period (225 m) → **Breakup of Pangea began**
  - ❖ Jurassic Period (195 m) → **All continents got separated except Europe and Asia.**
  - ❖ Cretaceous (136 m) → All continents moving further apart except Eurasia. India reaches equator.
- Cenozoic Era (70-0 m)
  - ❖ Paleogene Period
    - Formation of Deccan traps begin. Late cretaceous and early Cenozoic era
  - ❖ Neogene Period
    - Tertiary period (40-50 million years ago) India collides with Asia.
    - Formation of Himalays.**
  - ❖ Quaternary Period
    - 📅 Pleistocene epoch (1 m)
      - ✓ Stone Age
    - 📅 Holocene epoch (10,000 y)

## Evidence in support of Continental Drift



Tectonics

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## 4 evidences: Continental Drift theory

Zig-saw fit

Similarity of rocks



## Apparent Affinity of Physical Features



**Tectonics**

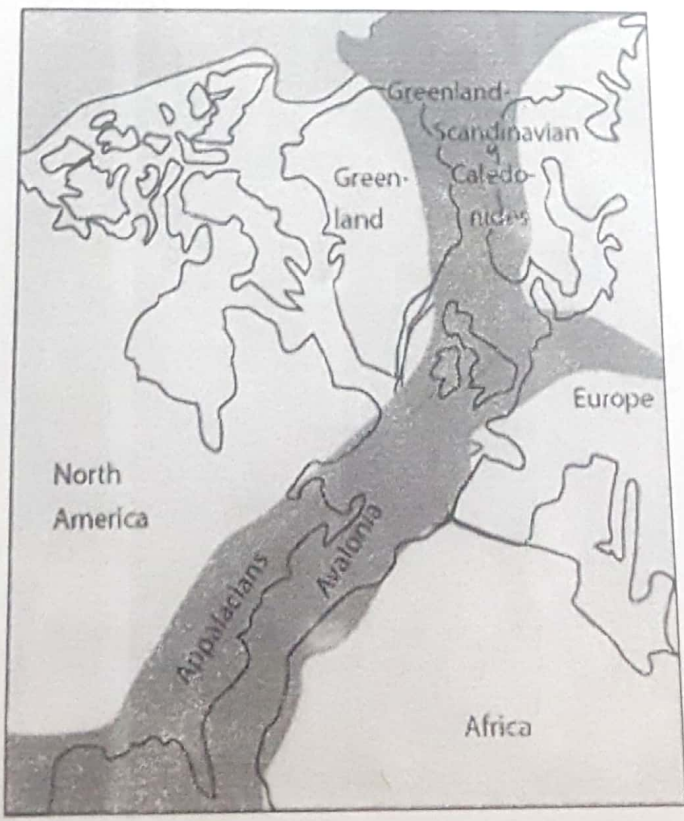
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land seems to fit in well with Ellesmere and Baffin islands.

- The west coast of India, Madagascar and Africa seem to have been joined.
- North and South America on one side and Africa and Europe on the other fit along the mid-Atlantic ridge.



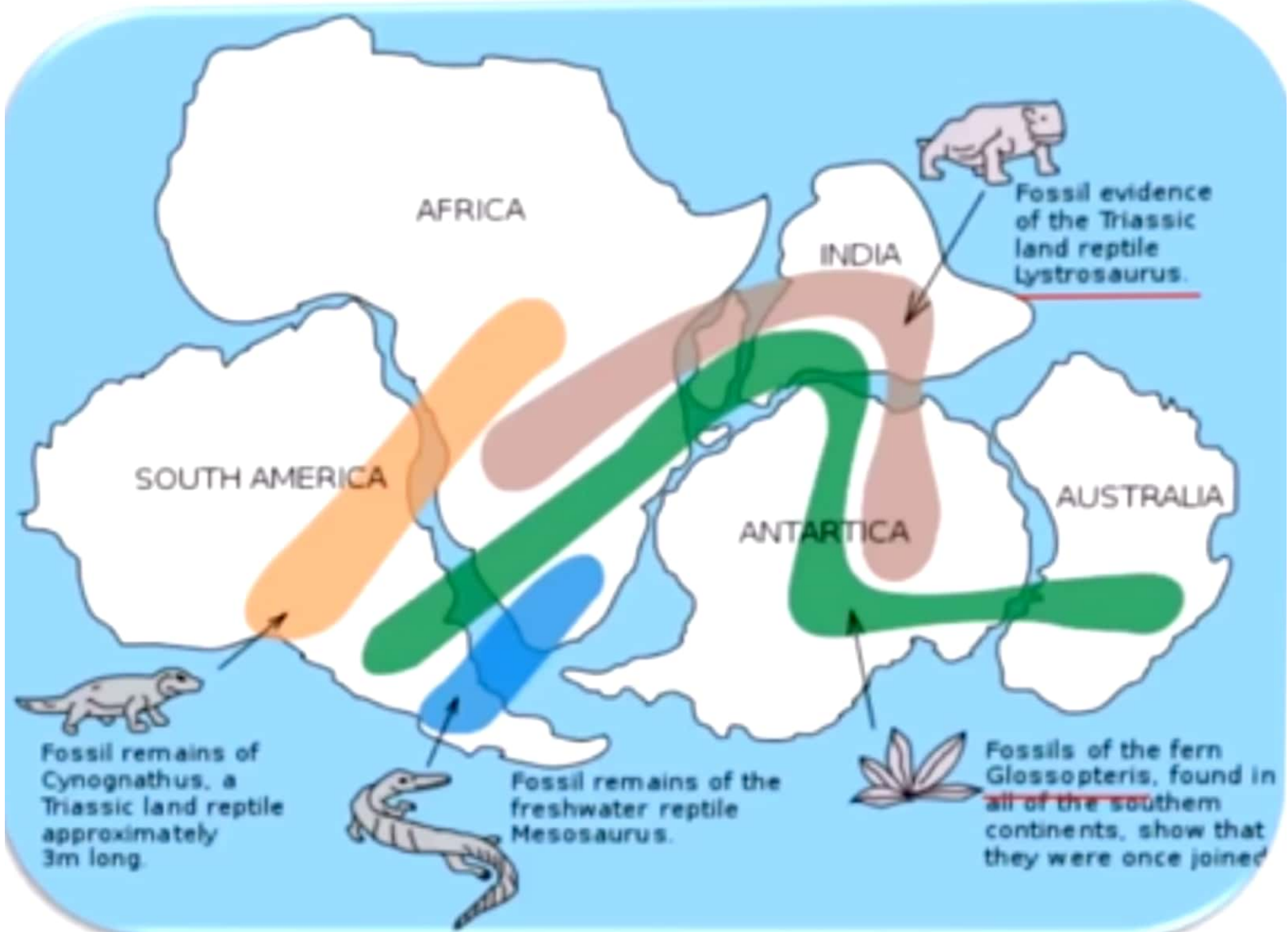
- The Caledonian and Hercynian mountains of Europe and the Appalachians of USA seem to be one continuous series.



Caledonian mountains



# Fossil and Botanical Evidences

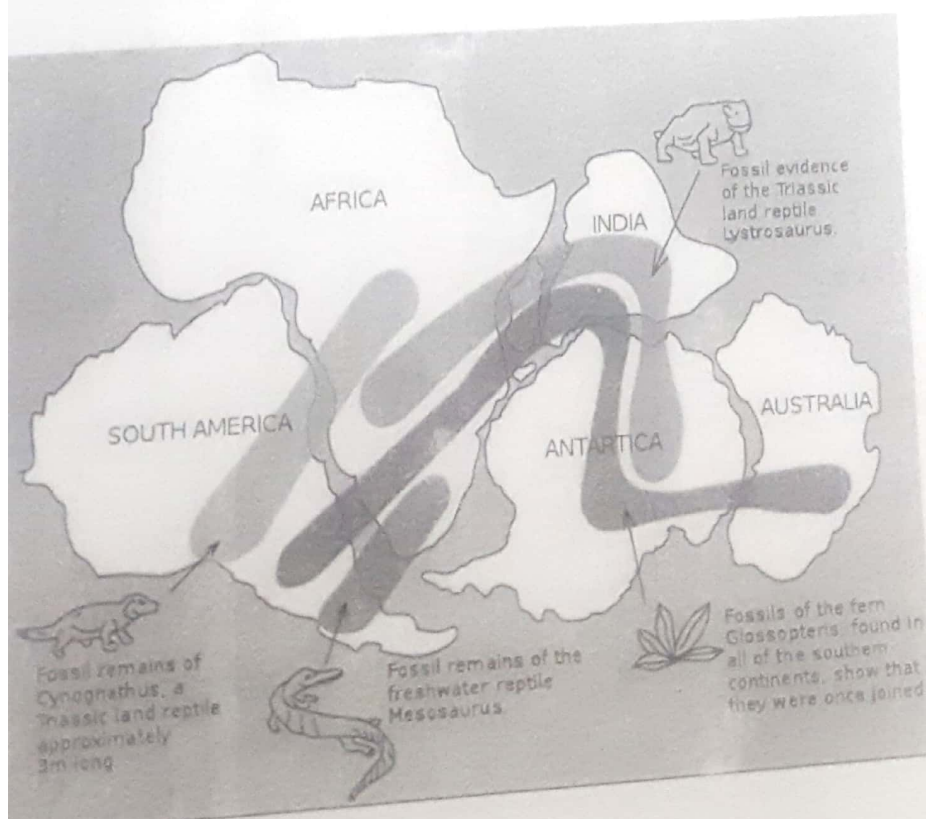


## Evolution of Fossils

- The observations that Lemurs occur in **India**, **Madagascar** and **Africa** led some to consider a contiguous landmass "Lemuria" linking these three landmasses.
- Mesosaurus was a small reptile adapted to shallow brackish water. The skeletons of these are found only in South Africa and Iraver formations of Brazil. The two localities presently are 4,800 km apart with an ocean in between them.

## 2.5 Botanical Evidence

- Presence of glossopteris vegetation in carboniferous rocks of India, Australia, South Africa, Falkland Islands (Overseas territory of UK), Antarctica, etc. can be explained on the basis of the fact that parts were linked in the past.



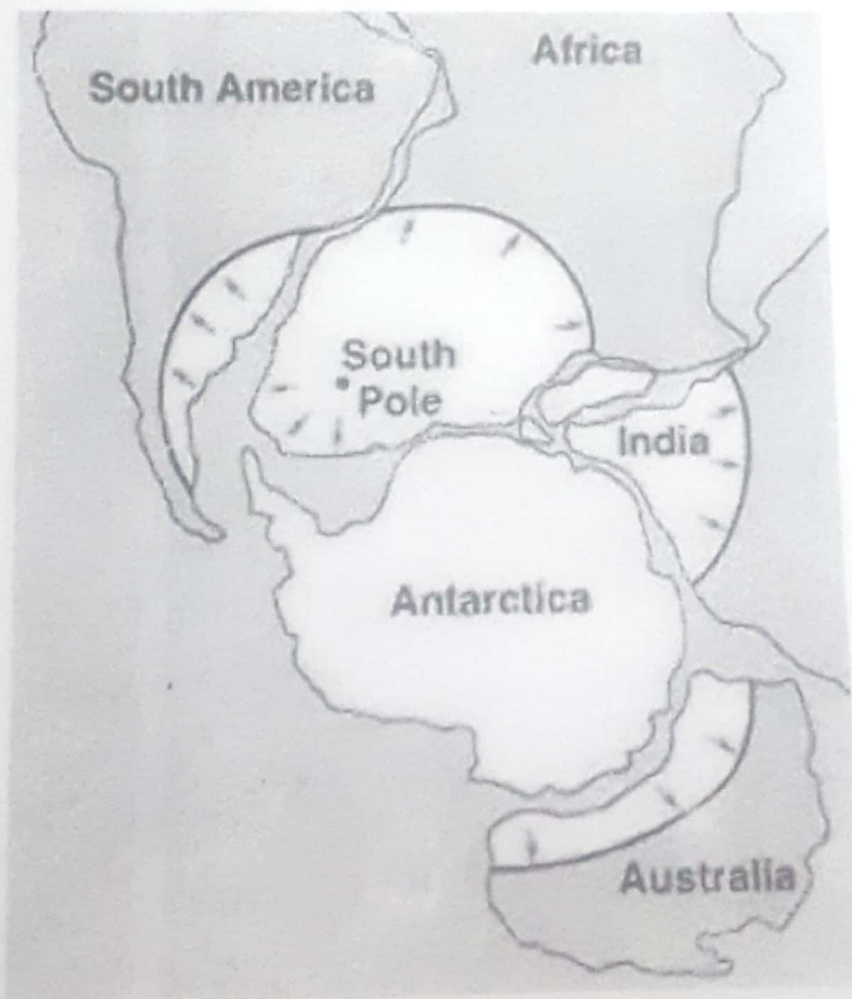
# Tillite Deposits





## 2.7 Tillite deposits

- It is the sedimentary rock formed out of deposits of glaciers. The Gondwana system of sediments from India is known to have its counter parts in six different landmasses of the Southern Hemisphere.
- At the base the system has thick Tillite indicating extensive and prolonged glaciation. Counter parts of this succession are found in Africa, Falkland Island, Madagascar, Antarctica and Australia besides India.



- Overall resemblance of the Gondwana type sediments clearly demonstrates that these landmasses had remarkably similar histories.

# Placer Deposits



## 2.8 Placer Deposits

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- Rich placer deposits of gold are found on the Ghana coast (West Africa) but the source (gold bearing veins) are in Brazil and it is obvious that the gold deposits of the Ghana are derived from the Brazil plateau when the two continents lay side by side.

1. Force of **Buouancy in Equator**- **Equatorward movement.**

Brought Angara and Gondwana close to eachother.

2. **Westward movement** – Splitting of America from Africa and Europe and its movement away from it.







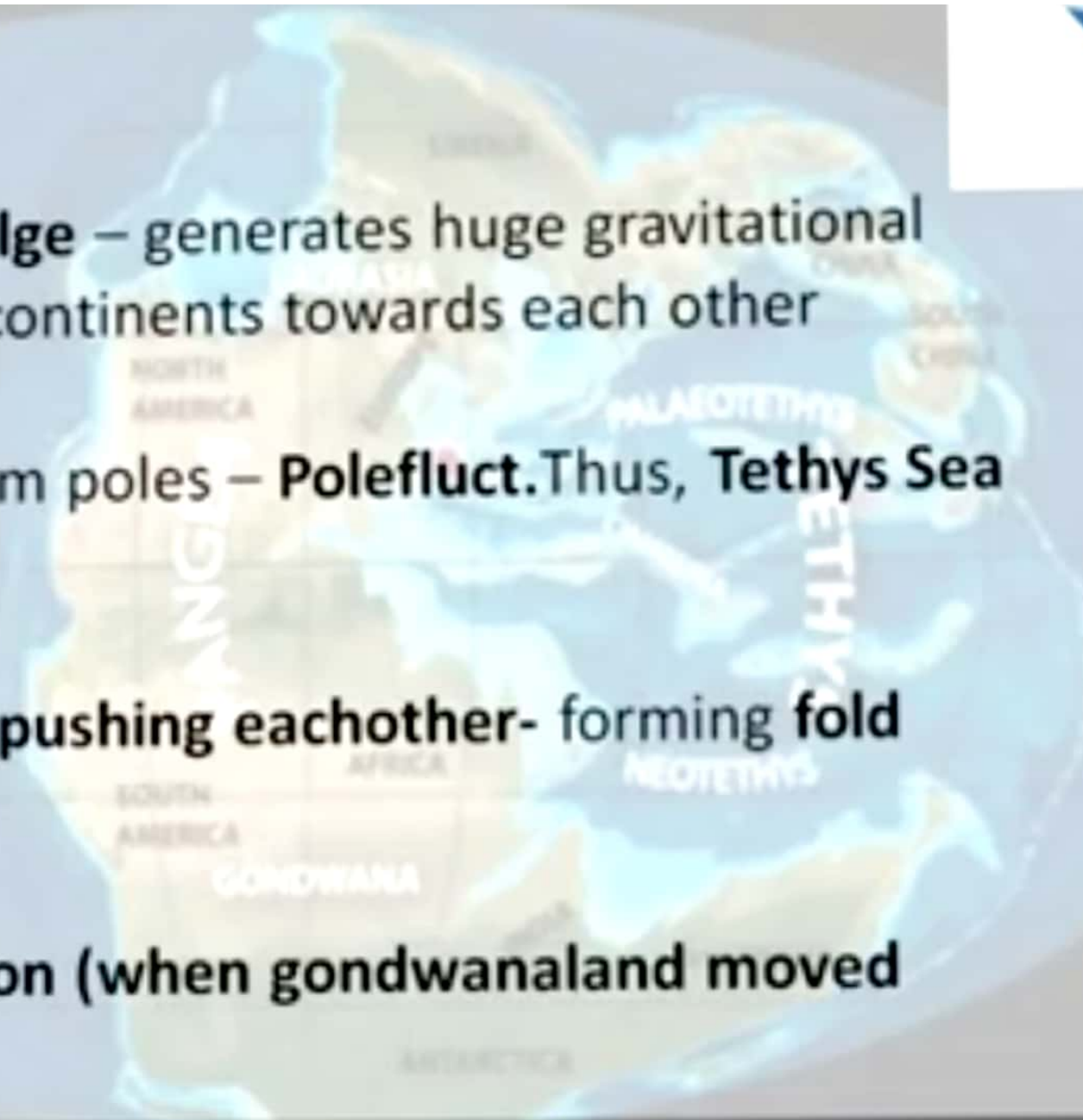
## Fast rotating earth

Creates **Equatorial bulge** – generates huge gravitational force which dragged continents towards each other

Thus, moves away from poles – **Polefluct**. Thus, **Tethys Sea Disappeared.**

Resulting- continents **pushing each other-** forming **fold mountains.**

**Indian ocean formation (when gondwanaland moved away from pole).**

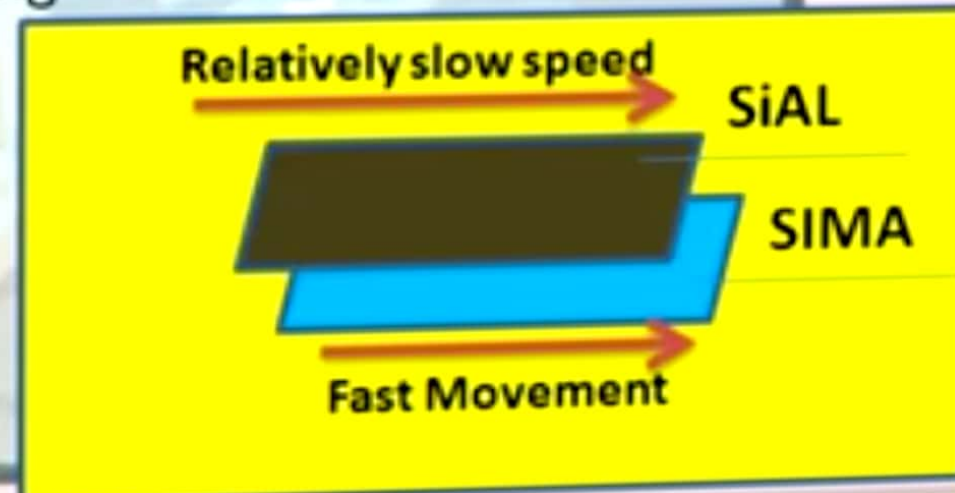


Mechanism – **differential gravitational pull** of moon over Continents and Oceans.

**Continents being closer** to moon than oceanic crust – experience **more gravitational pull**.

**Reduce the speed** of continent – resulting in **westward movement of continent**.

**Due to relatively slow speed** – appears moving westward.



- Wegener failed to explain why the drift began only in Mesozoic era and not before.**
- The theory doesn't take oceans into consideration.**
- Proofs heavily depend on assumptions and are very general in nature.**
- Forces like buoyancy, tidal currents and gravity are too weak to be able to move continents.**
- Modern theories (PT) accept the existence of Pangea and related landmasses but give a very different explanation to the causes of drift.**



## ...Criticism :

### 2. Forces of Equator.

Equatorial bulge doesn't have greater gravitational force compared to pole.

If (suppose) – equator dragging continent, then **howcome Africa and peninsular India** crossed Equator.





...Criticism :

- ✓ 3. Formation of mountains is unscientific because merely coming of two continent can't form giant himalayas.

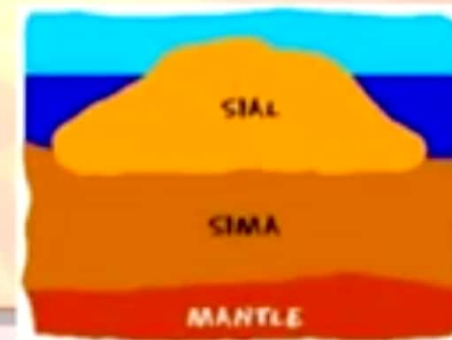


## ...Criticism :

### ✓ 4. Self contradictory

-SiAL over SIMA Smoothely.

-Then, howcome resistance applied by SiMA to form High Altitudes Rockies and Andes.



5. Didn't explained ,why did he chose carboniferous period as the **last phase of existence** of Panagea.

6. He **didn't talk about breaking** of – Australia, P India, and Africa.

7. His Explanation of **IslandArch/ leftover Island** – highly **unscientific**.

8. **JigSaw fit** was not perfect fit.

7. **Paleoclimatic evidence-** couldn't be basis of such strong belief.