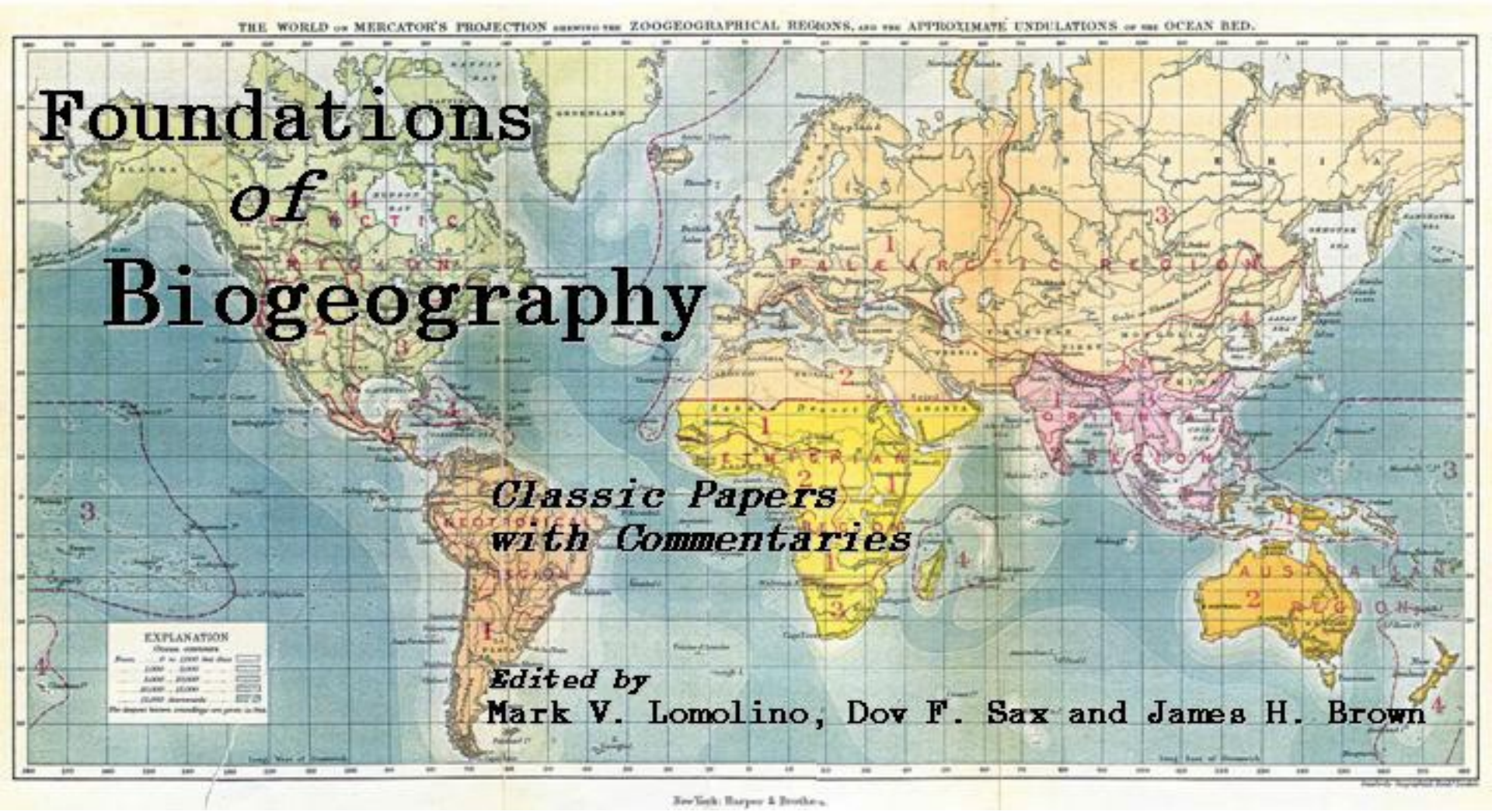


Patterns of distribution of organisms over the surface of the globe are **nonrandom**… this non-randomicity requires an explanation in terms of process or processes of biotic history that led to present day species distributions. (Myers & Giller 1988)

DIVERSIDAD, ESPACIO Y TIEMPO

Origen de la diversidad biológica **----** evolución x selección natural, evolución molecular, filogeografía

Fragmentación y cambio del espacio **----** Tectónica, orogénesis, expansión y contracción de los océanos, deriva continental, formación de montañas e islas

Escala de tiempo **---** edad del universo, sistema planetario, edad de la Tierra, eras geológicas, teoría de la Tierra.

BREVE HISTORIA DE LA BIOGEOGRAFIA

1600 – 1850 Pre-Evolution by Natural Selection and pre-Continental Drift – Linnaeus, Buffon, de Candolle, Lyell, Humboldt

1850 - 1900 Evolution by Natural Selection, fixed geography - Darwin, Wallace –Sclater (but other views by Hooker)

1900 - 1950 Evolution and ideas of Continental Drift – Simpson, Mayr, Darlington

1950 - 2000 Ecological and Historical Biogeography- Space, time and form. Continental Drift and climate change - Croizat, MacArthur & Wilson, Brown **Macroevolution**

Biogeógrafos Pre-Darwin

Museum d'histoire naturelle (Paris)

George- Louis Leclerc Comte de Buffon (1707-1778)

Considered by many to be **the father of Biogeography**

- He rejected an old generalization stating that **faunas "are the product of a given climatic region"**

- **Buffon's Law**: Mammals in new and old world tropics are not the same --- Therefore: *distant regions with similar climate (& similar-appearing vegetation) have different animal species* (later developed in the idea of evolutionary convergence)
  - Pierre Lattreille, insects of Old and New World
  - George Cuvier, reptiles in Africa and South America

- Aristócrata francés. Estudió matemáticas y medicina (después de graduarse en leyes en 1726).
- En la Escuela de Medicina conoció a Berthelot du Paty, apasionado de las plantas, con quien se abocó a la botánica.
- En 1734, a los 27 años, se integró como miembro de la *Academia de Ciencias* con una memoria sobre el calculo de probabilidades
- Sus cálculos de la edad de la Tierra le ocasionaron problemas con la Iglesia.

Principal obra de Buffon:

Histoire naturelle générale et particuliére, IX (París) **36 volúmenes** publicados entre 1761-1783. Su obra abordó desde el origen del sistema solar, la formación de la Tierra, la fosilización, las antiguas faunas y floras. Cinco volúmenes sobre los minerales. Criticada por sus afirmaciones en contra del Génesis.

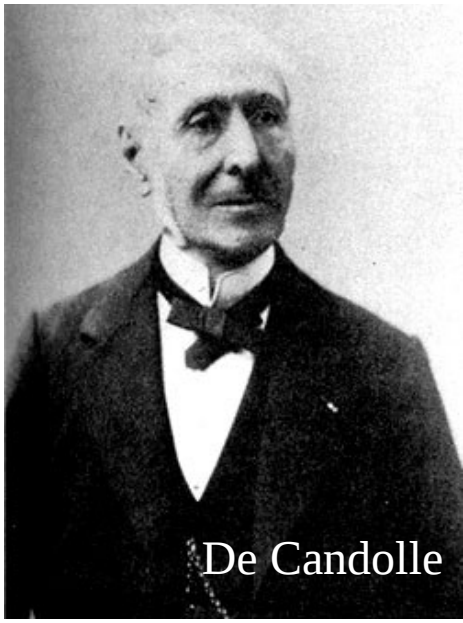
Otras obras: *Essai d'arithmétique morale* (1777) *Réflexion sur la loi d'attraction* (1748) *Les époques de la Terre* (1779). En esta ultima, sugiere que la edad del planeta era mucho mas de 6000 años y discute conceptos análogos al **uniformitarismo,** formulado más tarde por Charles Lyell.

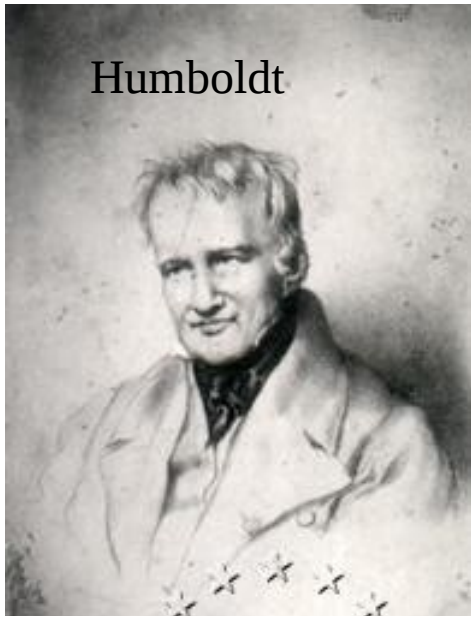
Tres precursores (período pre-evolución)

- Alexander **von Humboldt** (1769-1859):
  - Plant Vegetation types strongly correlated with local climate
  - Altitudinal Vegetation Zones (in the Andes)
  - Equivalent to latitudinal Belts of Vegetation

- August Pyramus **De Candolle** (1778-1841)
  - *Station* (ecological) and *Habitation* (geographical) concepts

- **Charles Lyell** (1795-1875)
  - Geólogo
  - Propuso el principio de uniformitarismo


De Candolle


Humboldt

Augustin Pyramus de Candolle (1779 - 1841)

- Uno de **los padres de la biogeografía junto a Buffon y Humboldt.**

- Propuso los términos "*station*" y "*habitation*" para referirse a las distribuciones ecológicas y geográficas de una especie. *Las "habitaciones" estarían relacionadas a causas geológicas, mientras que las "estaciones" a causas físicas* (ecológicas).

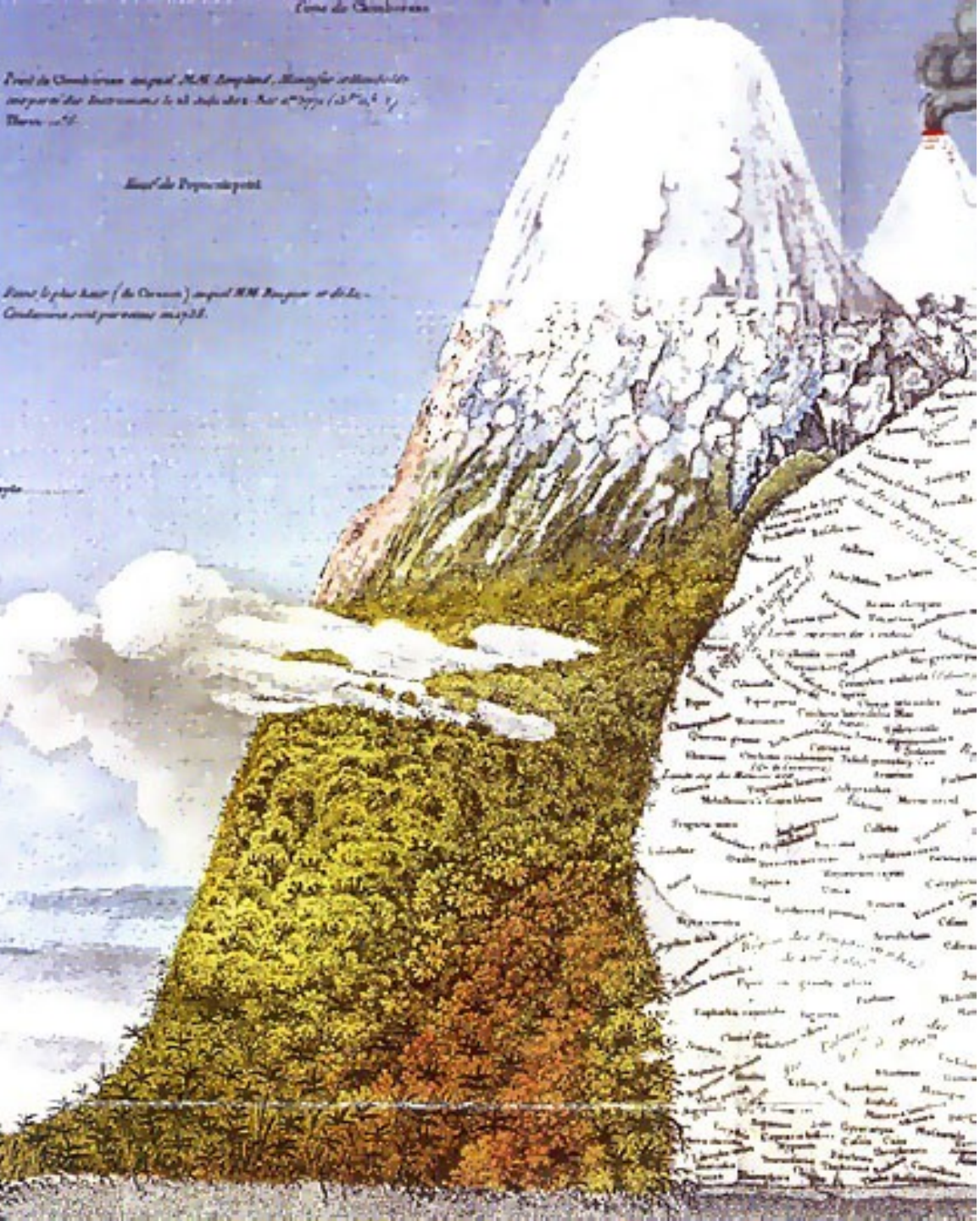
- Describió 20 *regiones botánicas* o áreas de endemismo en el mundo

- Fue fundador del Museo de Historia Natural de Génova.

Luma apiculata (DC) Burret

Friedrich Heinrich Alexander von Humboldt (1769-1859)

En 1779 obtuvo permiso del ministro español Urquijo para emprender un **viaje científico a Sudamérica** en compañía de Aime Bompland.
En 1800 remontó el río Orinoco y estableció la conexión de éste con el sistema amazónico. Se entrevistó con los botánicos Mutis y Caldas y analizó las corrientes del Océano Pacífico.
Realizó el primer estudio completo y riguroso de la Geografía de América.
Descubrió el uso del **guano** como fertilizante y postuló la existencia de una línea de conexión entre los volcanes americanos.
Geografía aritmética. Comprobó el descenso gradual de la temperatura en relación con la altitud (y latitud) y el de la intensidad magnética con la distancia al Polo.



Humboldt, Alexander von (1805). *Ensayo sobre la Geografia de las Plantas*. Ed. Siglo XXI (1997), Mexico, D.F.

Tableaux Physique of the Andes and neighbouring countries.

The highest peak is **Chimborazo** (6544 m), and the active volcano is Cotopaxi (5753 m); both are located in Ecuador (glaciares!)

The small print on the white area represents the names of plants he encountered at those elevations. According to Humboldt, the treeline on the equator is at 2000 m.

Invented **botanical arithmetic** (e.g. number of species per plant family) to define floral regions quantitatively

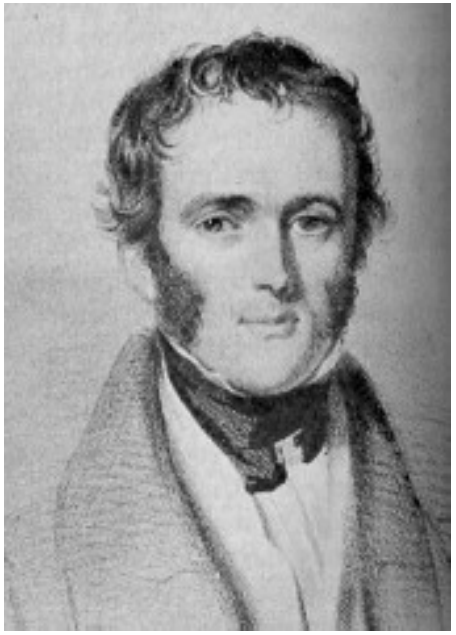
Ideas sociales de Humboldt sobre América

"According to the ideas which unfortunately have been adopted for ages, these distant regions are considered as tributary to Europe."

…The people, deprived of …means of instruction, were plunged in an ignorance so much deeper as the missionaries were unskilled in the Mexican languages and could substitute few new ideas in place of the old….

How shall we judge, from these miserable remains of a powerful people ….? If all that remained of the French or German nations were a few poor agriculturists, could we read in their features that they belonged to nations, which had produced a Descartes and Clairaut, a Kepler and a Liebnitz?

Alexander von Humboldt, *Political Essay on the Kingdom of New Spain*, trans. John Black (1811)



Charles Lyell (1795-1875), la principal teoría geológica del Siglo XIX

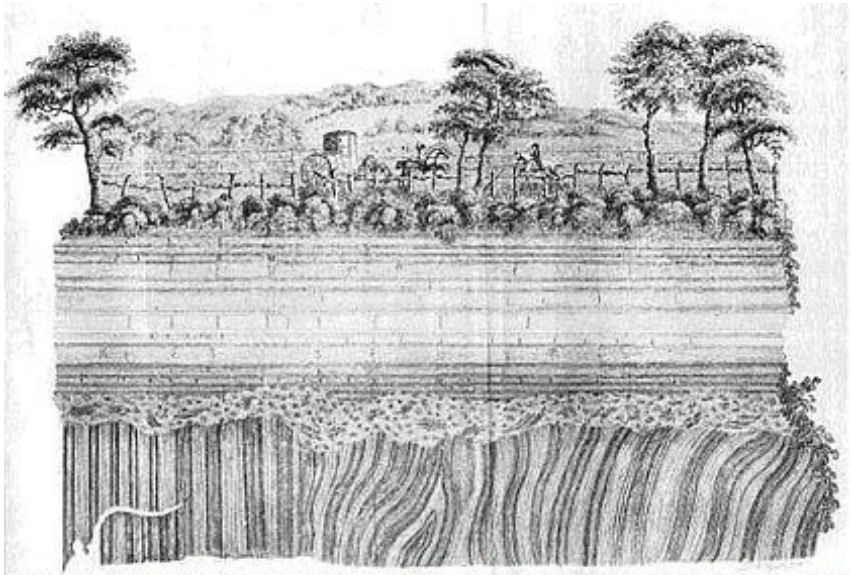
- Cuestionó la hipótesis del diluvio
- Desarrolló una visión original (o paradigma) del estudio de la geología que fue más tarde conocida como **uniformitarismo, según la cual los procesos del presente han operado de igual modo en el pasado.**

- Leyó y se inspiró en las obras de De Candolle y Buffon y en particular en la obra de James Hutton, *Theory of the Earth*

"Amid all the revolutions of the globe the economy of Nature has been uniform, and her laws are the only things that have resisted the general movement. The rivers and the rocks, the seas and the continents have been changed in all their parts; but the laws which direct those changes, and the rules to which they are subject, have remained invariably the same."—PLAYFAIR, *Illustrations of the Huttonian Theory*, § 374.

De la página inicial de "*Principles of Geology*"

Hutton's unconformity: Este concepto inspiró las ideas de Lyell, promoviendo una nueva visión del Tierra en continua renovación



CONCEPTO DE HUTTON: constancia de las fuerzas geológicas- mostrando que los procesos geológicos son más que la simple erosión gradual de continentes formados hace milenios.

La superficie era renovada por la emergencia de rocas ígneas, formando "inconformidades" de los estratos.

Junto a Lyell es forjador de una nueva noción de tiempo.

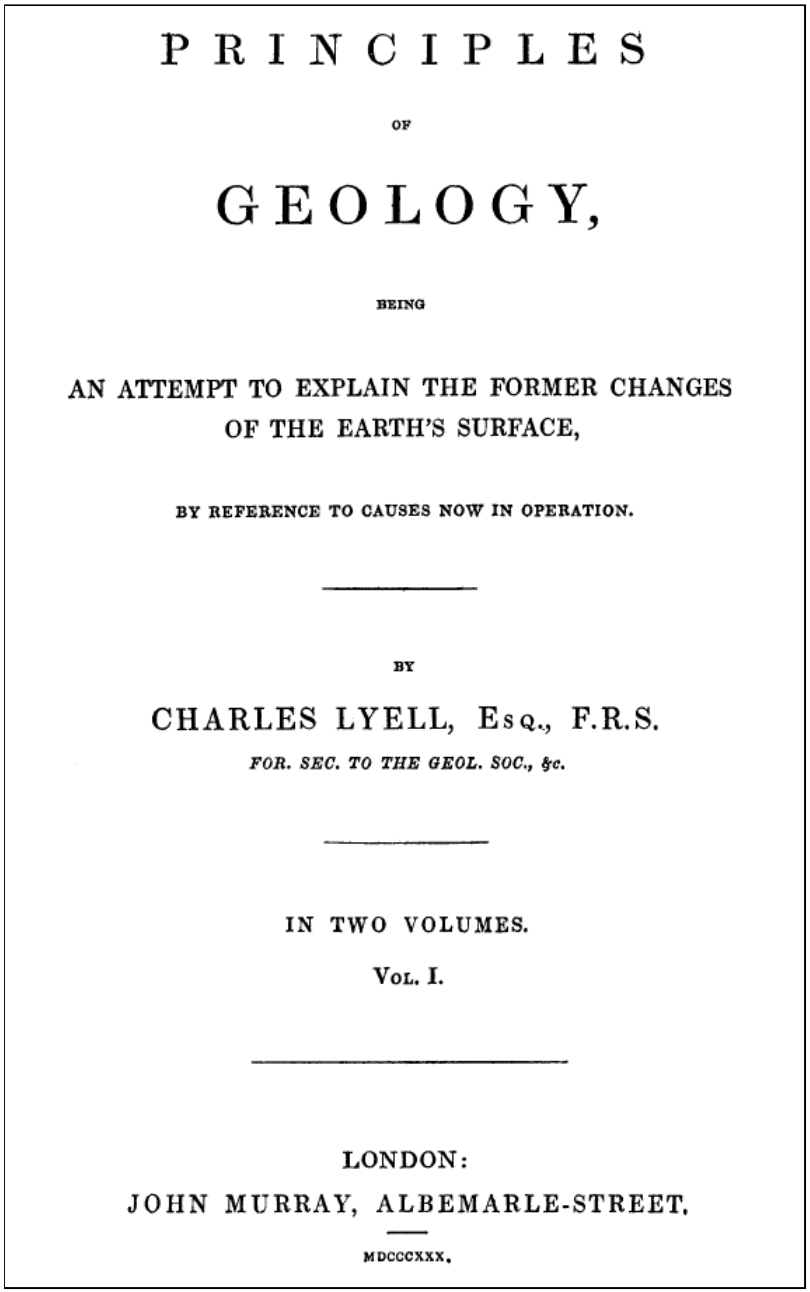
GEOCHEMISTRY

The lost continents

Albrecht W. Hofmann

Once subducted into the mantle, material from Earth's continental crust seems to disappear. But its distinctive isotopic signature has been found back at the surface — in volcanic rocks on a Pacific island.

Science, August 2007



PRINCIPLES

OF

GEOLOGY,

BEING

AN ATTEMPT TO EXPLAIN THE FORMER CHANGES OF THE EARTH'S SURFACE,

BY REFERENCE TO CAUSES NOW IN OPERATION.

BY

CHARLES LYELL, Esq., F.R.S.

FOR. SEC. TO THE GEOL. SOC., &c.

IN TWO VOLUMES.

VOL. I.

LONDON:

JOHN MURRAY, ALBEMARLE-STREET.

MDCCCXXX.

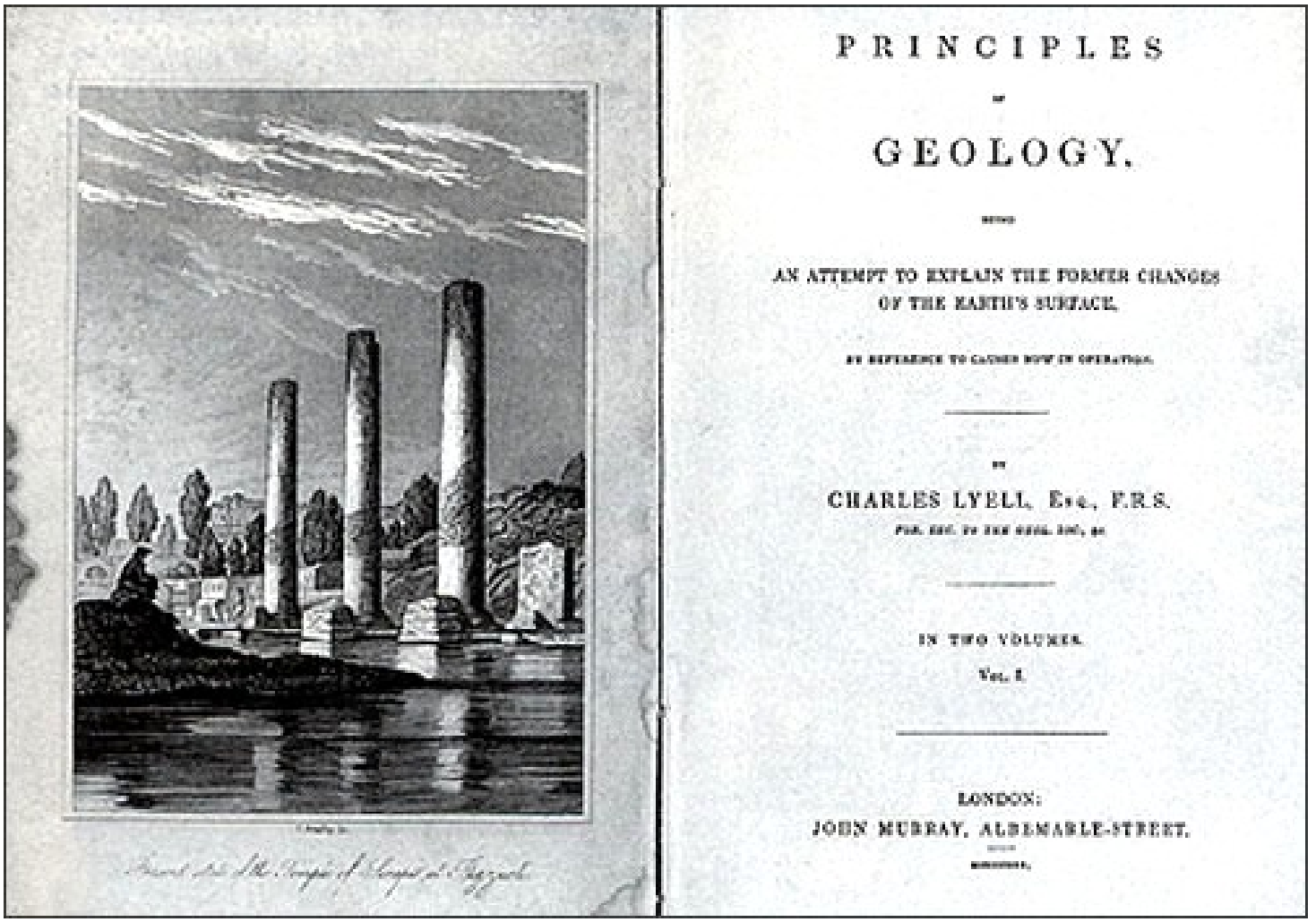
- Lyell advocated a *uniformitarian* view of geology. **This assumed first of all the constancy of natural laws**.

- *The kinds of causes which affected the Earth in the past must be assumed to have been exactly those we see in operation today* (erosion, volcanic action, earthquakes etc.)

- **Therefore, gradual processes could be responsible for great changes**!

- If *Lamarck* was right then religion was a fable, …and the moral fabric of society would crumble to dust. **A concerted refutation of Lamarck's theories became a central part of the *Principles*.**

- Lyell paradoxically made Lamarck's views better known in the English-speaking world than they ever had been. (Lamarck's work was not translated into English until 1914.)



PRINCIPLES

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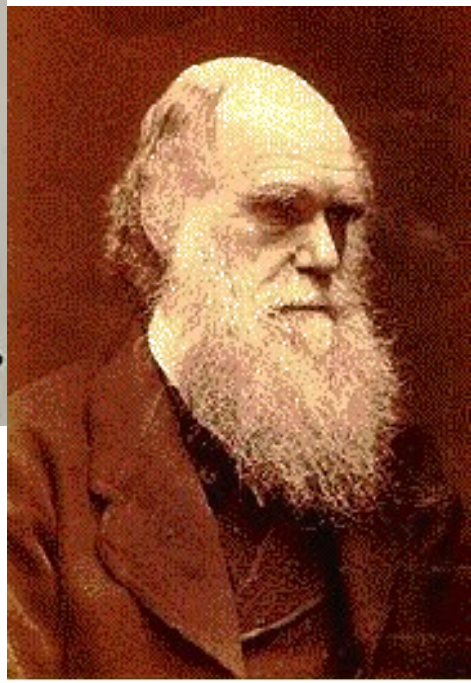
To demonstrate that *gradual processes could be responsible for great changes*, Lyell used an engraving of **the temple of Serapis**. The temple had, during the course of human history, been above sea level, then for a long period partially submerged, and again above sea level (dark bands of damage caused by waterborne life across the columns).

Período post-evolución por selección natural

- Lyell
- Darwin
- Hooker
- Wallace
- Huxley

Charles Darwin (1809-1882)



Ch. Darwin
Down 7th 1874.

"The present is the key to the past," the motto of uniformitarian science, greatly influenced **Darwin** who extended that principle to biology.

Species, like geologic features, evolved gradually or died out gradually. Like the forces Lyell talked of, the shifting and rising and falling of land (as illustrated by the Temple of Serapis), Darwin held that the forces seen today in the biologic world -- *reproduction, inheritance, and competition* -- gradually produced the whole diversity of life on Earth.

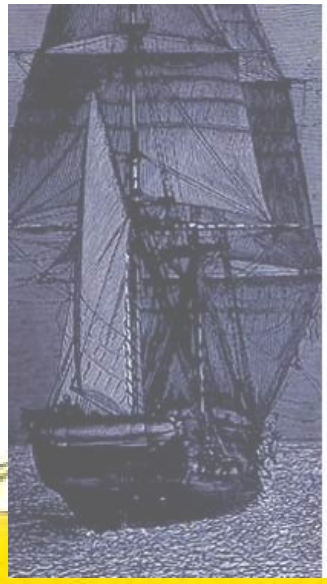
Rev. John Henslow

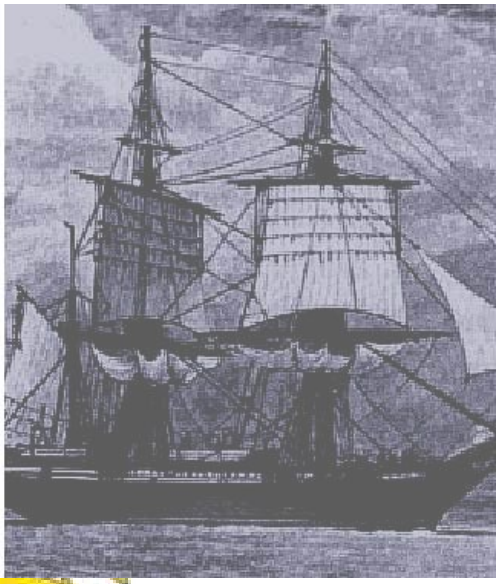
Capitán Robert Fitzroy, Marina Real Brtitanica

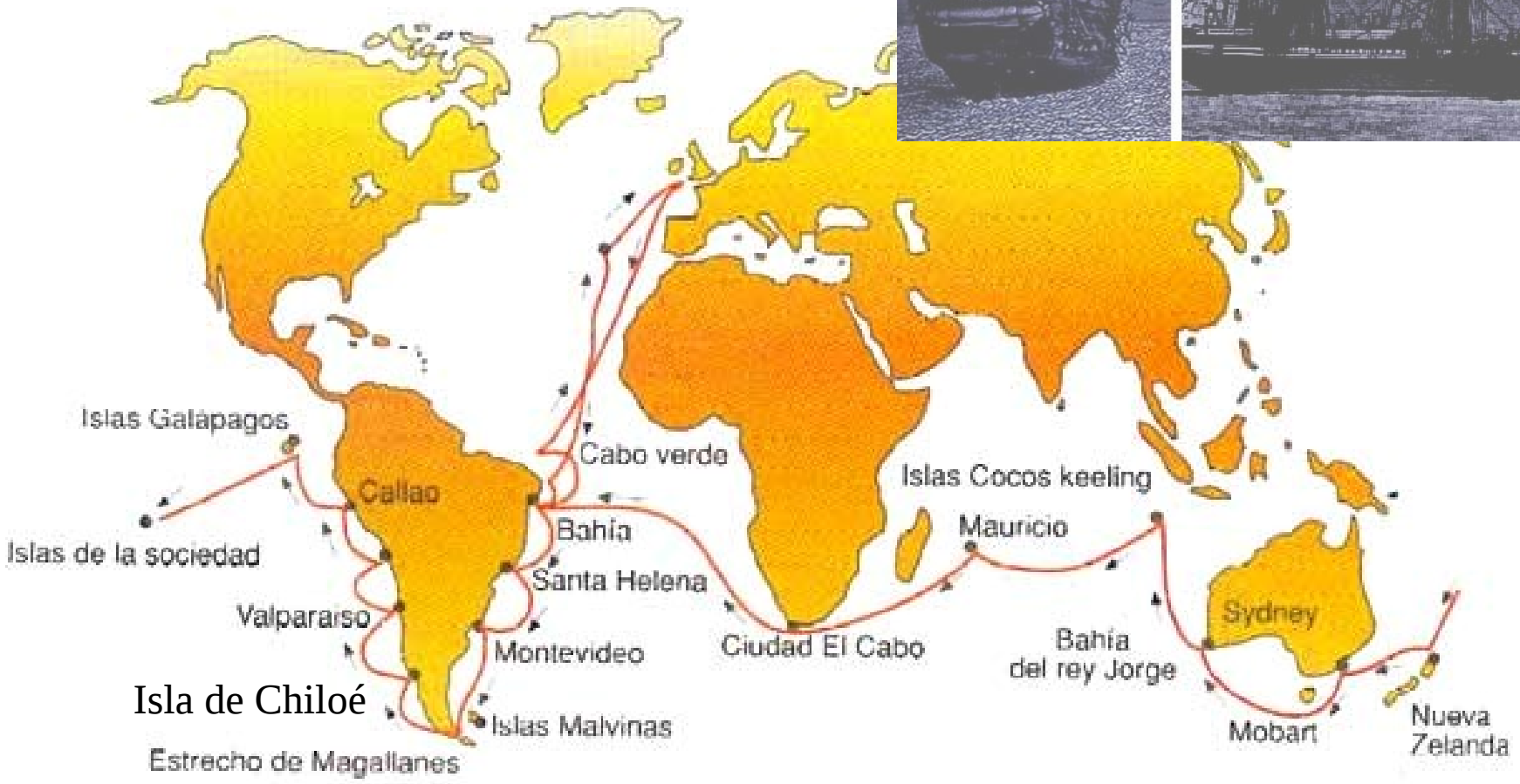
- Después de graduarse de Cambridge (1831), incierto sobre su futuro, **Darwin** recibió una carta de su profesor el Rev. John Henslow, donde le informaba que la marina británica buscaba un acompañante del Capitán Robert **Fitzroy,** preferiblemente un joven científico, sin paga, para una navegación alrededor del mundo.

- Henslow escribió a Darwin: "*No se desaliente usted por su escasa preparación y falta de experiencia, en mi opinión usted es claramente la persona indicada para el trabajo*."

Viaje de Darwin alrededor del mundo 1831- 1836







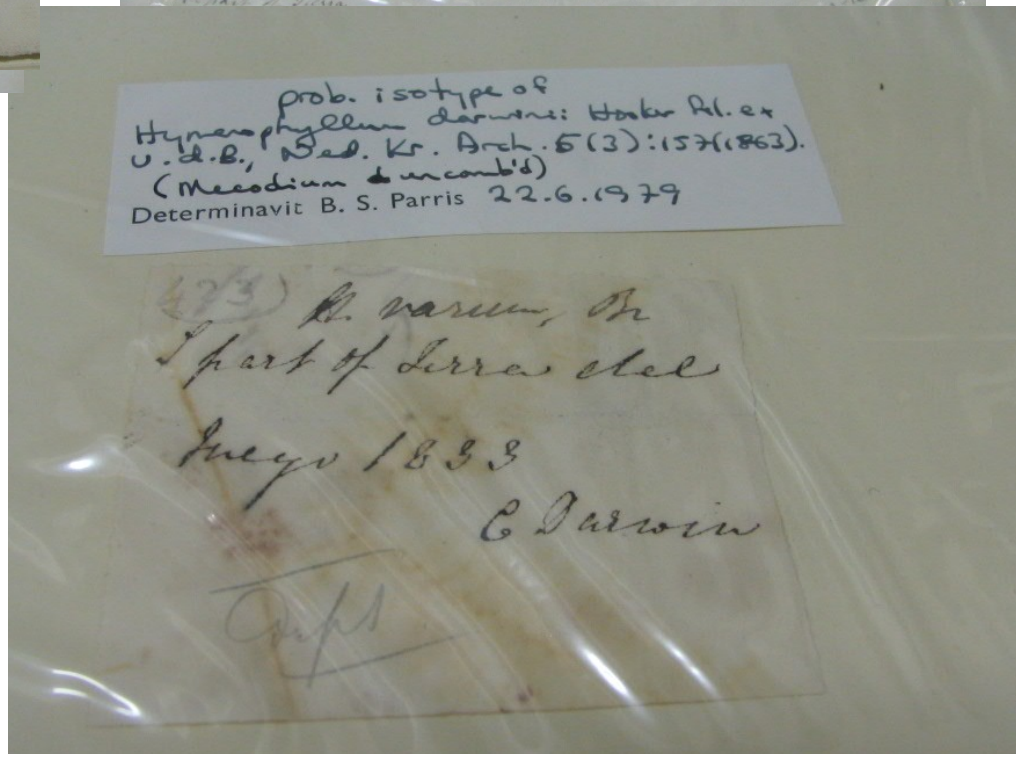
3 años en las costas de Sudamérica

The Beagle off the coast of Tierra del Fuego, watercolor by Conrad Martens

”The Voyage of the Beagle has been by far the most important event in my life and has determined my whole career . . . I have always felt that I owe to the voyage the first real training or education of my mind.”

Charles Darwin’s **Autobiography** (1876)

Monte Darwin, visto desde el Canal de Beagle, Magallanes



Berberis darwinii Michay

Eruption of Chaiten volcano, continental Chiloe, 2008

”Diariamente se refuerza en la mente del geólogo que nada, ni siquiera el viento tempestuoso, es tan inestable como el nivel de la corteza de esta tierra." (Voyage, pag. 333)

Después del terremoto y maremoto del 20 de Febrero de 1835, no quedó una casa en pie en todo *Concepción o Talcahuano*... "de lo cual vi abundantes pruebas en los miles de restos, muebles y mercancías, esparcidas en todas las playas" "…observé el suelo agrietado en muchas partes en dirección norte-sur…"

"La consecuencia más notable del terremoto fue **el ascenso permanente del terreno**, lo cual más correctamente debería considerarse como la **causa**"

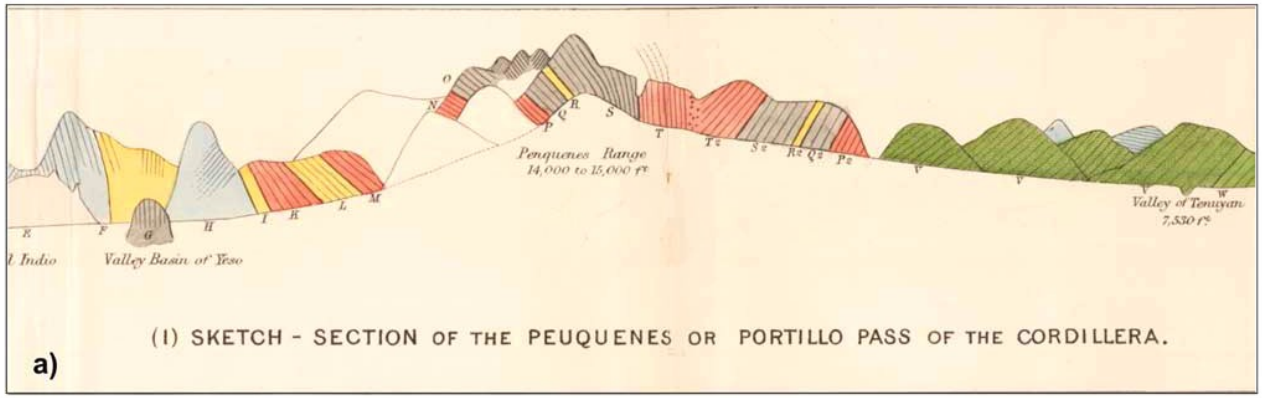
(*The Voyage of the Beagle*, p. 321)

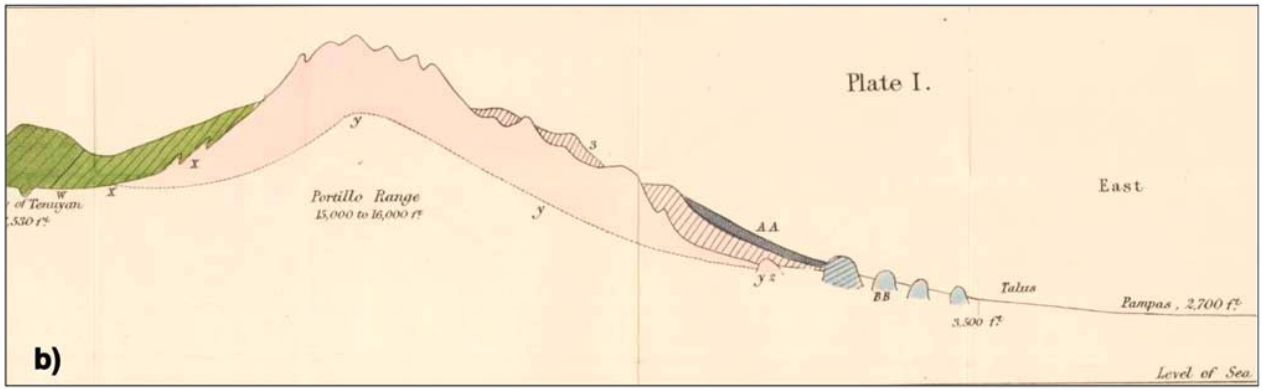
"Nadie puede dejar de admirar las inmensas fuerzas que han levantado estas montañas…y más asombroso aún, **las edades incalculables** que se han requerido para que sean horadadas, erosionadas y moldeadas por la naturaleza." *Diario del Beagle*

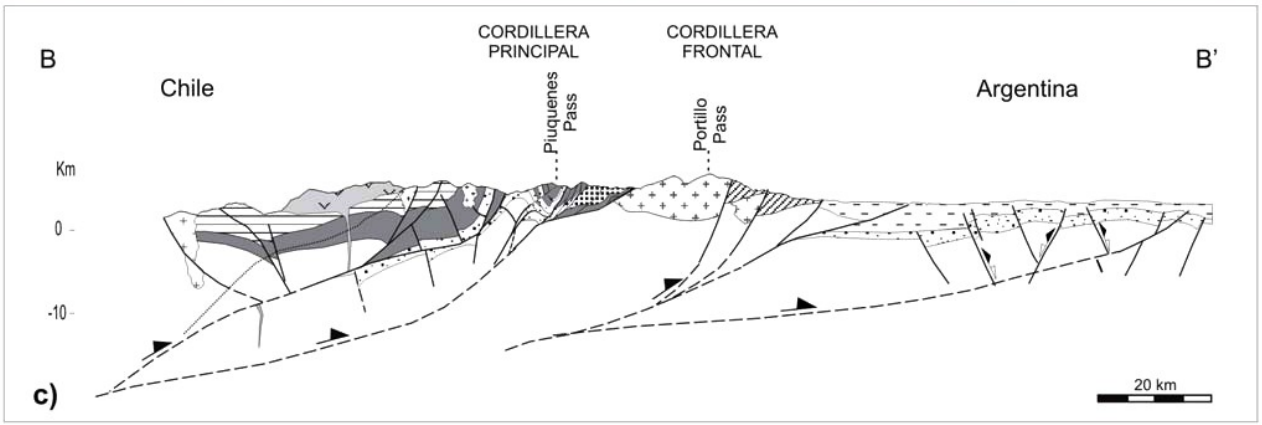
Esquemas de la Cordillera central, paso Piuquenes y Portillo, de Darwin (1846) y actual

Darwin fue uno de los primeros en reconocer … la secuencia de deformación asociada al levantamiento Andino… como lo demuestran sus brillantes observaciones efectuadas ya hace más de 150 años.

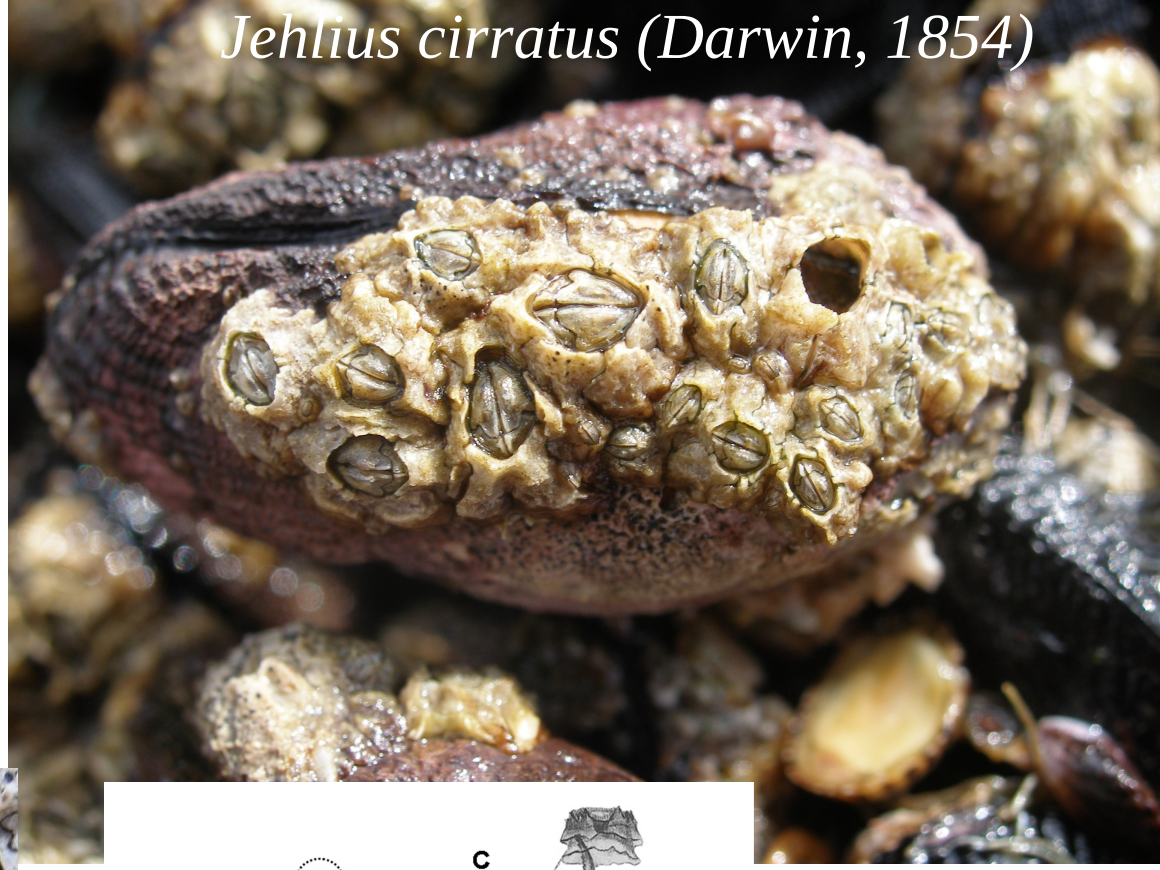
(Giambiagi et al. 2009)

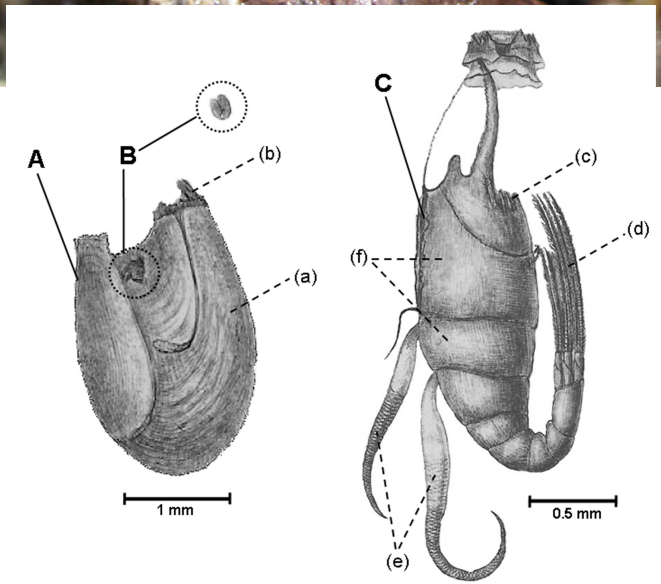






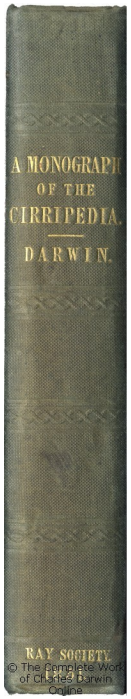
En las playas del Archipiélago de Chonos, en enero de 1835, **Darwin encontró a *'Mr. Arthrobalanus'*,** una clase inusual de cirrípedo, que carecía de placas externas y perforaba su refugio en las conchas de loco. Etiquetó cuidadosamente las muestras y las llevó consigo a In

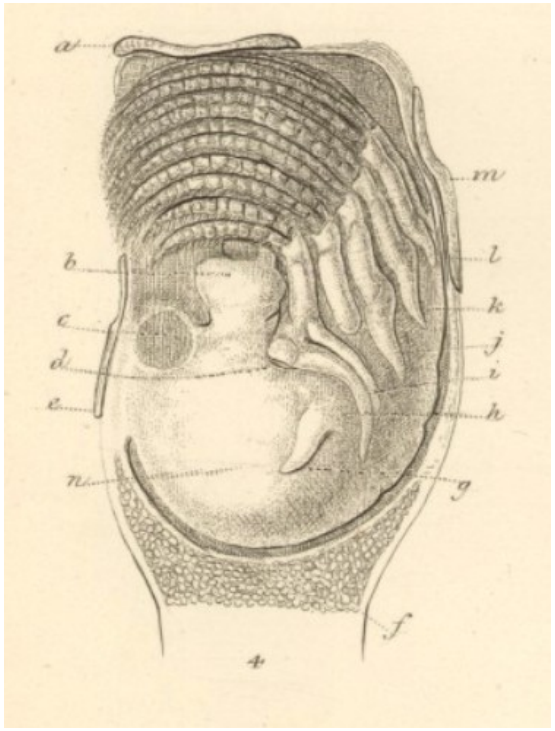


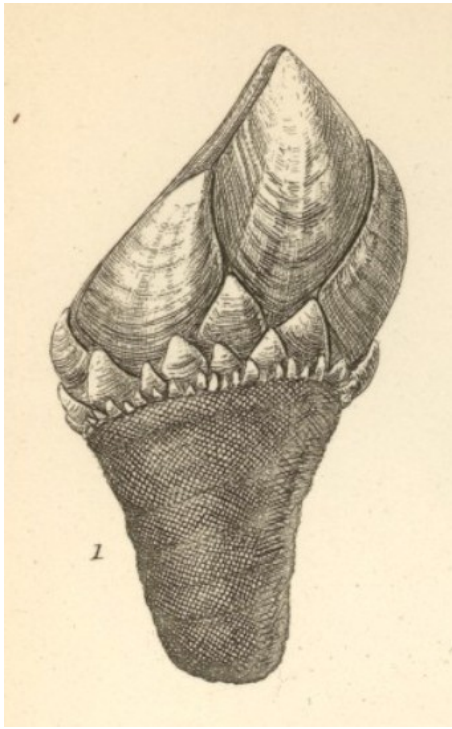


Cryptophialus minutus (Darwin 1854)

De vuelta en Inglaterra, Darwin dedicó **ocho años** a disectar y estudiar cientos de cirrípedos, escribió cuatro volúmenes y resolvió el enigma de Mr. Arthrobalanus, trabajo por el cual recibió **la medalla de la *Royal Society*** (Stott 2003)



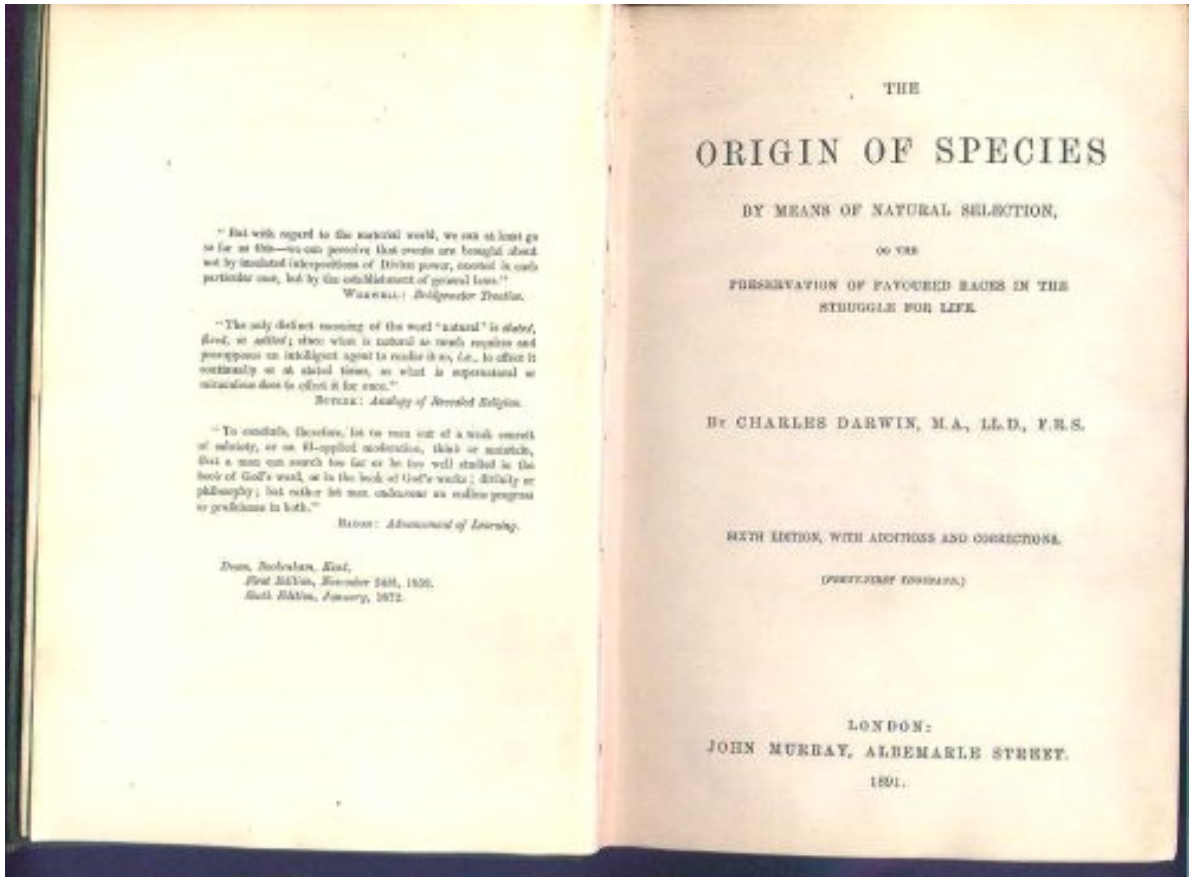




Darwin y los cirrípedos (1846-1854)

“Creo que mi trabajo en los cirrípedos posee considerable valor, porque además de discribir varias formas nuevas y notables, progresé en la identificación de las homologías entre varias partes de la anatomía… este trabajo me fue de gran utilidad, cuando en el *Origen de las Especies* tuve que discutir los principios de una clasificación natural.”

Autobiography of C. Darwin.



THE

ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

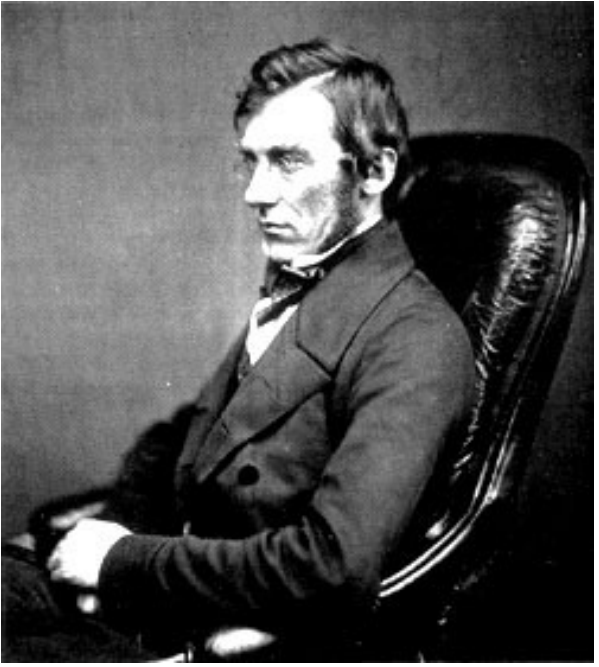
By CHARLES DARWIN, M.A., LL.D., F.R.S.

SIXTH EDITION, WITH ADDITIONS AND CORRECTIONS.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1891.

En 1859, ya establecido en Inglaterra, 23 años después del viaje del Beagle, publicó "*El origen de las especies*". [Anteriormente había publicado su *Diario de Viaje*, dos volúmenes sobre la geología de Sudamérica y cuatro de taxonomía de cirrípedos vivos y fósiles.]

"Durante mi travesía a bordo del H.M.S. Beagle, …me llamaron la atención ciertos hechos de la distribución y de las relaciones geológicas de los habitantes extintos y vivientes de Sudamérica. Estos hechos, a mi parecer, nos pueden ayudar a comprender *el origen de las especies* – misterio de misterios, como ha sido llamado por uno de nuestros mas grandes filósofos."



Joseph Dalton Hooker (1817-1911)

"The Voyage of the Beagle impressed me profoundly…to follow in [Darwin's] footsteps, at however great a distance, seemed to be a hopeless aspiration; nevertheless they quickened my enthusiasm in the desire travel and observe" (Hooker, 1899).

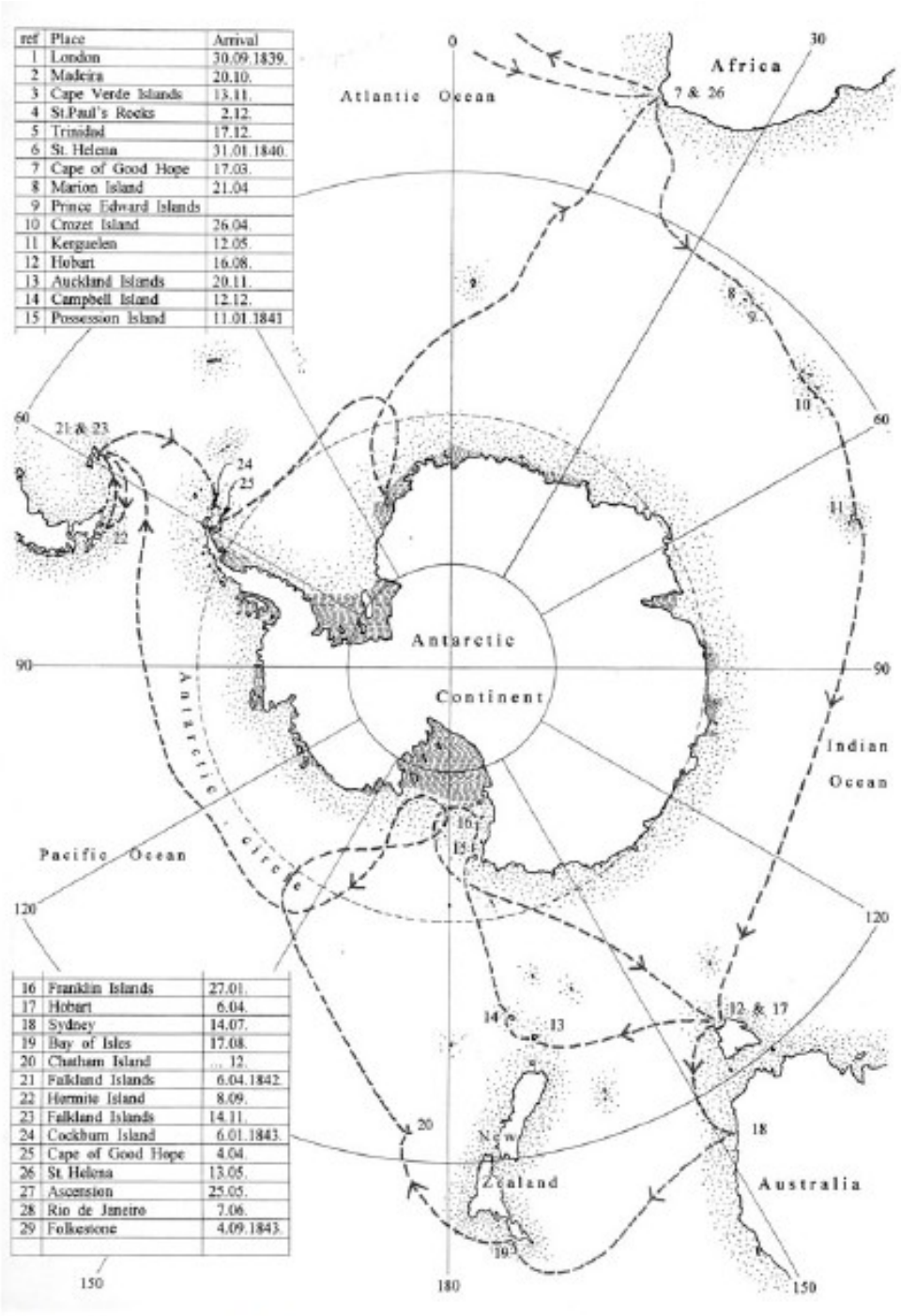
Fashion setter. Hooker's *Rhododendrons of Sikkim Himalaya* (1849) led many British gardeners to grow the genus for its colorful blossoms.

November 8, 2008

- Uno de los botánicos ingleses mas importantes del siglo XIX.
- Director del Kew Botanical Garden (sucesor de su padre William Hooker)
- En 1839 participó en la expedición antártica de James Clark Ross, que recorrió el sur de **Sudamérica, Nueva Zelandia y Tasmania**.
- Obras: *Flora Novae-Zelandiae*, 1852-1855, *Flora Tasmaniae*, 1855-1859, *Flora Antarctica*, 1844-1847.

Erebus &Terror en Kerguelen's Land- Antarctica

El viaje del joven Hooker (1839-1843)



ref	Place	Arrival
1	London	30.09.1839.
2	Madeira	20.10.
3	Cape Verde Islands	13.11.
4	St.Paul's Rocks	2.12.
5	Trinidad	17.12.
6	St. Helena	31.01.1840.
7	Cape of Good Hope	17.03.
8	Marion Island	21.04
9	Prince Edward Islands	
10	Crozet Island	26.04.
11	Kerguelen	12.05.
12	Hobart	16.08.
13	Auckland Islands	20.11.
14	Campbell Island	12.12.
15	Possession Island	11.01.1841
16	Franklin Islands	27.01.
17	Hobart	6.04.
18	Sydney	14.07.
19	Bay of Isles	17.08.
20	Chatham Island	... 12.
21	Falkland Islands	6.04.1842
22	Hermite Island	8.09.
23	Falkland Islands	14.11.
24	Cockburn Island	6.01.1843.
25	Cape of Good Hope	4.04.
26	St. Helena	13.05.
27	Ascension	25.05.
28	Rio de Janeiro	7.06.
29	Folkestone	4.09.1843.

Berry, R. J. (2009) *Biol. J. of the Linnean Society* 96, 462-481

J. D. Hooker (1896)

He found that it was common for same families and even genera [of plants] to be present in widely separated areas such as New Zealand, Australia, Tasmania and Patagonia.

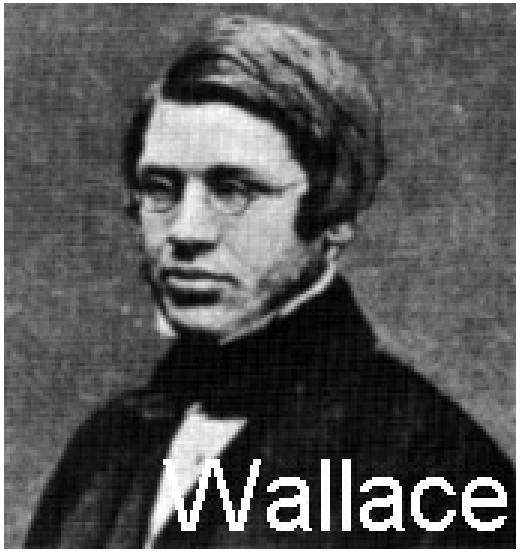
He suggested that these lands had been joined together, and geological events had caused their breakup. [*vicariance*]

He classified many of the plants collected by Darwin and became one of his correspondents and close friends.

Hooker was an evolutionist and one of Darwin's best friends

'In the present essay I shall advance the hypothesis that species are derivative and mutable; and this chiefly because, whatever opinions a naturalist may have adopted to the origin and variation of species, every candid mind must admit that the facts and arguments upon which he has grounded his conviction require revision since the recent publication by *the Linnean Society* of the ingenious and original reasonings and theories of Mr Darwin and Mr Wallace'.

Hooker in the *Foreword* to *Flora Tasmaniae* (1860)

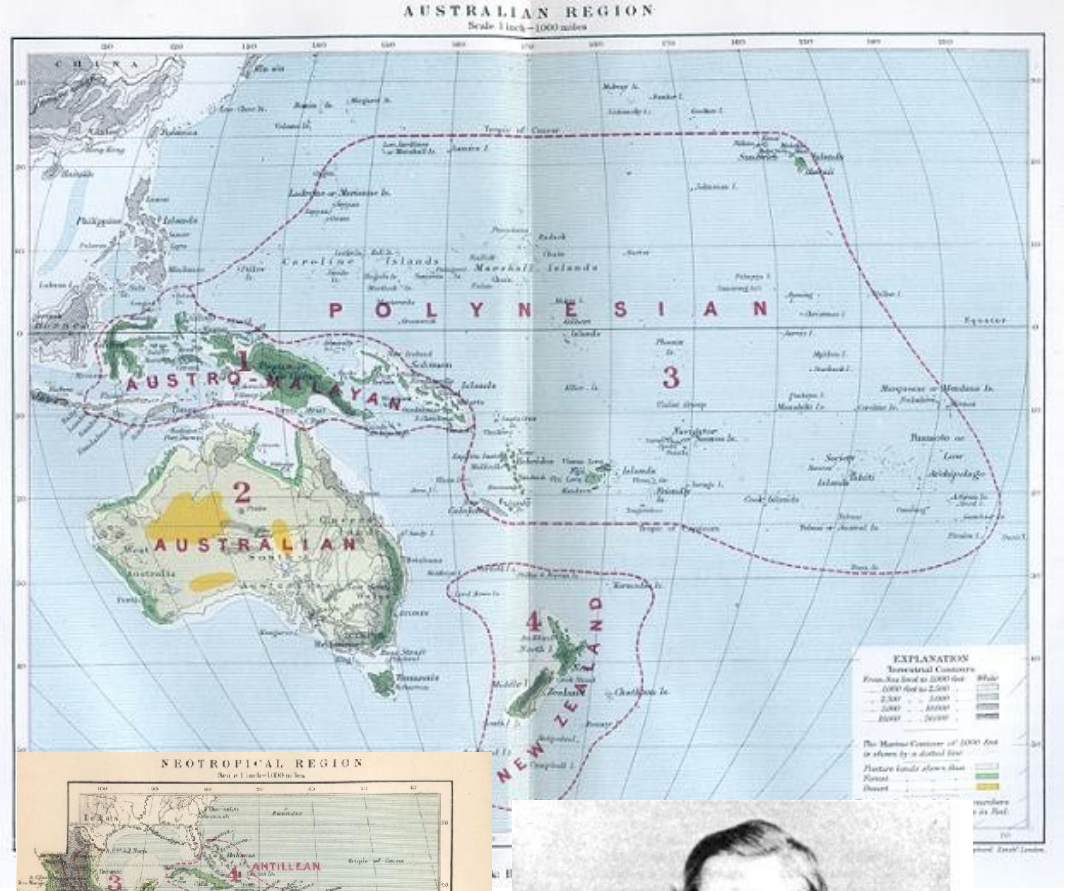


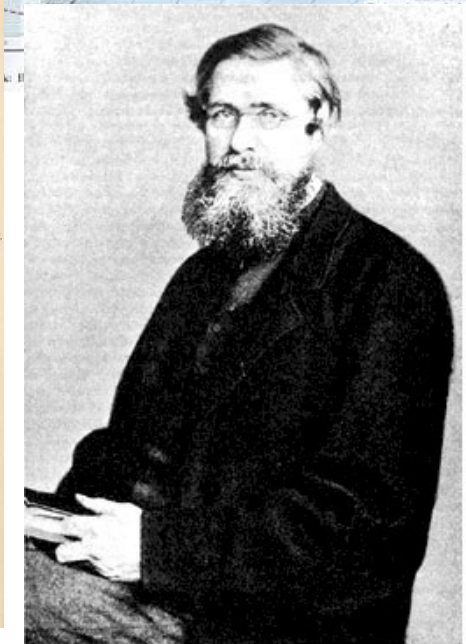
Alfred Russell Wallace (1823-1913)

A visionary scientist in his own right, a daring explorer and a passionate socialist

- Biotic Regions similar to Sclater's
- The father of Zoogeography
  - Distance not equal to taxonomic similarity
  - Integrated geological, fossil, evolutionary information
  - Paleoclimate influences present distributions

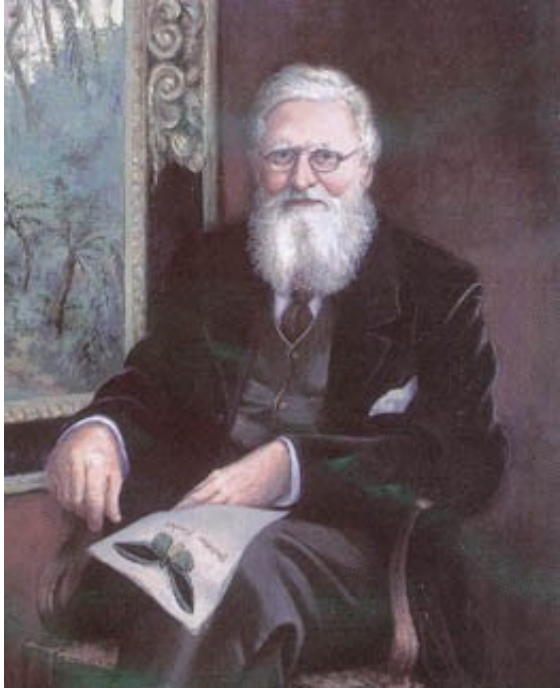
Wallace, AR (1876) *The geographic distribution of animals with a study of the relations of living and extinct faunas as elucidating the past changes of the Earth's surface*. MacMillan, Londres.





"A great part of the southern portion of America is more recent than the central tropical mass, and must have had at some time a closer connection than at present with the Antarctic lands and Australia…"
(Wallace 1864)

Wallace, un pionero de la conservación:



[sobre la responsabilidad de los gobiernos por la exploración de la historia natural. . .]

"… as a few lost letters may make a sentence unintelligible, so the extinction of the numerous forms of life which the progress of cultivation invariably entails will necessarily render obscure this invaluable record of the past. It is, therefore, an important object, which governments and scientific institutions should immediately take steps to secure, that in all tropical countries… the most perfect collections possible in every branch of natural history should be made and deposited in national museums….

If this is not done, future ages will certainly look back upon us as a people so immersed in the pursuit of wealth as to be blind to higher considerations."

--from A. R. Wallace,1863, On the Physical Geography of the Malay Archipelago. *Journal of the Royal Geographical Society* 33: 217-234, on page 234.

Charles Lyell and Jos. D. Hooker presented Darwin and Wallace's Paper to the Linnean Society

The accompanying papers, which we have the honour of communicating to the *Linnean Society*, and which all relate to the same subject, viz. the Laws which affect the Production of Varieties, Races, and Species, contain the results of the investigations of two indefatigable naturalists, Mr. Charles Darwin and Mr. Alfred Wallace.

These gentlemen having, independently, and unknown to one another, conceived the same very ingenious theory to account for the appearance and perpetuation of varieties and specific forms of our planet, *may both fairly claim the merit of being original thinkers in this important line of inquiry*…

Documents presented by Lyell and Hooker to the Linnean Society of London, June 30th 1858:

1. Extracts from a MS. Work on Species by Mr. Darwin, which was *sketched in 1839*, *and copied in 1844*, when the copy was read by Dr. Hooker… and communicated to Sir Charles Lyell.
2. An abstract of a private letter addressed to Professor Asa Gray, of Boston, U.S., in October 1857, by Mr. Darwin, in which he repeats his views…
3. An Essay by Mr. Wallace, entitled "On the Tendency of Varieties to depart indefinitely from the Original Type." This was written …in February 1858, for the perusal of his friend and correspondent Mr. Darwin.

En 1908, durante la commemoración número 50 de la lectura del paper del que fueron ambos coautores en la Sociedad Lineana, Wallace expresó:

“ I was then (as often since) the “young man in a hurry”: he the painstaking and patient student, seeking the full demonstration of the truth that he had discovered, rather than to achieve immediate personal fame.

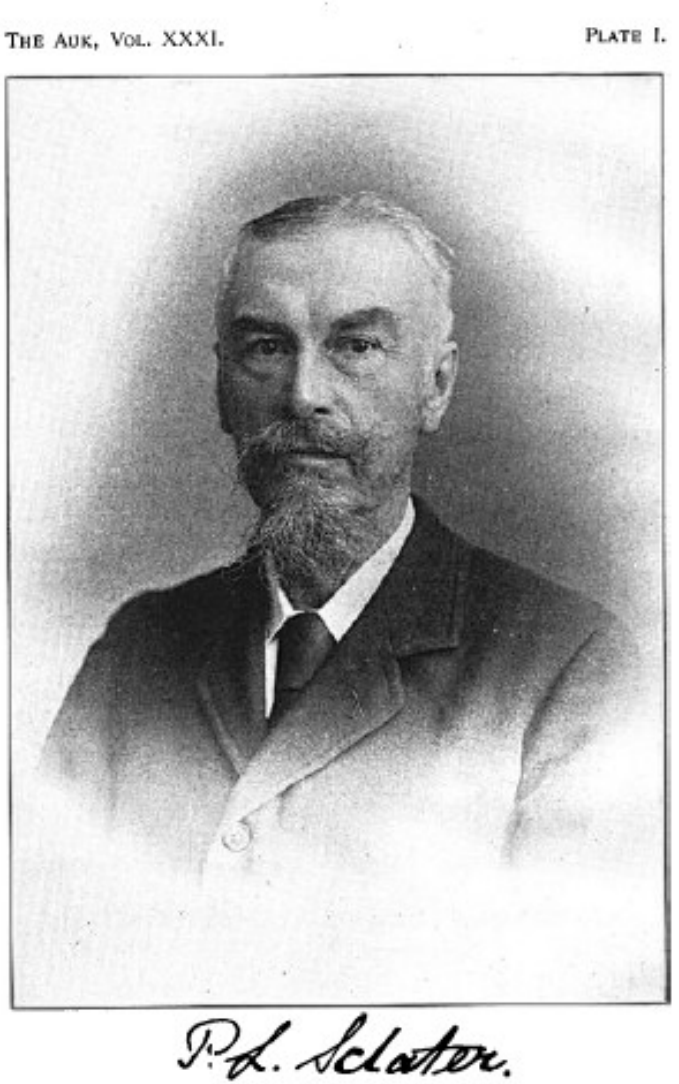
Sarawak Law:

“*Every species has come into existence coincident both in space and time with a pre-existing closely allied species*.”

AR Wallace (1855)*: On the Law which has Regulated the Introduction of New Species*. Annals and Magazine of Natural History 16, 184-196.

Berry, A. (2013) *Nature* 496, 162.

Philip Lutley Sclater (1829 – 1913)



- English lawyer and zoologist, educated in Winchester College and Christ Church College, Oxford where he studied ornithology

- In 1858, he published a fundamental paper in the *Proceedings of the Linnean Society* proposing six major zoological regions: **Palearctic, Aethiopian, Indian, Australasian, Nearctic and Neotropical**. (“The primary ontological divisions of the Earth’s surface”)

- Sclater’s biogeographic regions, modified later by Wallace, and others, have stood the test of time.

Biogeographic Subdivisions of the Earth

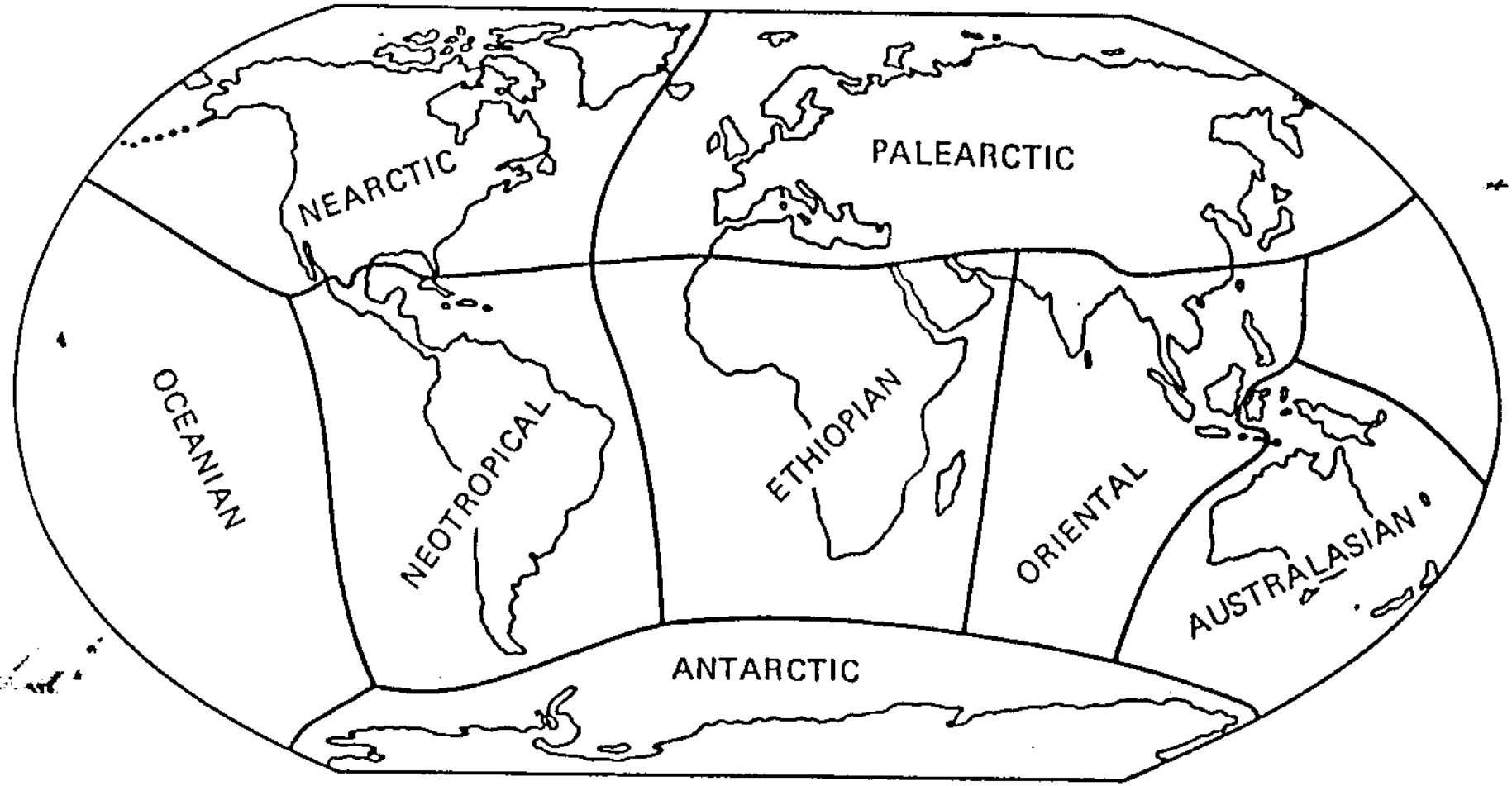


Figure 1.1 Biogeographic regions of the world. Compiled from several sources and combining zoogeographical and phytogeographical systems.

Source: Pielou, E. C. (1980)

Diversidad, espacio y tiempo en la primera mitad del siglo 20


Wegener

- A. L. **Wegener** Continental Drift Theory (CV)

- George Gaylord **Simpson** Vertebrate Paleontologist
  Variations within single species attributed to genetics

  Centers of Origin (based on current patterns) and then steady dispersal in all directions until a barrier is found

- Phillip J. **Darlington** Zoologist
  Biogeography of beetles and dispersal over fixed geography

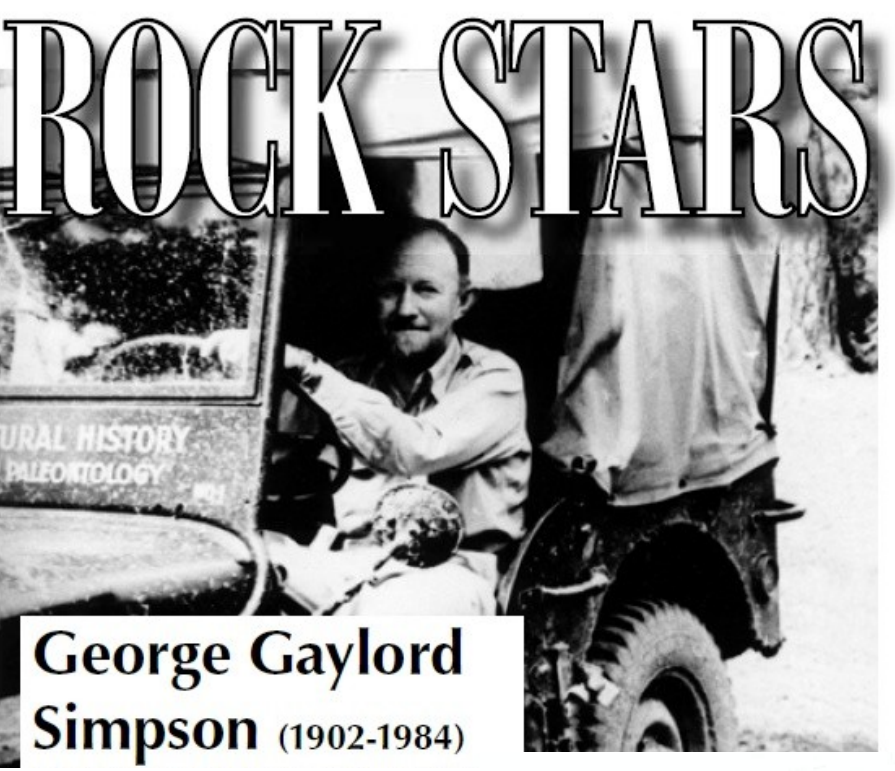
- Ernst **Mayr**
  - Biological species concept (potential interbreeding to produce fertile offspring)
  - Allopatric speciation (arising through geographic isolation)


Simpson 1965

Darlington, Philip Jackson, Jr. (1904-1983)

Darlington was one of the twentieth century's best known zoogeographers after initially forging a solid career as a specimen collector and taxonomist. His early field studies, focused on insects (especially carabiid beetles) notably in Colombia, Puerto Rico, Haiti, Cuba and New Guinea, **he also traveled to Australia and in later years, Tierra de Fuego**. Influenced by the writings of **Alfred Russell Wallace** and the dispersal-dominated ideas of **George Gaylord Simpson**, he took a dim view of the notion of continental drift.

Obras: *Zoogeography: The Geographical Distribution of Animals* (1957), and *Biogeography of the Southern End of the World* (1965).



GEORGE GAYLORD SIMPSON (1902-1984)
Paleontologist & evolutionist

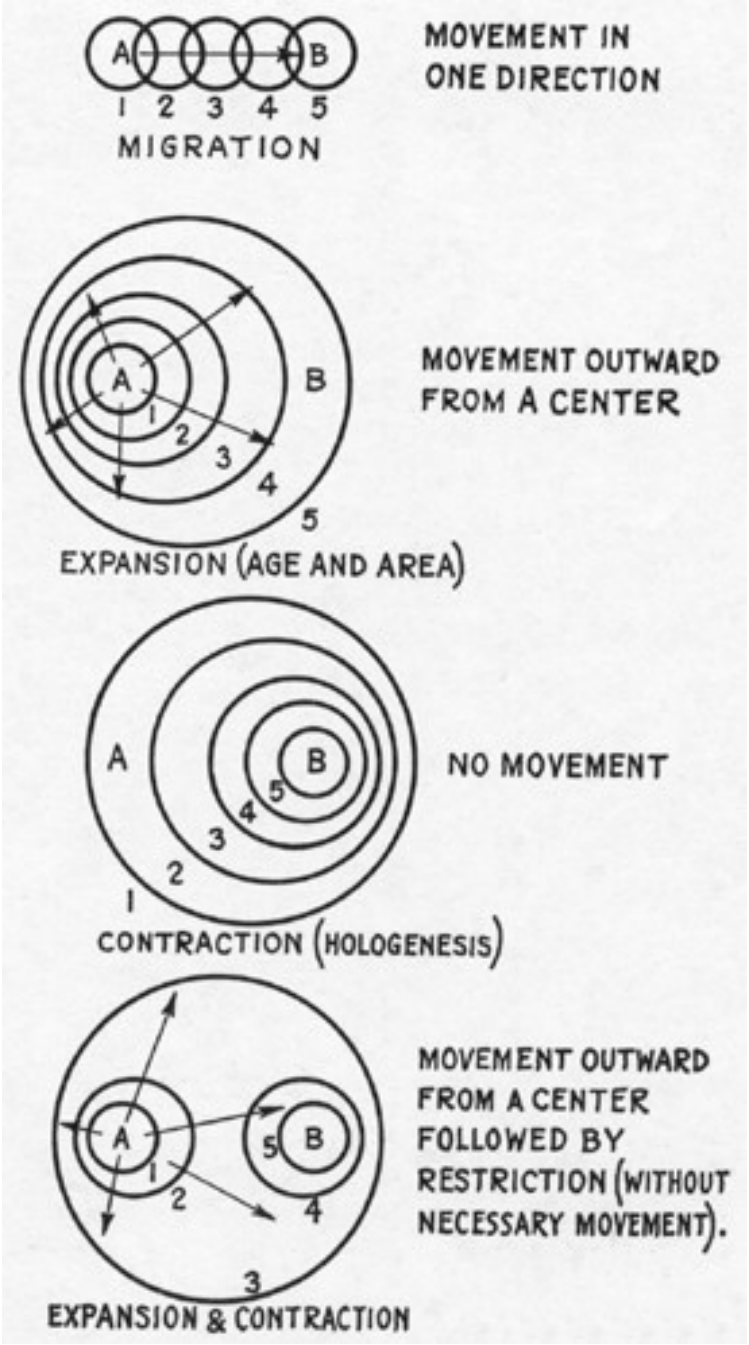
Escribió su tesis doctoral sobre la diversificación de los mamíferos del Mesozoico (Yale University 1916). En 1917 se unió al Museo de Historia Natural de New York.

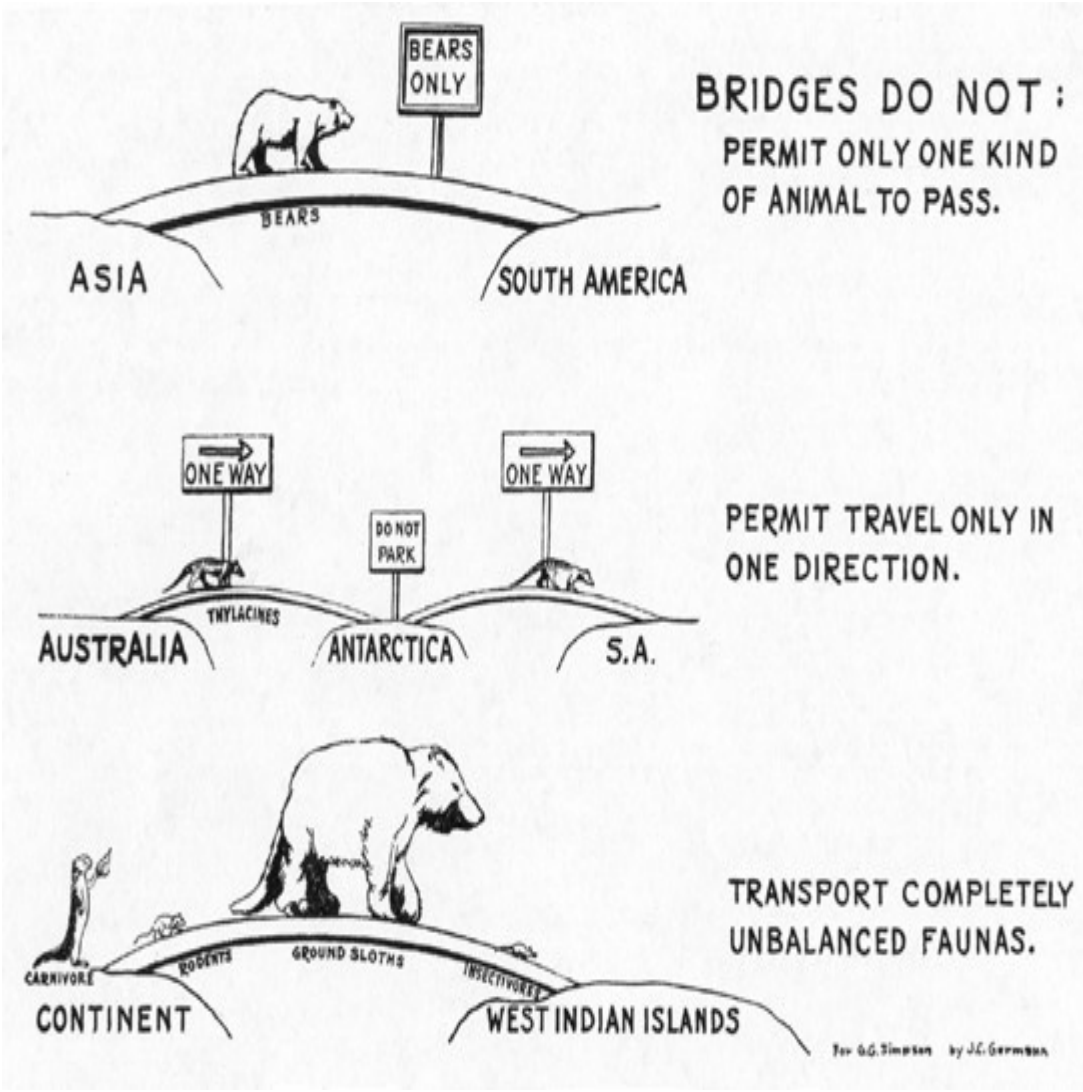
Su famosa monografía en **la evolución de los caballos**, basada en un cuidadoso análisis el registro fósil, mostró que muchos linajes se extinguen sin que exista un progreso hacia modelo predeterminado.

Obras:
Tempo and Mode in Evolution (1944)
Principles of Classification and a Classification of Mammals (1945)
The Geography of Evolution (1965)

Simpson in Patagonia 1933-34

Simpsons' ideas about dispersal





About the Great American interchange

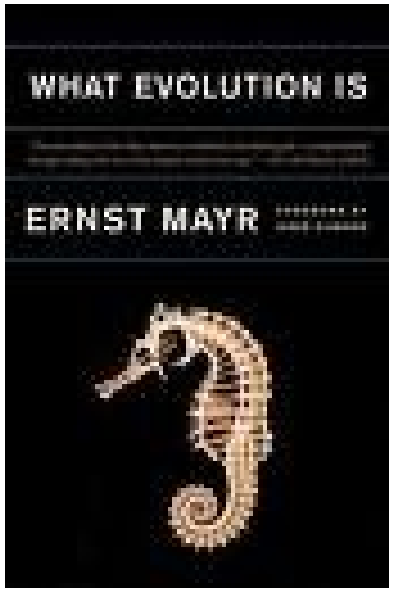
1. Those that **expanded into the other continent** and then **became extinct in both**:
   (a) Of South American origin: Glyptodonts, ground sloths (several families).
   (b) Of North American origin: Gomphotheres (bunodont mastodonts), horses.

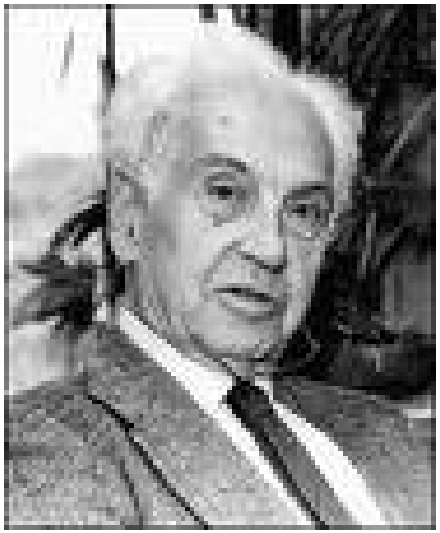
2. Those that **expanded into the other continent** and **then contracted** (or in one case became extinct) there but were not much restricted in their original home:
   (a) Of South American origin: Capybaras, armadillos.
   (b) Of North American origin: None.

3. Those that **expanded into and survived in the other** continent and **became restricted or extinct in their continent of origin**:
   (a) Of South American origin: None.
   (b) Of North American origin: Tapirs, camels, peccaries, short-faced bears.

Simpson, G. G. (1940) Mammals & Land Bridges. *Journal of the Washington Academy of Sciences* 30: 137-163.

Ernst Walter Mayr (1904- 2005)





Ornithologist, born in Germany

Co-responsible for the Modern Evolutionary Synthesis (1940s)

"A new species develops if a population which has become geographically isolated from its parental species acquires during this period …characters that promote or guarantee reproductive isolation…" In: *Systematics and the Origin of Species* (1942)

His theory of geographic speciation, disregarded the possibility of sympatric speciation

Segunda mitad del siglo 20

(technological revolution, ecology, paleontology)

- **Leon Croizat** (1894-1982)

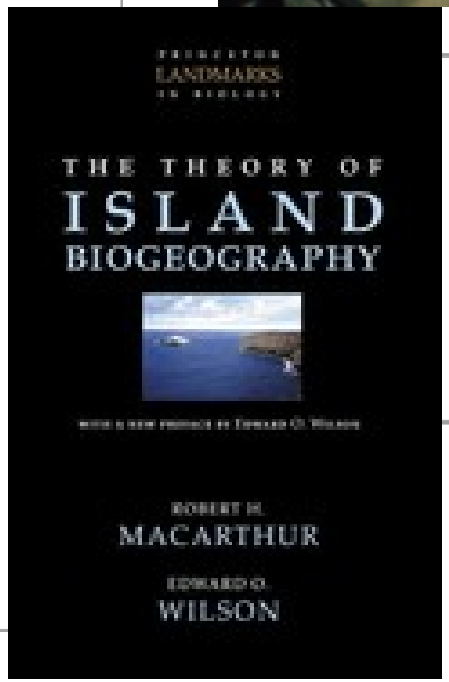
  Vicariance biogeography (1958)

  Disjunction of multiple species due to the growth of barriers

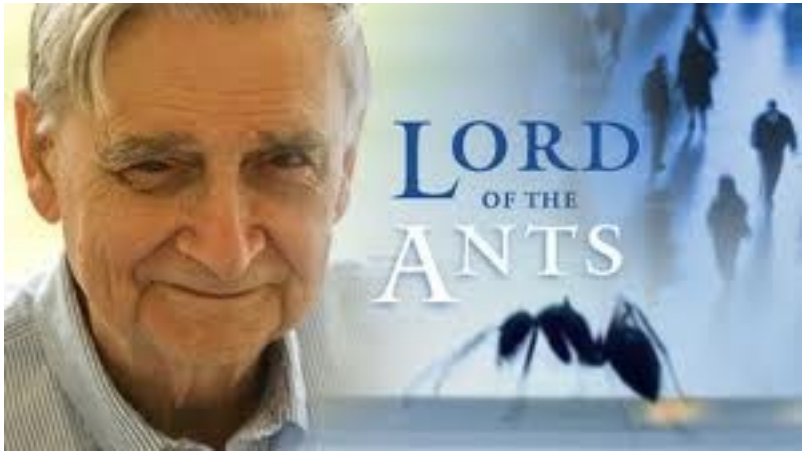
- R. H. **MacArthur** (1930-1972) and E. O. **Wilson** (1929-…)

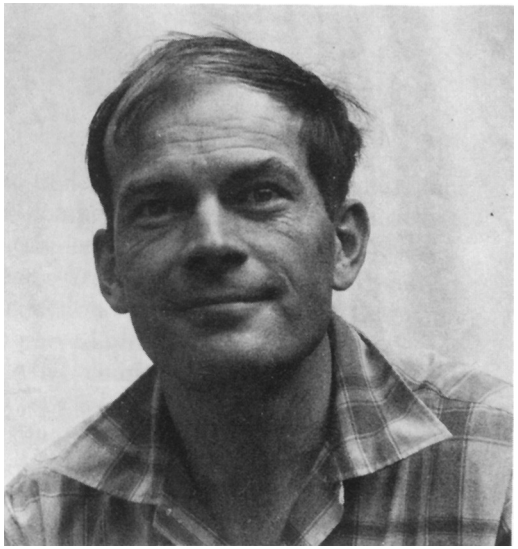
  The Theory of Island Biogeography

- Radiometric dating
- Plate Tectonics (magnetometers, sonar, ocean spreading)



Leon Croizat during the 1950-1951 Franco-Venezuelan expedition to the sources of the Orinoco River



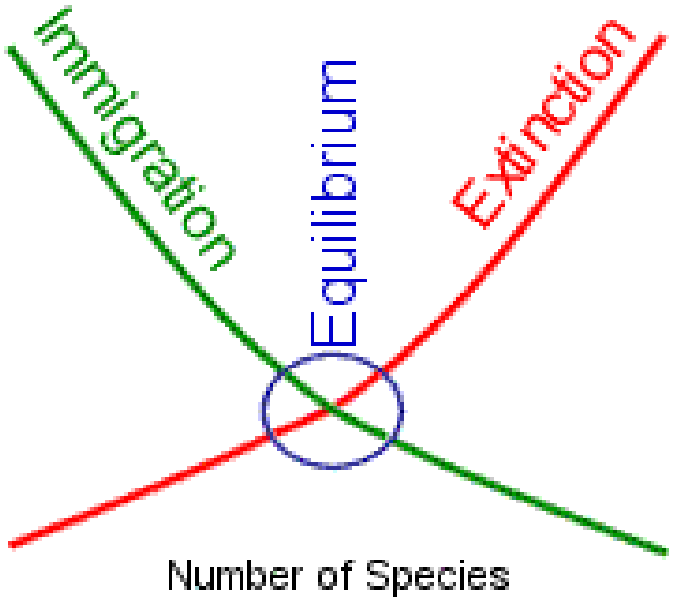


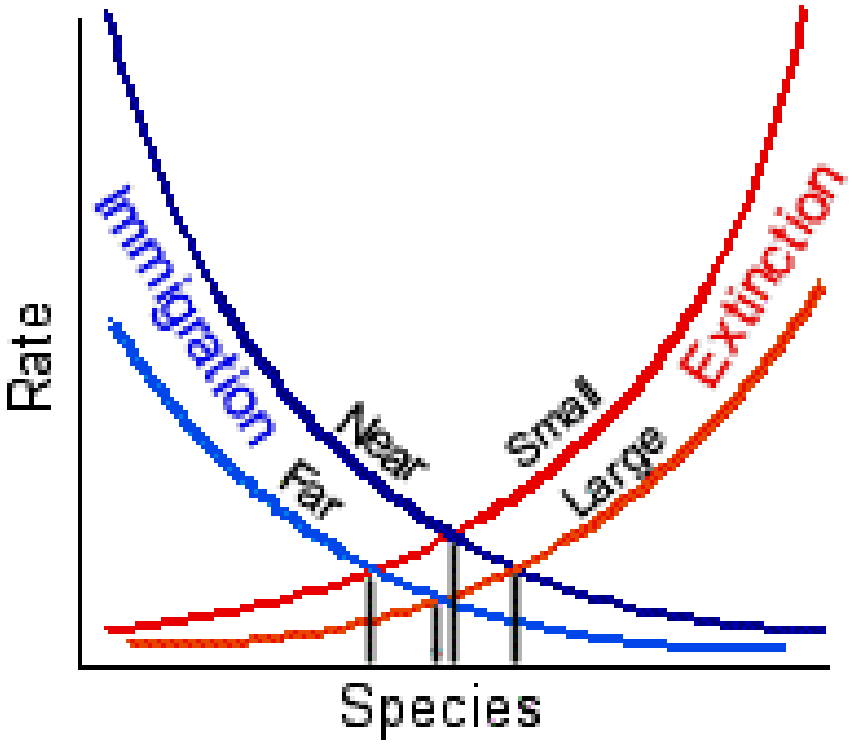
Early in his career, E. O. Wilson conducted work on the classification and ecology of ants in New Guinea and other Pacific islands, and in the American tropics. In 1963 his work and his conception of species equilibrium led him to the theory of island biogeography, which he developed with Robert H. MacArthur of Princeton University. In their theory, immigration and extinction, the determinants of biodiversity at the species level, were tied to area (distance of islands from source regions) and the basic properties of ecology and demography.

The work culminated in their 1967 book *The Theory of Island Biogeography*, which has been a standard reference work ever since. The theory greatly influenced the discipline of ecology and became a cornerstone of conservation biology.

Equilibrium Theory of Island Biogeography

- Immigration Rates depend on **Distance**
- Extinction Rates depend on **Area**





Panbiogeografía

Leon Croizat (1894-1982)

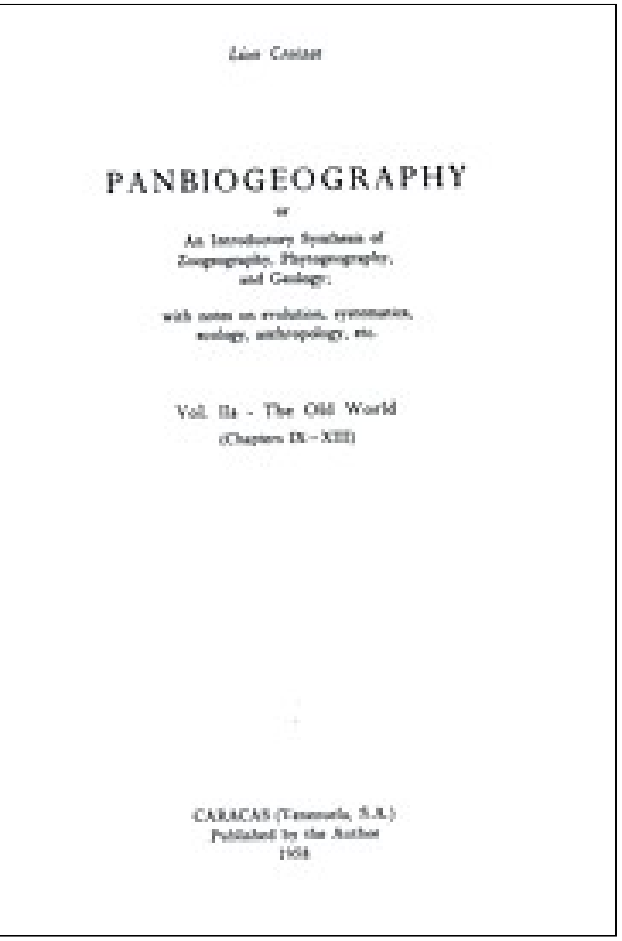
panbiogeography: distantly-related taxa have similar disjunction patterns

Patterns are due to contraction and fragmentation of former ranges

Emphasis on **multiple taxa** rather than single group (*cf.* center of origin)

Tracks (Líneas conectan áreas disjuntas)

Croizat, L. 1952. Manual of Phytogeography. Junk, The Hague
Croizat, L. 1958. Panbiogeography. Caracas.
Croizat, L. 1960. Principia Botanica. Caracas.
Croizat, L. 1964. Space, Time, Form: The Biological Synthesis. Caracas


Léon Croizat

PANBIOGEOGRAPHY

or

An Introductory Synthesis of
Zoogeography, Phytogeography,
and Geology;

with notes on evolution, systematics,
ecology, anthropology, etc.

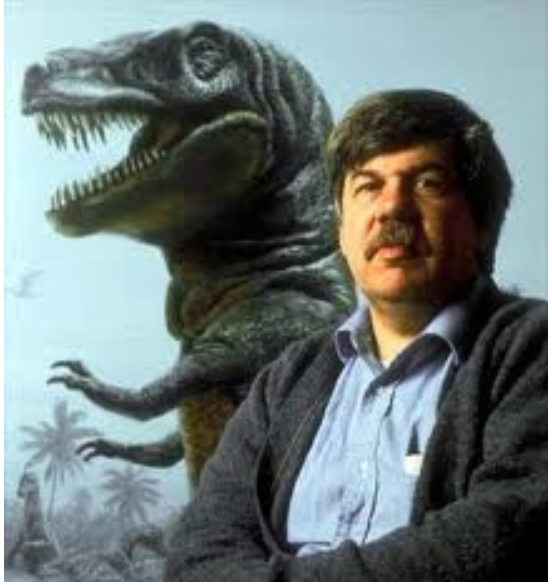
Vol. IIa - The Old World
(Chapters IX–XIII)

CARACAS (Venezuela, S.A.)
Published by the Author
1958

THE CURRENT GEOGRAPHIC DISTRIBUTION OF AN ORGANISMS RESULTS FROM THE VICARIANT FORMATION OF TAXONOMIC GROUPS HAVING PART IN IT, NOT FROM THE BYPRODUCTS OF MIGRATORY "JUMPS" EFFECTED BY THESE SAME GROUPS WHEN PASSING FROM A SUPPOSED "CENTER OF ORIGIN" TO ANOTHER WITH THE HELP OF "MEANS OF DISPERSAL" FREQUENTLY SAID TO BE "MYSTERIOUS", ETC.

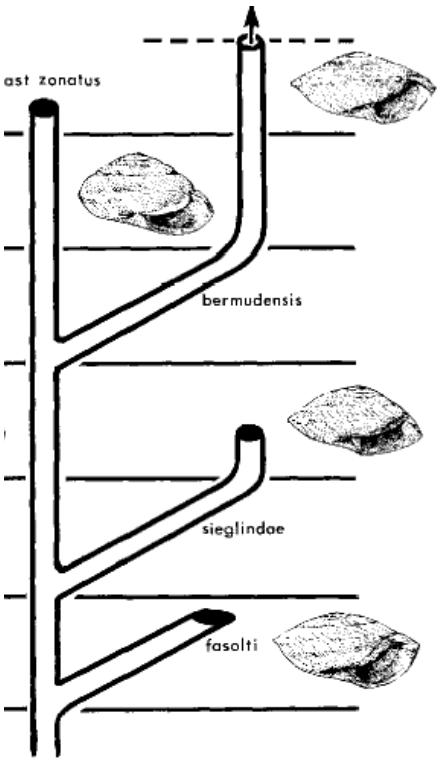
It cannot be denied that the boundaries of the geographic distribution of an individual of a group or individuals may alter in relation to climatic changes, etc. What is certainly inadmissible is the disorderly "migration" by sheer chance what is typical of the "zoogeography" and "phytogeography" of Darwin’s tradition**.**

L. Croizat (1984) Charles Darwin and his theories. (Translation of 1977 paper in Spanish)



Wonderful life

Stephen J. Gould
(1941 – 2002)



En 1972 propuso junto a Niles Eldredge la **Teoría del Equilibrio Punteado** como una alternativa al gradualismo filético y una forma de explicar los “hiatos” del registro fósil. Una teoría evolutiva desde la perspectiva paleontológica.

In this paper we shall argue:

(1) The expectations of theory color perception to such a degree that new notions seldom arise from facts collected under the influence of old pictures of the world. New pictures must cast their influence before facts can be seen in different perspective.

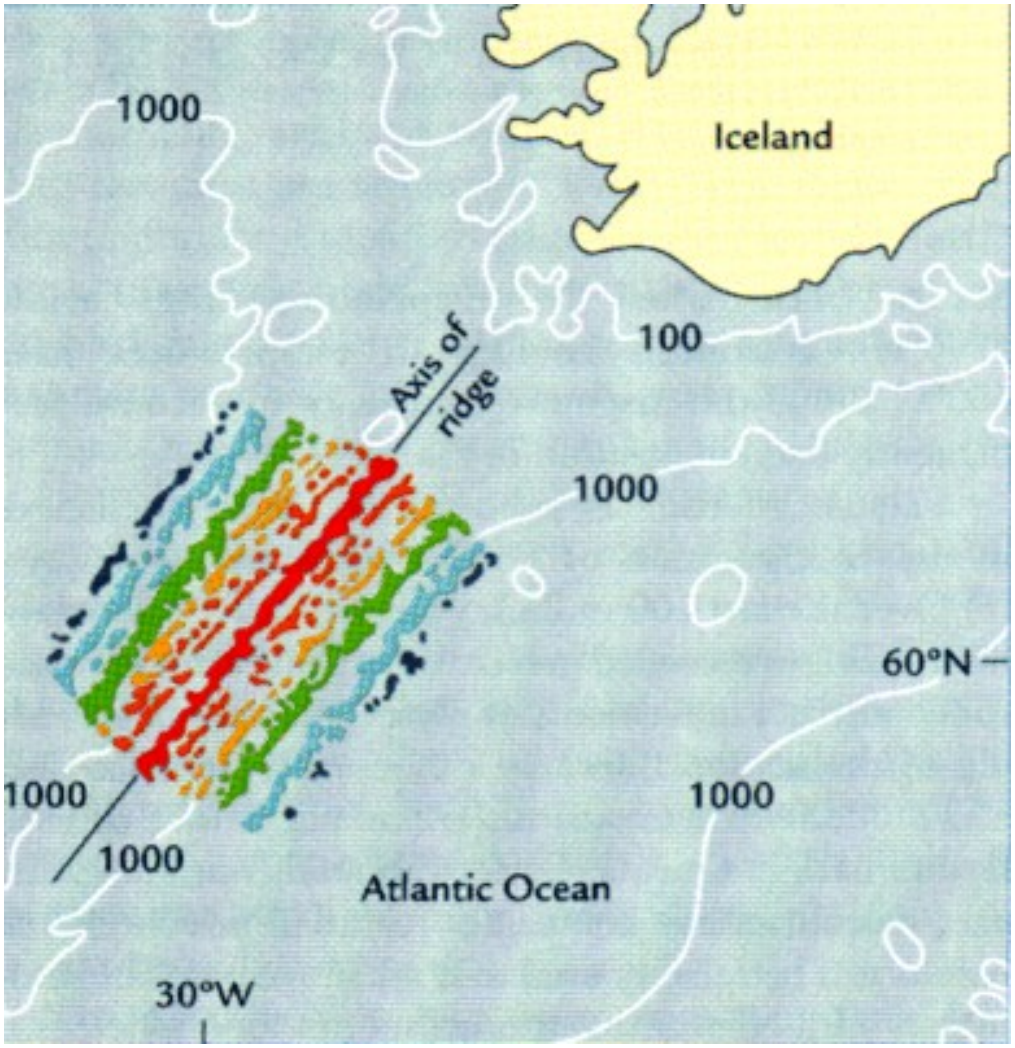
Eldredge, N. & Gould, S. J. (1972) Punctuated equilibria: an alternative to phyletic gradualism. In *Models in Paleobiology* (Schopf, T.J.M., ed.), pp. 82–115, Freeman, Cooper and Co.

CONCLUSIONES

Diversidad, tiempo y espacio son elementos comunes e interconectados del análisis y la teoría biogeográfica.

La teorías biogeográficas son teorías sintéticas que dan cuenta de los patrones historicos de biodiversidad en un mundo cambiante.

Grandes revoluciones conceptuales que han modificado nuestra comprensión de la relación entre tiempo, espacio y diversidad biológica incluyen: la teoría sobre el origen de las especies por selcción natural, la deriva continental, el uniformitarianismo, la profundidad del tiempo geológico, la teoría ecológica.



Ocean Floor spreading

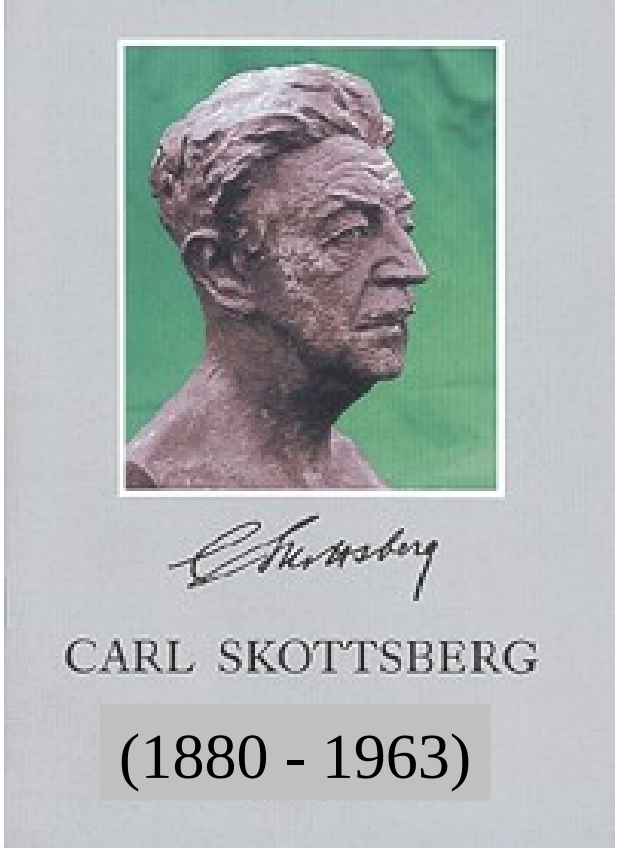
Paleomagnetic Time Scale

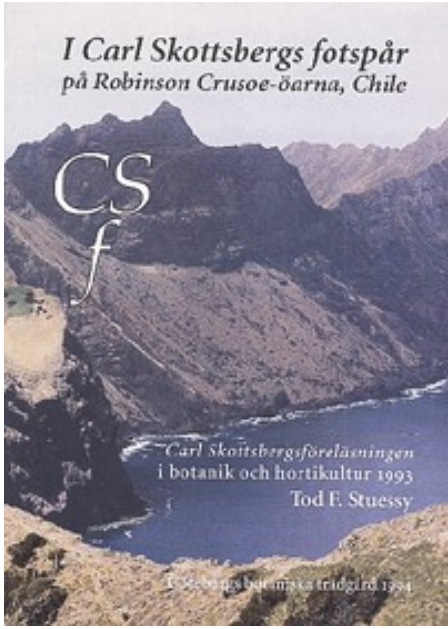
Bruhnes 0-0.73 ma
Matuyama 0.73 - 2.48 ma
Gauss 2.48 - 3.40 ma
Gilbert 3.40 - 5.89 ma

Skottsberg, Carl Johan Fredrik (Sweden 1880-1963)

Life Chronology

--born in Karlshamn, Sweden, on 1 December 1880.
--1899-1960: numerous travels, all over the world, to study botany
--1901-1904: takes part in the Swedish Antarctic expedition under Nordenskjold
--1907: receives his doctorate from the University of Uppsala; hired as lecturer at the University
--1907-1909: leads expedition to southern South America, the Falkland Islands, Juan Fernandez, and South Georgia
--1911: publishes his *The Wilds of Patagonia* (in English)
--1915: commissioned by the city of Göteborg to create a botanical garden
--1916-1917: leads expedition to Juan Fernandez, Easter Island, and Chile
--1919: advanced to the rank of professor at Uppsala, but moves to Göteborg shortly thereafter
--1919-1948: director of the botanical garden at Göteborg
--1920-1956: edits the three volumes of *The Natural History of Juan Fernandez and Easter Island*
--1922, 1926, 1938, 1948: research in Hawaii
--1924-1937: secretary of the Royal Society of Science and Letters of Göteborg
--1929-1949: secretary of the International Commission for Preservation of Wild Life in the Pacific (and president, 1948-1949)
--1931: advanced to rank of professor at Göteborg
--1949: president of the Royal Swedish Academy
--1950: president of the Seventh International Botanical Congress
--1950: made a member of the Royal Society of London
--1960: publishes his "Remarks on the Plant Geography of the Southern Cold Temperate Zone" in the *Proceedings of the Royal Society of London, Series B*
--dies at Göteborg on 14 June 1963.





"Remarks on the Plant Geography of the Southern Cold Temperate Zone" in the *Proceedings of the Royal Society of London, Series B* (1960)

Skottsberg ranks among the greatest botanical explorers of the twentieth century. **His early investigations focused on Antarctica and the Magellanic region**, but in later years he would travel to all of the continents, and most of them several times. **He eventually came to support Joseph Hooker's earlier opinions on the role of Antarctica in helping to distribute species around the southern half of the globe**, a view incorporating general waxing and waning of glacial episodes, and associated corridor dispersal along mountain chains (especially the Andes).