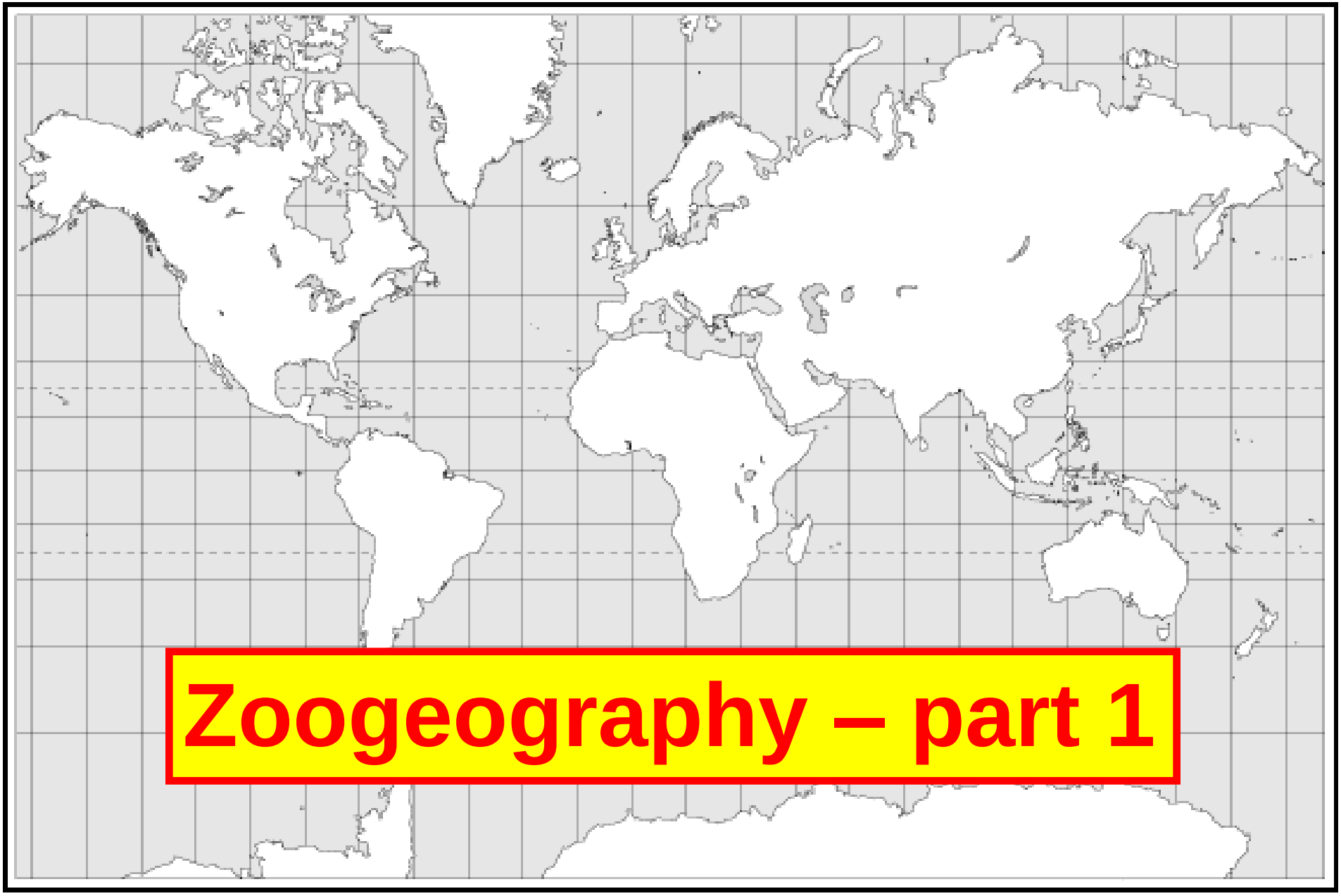
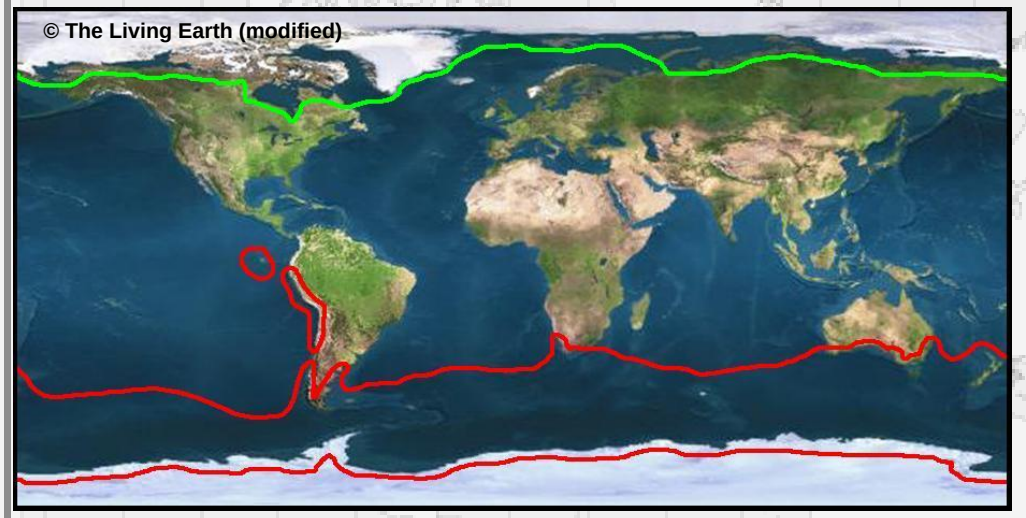


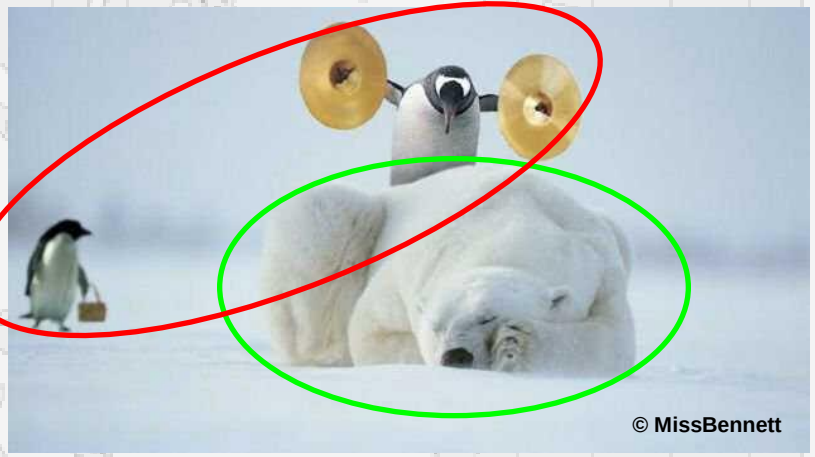
Zoogeography – part 1

Definition

What is wrong with this figure?

Definition





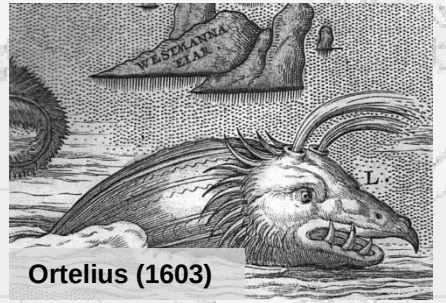
! The polar bear and the penguin do not live together !

Zoogeography

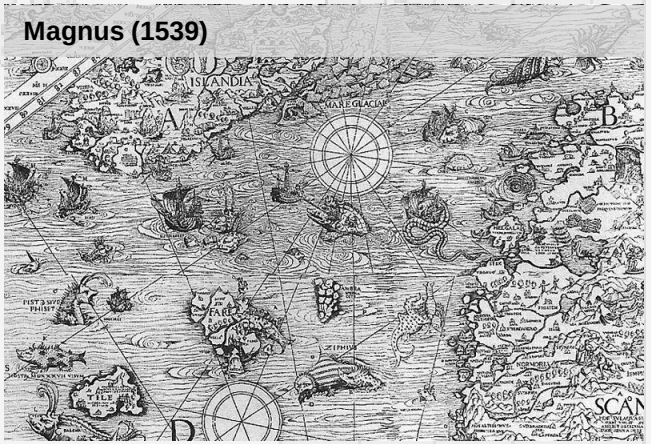
= the branch of biogeography that is concerned with the geographic distribution of animals on earth.

History

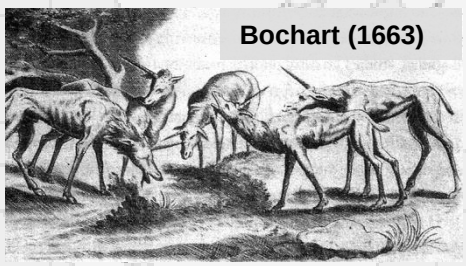
Traveler's tales about strange creatures to be found elsewhere in the world are regarded as the origin of zoogeography.



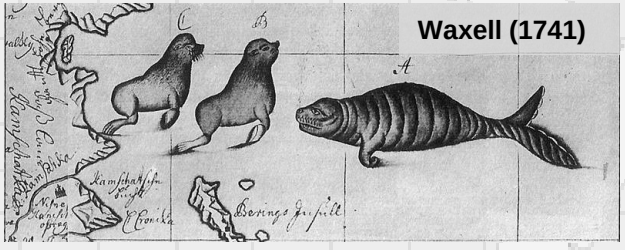
Ortelius (1603)



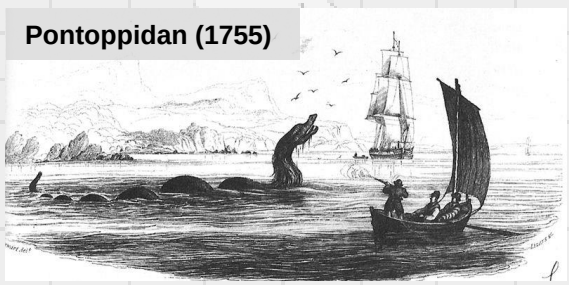
Magnus (1539)



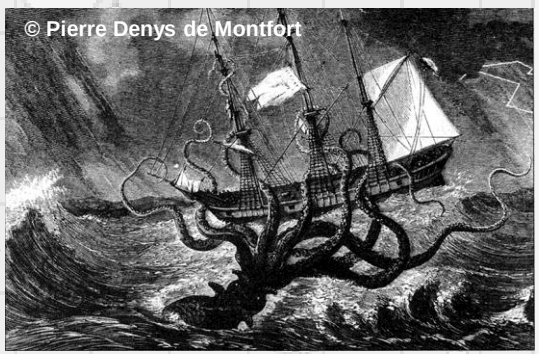
Bochart (1663)



Waxell (1741)



Pontoppidan (1755)



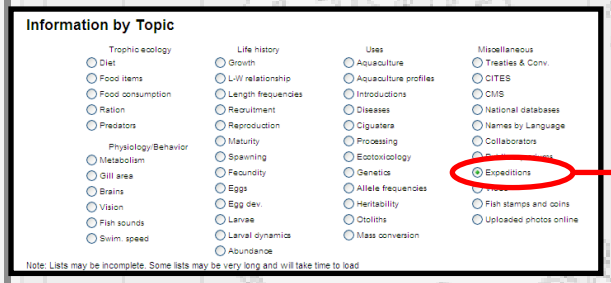
© Pierre Denys de Montfort

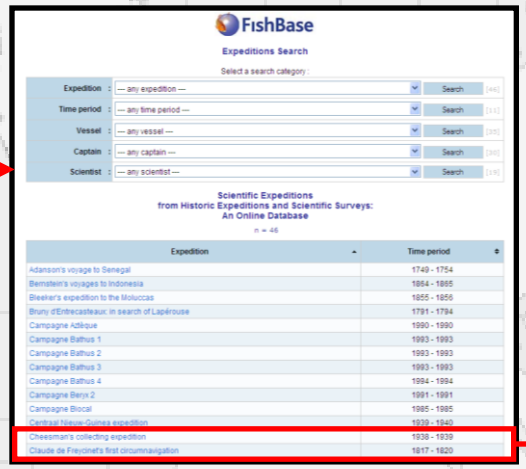
After the 18th century, exploration expanded and became more scientific. Since this period distributional information was regarded as an important contribution to knowledge.

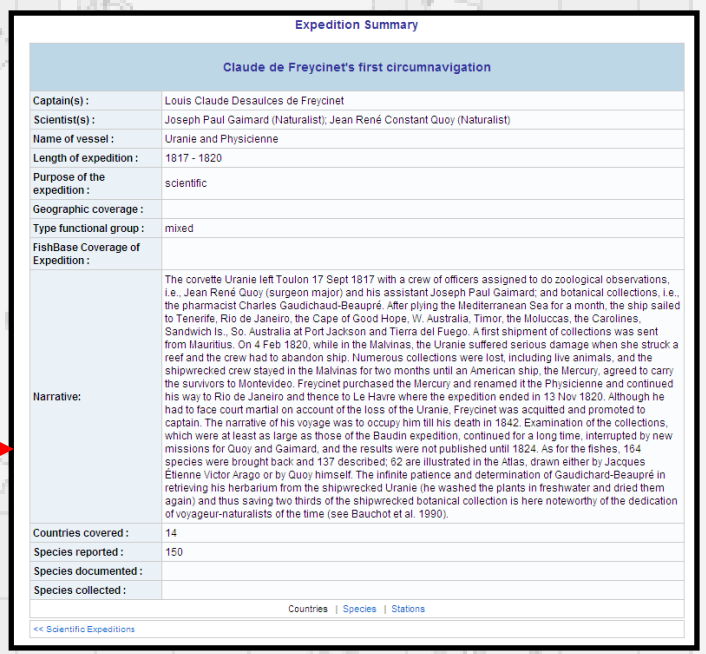
figures: © www.strangescience.net (except noted)

History

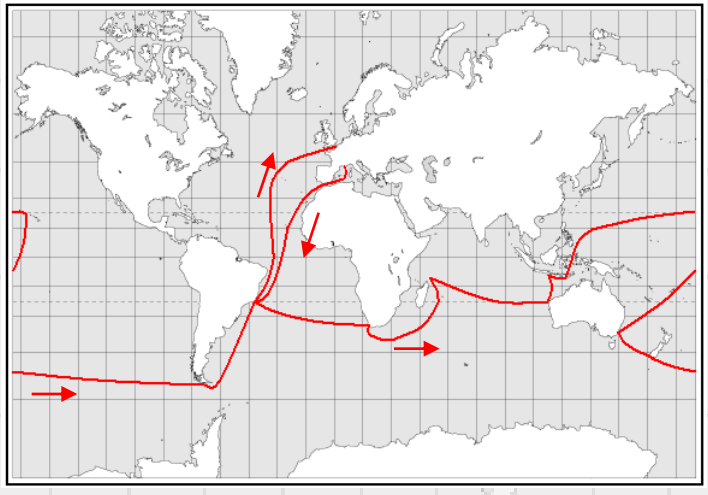
FishBase







de Freycinet's first circumnavigation (1817-1820)



Captain: Louis Claude Desaulces de Freycinet

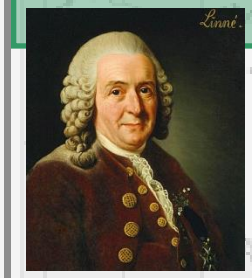
Scientists: Jean René Constant Quoy & Joseph Paul Gaimard

Royal Museum for Central Africa (RMCA Tervuren)

FishBase and Fish Taxonomy Training Session 2017

History

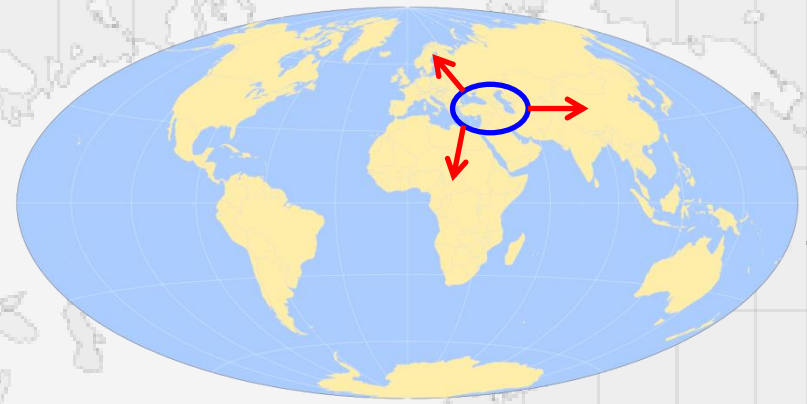
Carolus Linnaeus (1707-1778)



➔ He developed a system to classify life that included the binomial nomenclature.

"How did different species become adapted to so many different environments"

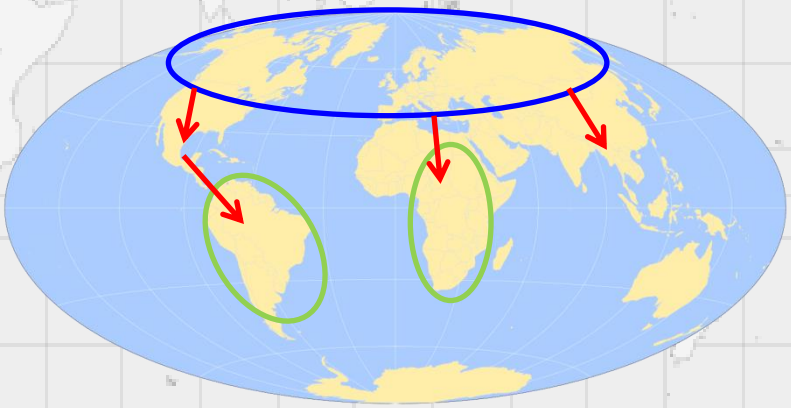
1. There is a 'center of origin' [Mount Ararat] from which species originate and disperse to its respective environment.



Comte de Buffon (1707-1788)

➔ He was the first person to discuss a large number of evolutionary problems.

"climates and species are mutable" (changeable)



Buffon's Law: "Environmentally similar but isolated regions have distinct assemblages of mammals and birds"

* life originated on northern landmasses.
* life spread southward as climates cooled.

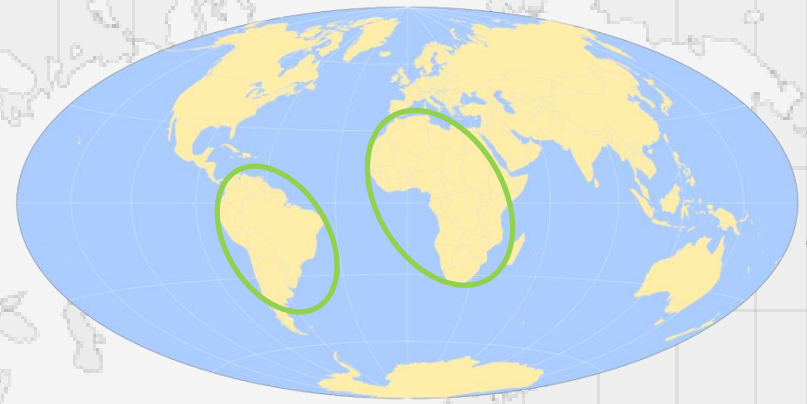
2. Ecological conditions control the regularities in distribution patterns.

History

Alexander von Humboldt (1769-1859)

➔ He was one of the first to propose that the lands bordering the Atlantic Ocean were once joined.

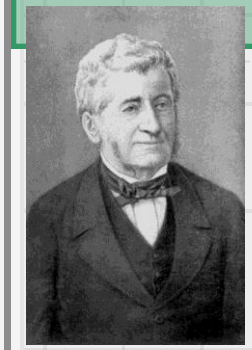
"Plant geography finds the separation of Africa and South America occurred before the development of living organisms"



He was convinced that the history of organisms and the history of earth were intimately linked.

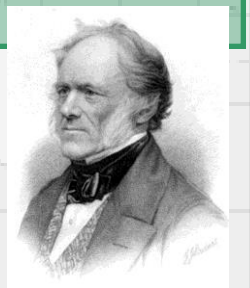
3. Changes in earth history (vicariance) could explain present day patterns.

Adolphe Brongniart (1801-1876)



➔ Adolphe Brogniart was the 'father of paleobotany'. He concluded that the earth's climate was highly mutable and used the fossil record to infer past climates.

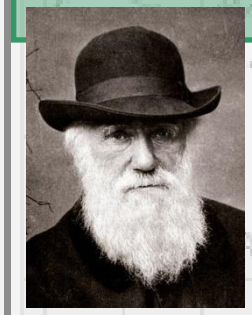
Charles Lyell (1797-1875)



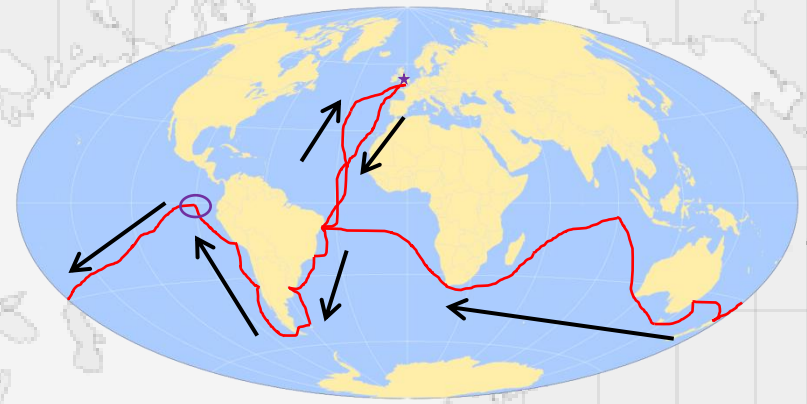
➔ Charles Lyell was the 'father of geology'. He also thought climates changed through time and found fossils adapted to different habitats than from they were discovered. He recognized that the earth must be much older than just a few thousand years. However, he rejected the idea that species are also dynamic.

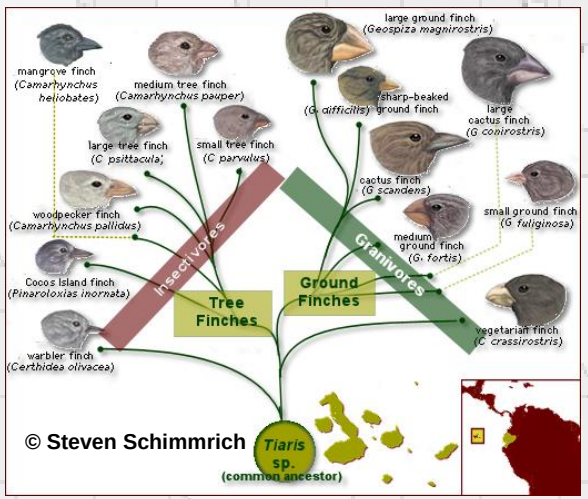
History

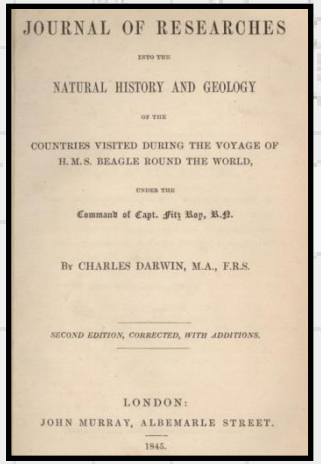
Charles Darwin (1809-1882)



He made important collections and notes during his voyage with the HMS Beagle (1831-1836).






JOURNAL OF RESEARCHES

INTO THE

NATURAL HISTORY AND GEOLOGY

OF THE

COUNTRIES VISITED DURING THE VOYAGE OF H.M.S. BEAGLE ROUND THE WORLD,

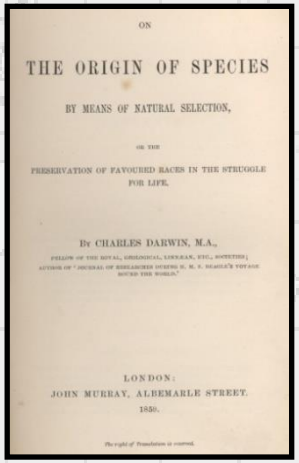
UNDER THE

Command of Capt. Fitz Roy, R.N.

By CHARLES DARWIN, M.A., F.R.S.

SECOND EDITION, CORRECTED, WITH ADDITIONS.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1845.


ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

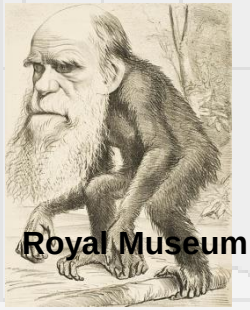
OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

By CHARLES DARWIN, M.A.,

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.

➔ Charles Darwin established that all species of life have descended over time from common ancestors, and he proposed the scientific theory that this branching pattern of evolution resulted from a process that he called natural selection, in which the struggle for existence has a similar effect to the artificial selection involved in selective breeding.

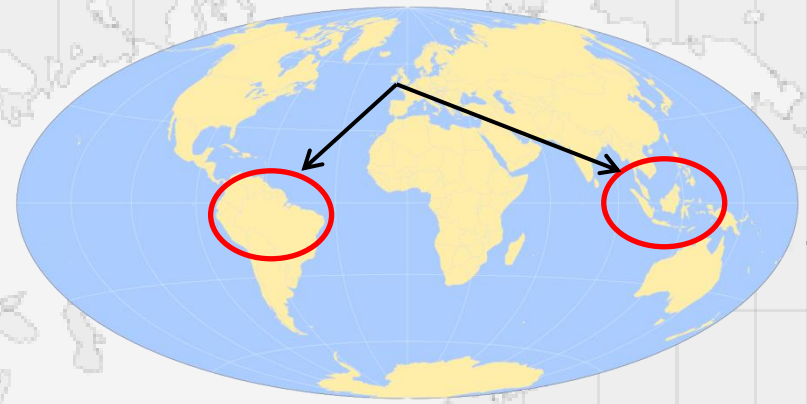


➔ Charles Darwin became the leading author of evolutionary theory.

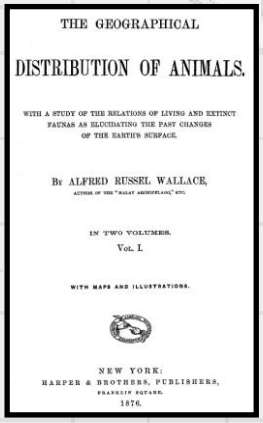
History

Alfred Russell Wallace (1823-1913)

➔ Alfred Russell Wallace is the 'father of zoogeography'. Together with Charles Darwin he was also the co-discoverer of evolution by means of natural selection.



[1848-1852] – expedition to the Amazon rainforest.
[1854-1862] – expedition to the Malay Archipel.



THE GEOGRAPHICAL
DISTRIBUTION OF ANIMALS.

WITH A STUDY OF THE RELATIONS OF LIVING AND EXTINCT FAUNAS AS ELUCIDATING THE PAST CHANGES OF THE EARTH'S SURFACE.

By ALFRED RUSSEL WALLACE,

IN TWO VOLUMES.
Vol. I.

WITH MAPS AND ILLUSTRATIONS.

NEW YORK:
HARPER & BROTHERS, PUBLISHERS,
1876.

In the Malay Archipel, he developed the same ideas on evolution by natural selection as Darwin. However, they had a different view:

* Darwin: evolution is caused by a competition between individuals, the 'survival of the fittest'.
* Wallace: evolution is caused by an environmental pressure.

➔ Based on his own expeditions and his correspondence with other scientists, he published his book 'The geographical distribution of animals' in 1876.

"The different parts of the world support greatly different assemblages of organisms"

History

Alfred Russell Wallace (1823-1913)

"The different parts of the world support greatly different assemblages of organisms"

The different organisms are not at random distributed but:

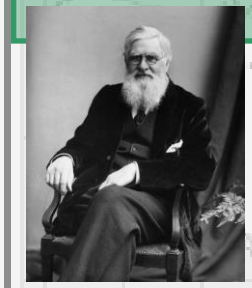
1. Continental regions had more or less uniform biotas, but with great discontinuities.

2. The biotas of some parts of the world were much more unusual compared to other parts.

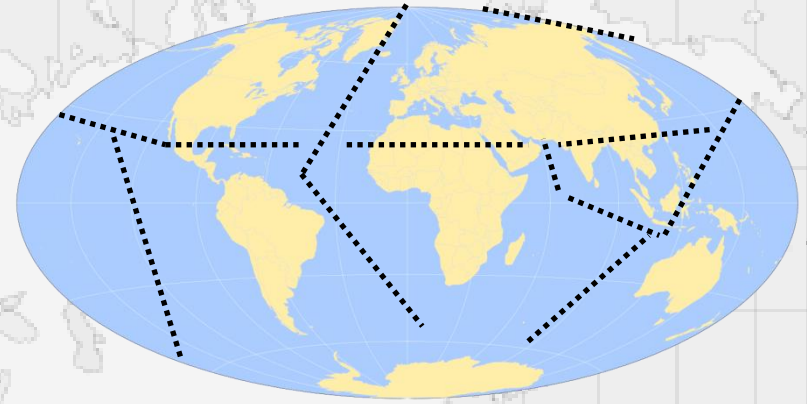
3. Elements of the biotas of certain continents were related to each other more closely than they were to elements from biotas of other continents.

History

Alfred Russell Wallace (1823-1913)

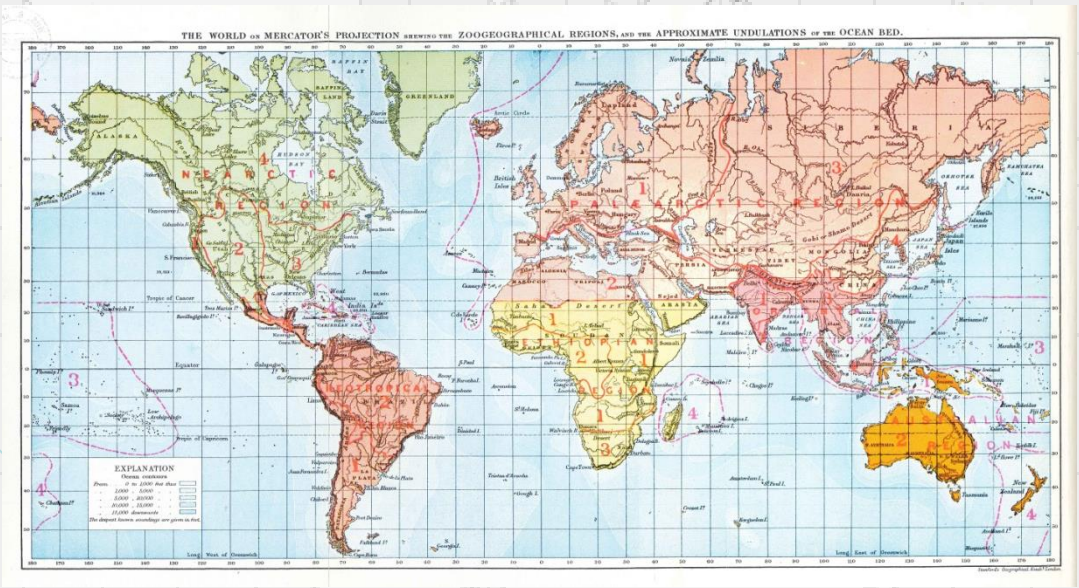


"The different parts of the world support greatly different assemblages of organisms"



The continental regions were occupied by typical arrays of related organisms, different from other such regions. These regions are called the ZOOGEOGRAPHIC REALMS.

"In the archipelago there are two distinct faunas rigidly circumscribed, which differ as much as those in South America and Africa and more than those of Europe and North America"

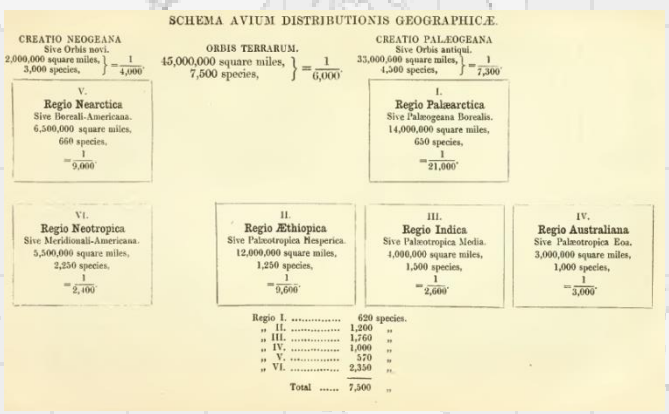


Royal Museum for Central Africa (RMCA Tervuren)

FishBase and Fish Taxonomy Training Session 2017

Zoogeographic realms

Philip Sclater (1829-1913) was an ornithologist and he identified the main zoogeographic region of the world on the basis of the avian fauna [1858].



SCHEMA AVIUM DISTRIBUTIONIS GEOGRAPHICÆ.

CREATIO NEOGEANA
Sive Orbis novi.
2,000,000 square miles, } = 1/4,000
3,000 species, }

ORBIS TERRARUM.
45,000,000 square miles, } = 1/6,000
7,500 species, }

CREATIO PALÆOGEANA
Sive Orbis antiqui.
33,000,000 square miles, } = 1/7,300
4,500 species, }

V. Regio Nearctica
Sive Boreali-Americana.
6,500,000 square miles,
650 species,
= 1/9,000

I. Regio Palæarctica
Sive Palæogeana Borealis.
14,000,000 square miles,
630 species,
= 1/21,000

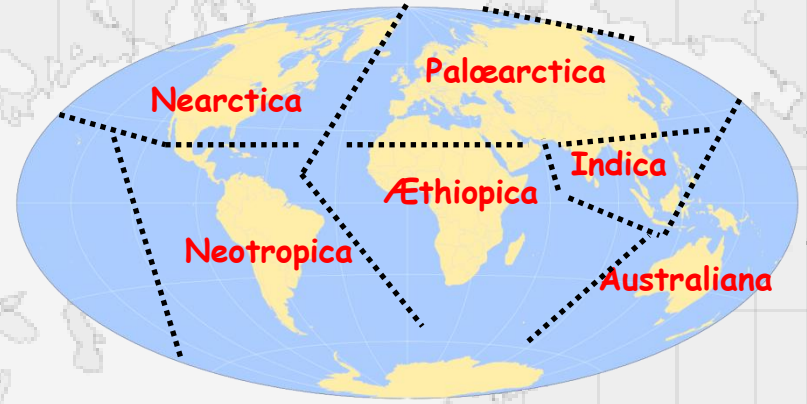
VI. Regio Neotropica
Sive Meridionali-Americana.
5,500,000 square miles,
2,250 species,
= 1/2,400

II. Regio Æthiopica
Sive Palæotropica Hesperica.
12,000,000 square miles,
1,250 species,
= 1/9,600

III. Regio Indica
Sive Palæotropica Media.
4,000,000 square miles,
1,500 species,
= 1/2,600

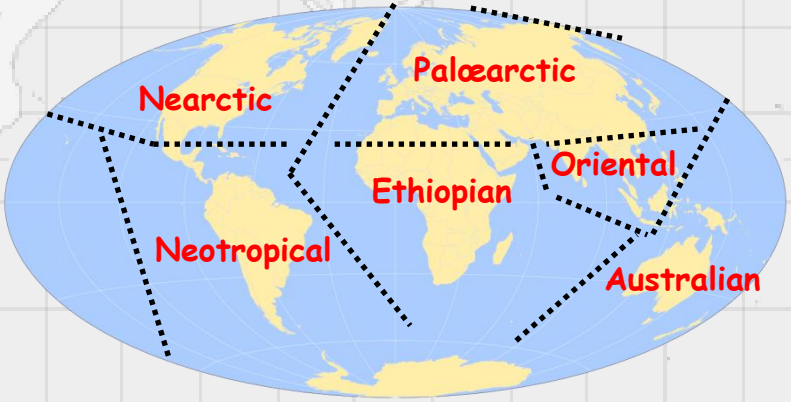
IV. Regio Australiana
Sive Palæotropica Eoa.
3,000,000 square miles,
1,000 species,
= 1/3,000

Regio I.	620 species.
„ II.	1,200 „
„ III.	1,760 „
„ IV.	1,000 „
„ V.	570 „
„ VI.	2,350 „
Total	7,500 „



Alfred Russel Wallace agreed with Sclater's classification, but he suggested that the regions should be based on mammals. He also proposed some other names [1876].

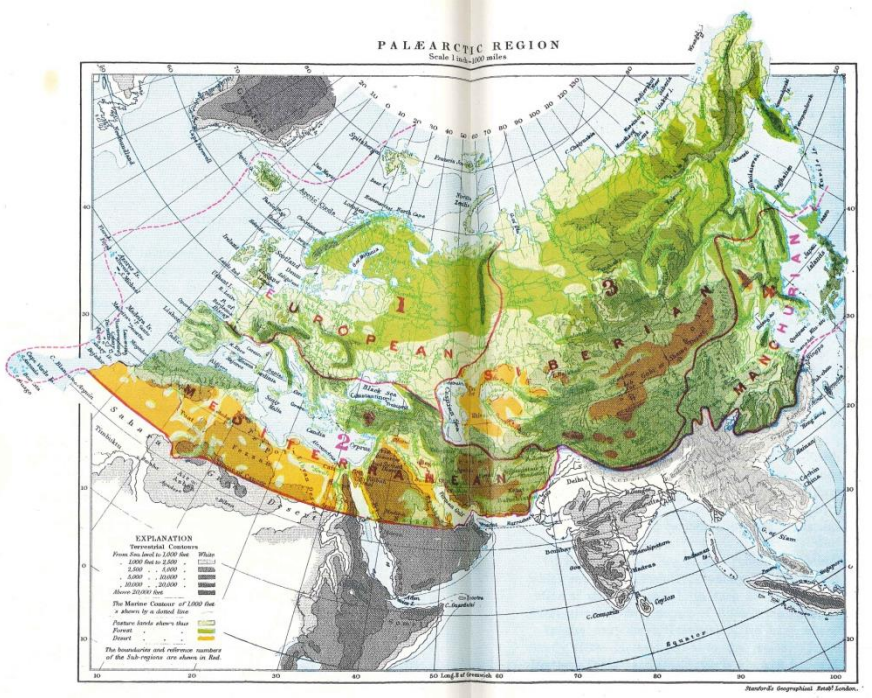
- **Mammals are dependent for their means of dispersal upon continuity of land.**
- **Mammals are too large to be carried accidently across the seas.**
- **There is a better knowledge of extinct mammals than of any other existing group.**



Regions.			
Neogæa	Neotropical ...	Austral zone.....	Notogæa.
	Nearctic.....	Boreal zone	Arctogæa.
Palæogæa	Palæarctic ...		
	Ethiopian	Palæotropical zone	
	Oriental		
	Australian ...	Austral zone	Notogæa.

Zoogeographic realms

1. Palearctic region



The Palearctic region is the largest zoogeographic region and comprises all the temperate portions of the great eastern continents. It includes the terrestrial regions of Europe, Asia north of the Himalaya, North Africa and the northern and central parts of the Arabian peninsula.

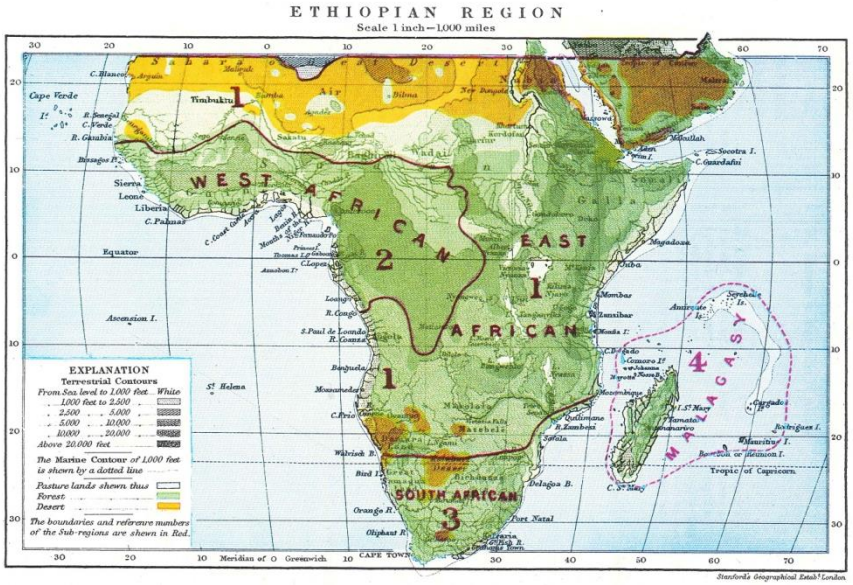
The region can be divided in:

A. European subregion.
B. Mediterranean subregion.
C. Siberian subregion.
D. Manchurian subregion.

Endemic mammal families (3):
ex. Calomyscidae, Prolagidae†(1774), Lipotidae†(2006)

Zoogeographic realms

2. Ethiopian region



The Ethiopian region consists of tropical and south Africa. Also included are the south-west extremity of the Arabian peninsula, Madagascar and a few other islands.

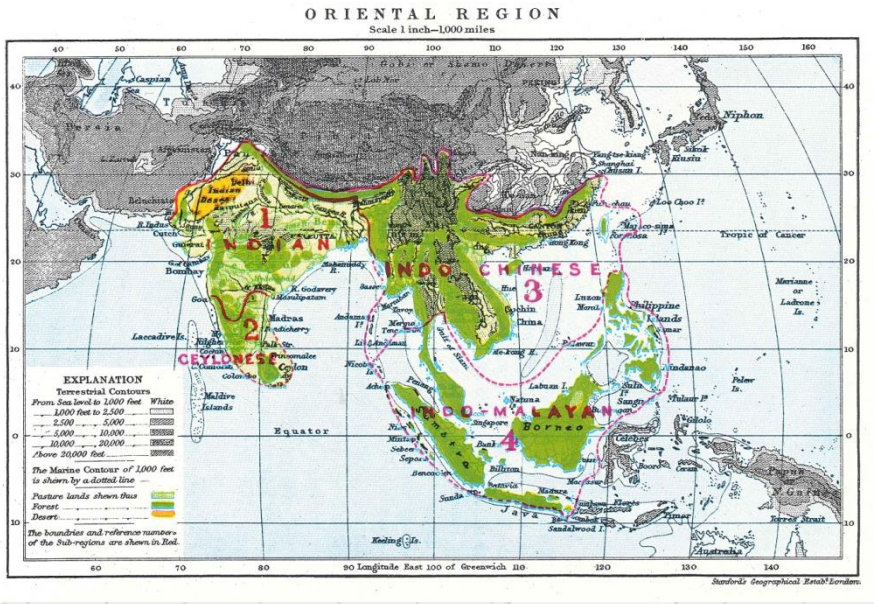
The region can be divided in:

A. East African subregion.
B. West African subregion.
C. South African subregion.
D. Malagasy subregion.

Endemic mammal families (20):
ex. Tenrecidae, Chrysochloridae, Orycteropodidae, Cheirogaleidae, Lemuridae, Lepilemuridae, Indriidae, Daubentoniidae, Galagidae, Nesomyidae, Anomaluridae, Pedetidae, Bathyergidae, Petromuridae, Thryonomyidae, Myzopodidae, Eupleridae, Nandiniidae, Hippopotamidae, Giraffidae

Zoogeographic realms

3. Oriental region



The Oriental region stretches from Pakistan over the subcontinent of India to south-east Asia, between central China in the north to Java, Bali and Borneo in the south. It includes also the Philippines and Taiwan.

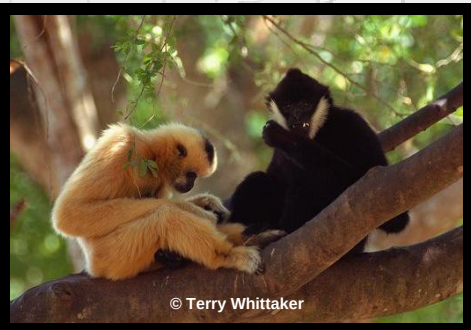
The region can be divided in:

A. Indian subregion.
B. Ceylonese subregion.
C. Indo-Chinese subregion.
D. Indo-Malayan subregion.

Endemic mammal families (6):
ex. Tupaiidae, Ptilocercidae, Cynocephalidae, Hylobatidae, Craseonycteridae, Platanistidae

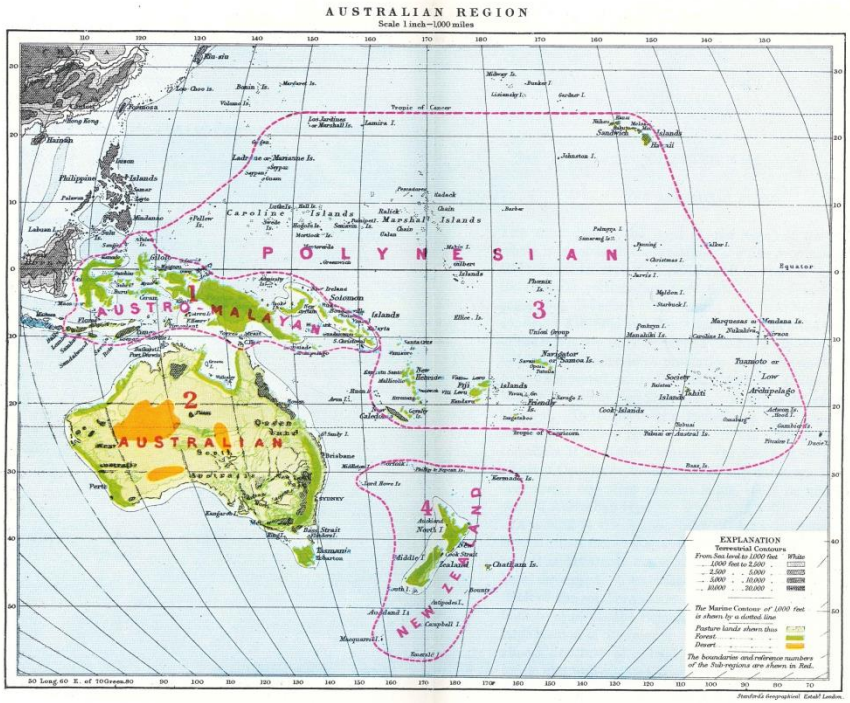

© Anthony Cramp


© Tim Laman


© Terry Whittaker

Zoogeographic realms

4. Australian region



The Australian region includes Australia, New Guinea, the eastern region of the Indonesian archipel, New Zealand and the islands in the Pacific Ocean.

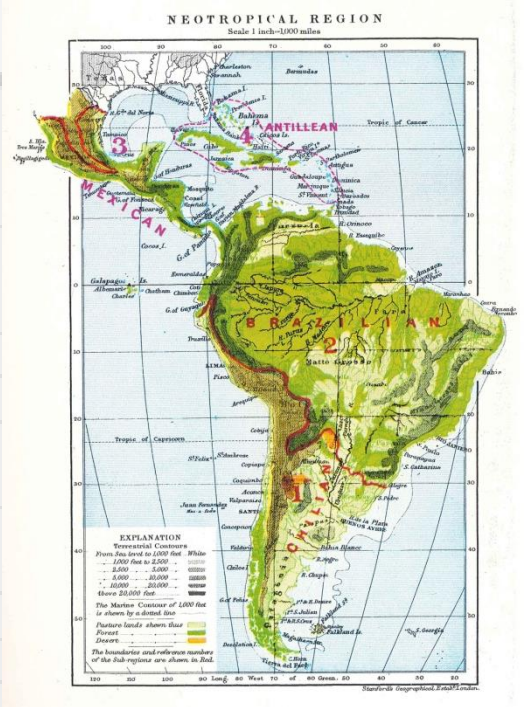
The region can be divided in:

A. Austro-Malayan subregion.
B. Australian subregion.
C. Polynesian subregion.
D. New Zealand subregion.

Endemic mammal families (21):
ex. Tachyglossidae, Ornithorhynchidae, Notoryctidae, Thylacinidae†(1936), Myrmecobiidae, Dasyuridae, Thylacomyidae, Chaeropodidae†(1901), Peramelidae, Phascolarctidae, Vombatidae, Burramyidae, Phalangeridae, Pseudocheiridae, Petauridae, Tarsipedidae, Acrobatidae, Hypsiprymnodontidae, Potoroidae, Macropodidae, Mystacinidae

Zoogeographic realms

5. Neotropical region



The Neotropical region includes South America, Central America and the Caribbean Islands.

The region can be divided in:

A. Chilean subregion.
B. Brazilian subregion.
C. Mexican subregion.
D. Antillean subregion.

Endemic mammal families (29):
ex. Caenolestidae, Microbiotheriidae, Bradypodidae, Megalonychidae, Cyclopedidae, Myrmecophagidae, Cebidae, Aotidae, Pitheciidae, Atelidae, Chinchillidae, Dinomyidae, Caviidae, Dasyproctidae, Cuniculidae, Ctenomyidae, Octodontidae, Abrocomidae, Echimyidae, Myocastoridae, Capromyidae, Heptaxodontidae†(1700), Nesophontidae†(1700), Solenodontidae, Noctilionidae, Furipteridae, Thyropteridae, Natalidae, Iniidae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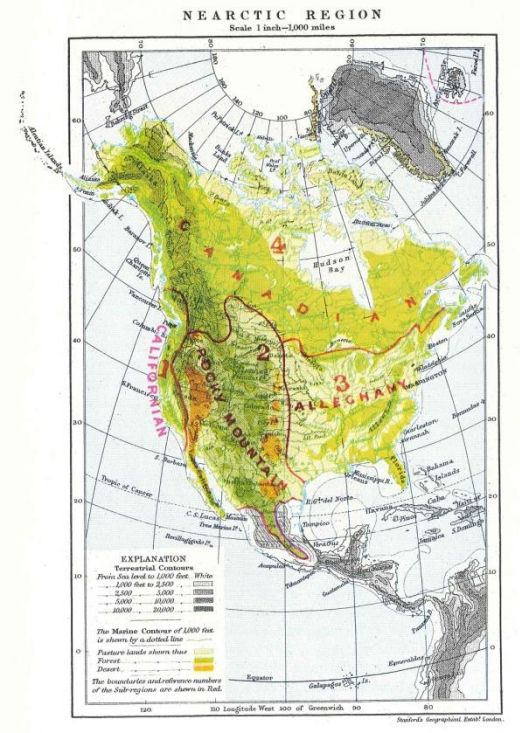
Zoogeographic realms

6. Nearctic region



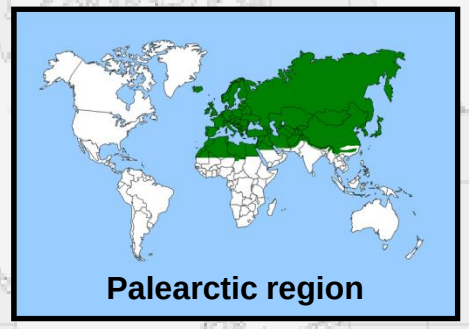
The Nearctic region is the major part of North America, including Greenland, Bermuda and the mountains in Mexico.

The region can be divided in:

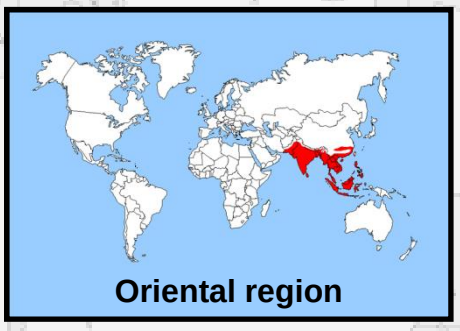
A. Californian subregion.
B. Rocky Mountain subregion.
C. Alleghany subregion.
D. Canadian subregion.

Endemic mammal families (2):
ex. Aplodontiidae, Antilocapridae

Zoogeographic realms

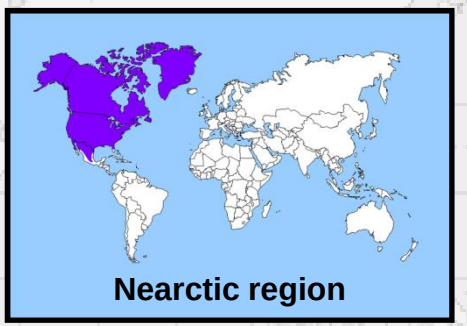

Palearctic region


Ethiopian region


Oriental region

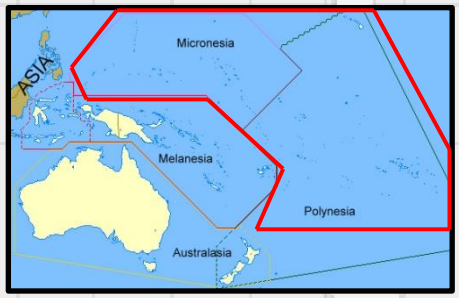

Australian region


Neotropical region


Nearctic region

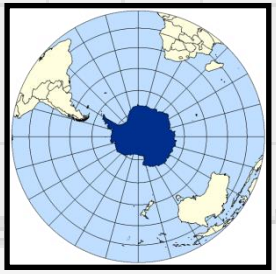
7. Oceania ecozone

The Oceania ecozone includes the Pacific Ocean islands of Micronesia, the Fijian islands, and most of Polynesia.



8. Antarctic ecozone

The Antarctic ecozone includes Antarctica and several island groups in the southern Atlantic Ocean and Indian Ocean.



Zoogeographic realms

ZZZZ

New insights in zoogeography

* Mayr (1944)
* Hagmeier (1966)
* Cox (2001)
* Kreft & Jetz (2010)

An Update of Wallace's Zoogeographic Regions of the World

Ben G. Holt,[1*] Jean-Philippe Lessard,[1*†] Michael K. Borregaard,[1] Susanne A. Fritz,[1,2] Miguel B. Araújo,[1,3,4] Dimitar Dimitrov,[5] Pierre-Henri Fabre,[5] Catherine H. Graham,[6] Gary R. Graves,[1,7] Knud A. Jønsson,[5] David Nogués-Bravo,[1] Zhiheng Wang,[1] Robert J. Whittaker,[1,8] Jon Fjeldså,[5] Carsten Rahbek[1]

[2013]

➔ **Based on the distributions and phylogenetic relationships of 21.037 species of amphibians, birds and mammals.**

➔ **20 zoogeographic regions, grouped into 11 larger realms.**

The continental drift

Alfred Wegener (1880-1930)

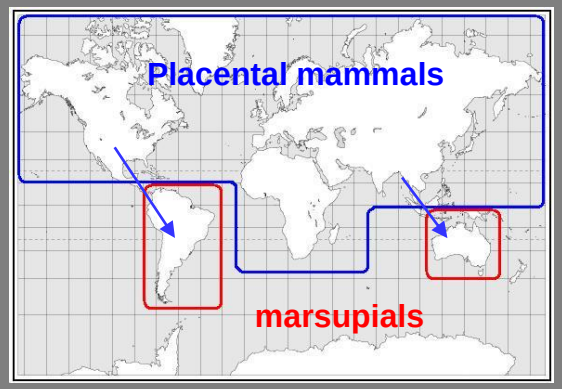
The zoogeographic regions are defined mainly based on the distribution of mammals. According to Alfred Wegener, continental drift is an important factor in the explanation of the distribution of animals.

He presented data from different disciplines supporting the theory of continental drift. This became part of the larger theory of plate tectonics.

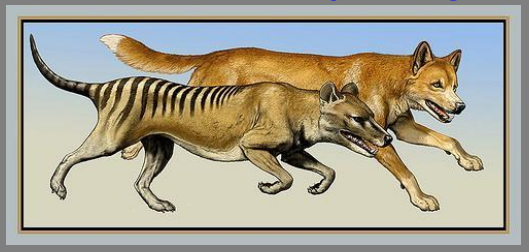
➔ He published his results in 1915 in his book “Die Entstehung der Kontinente und Ozeane” [“The Origin of Continents and Oceans”].

The earth and all of its contents have a very long history. It formed around 4,5 billion years ago. During this period it developed: biological and geological change has been constantly occurring on our planet since the time of its formation. Organisms continuously evolve, taking on new forms or going extinct in response to an ever-changing planet. This is called the process of evolutionary change and diversification.

These unique coincidences between lineage originations (branchings) and the particular parts of the earth where they happen have a profound impact on where the descendants are found today.



Canis lupus dingo



Thylacinus cynocephalus †

The continental drift

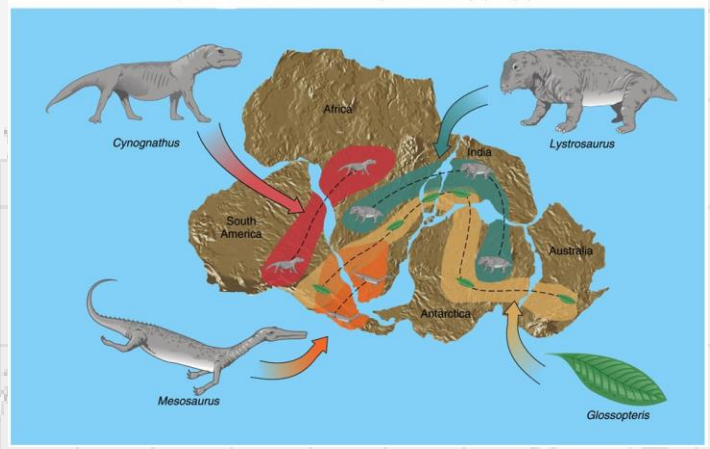
Alfred Wegener (1880-1930)

"The geography of the earth is not static, but moving without interruption. It has a long history, with continents at times widely separated and at other times agglomerated into large lumps."

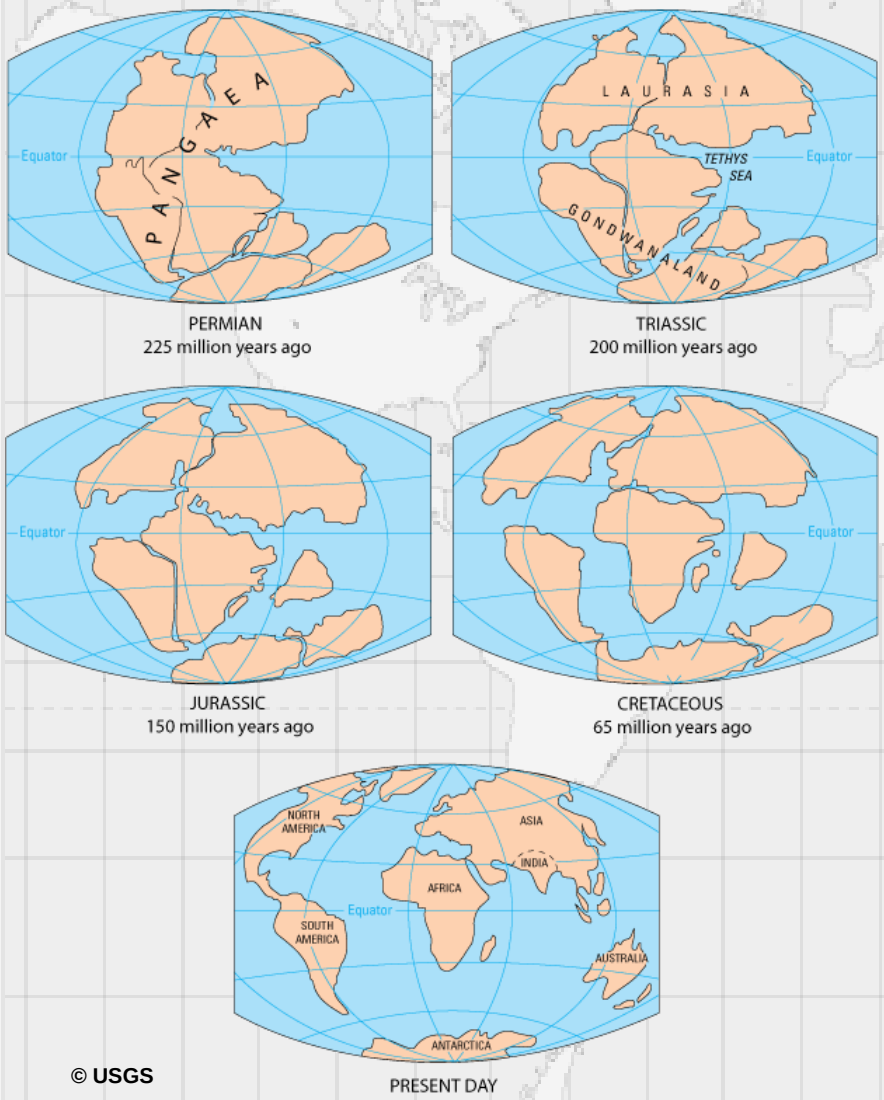
This process is called: CONTINENTAL DRIFT.

Wegener's ideas were based on:

1) **The near perfect fit of North America, South America, Africa and Europe if the Atlantic Ocean was closed.**
2) **Evidence for a common glaciation in the southern continents.**
3) **Similarities in rocks and fossils on continents separated by the Atlantic Ocean.**

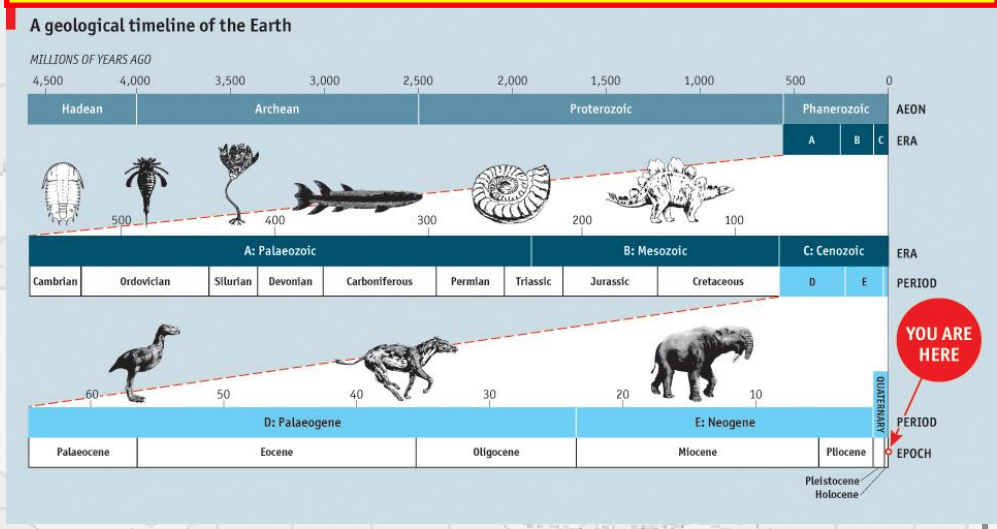


The continental drift



© USGS

Continental drift is the movement of continents with respect to one another over the earth's surface.



Land masses on earth have been drifting around almost since they were first formed 4 billion years ago.

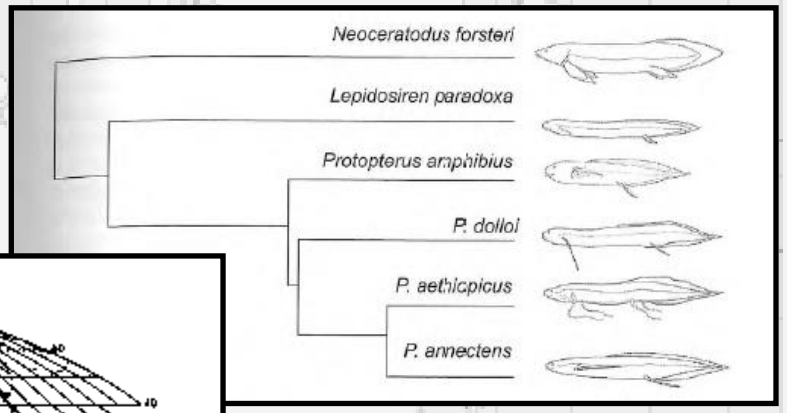
Pangea was the supercontinent during Perm, the period just before the dinosaurs existed. It was surrounded by a gigantic ocean, Panthalassa.

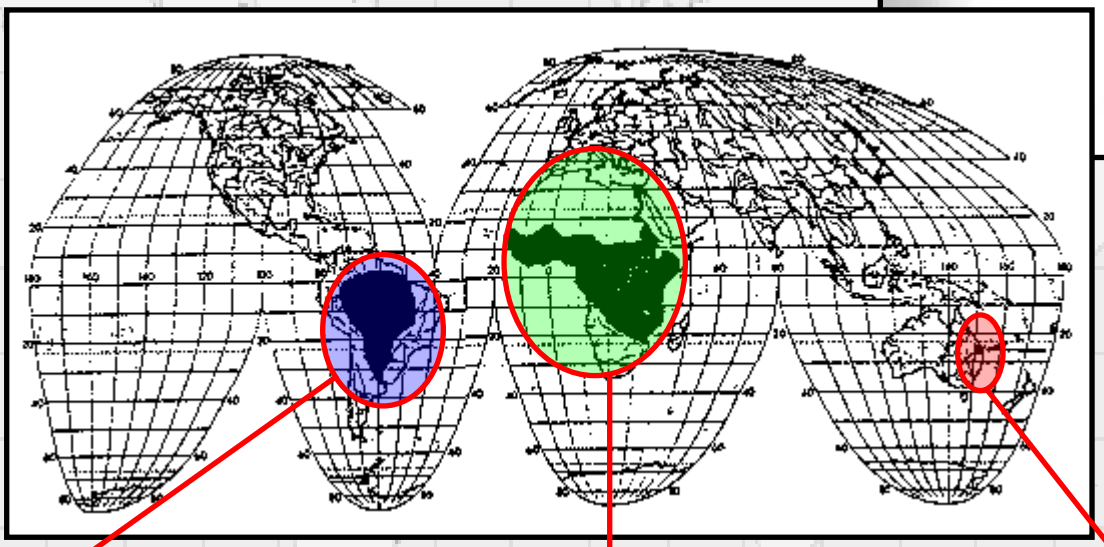
200 million years ago, Pangea broke up into 2 continents: Gondwana and Laurasia.

135 million years ago, both continents broke up into the different continents as we know them today.

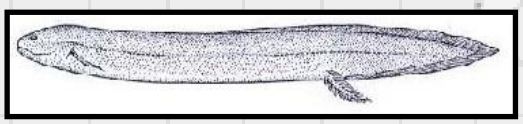
The continental drift

Biological evidence for the existance of continental drift is the present distribution of lungfishes.

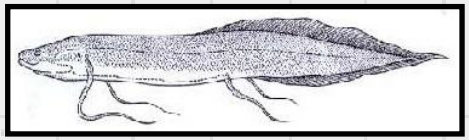




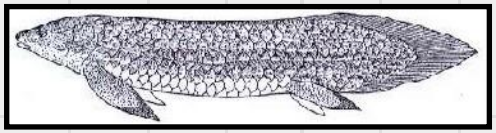
Lepidosirenidae



Protopteridae



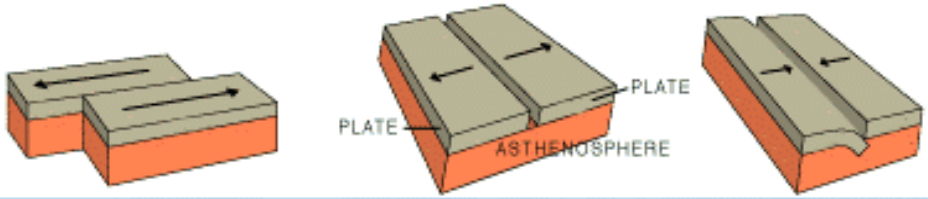
Ceratodontidae



Pictures from Kuhn-Schnyder (1953) - modified

Plate tectonics

The theory of the continental drift was superseded by the theory of plate tectonics. This is a scientific theory that describes the large-scale motions of the earth's lithosphere. The lithosphere is broken up into different tectonic plates, which move relative to each other. Where plates meet, their relative motion determines the type of boundary: convergent, divergent, or transform.



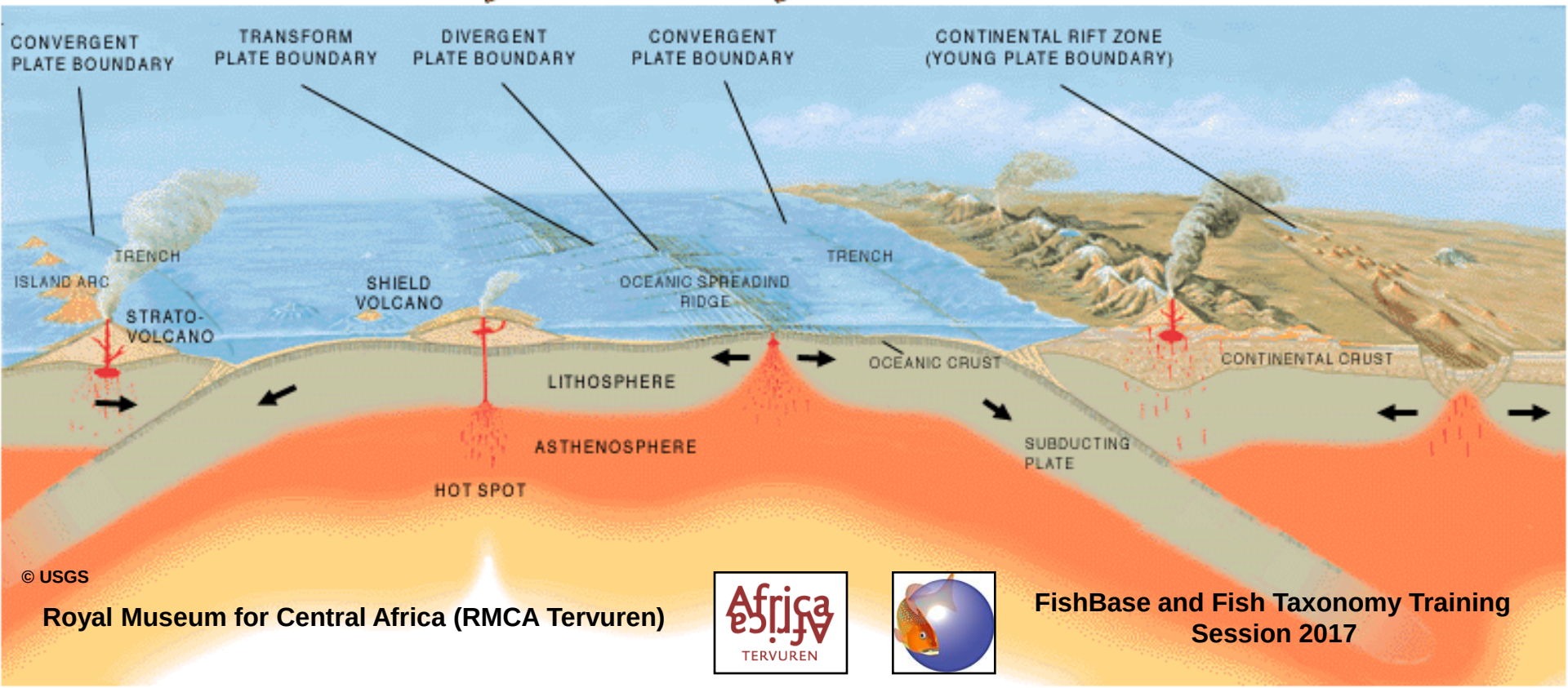
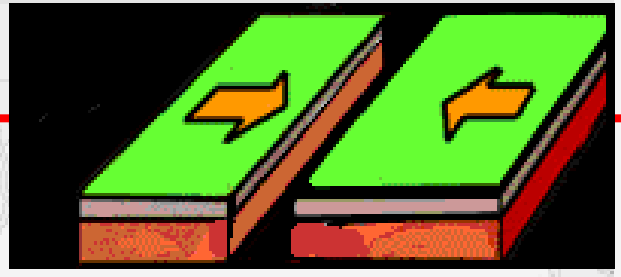
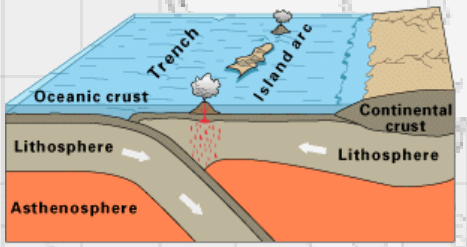


Plate tectonics



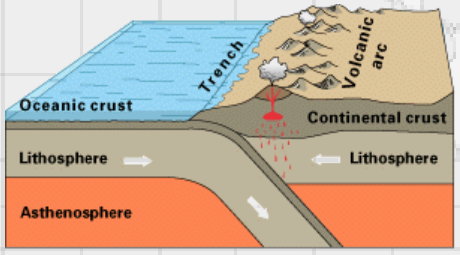
1. Convergent boundaries

Convergent boundaries exist between two tectonic plates that are moving towards one another.



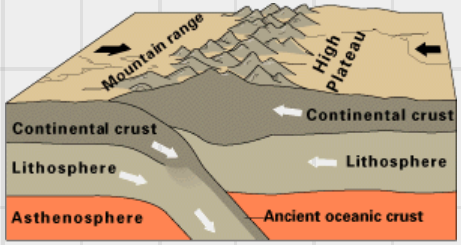
Oceanic-oceanic convergence

I. A first type of collision is the result of convergence between two oceanic plates. One plate subducts under the other plate forming a subduction zone. This leads to the phenomenon of partial fusion of the absorbed plate. The resulting magma goes up towards the surface: a part remains in the lithosphere, but another part is expelled on the surface, producing volcanos.



Oceanic-continental convergence

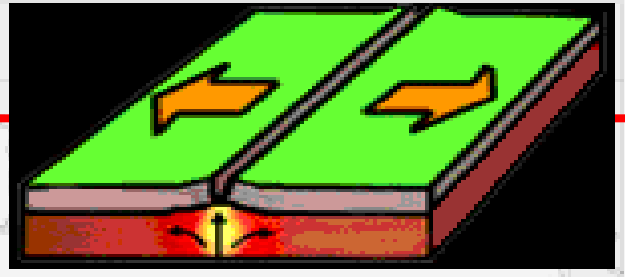
II. A second type of collision is the result of convergence between an oceanic plate and a continental plate. The denser oceanic plate subducts under the continental plate with the same phenomenon as the first type as consequence.



Continental-continental convergence

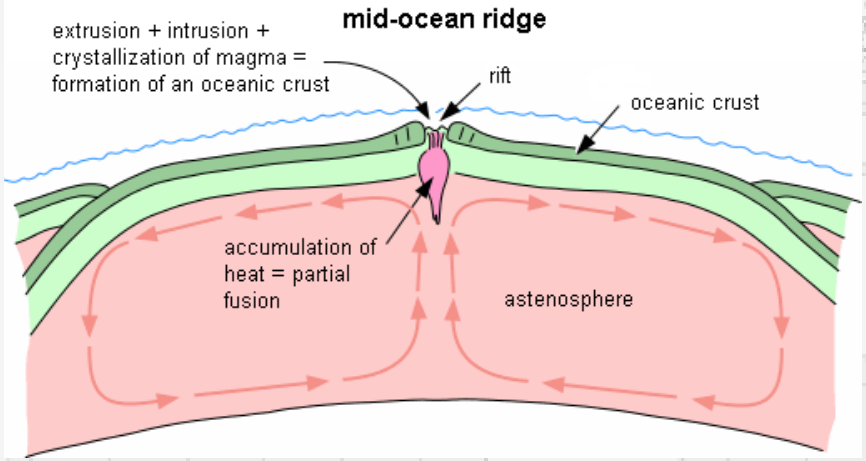
III. A third type of collision implies the convergence of two continental plates. The force of displacement is not strong enough to subduct one of the two plates. All the sedimentary material is compressed and raised to form a mountain range where rocks are folded and faulted.

Plate tectonics



2. Divergent boundaries

Divergent boundaries exist between tectonic plates that are moving away from each other.



There exists a heat flow which goes from the center of the earth to its outside. This convection causes a heat concentration in a zone where the heated material dilates. The heat concentration leads to a partial fusion with the earth's mantle which produces magma. In the rigid part of the earth's mantle (lithosphere), this convection produces forces of tension which make that two plates diverge.

A part of this magma crystallizes in the lithosphere, whereas another part is expelled on the oceanic bottom in the form of lava and forming underwater volcanos.

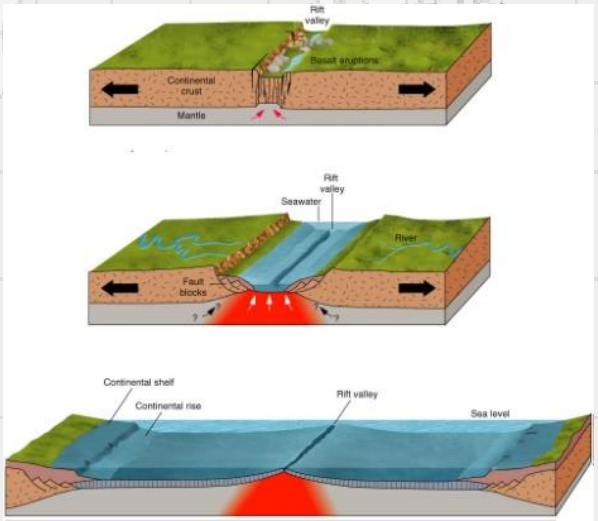
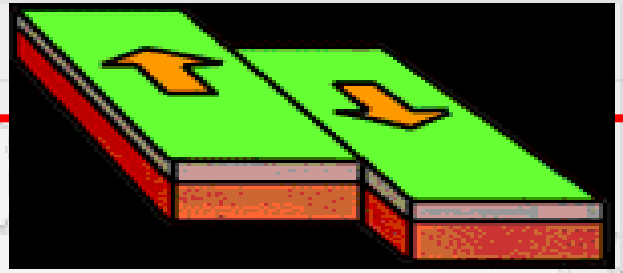
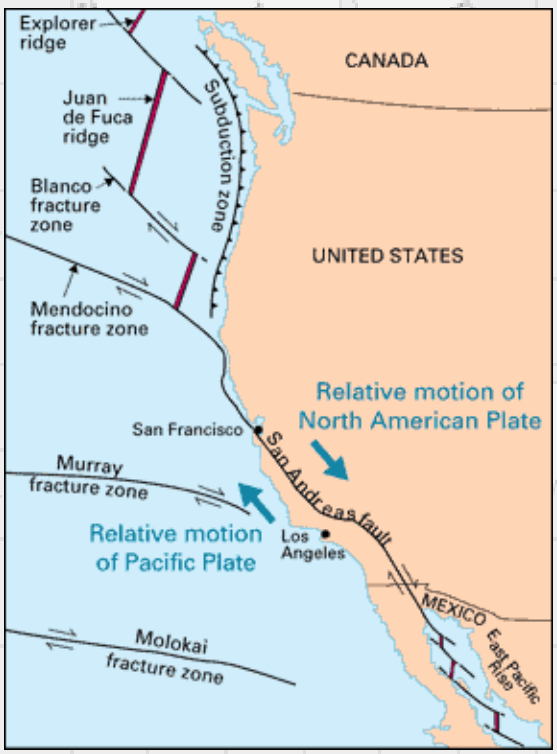


Plate tectonics

3. Transform boundaries



Transform boundaries occur when tectonic plates slide and grind against each other along a transform fault.



Transform boundaries correspond to great fractures which affect all of the thickness of the lithosphere. These faults allow to accomodate differences in movement rate or even opposed movements between plates. A good example is the famous San Andreas fault in California.

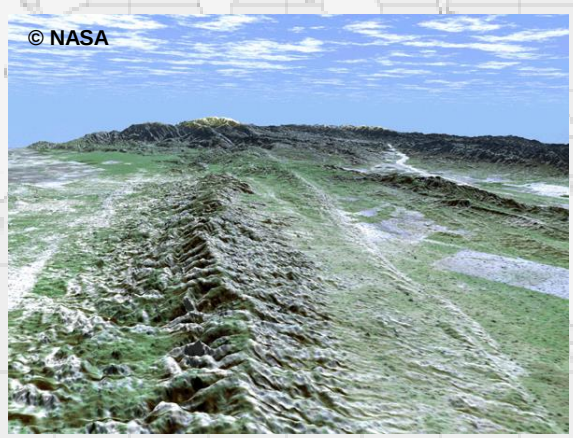


Plate tectonics

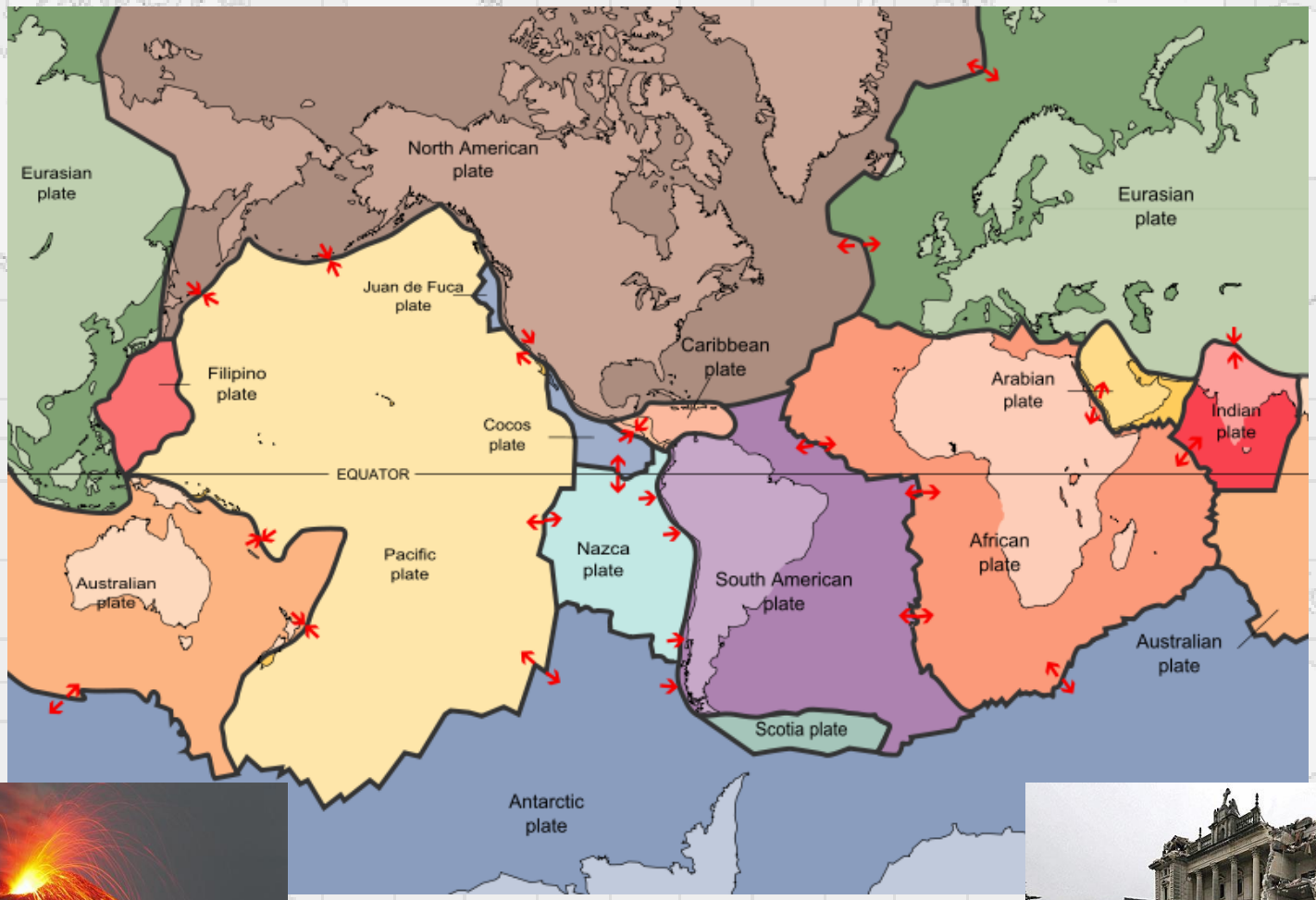
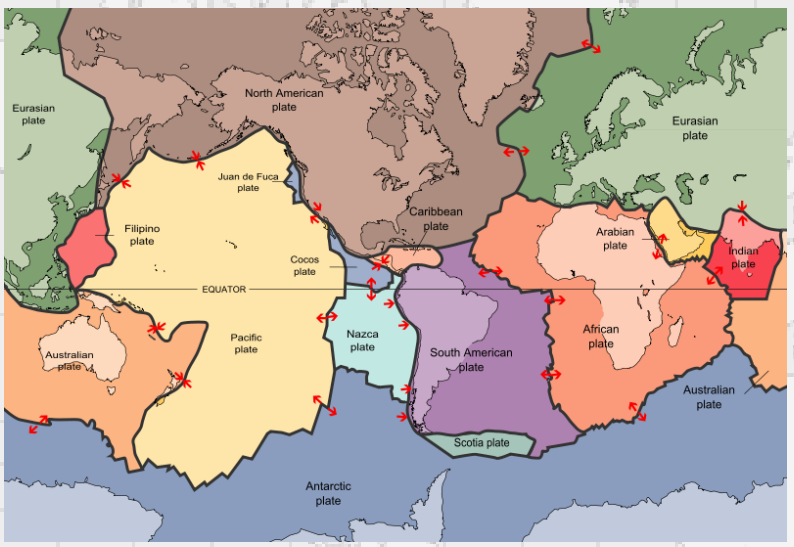
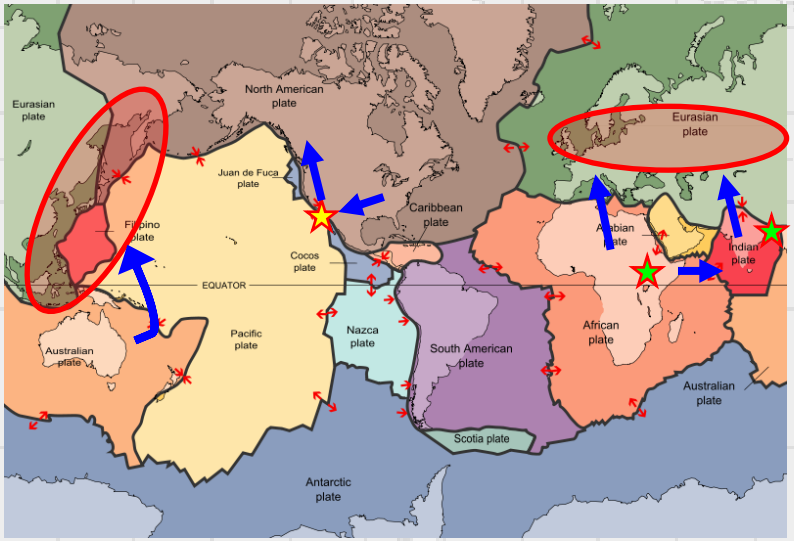


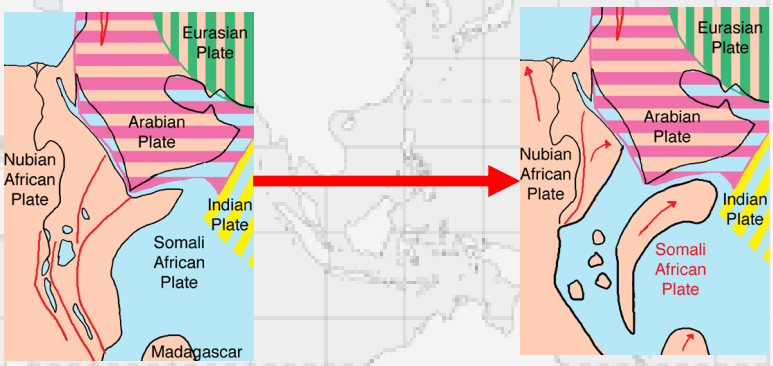
Plate tectonics





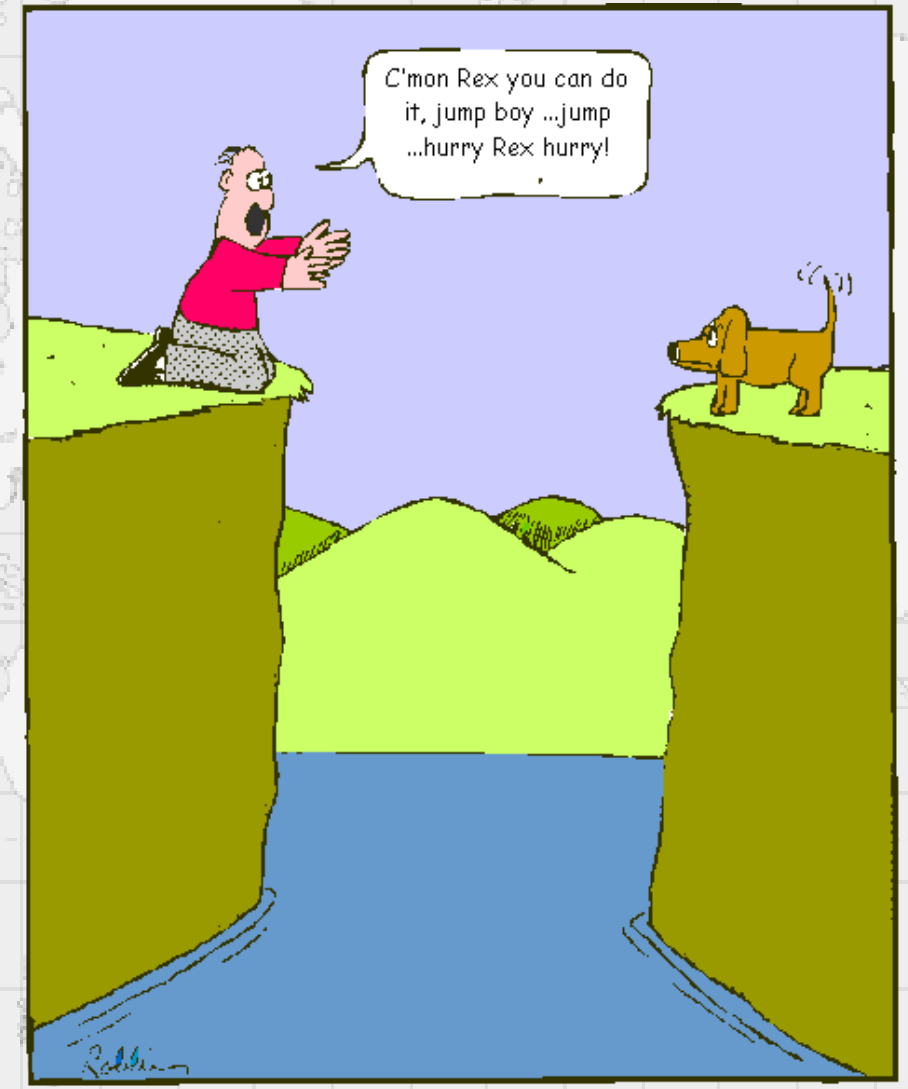
The Great East African Rift

The Great East African Rift is created by the crevice and separation of the African and Arabic plate (started about 35 million years ago), and by the continuous separation of eastern Africa with the rest of Africa (started about 16 million years ago).



Royal Museum for Central Africa (RMCA Tervuren)

FishBase and Fish Taxonomy Training Session 2017



Tragedies of the continental drift