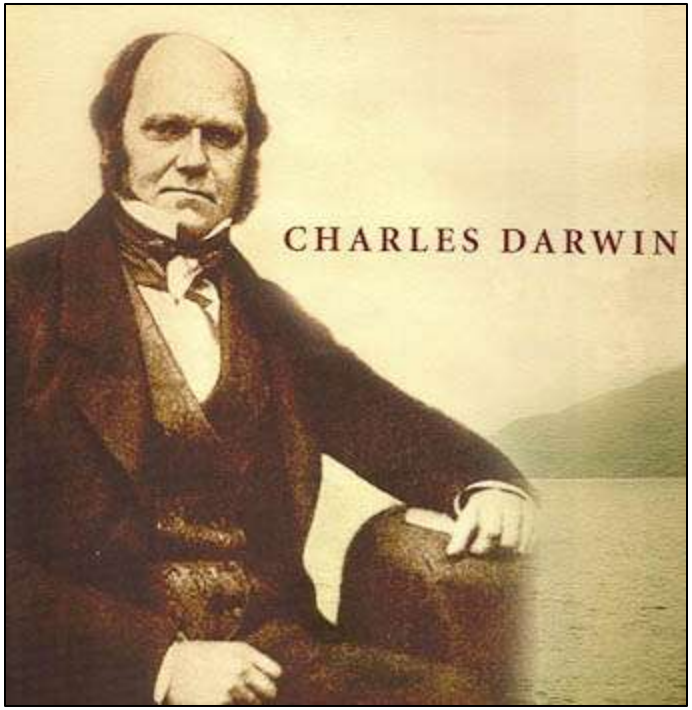


Early 1800s

Natural history very active

Taxonomy established - Linnaeus

Geology is an established field, strata mapped out, Smith, Lyell

Age of Earth estimated to be millions of years by Hutton

Fossils accepted as extinct animals, Cuvier

Similarities between anatomy and embryology were noted

Mechanisms of evolution proposed – Buffon, Lamarck

<u>Still, the questions were:</u>

What natural mechanism could explain evolution?

What hereditary mechanism could explain variation and enable organisms to change?

Darwin answered part of this. It took until the 1920s to fully work out.

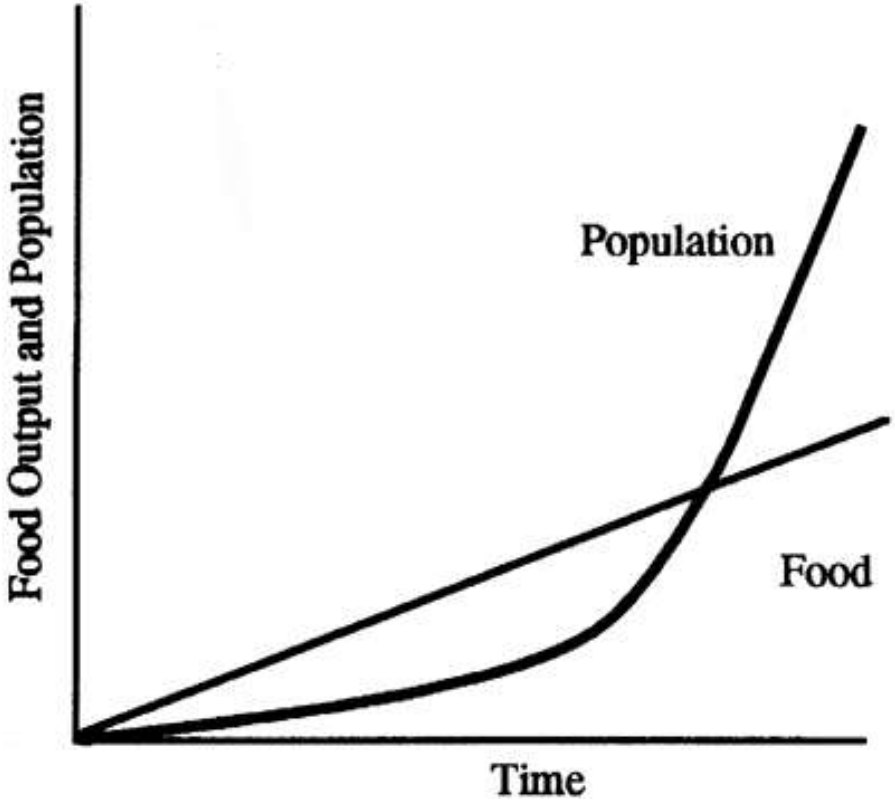
After returning to England, Darwin spent 20 years collecting and systematizing his evidence, although it was his experiences on the voyage of the H.M.S. Beagle that had the greatest impact on him.

He had almost all the pieces of the puzzle of evolution. He believed that individuals vary and that these differences could be inherited.

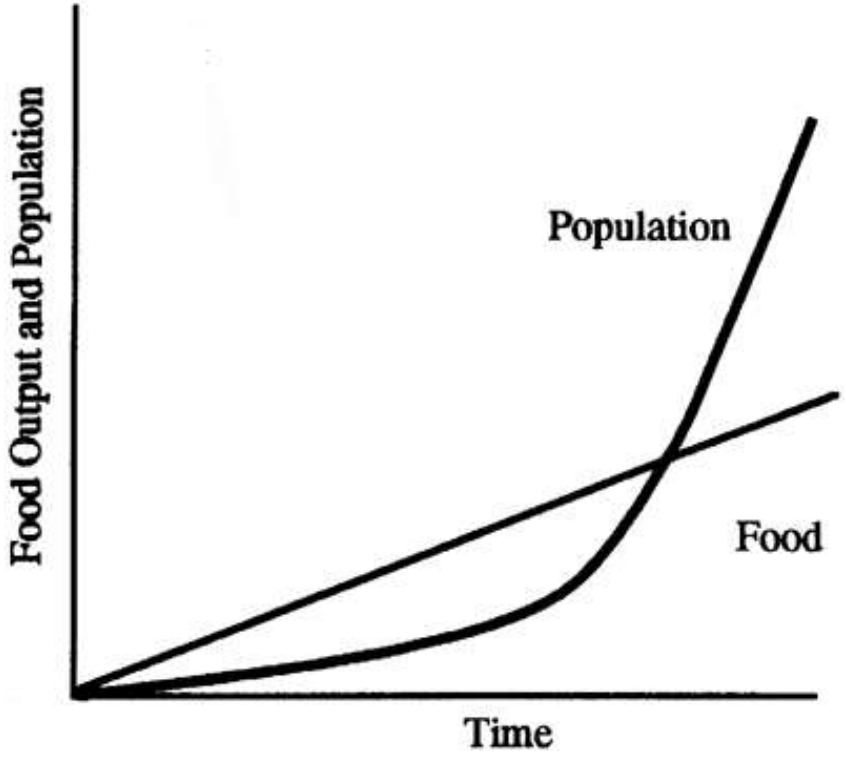
What he did not have was a mechanism that could explain <u>how</u> this variation was inherited.

Influence of Malthus

Two years after he returned Darwin read **"Essay on the Principle of Population"** by the political economist **Thomas Malthus**, a British clergyman, who argued that human populations always increase faster than the food supply.



Influence of Malthus



Malthus wrote, "It may safely be pronounced therefore that the population when unchecked, goes on doubling itself every 25 years, or increases in a geometrical ratio."

Darwin wrote:

"A **struggle for existence** inevitably follows from the high rate at which all organic beings tend to increase. It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms: for in this case there can be no artificial increase of food, and no prudential restraint from marriage."

In June of 1842, Darwin wrote a 35 page brief abstract of his theories, and with encouragement of his friends, wrote a 230 page expansion of his ideas in the summer of 1844.

Darwin's eventual plan was for a multi-volume essay laying out his ideas and examples.

- The arrival of a letter from Alfred Russell Wallace in the summer of 1858 changed his sedate pace.

Alfred Russell Wallace (1823 –1913)

British naturalist, explorer, geographer, anthropologist, and biologist.

Travelled extensively in South America and Malaysia..

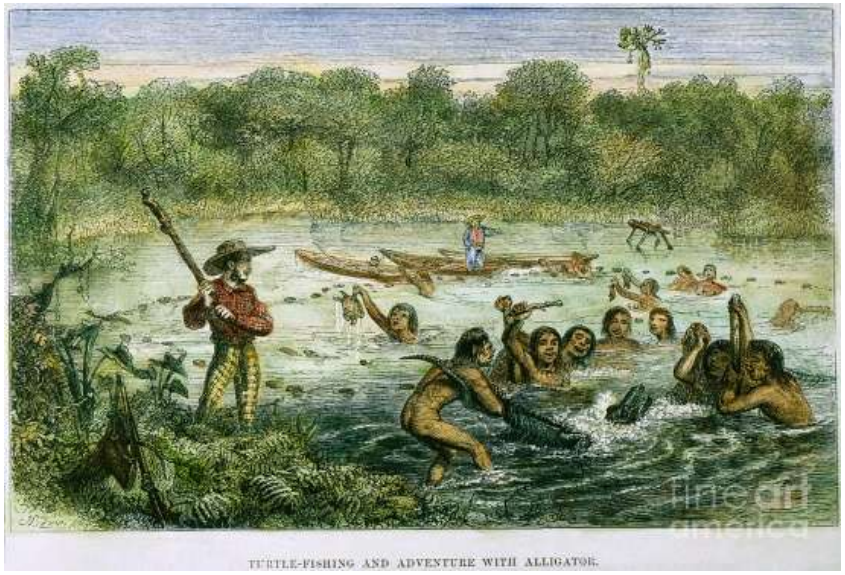
Best known for independently conceiving the theory of evolution through natural selection.

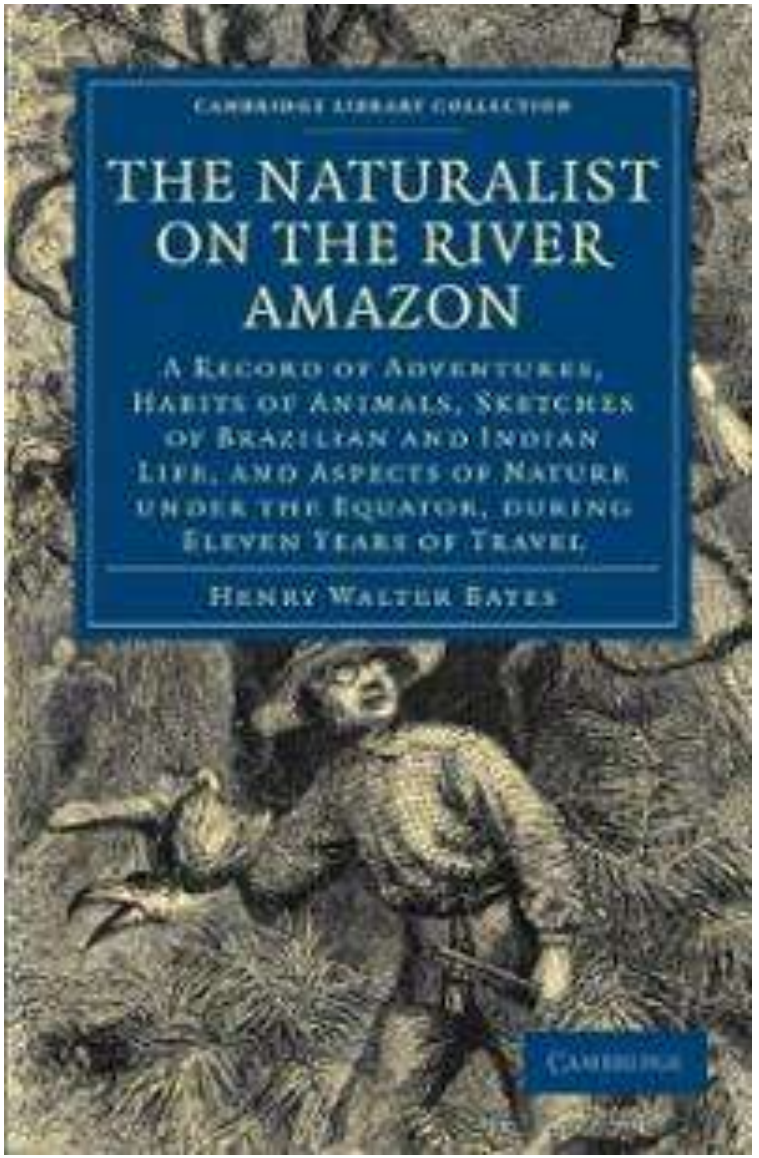
1858 - Described natural selection in an essay he sent to Darwin to forward to Charles Lyell.

His paper on the subject was jointly published with some of Charles Darwin's writings in 1858.

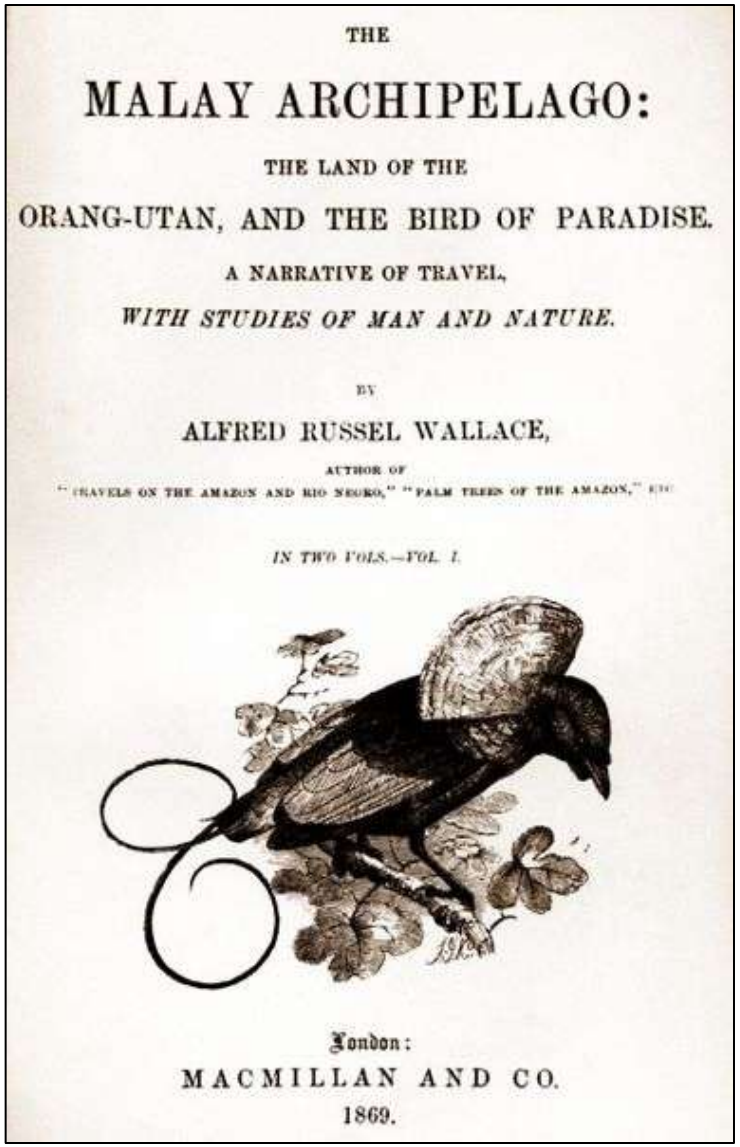
1859 - Prompted Darwin to publish his own ideas in *On the Origin of Species* in 1859.

Wallace explored the Amazon with **Henry Bates** for a few years, then went on to explore Indonesia, Malaysia





Wallace's books were very popular……


THE

MALAY ARCHIPELAGO:

THE LAND OF THE

ORANG-UTAN, AND THE BIRD OF PARADISE.

A NARRATIVE OF TRAVEL,

WITH STUDIES OF MAN AND NATURE.

BY

ALFRED RUSSEL WALLACE,

AUTHOR OF

"TRAVELS ON THE AMAZON AND RIO NEGRO," "PALM TREES OF THE AMAZON," ETC.

IN TWO VOLS.—VOL. I.

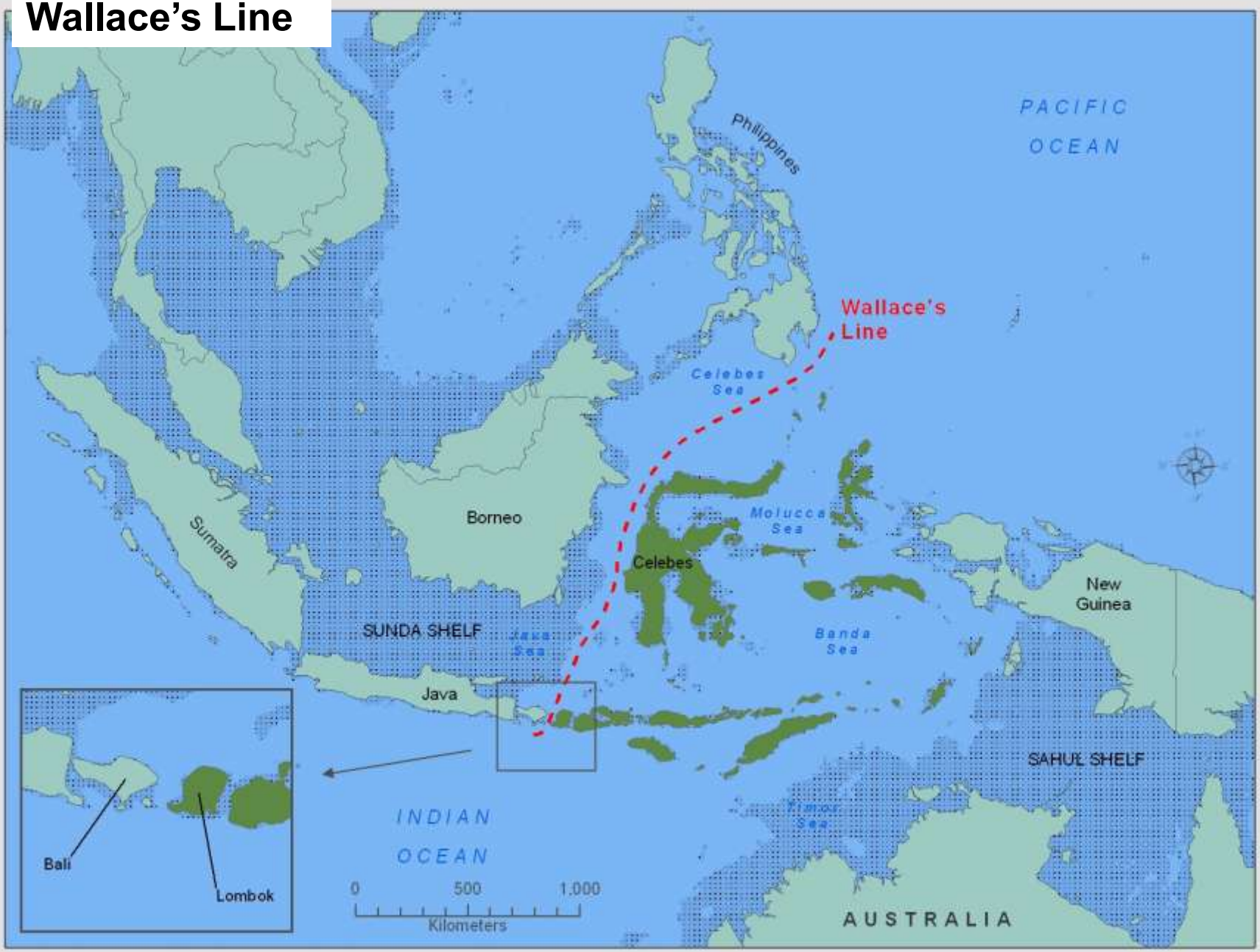
London:

MACMILLAN AND CO.

1869.

Chronicles his scientific exploration, during the eight-year period 1854 to 1862, of the southern portion of the Malay Archipelago including Malaysia, Singapore, the islands of Indonesia, then known as the Dutch East Indies, and the island of New Guinea

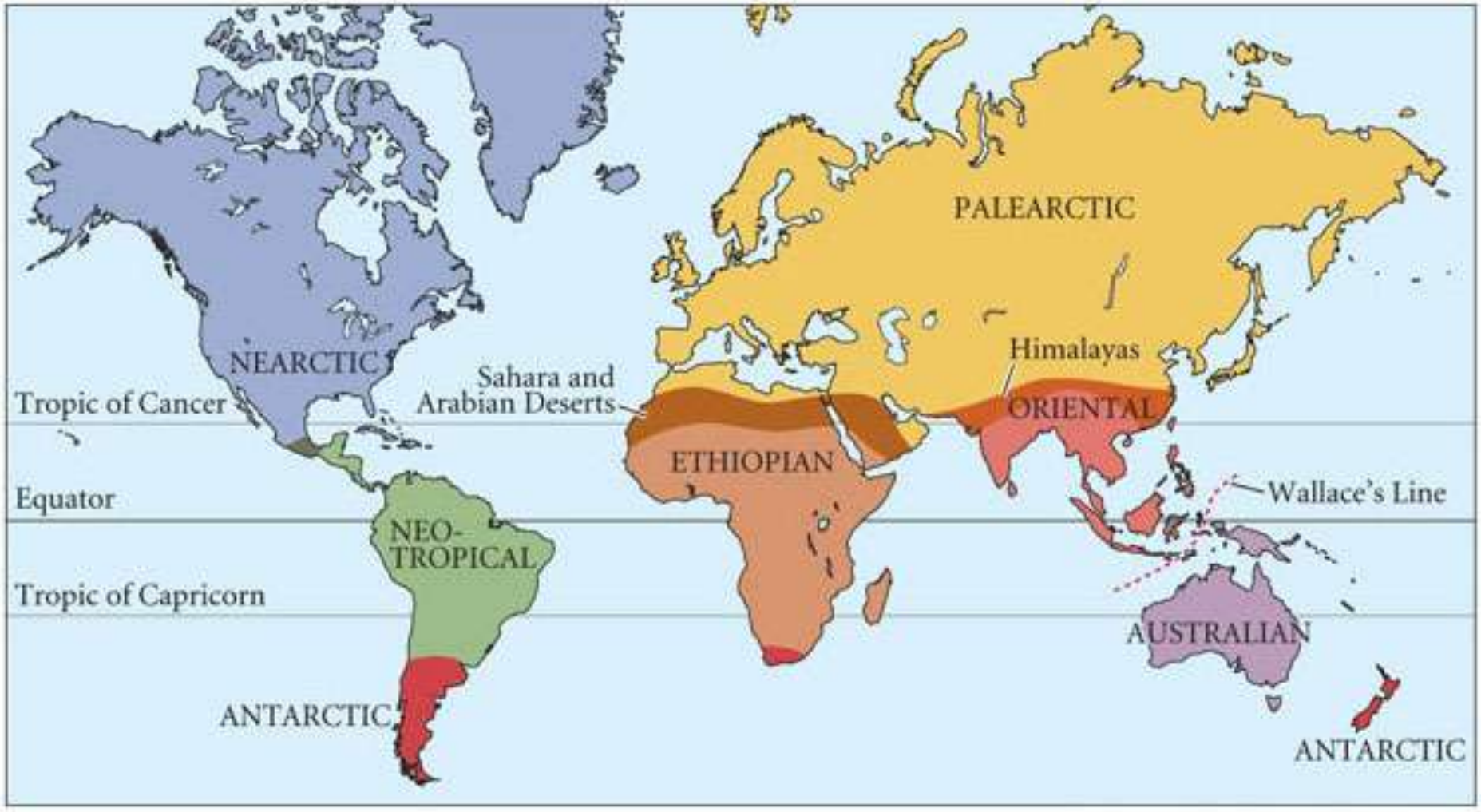
Wallace's Line



Wallace's line delineates Australian and Southeast Asian fauna.
The probable **extent of land at the time of the last glacial maximum**, when the sea level was more than 110 m lower than today.
Deep water formed a water barrier

Biogeographic Realms

Idea developed by Wallace



EVOLUTION, Figure 6.2 © 2005 Sinauer Associates, Inc.

1858- Wallace, a naturalist working overseas in the Malay Peninsula, asked for Darwin's opinion on Wallace's own ideas about natural selection.

This letter prompted Darwin to present Wallace's letter and a selection from Darwin's own unpublished notebooks simultaneously at the July 1, 1858 meeting of the Linnaean Society of London.

1859 - The positive scientific reception of these ideas compelled Darwin to publish *On the Origin of Species* on November 22, 1859 in a first edition of 1,250 copies.

On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection. By CHARLES DARWIN, Esq., F.R.S., F.L.S., & F.G.S., and ALFRED WALLACE, Esq. Communicated by Sir CHARLES LYELL, F.R.S., F.L.S., and J. D. HOOKER, Esq., M.D., V.P.R.S., F.L.S., &c.

[Read July 1st, 1858.]

London, June 30th, 1858.

MY DEAR SIR,—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 of specific forms on our planet, may both fairly claim the merit of being original thinkers in this important line of inquiry; but neither of them having published his views, though Mr. Darwin has for many years past been repeatedly urged by us to do so, and both authors having now unreservedly placed their papers in our hands, we think it would best promote the interests of science that a selection from them should be laid before the Linnean Society.

Taken in the order of their dates, they consist of:—

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 its contents afterwards communicated to Sir Charles Lyell. The first Part is devoted to "The Variation of Organic Beings under Domestication and in their Natural State;" and the second chapter of that Part, from which we propose to read to the Society the extracts referred to, is headed, "On the Variation of Organic Beings in a state of Nature; on the Natural Means of Selection; on the Comparison of Domestic Races and true Species."

2. An abstract of a private letter addressed to Professor Asa Gray, of Boston, U.S., in October 1857, by Mr. Darwin, in which

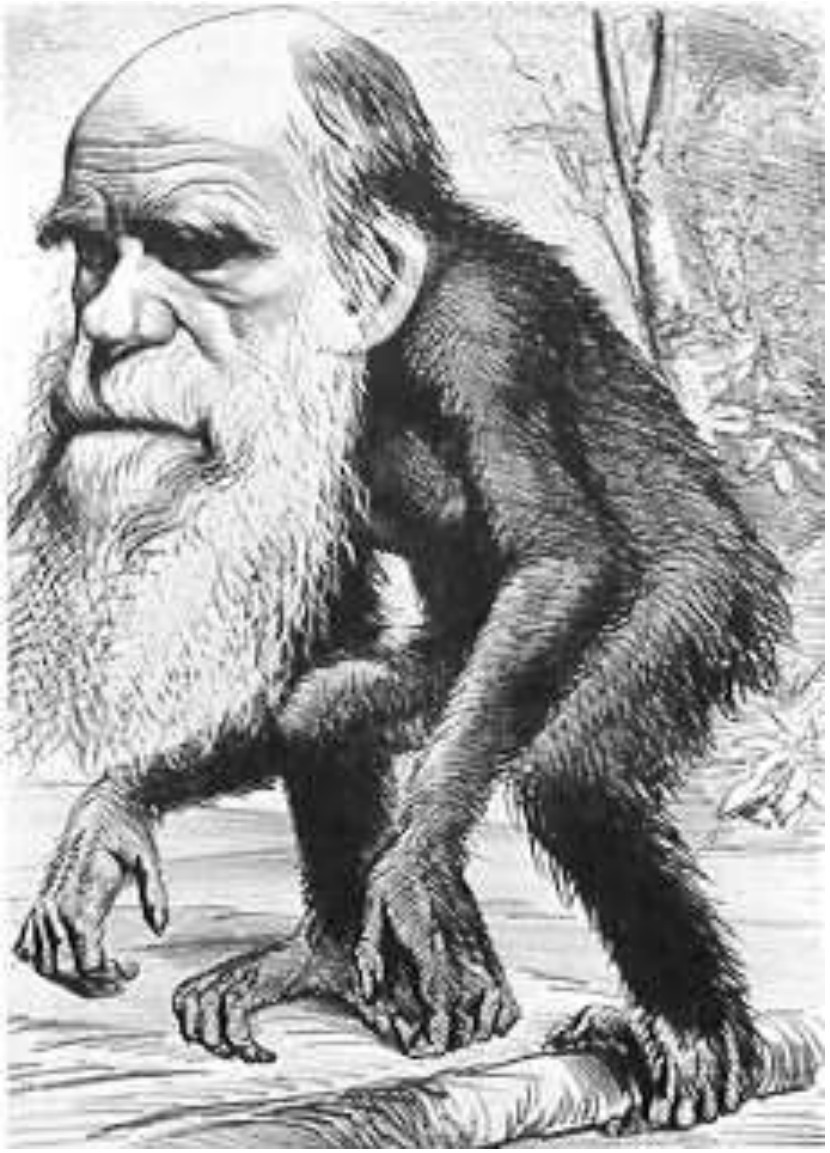
* This MS. work was never intended for publication, and therefore was not written with care.—C. D. 1858.

On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life. (later shortened to just Origin of Species)

Has two main claims:

1. Living species are related by **common ancestry**
2. The main cause of adaptive modification is the action of **natural selection** (and related mechanisms) on individual variation

Darwin's ideas were immediately controversial in the public eye, although most scientist's were quickly convinced of the validity of his arguments.



Reaction to Darwin and the Origin of Species

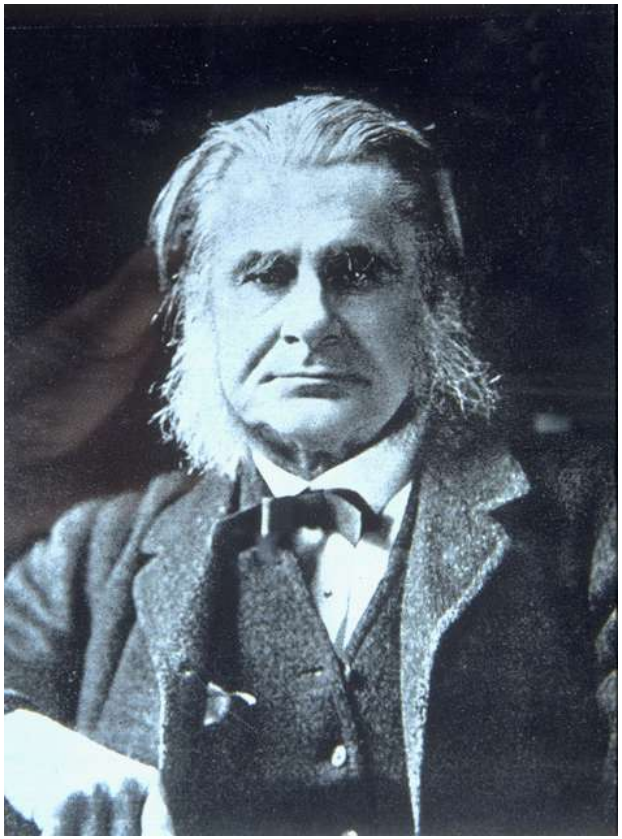
What initially made *The Origin of Species* different from other works was the **volume and quality of data** that Darwin presented in support of his arguments.

What made Darwin's ideas different from others in the long run, however, was that **new evidence continued to support the basic principles that he put forward**.

The most favorable reaction actually came from the Germans, in part because Germany had a broader freethinkers movement and philosophical materialism had been relatively widely adopted there.

The British were more skeptical, but this was in part due to the fact that so many works on evolution had already been published in England.


VANITY FAIR
MEN OF THE DAY, No. 22



Thomas Henry Huxley – Darwin's Bulldog

letter to Darwin, 1859……

"As for your doctrines I am prepared to go to the Stake if requisite. . .
I trust you will not allow yourself to be in any way disgusted or annoyed by the considerable abuse & misrepresentation which unless I greatly mistake is in store for you. . . And as to the curs which will bark and yelp -- you must recollect that some of your friends at any rate are endowed with an amount of combativeness which (though you have often & justly rebuked it) may stand you in good stead --
I am sharpening up my claws and beak in readiness "

after reading….
"How stupid of me not to have thought of that"

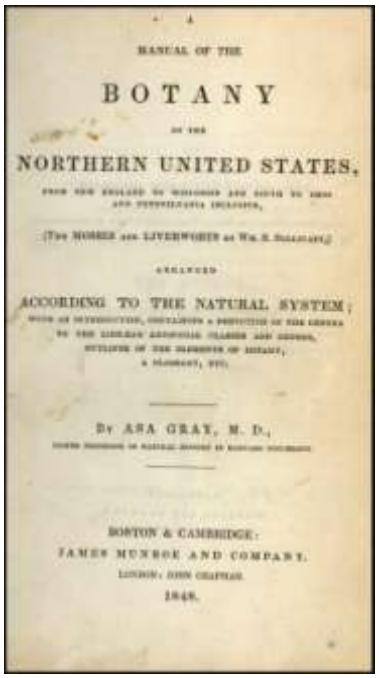
Meeting of the British Association and Debate, Oxford on 30 June 1860

Bishop Wilberforce asked…
"Was it through his grandfather or his grandmother that he claimed his descent from a monkey?"

Huxley answered..
"I would not be ashamed to have a monkey for my ancestor, but I would be ashamed to be connected with a man who used his great gifts to obscure the truth."

the negative reaction from the religious community was overwhelming

Darwin Support in the U.S.



Asa Gray (1810-1888)

Botanist at Harvard

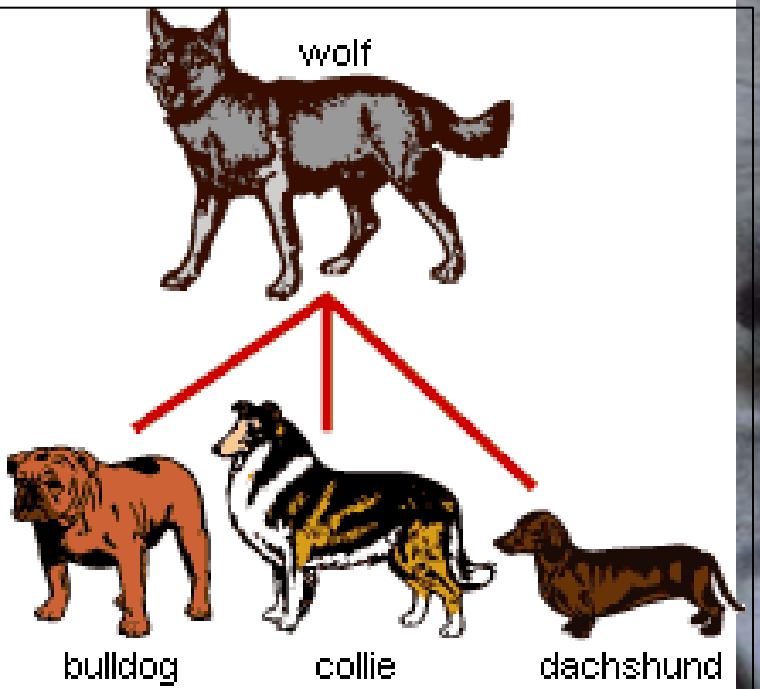
Following the publication of the *Origin*, commenced an enthusiastic and a lifelong correspondence with Darwin.

Gray believed that natural selection was the mechanism through which God brought new species into the world.

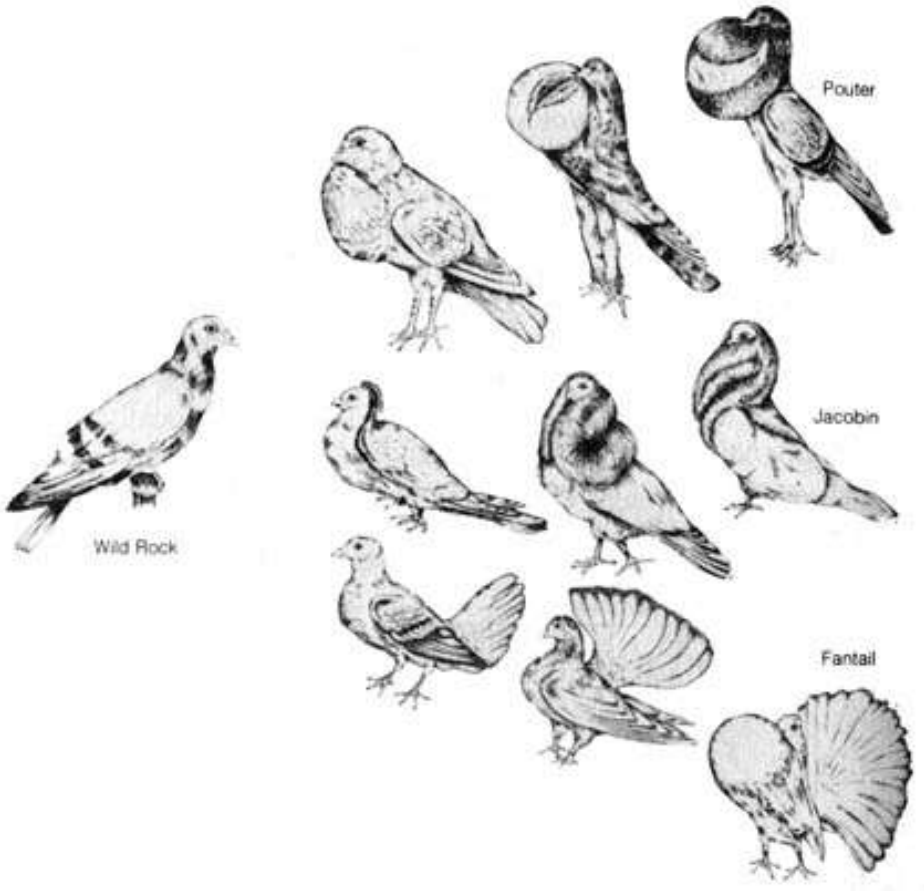
He was influential in ensuring that the *Origin* had a ready reception in the United States, and defended the work against the charge of atheism.

Origin of Species - Chapters

We see diverse forms that are descended from single ancestor



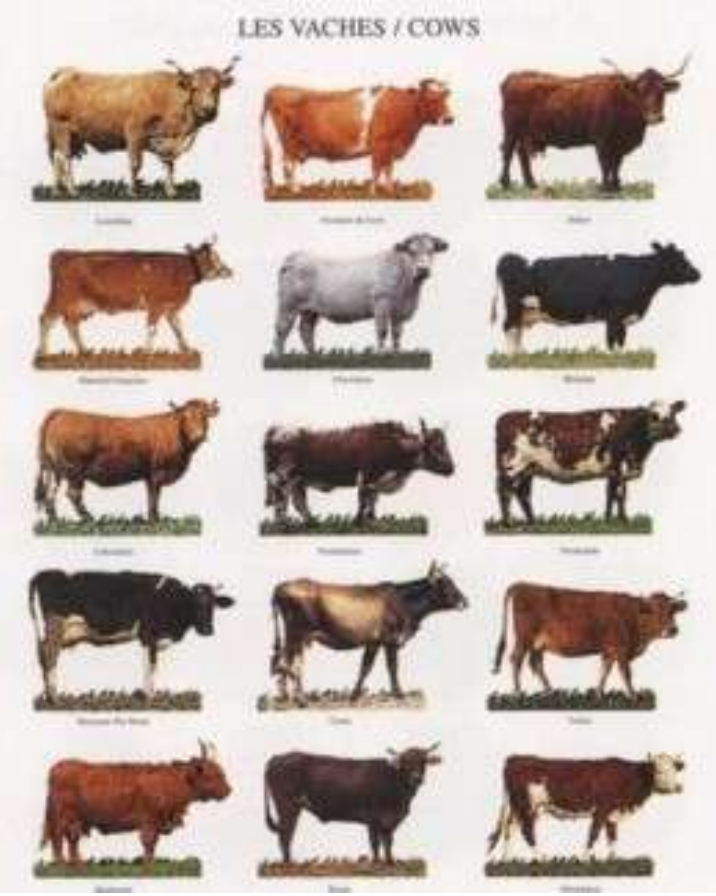
Variation Under Domestication (Chapter 1)

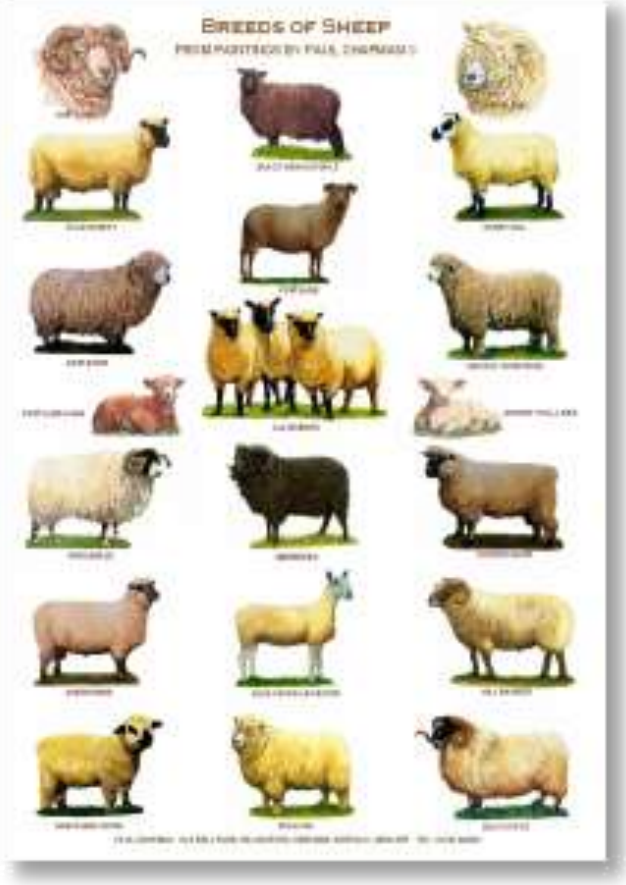


"Great as the differences are between the breeds of pigeons, I am fully convinced …all have descended from the rock-pigeon (*Columba livia*)... "

Variation in Cattle and Sheep – Selection by Breeders

Farmers have been unwitting evolutionists since they began, as they have shaped the characteristics of domesticated species.



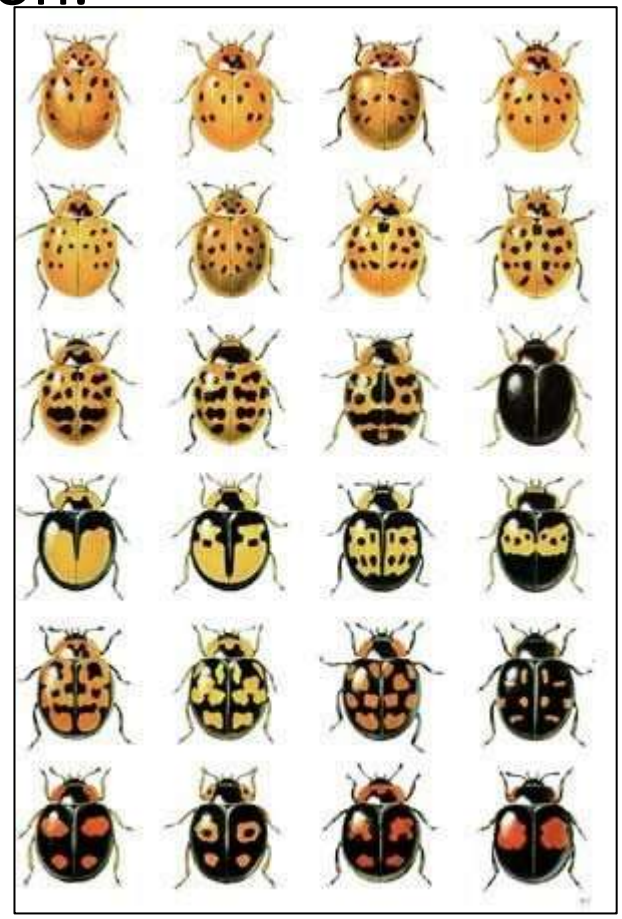


"The great power of this principle of selection is not hypothetical. It is certain that several of our eminent breeders have, even within a single lifetime, modified to a large extent some breeds of cattle and sheep... "

Variation under Nature (Chapter 2)

The natural world is full of variation.

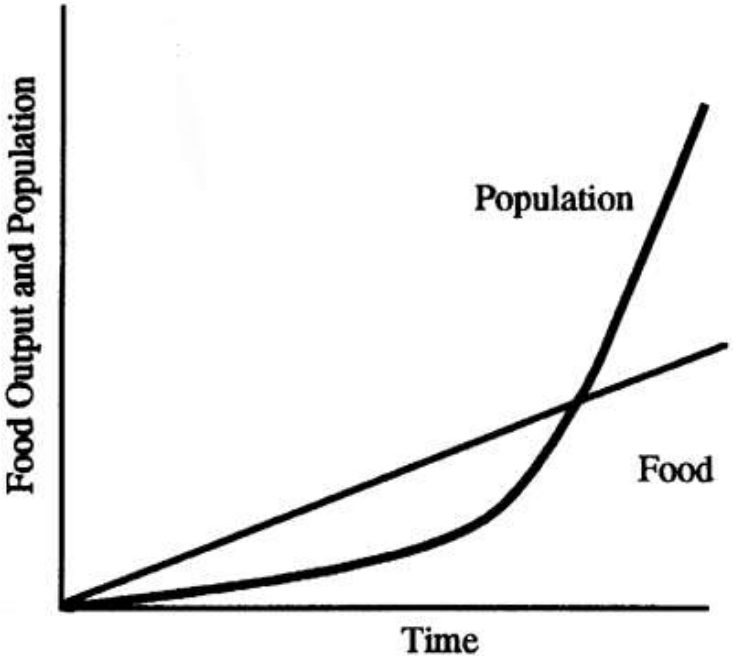
Heliconia Butterfly (*Heliconius antiochus*) showing color variation within one species, Costa Rica



Harlequin Ladybugs
Variation within one species

The Struggle for Existence, Natural Selection (Chap. 3, 4)

"I have called this principle, by which each slight variation, if useful, is preserved, by the term of Natural Selection, in order to mark its relation to man's power of selection. We have seen that man by selection can certainly produce great results, and can adapt organic beings to his own uses, through the accumulation of slight but useful variations, given to him by the hand of Nature. "

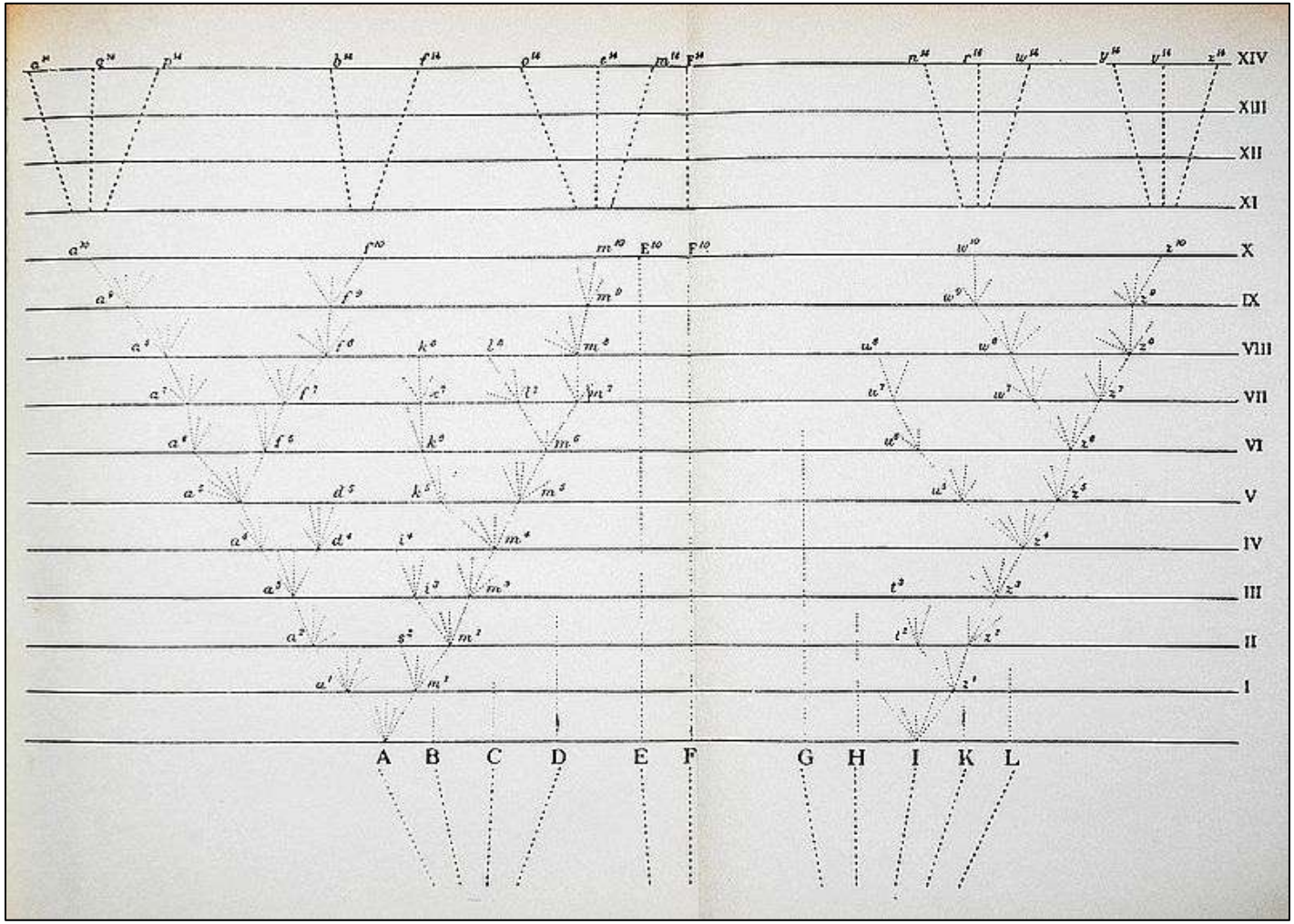


- ***"as more individuals are produced than can possibly survive, there must in every case be a struggle for existence, "***
- **"It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms"**

All species have the potential to increase vastly in number, given time - but they do not, because of lack of food or because of disease, predation or for want of a home.

Tree Diagram from the Origin of Species

Shows some lineages becoming extinct due to Natural Selection

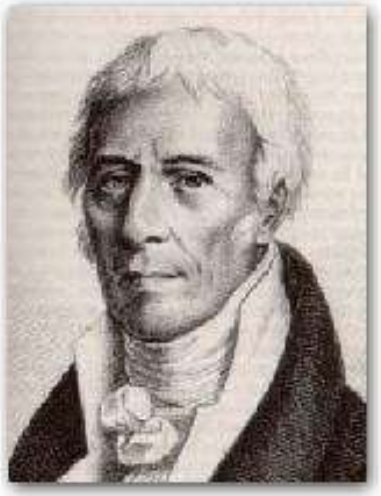


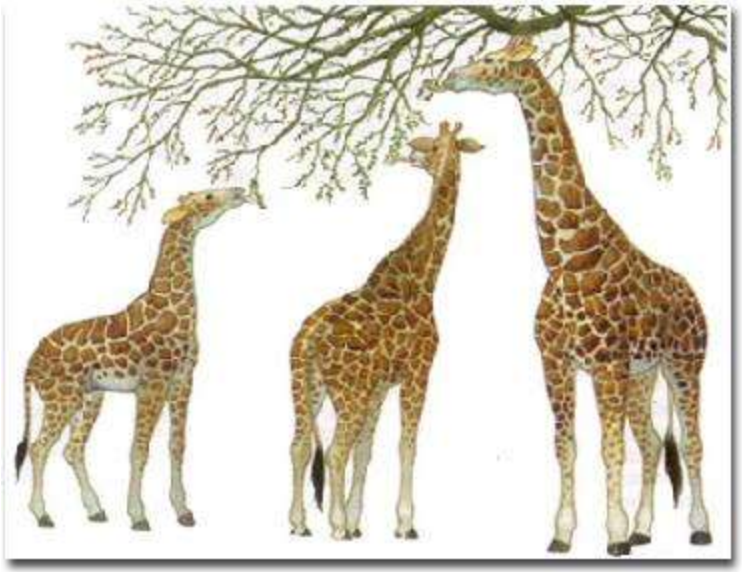
Laws of Variation (Use and Disuse) (Chap. 5)

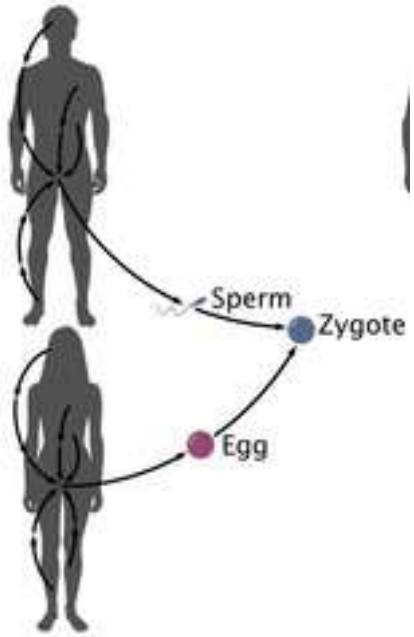
Discusses ideas on how species might change, but never developed a clear mechanism for inheritance.

Reviews Lamarck's "Inheritance of Acquired Characters" (Use and Disuse)

Blending Inheritance, Pangenesis







The Lesser Rhea or Darwin's Rhea

Species vs Variety?

How could a species evolve into a new species in the same locality as its parents?

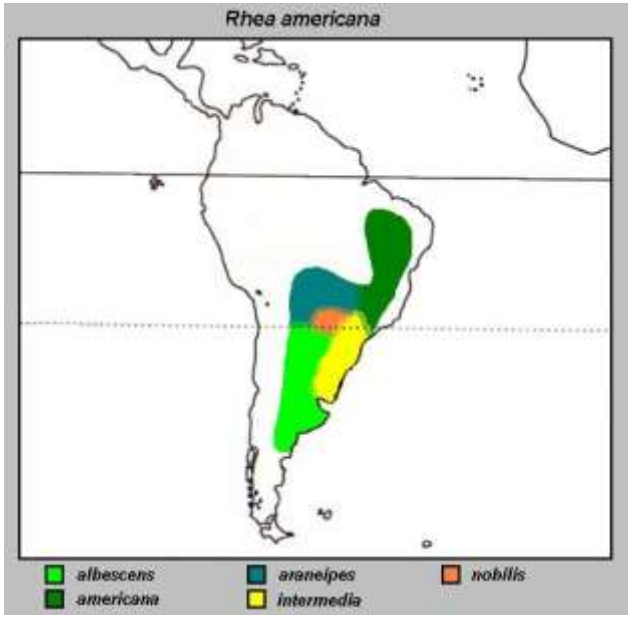
Rhea Distribution

in Argentina

Lyell had written that changes in flora and fauna might be **explained by their isolation in different ecological circumstances**.

Darwin thought that this might account for the rheas being very different in separate parts of South America.

The Greater Rhea



Difficulties of the Theory (Chap. 6, 7, 8)

Rarity of Transitional Forms?

Darwin….

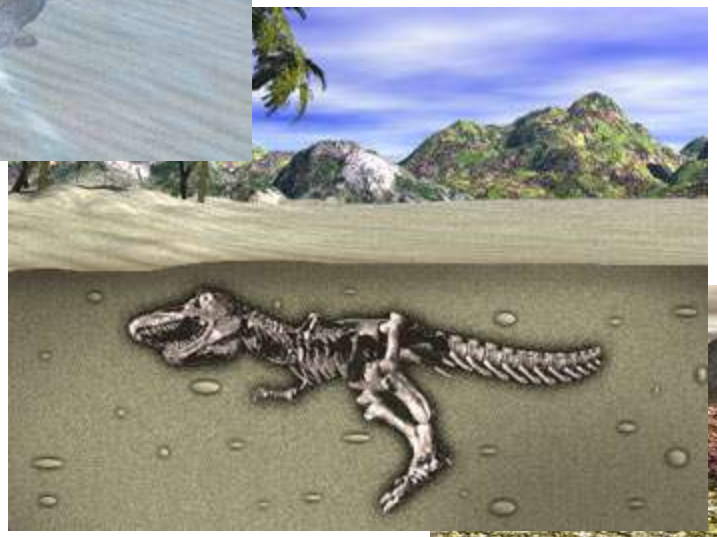
"innumerable transitional forms must have existed, …. why do we not find them embedded in countless numbers in the crust of the earth?"

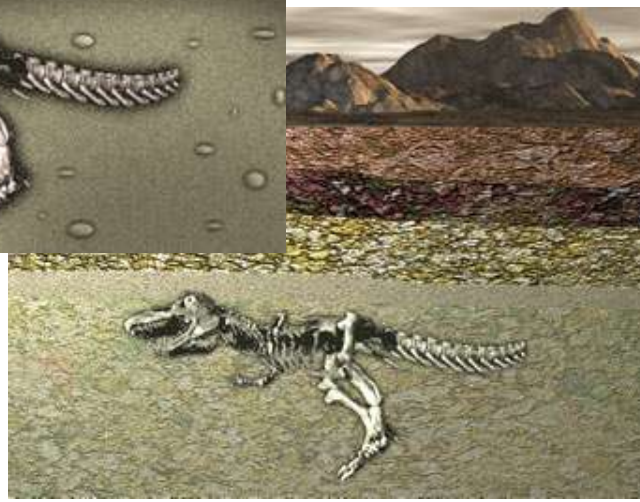
Limitations of transitional fossils:

Some organisms don't fossilize well: terrestrial animals, invertebrates

Some strata do not produce many fossils

Fossils are hard to find!





Virtually all fossils occur in or near water, through a process of sedimentation, pressure, and mineralization

The chances of being undisturbed and completely buried are very remote

Age of the Earth

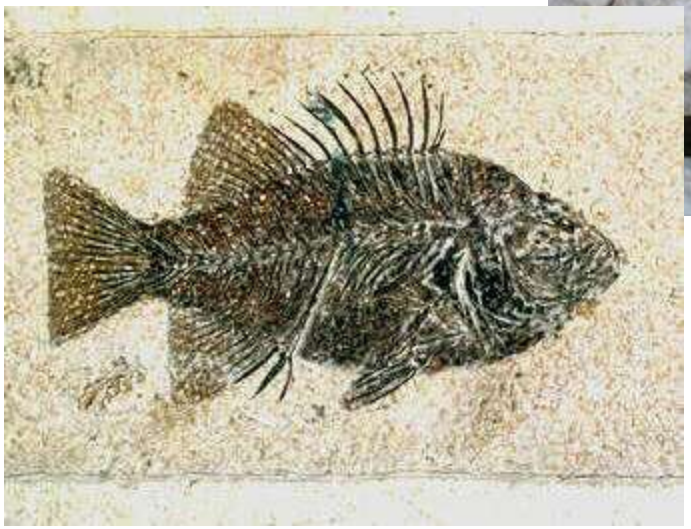
Official Church age 6,000 years old
For Darwin's theory to work the earth would have to be very old

Buffon had suggested the earth was about 75,000 years old, and he divided these years in epochs to match the seven days of creation.

William Thompson (Lord Kelvin) calculated the age of the earth's crust at **100 million years** based on presumed cooling rate of the sun and other factors, but that only the last 20-40 million years would be cool enough for life.

Critics maintained this was not enough time.
Darwin had no real answer for the age of the earth.

Radiometric Dating



Ages of the rocks in which the fossils occur can be estimated by radiometric dating.

Parent Isotope	Stable Daughter Product	Half-Life Values
Uranium-238	Lead-206	4.5 billion years
Uranium-235	Lead-207	704 million years
Thorium-232	Lead-208	14.0 billion years
Rubidium-87	Strontium-87	48.8 billion years
Potassium-40	Argon-40	1.25 billion years
Samarium-147	Neodymium-143	106 billion years
Carbon-14	Nitrogen-14	5730 years

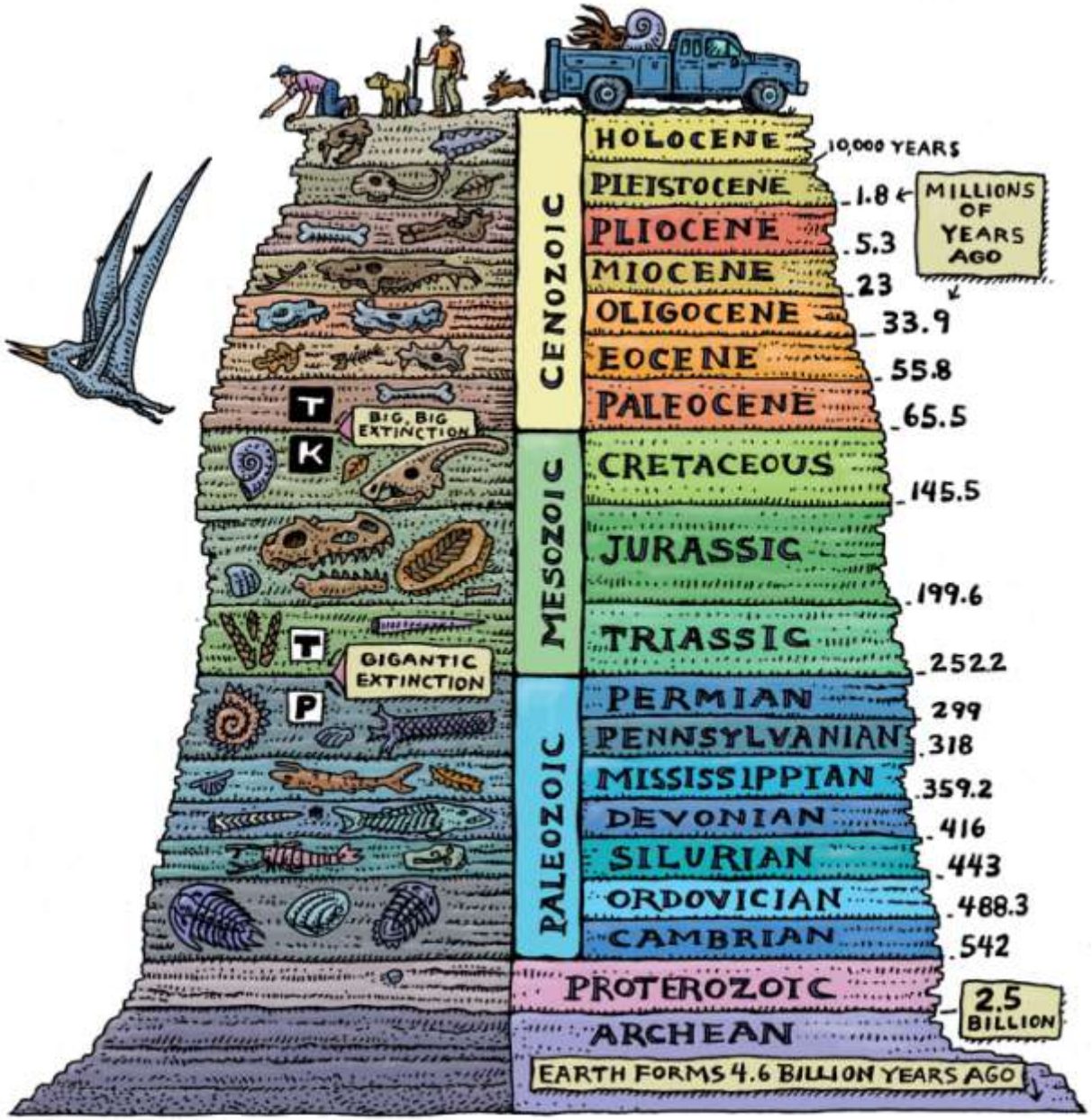
The mathematical expression that relates radioactive decay to geologic time is called the age equation and is:

$$t = \frac{1}{\lambda} \ln\left(1 + \frac{D}{P}\right)$$

where t is the age of the rock or mineral specimen,
D is the number of atoms of a daughter product today,
P is the number of atoms of the parent isotope today,
ln is the natural logarithm (logarithm to base e), and
λ is the appropriate decay constant.

(The decay constant for each parent isotope is related to its half-life, $t^{1/2}$ by the following expression: $t^{1/2} = \frac{\ln 2}{\lambda}$

Abrupt changes in fossil record due to major extinction events

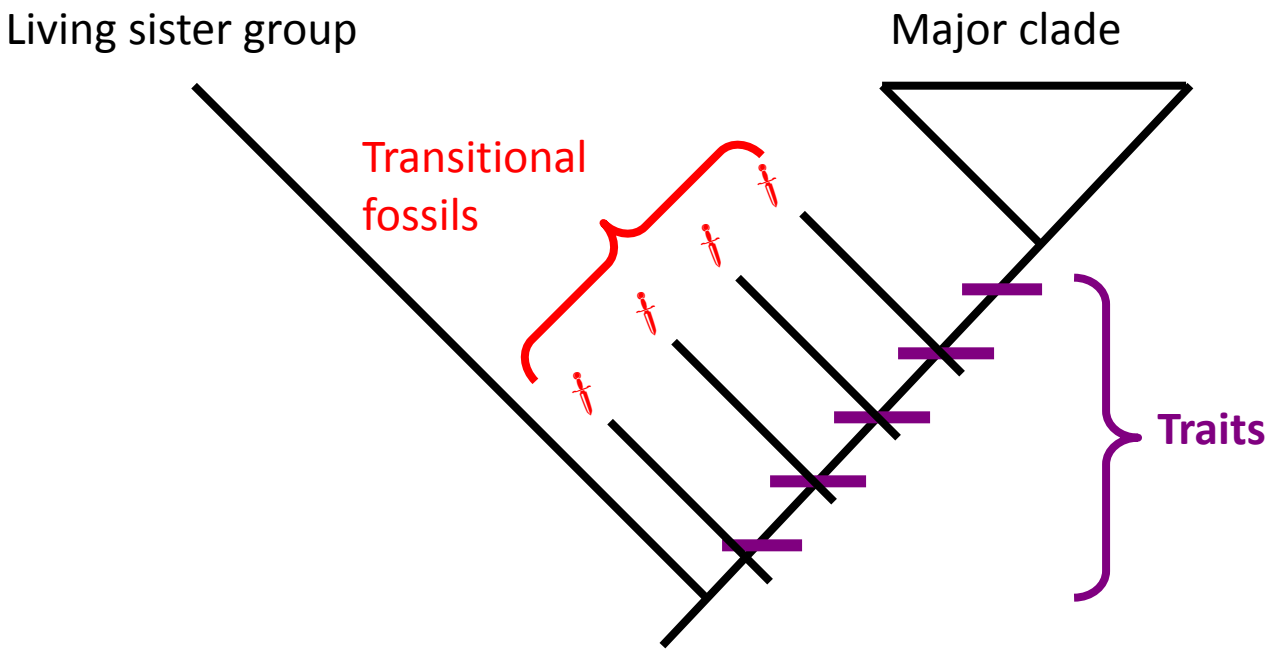


Transitional forms for bats?

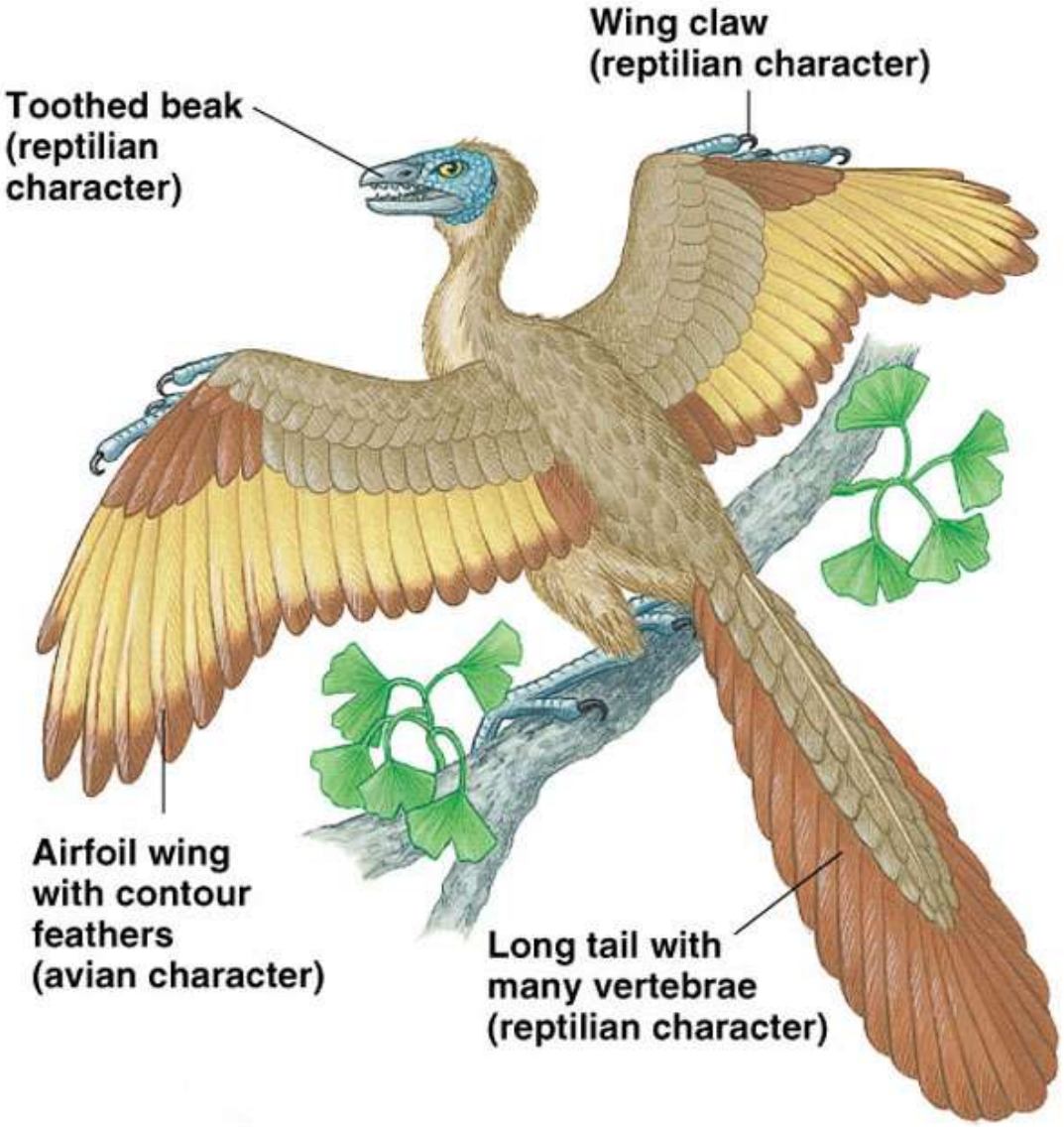
Darwin discussed how bats might have evolved from non-flying ancestors such as flying squirrels and flying lemurs.

Many Transitional Forms Have been Found Since Darwin's Time

- Fossil record
  - Transitional fossils (sometimes in temporal sequence): consistent with the existence of real common ancestors

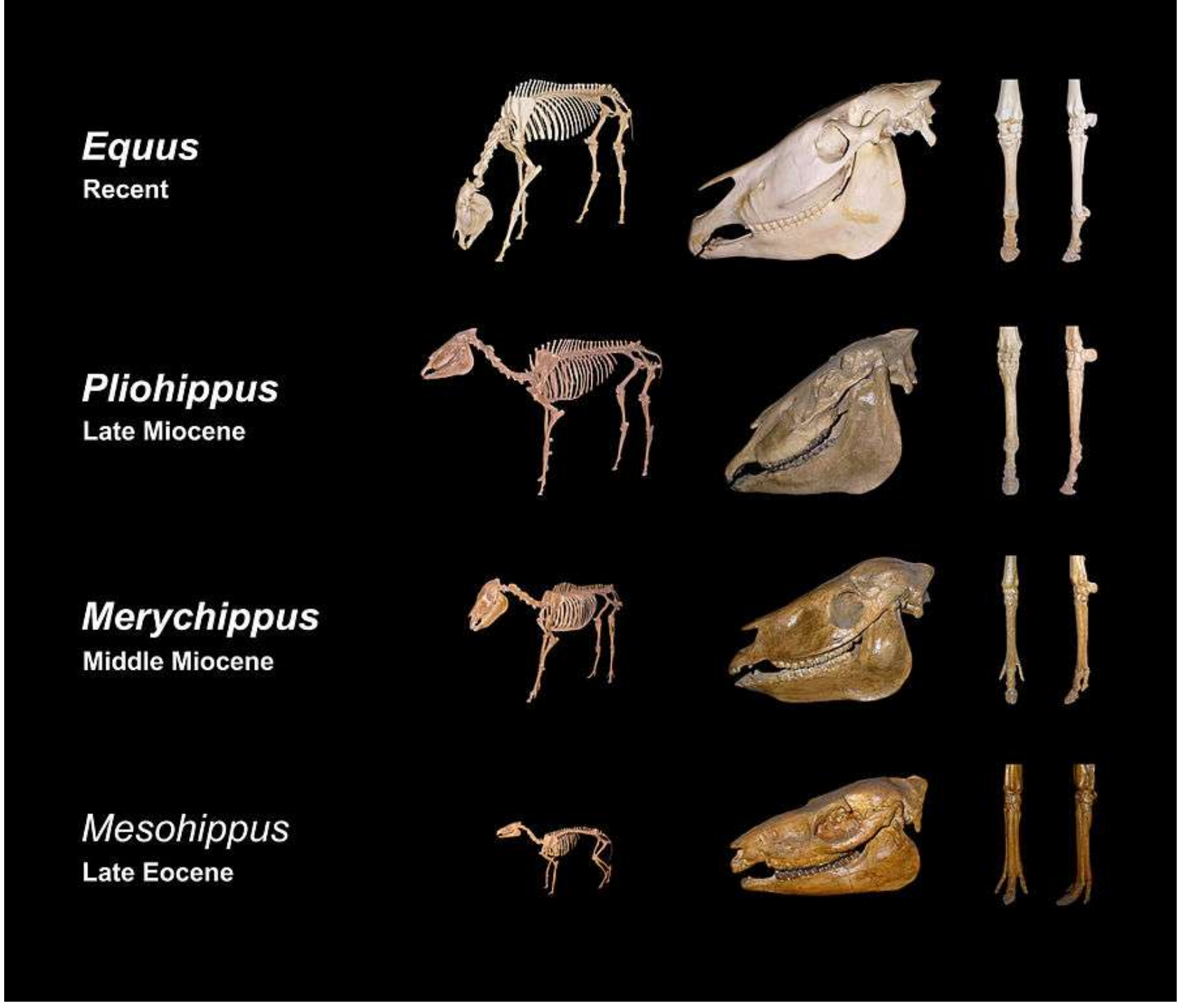


Archeopteryx – bird-like dinosaur discovered in 1861



EVOLUTION OF THE HORSE

POOKYNS-5


Equus
Recent
Pliohippus
Late Miocene
Merychippus
Middle Miocene
Mesohippus
Late Eocene

George G. Simpson – relationships are not linear!

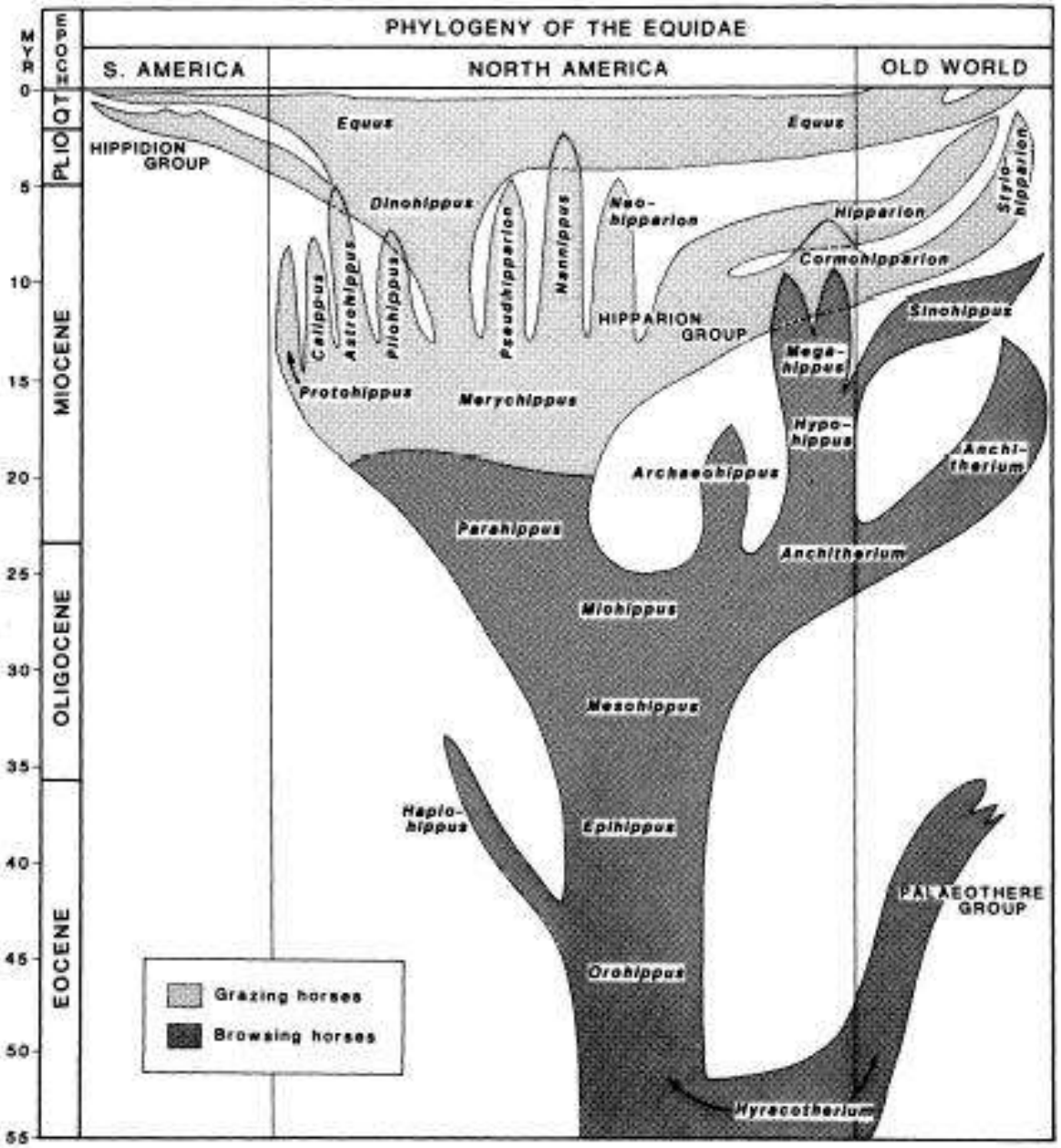
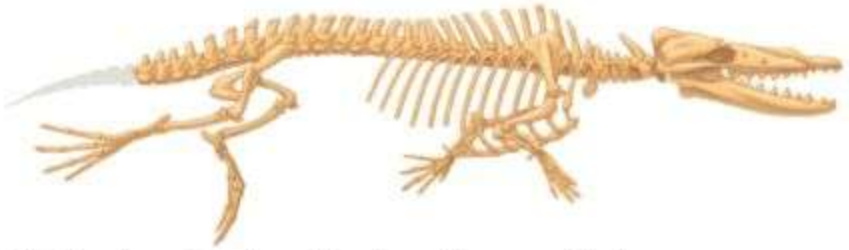


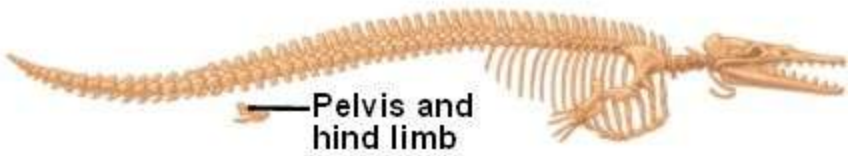
FIGURE 1. Current phylogeny of the Equidae, with particular emphasis on the North American taxa.

Transitional Forms: Evolution of Whales

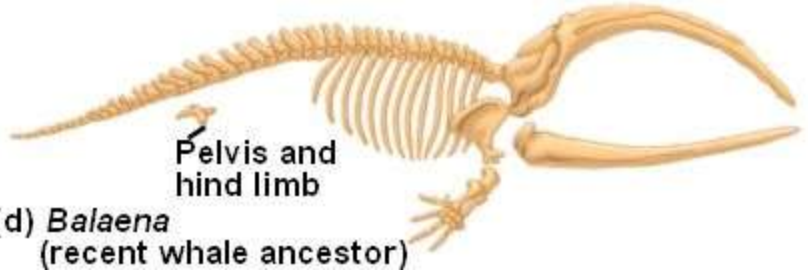
(a) *Pakicetus* (terrestrial)



(b) *Rhodocetus* (predominantly aquatic)



(c) *Dorudon* (fully aquatic)



(d) *Balaena*
(recent whale ancestor)

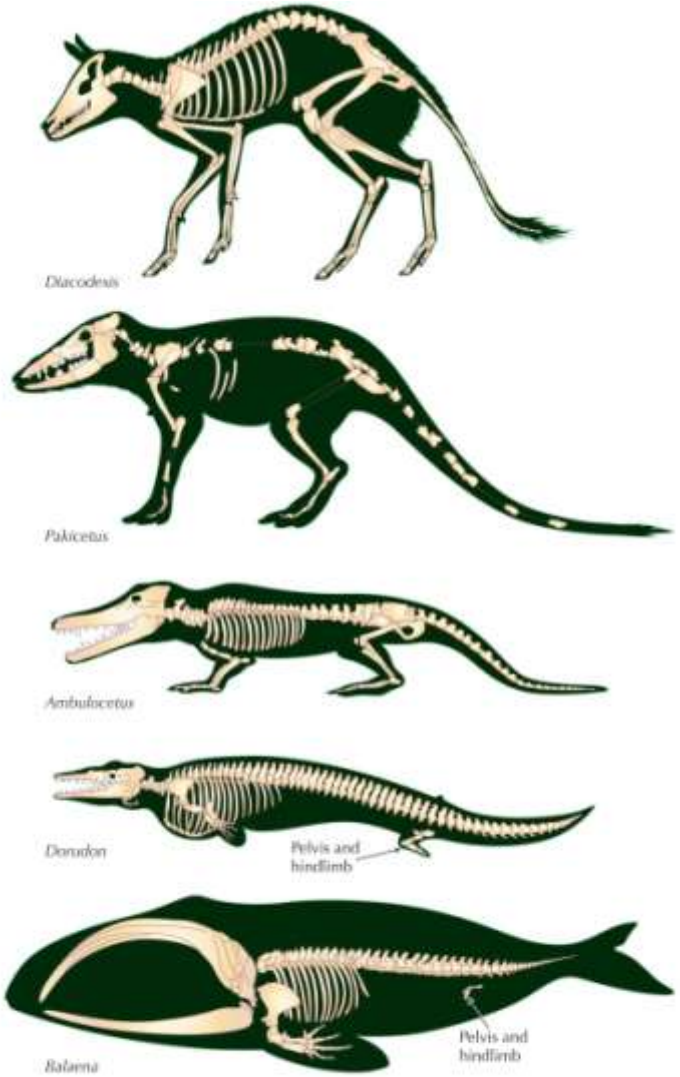


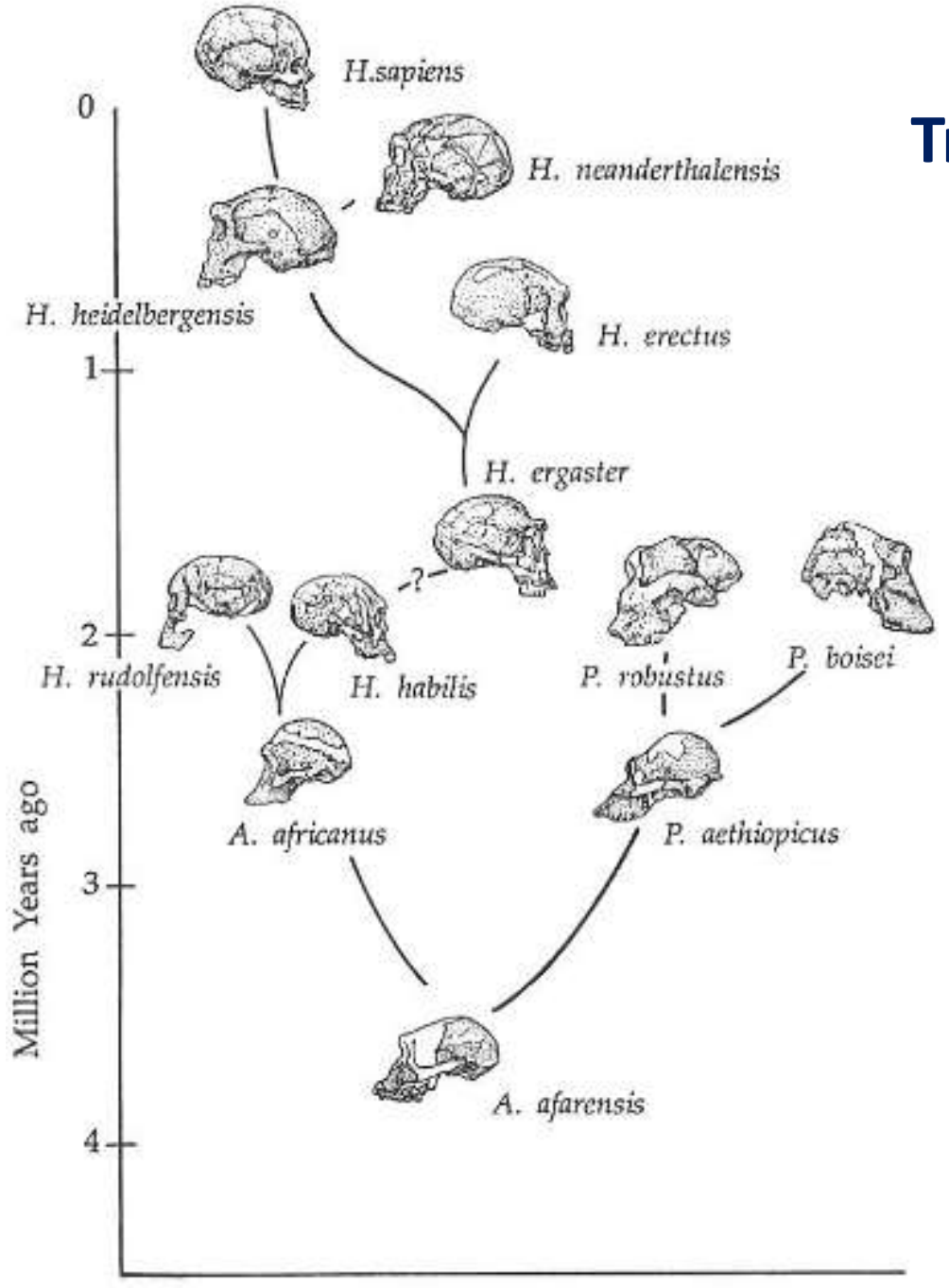
FIGURE 3.18. A series of fossils from the Eocene (~50 Mya) hippo-like artiodactyl (*Diacodexis, top*) to a skeleton of the modern whale (e.g., *Balaena, bottom*) shows how mammals adapted to life in the sea. Among the most important changes, the pelvis and hindlimbs were reduced, the tail was lengthened for swimming, and the jaws were modified for feeding on plankton.

3.18, redrawn from de Muizon C., *Nature* **413**: 259–260, © 2001 Macmillan, www.nature.com

Ambulocetus natans in action. A reconstruction of an early close cousin of whales.

Artist Carl Buell

Transitional Forms: Hominid

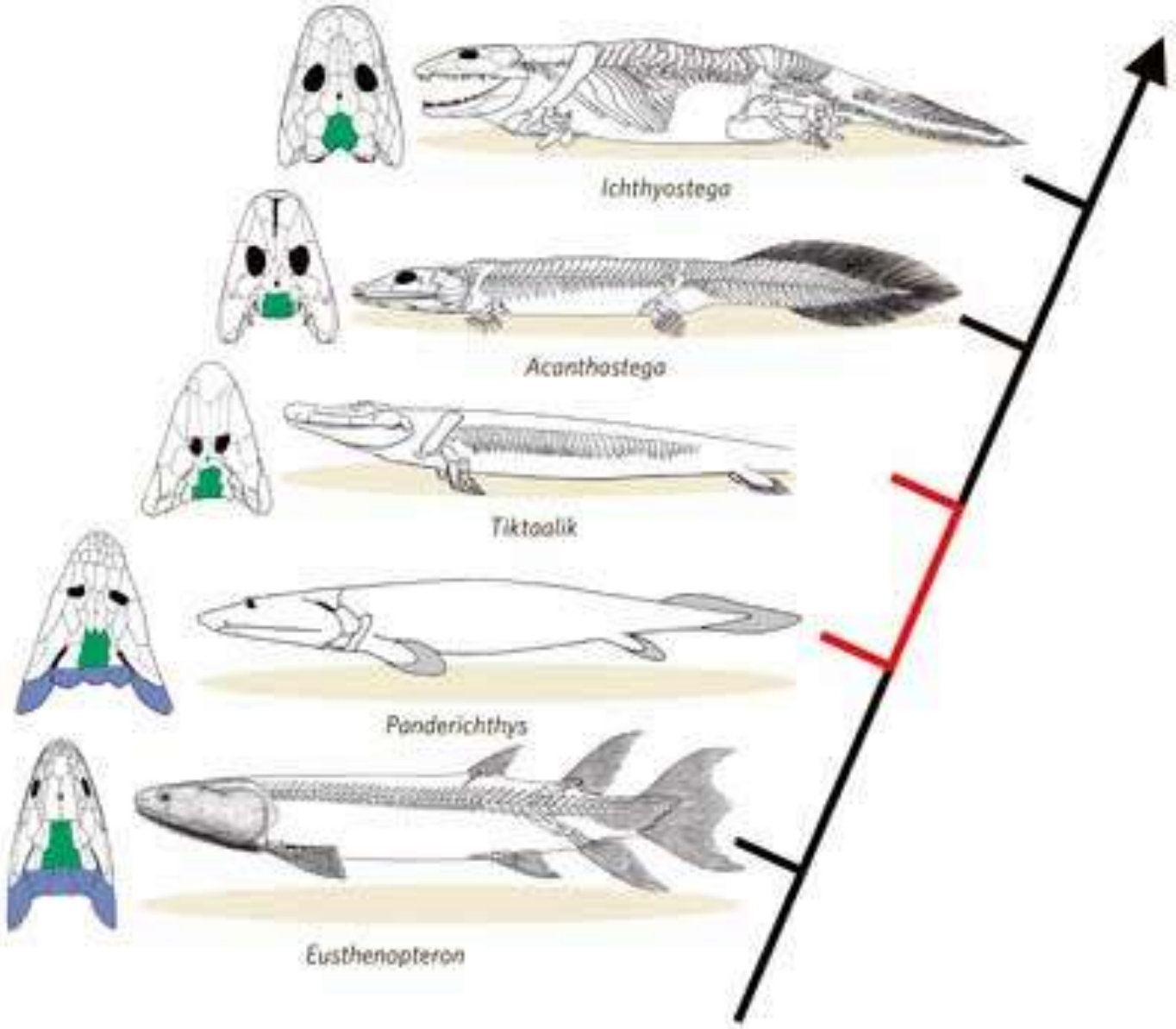


Australopithecus
Homo erectus
Homo sapiens

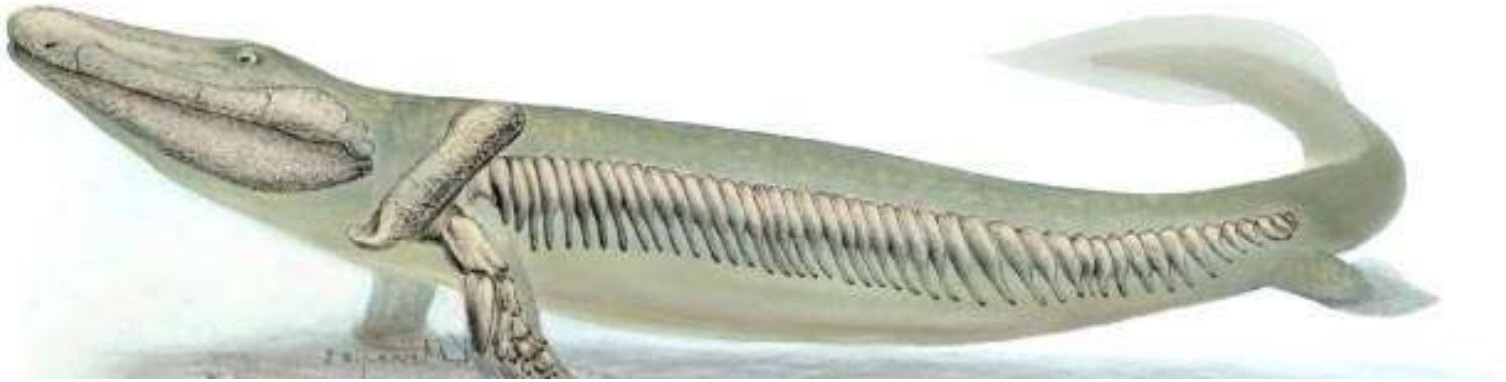
(A) Pan troglodytes, chimpanzee, modern
(B) Australopithecus africanus, 2.6 MYA
(C) Australopithecus africanus, 2.5 MYA
(D) Homo habilis,1.9 MYA
(E) Homo habilis, 1.8 MYA
(F) Homo rudolfensis, 1.8 MYA
(G) Homo erectus, 1.75 MYA

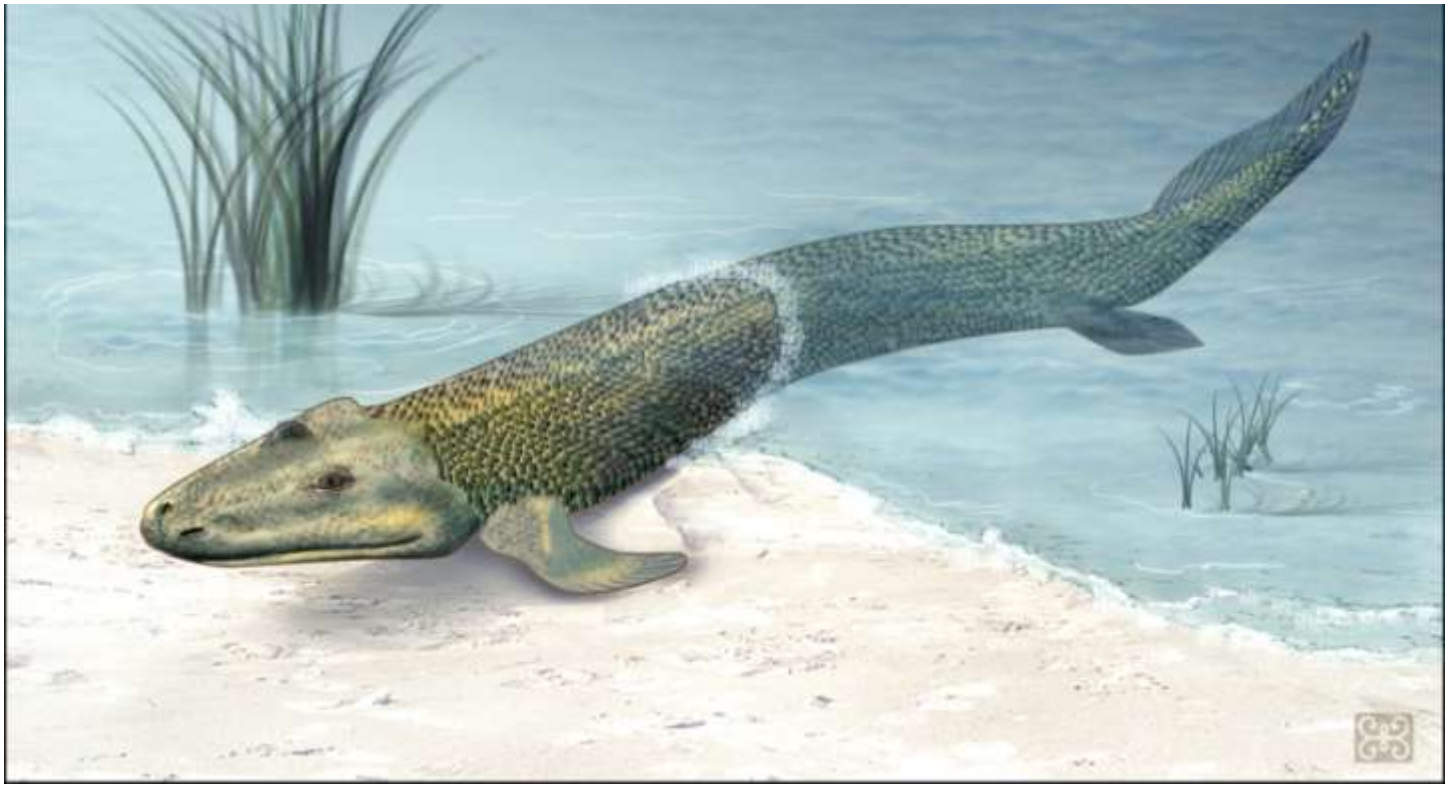
(H) Homo ergaster 1.75 MYA
(I) Homo heidelbergensis, 300,000 - 125,000
(J) Homo sapiens neanderthalensis, 70,000 YA
(K) Homo sapiens neanderthalensis, 60,000 YA
(L) Homo sapiens neanderthalensis, 45,000 YA
(M) Homo sapiens sapiens, Cro-Magnon 30,000 YA
(N) Homo sapiens sapiens, modern

Transitional forms from fish to amphibians



Tiktaalik – discovered in 2004



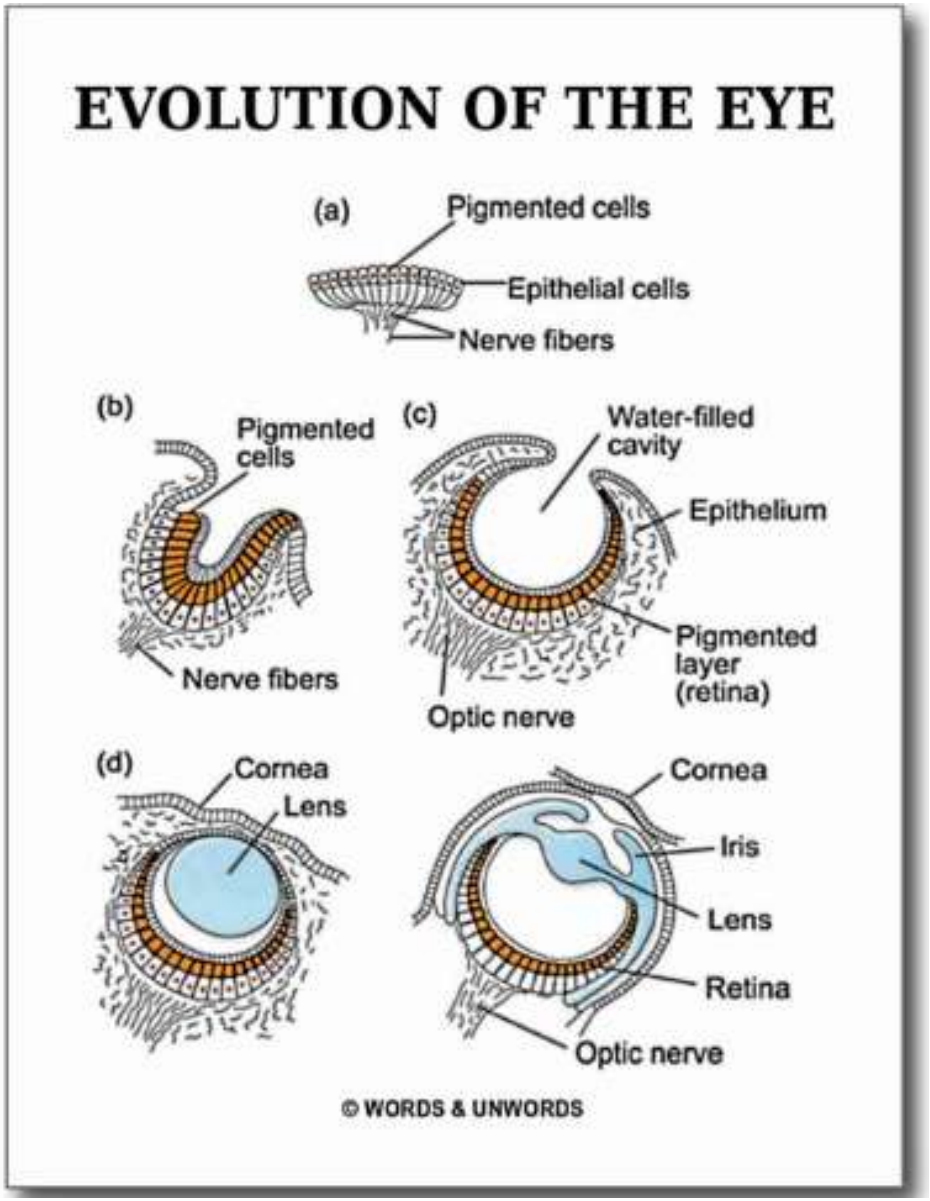


Coelacanth - a rare type of lobe-finned fish that closely resembles fossils from 400 Million years ago was discovered in 1938 off Madagascar, Comoros, and later in Indonesia

Difficulties of the Theory (Chap. 6)

Origin of Complex Structures?

How could such a gradual and seemingly random process as natural selection account for the occurrence of such perfect organs as the human eye?



Instinct (Chapter 8)-

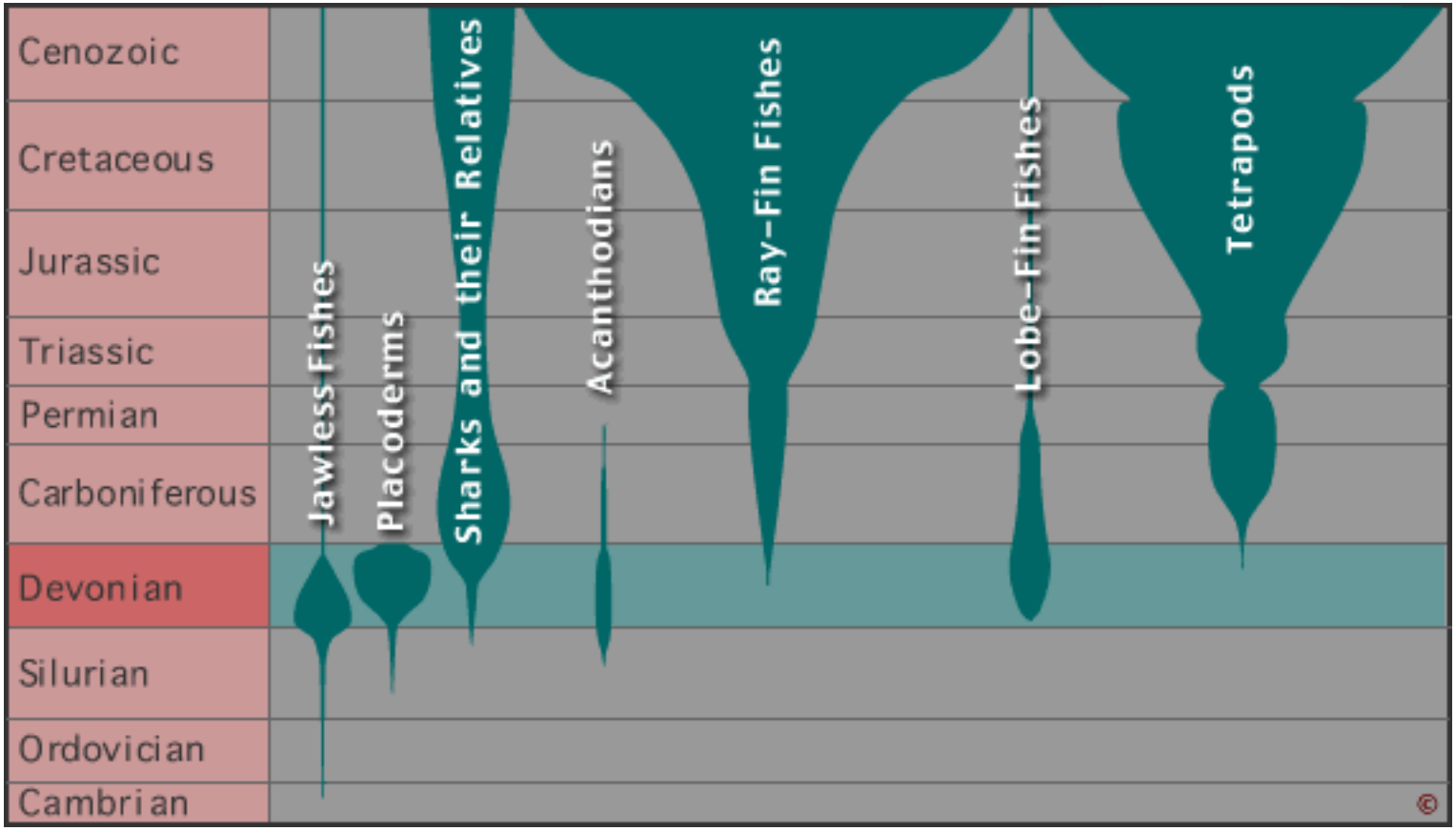
Evolution of instinct and behavior

Capture brood of other ant species to increase the worker force of their colony slavery

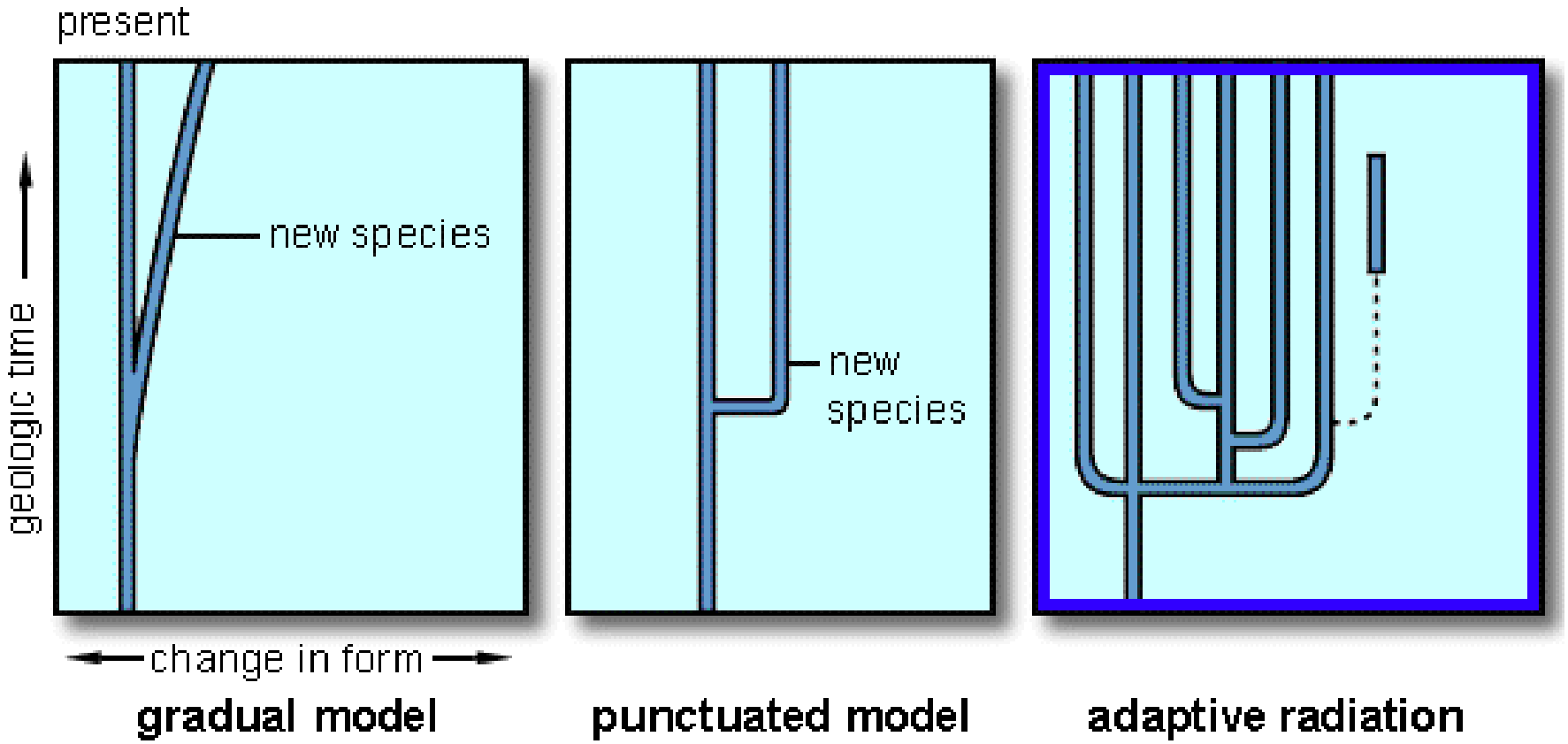
Darwin proposed slavery developed as a by-product of brood predation among related species

Geological Succession of Organic Beings (Chapter 11)

Using fossils, we can trace the history of life on earth back through time. Older life forms are simpler than more modern forms. We see the transition of ancestral forms into the forms we see today.



Gradualism vs Punctuated Equilibrium



Geographical Distribution (Chapters 12, 13)

Organisms are not distributed uniformly, or randomly, across the surface of the planet.

If species have evolved, we would expect their geographic patterns of distribution to reflect this evolutionary history.

They do.

> "In considering the distribution of organic beings over the face of the globe, the first great fact that strikes us is, that neither the similarity nor the dissimilarity of the inhabitants of various regions can be wholly accounted for by climatal and other physical conditions."
>
> Charles Darwin, *The Origin of Species*

What are patterns of distribution of species seen across the globe?

Geographical regions have characteristic **biotas.**

Similar/closely related taxa tend to be closer together than more distantly related groups.

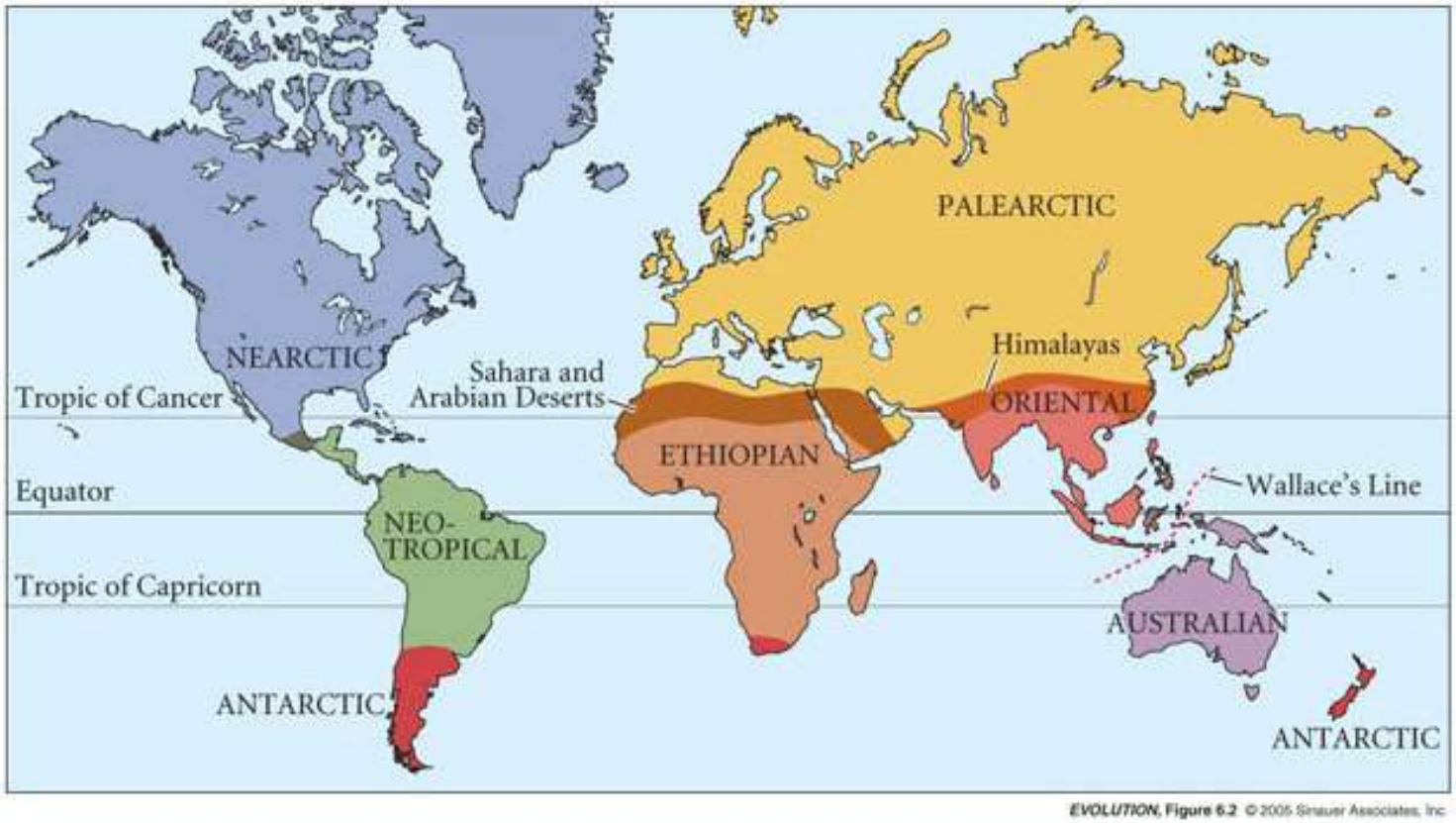
Similar environments are found in different areas BUT the same species may not be found in all places where they could be!

Not closely related species in similar environments may appear similar due to convergence.

Geographical Distribution (Chapter 12)

Biogeographical Realms

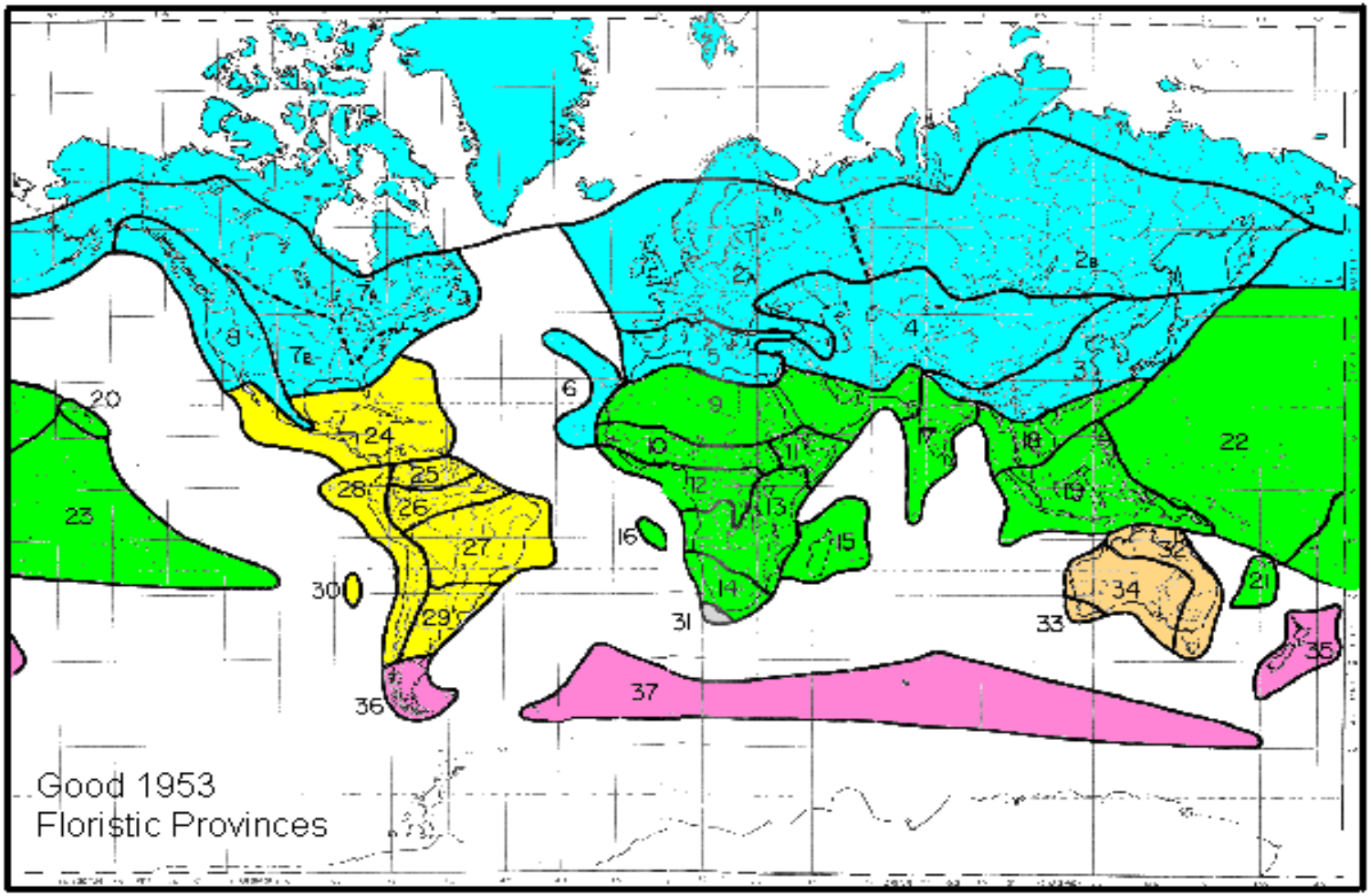
Each is separated by formidable barriers (Sahara, Himalaya). Going from one region to another is like going into a different world. **Each has a distinct fauna**. (regions worked out by Wallace)



Animals in different regions come from ancestors in that region and adapted over time to the conditions there.

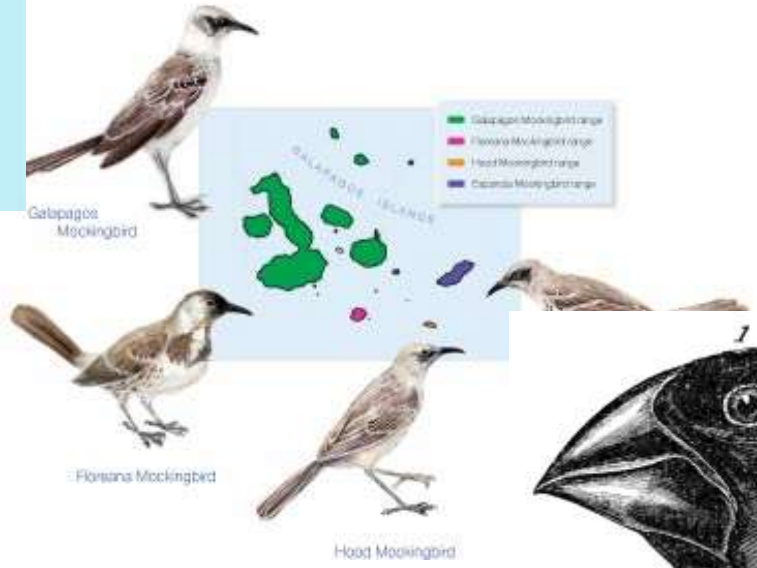
Distinct Floras across Similar Environments

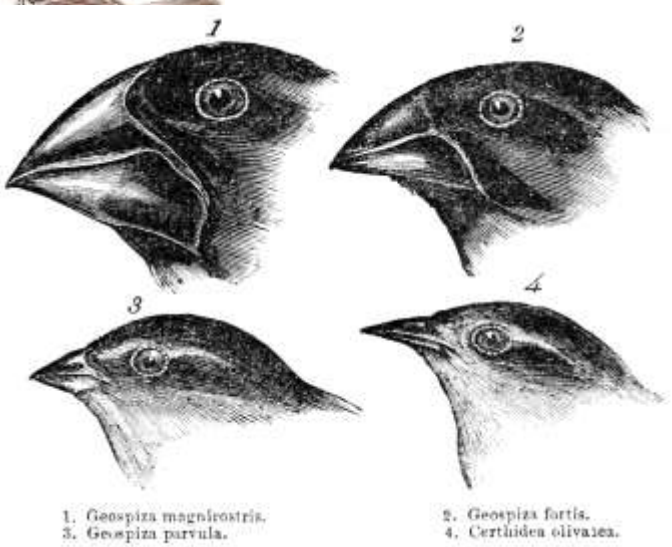
Good's Floristic Regions



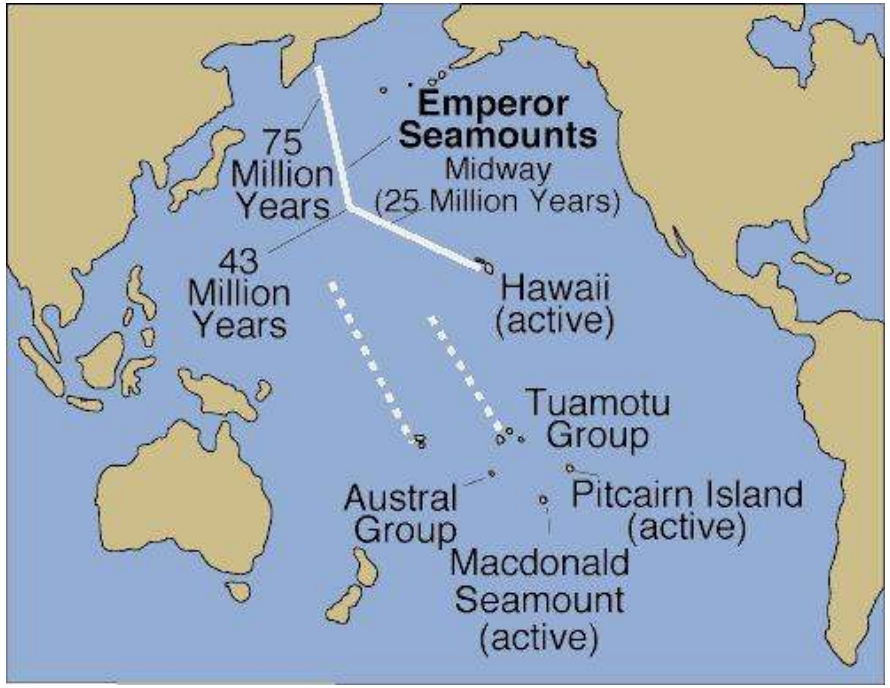
Oceanic Islands: Evidence for Evolution and Adaptation

Species found on islands are different from, but closely resemble mainland species.





Oceanic Islands: Evolution and Adaptation



The total number of species on oceanic islands is small compared to the number on an equal area of continent

Proportion of **endemic species** is very high

Oceanic islands are missing entire Classes (amphibians, mammals)

Endemic species often possess characters that are adaptive elsewhere, but are useless characters on the island

Endemic species often show (new) adaptive traits not possessed by any of their relatives

Some predictions…..

Spatial and geographical distribution of species should be consistent with their predicted genealogical relationships.

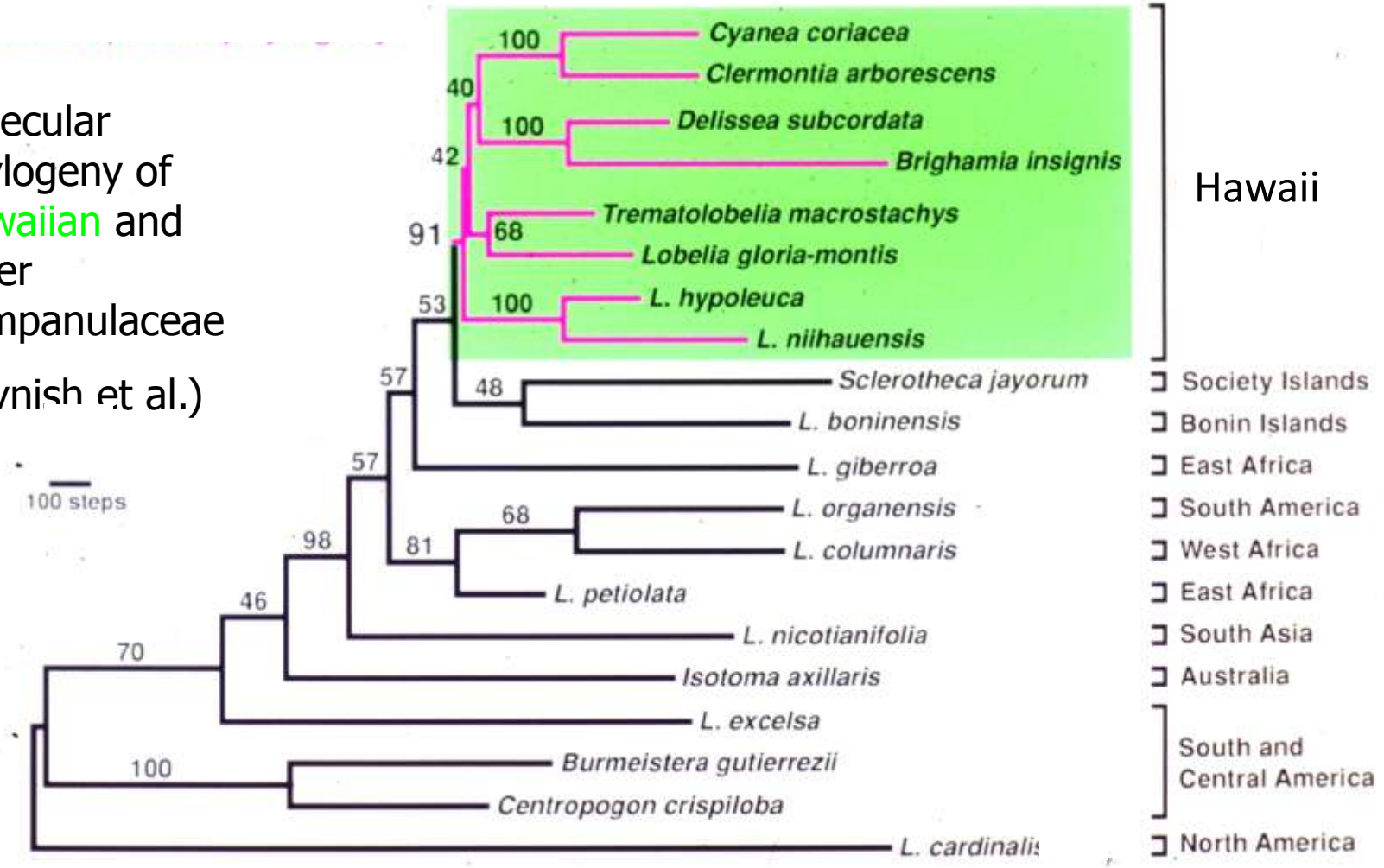
Closely related contemporary species should be close geographically, regardless of their habitat or specific adaptations. **If they are not, there had better be a good explanation**, (i.e. sea animals, birds, human introduction, continental drift, or extensive time since their divergence).

Floras and faunas isolated longest will be most different (Australia).

Biogeography: closely related species often live near each other

Molecular phylogeny of Hawaiian and other Campanulaceae

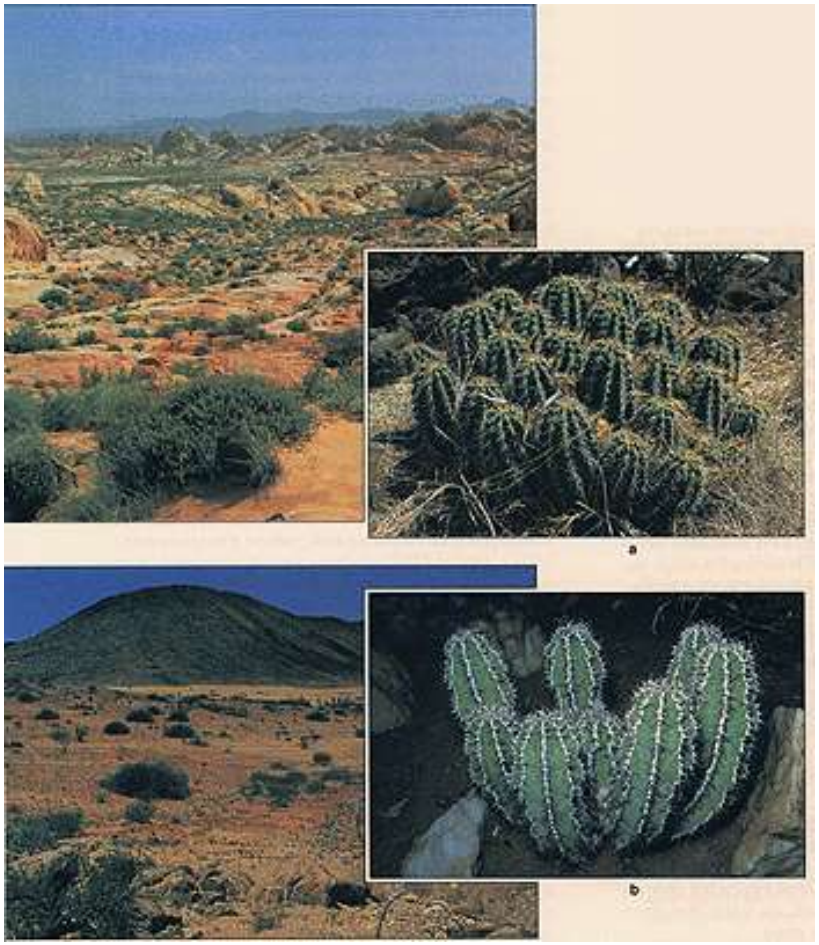
(Givnish et al.)



Biogeography: Organisms separated by great physical barriers, such as oceans and mountains, are often quite different, even though the environments are much the same.

Members pineapple family inhabit many diverse habitats (such as rainforest, alpine, and desert areas), but only in the Americas, not African or Asian tropics .

Similar Climate, Different Taxa



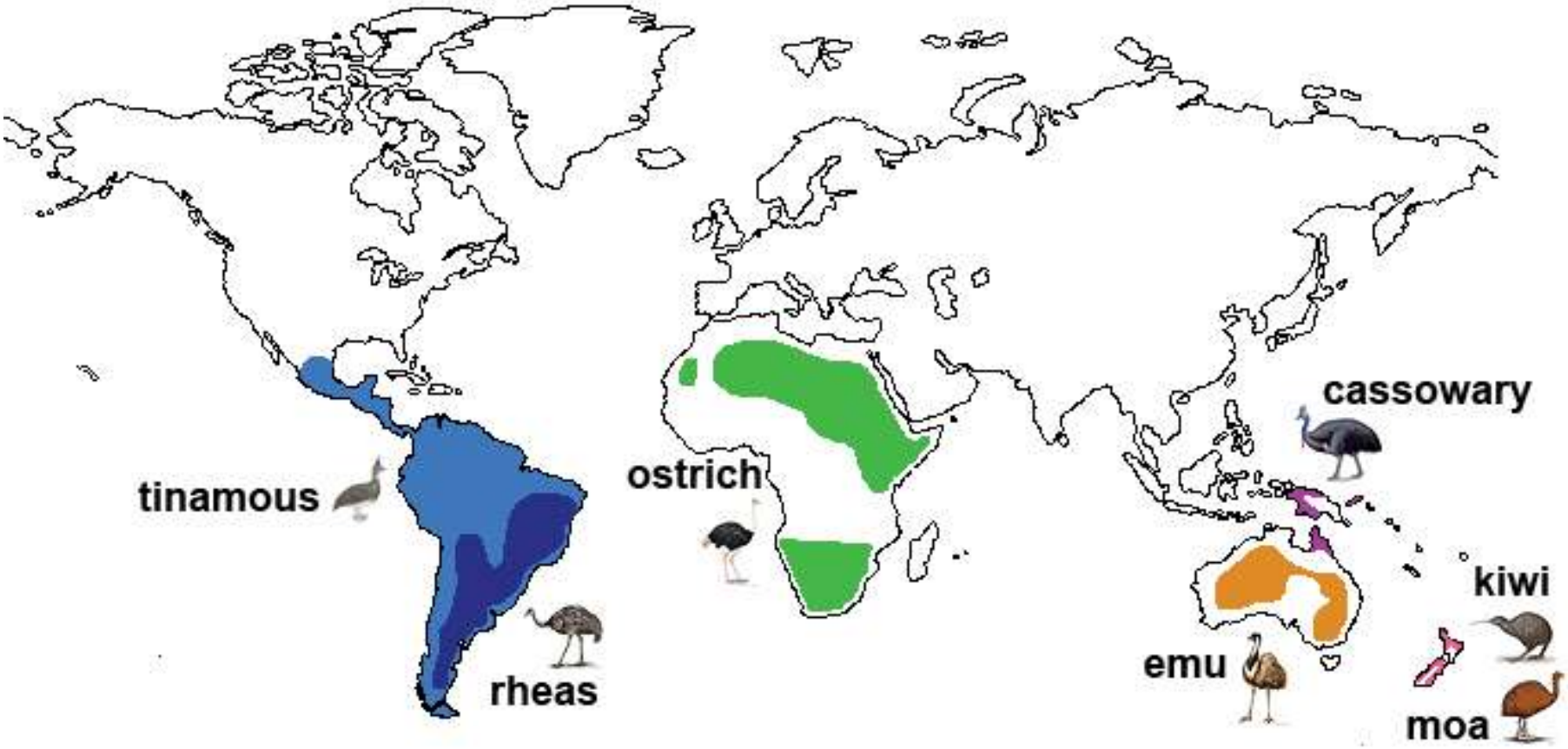
Cactaceae in North American deserts

Euphorbiaceae in southern African deserts

= Convergent evolution

Humans introduced the only Cacti found in the Australian outback, and they grow quite well in their new geographical location.

Distribution of Ratites



Ratites are an ancient lineages of flightless birds, represented by the three species above, plus a few others in Australia/New Guinea/New Zealand (cassowaries, kiwis). Birds first arose in the Jurassic.

Land Bridges were proposed to link continents before idea of continental drift accepted in 1960s

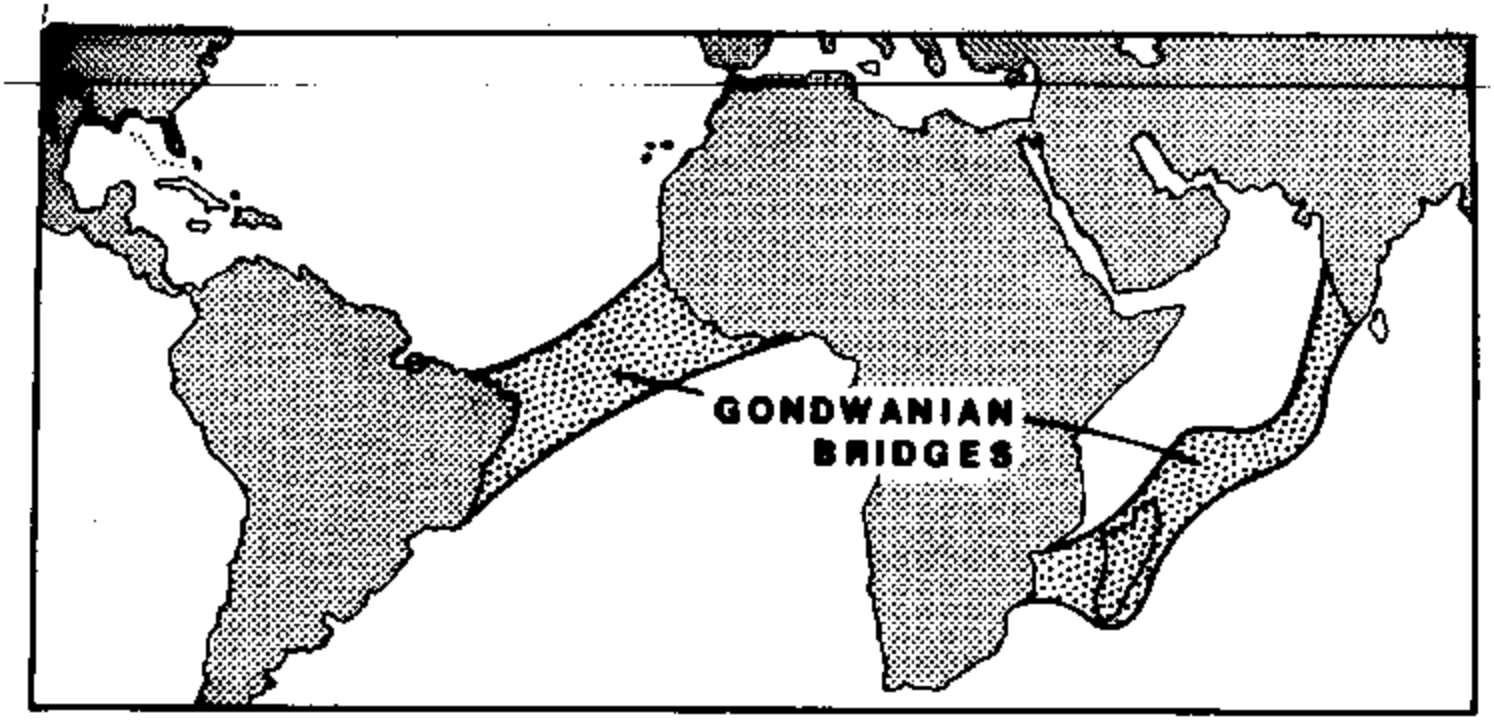
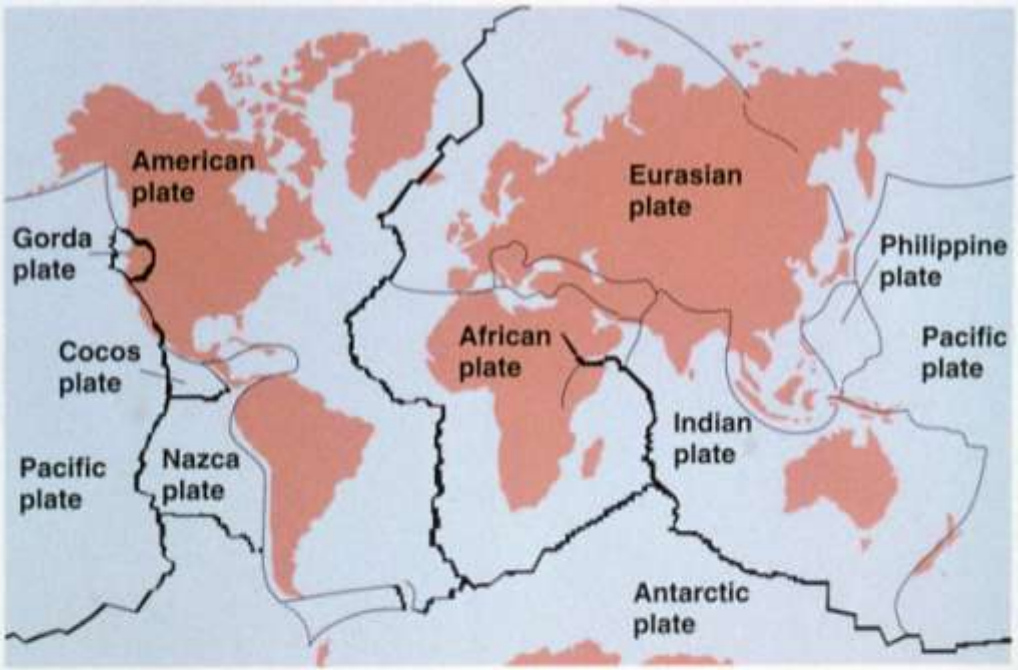
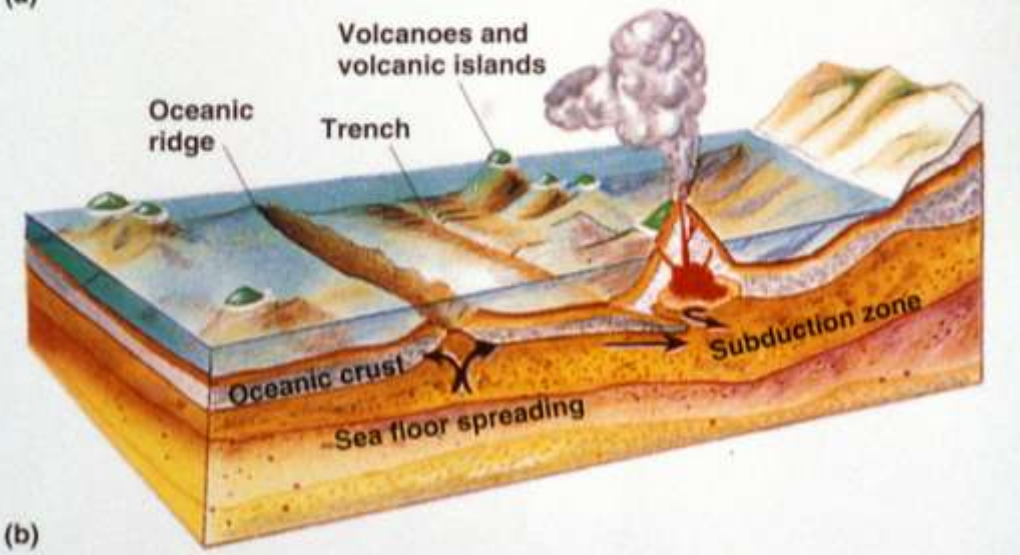


FIGURE 5 Land bridges used to be the paleontologists' explanation for the geographic dispersion of species across regions that are now deep oceans. Shown here are the land bridges proposed in Wegener's time.

Continental Drift – breakup of Pangaea



(a)



(b)

Pangea Supercontinent

Rifting at 200 Million Years Ago

Pangaea

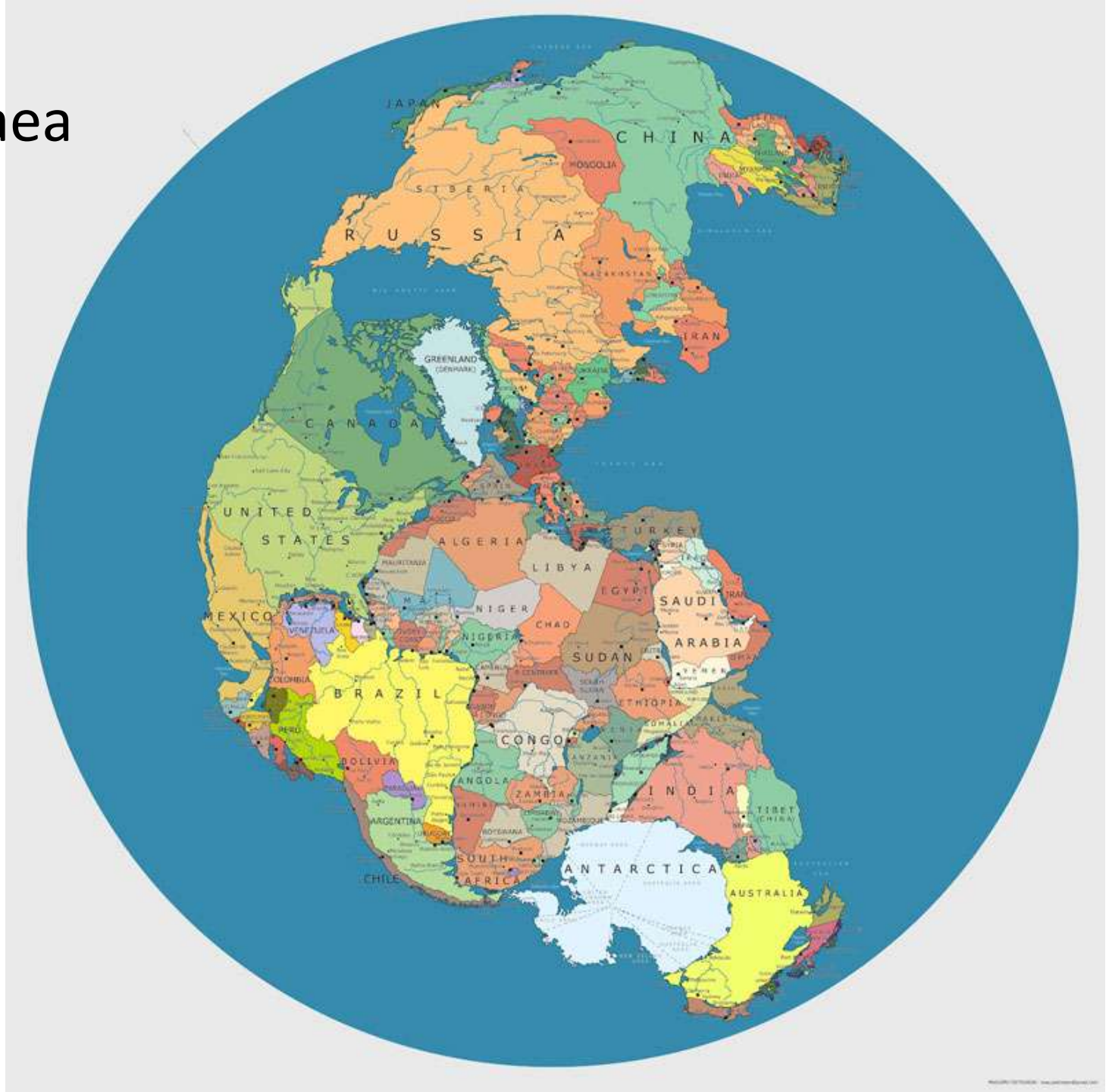
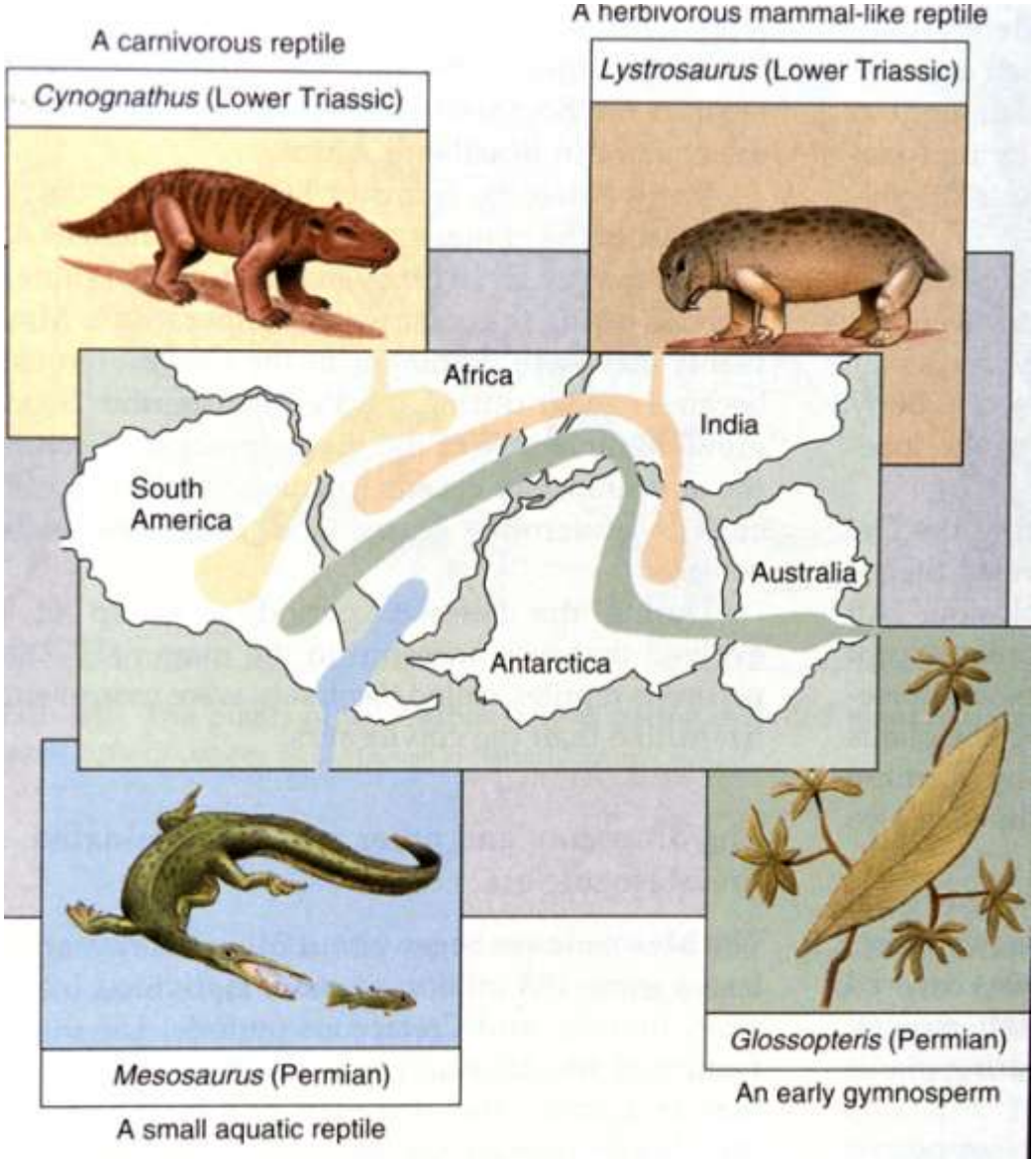
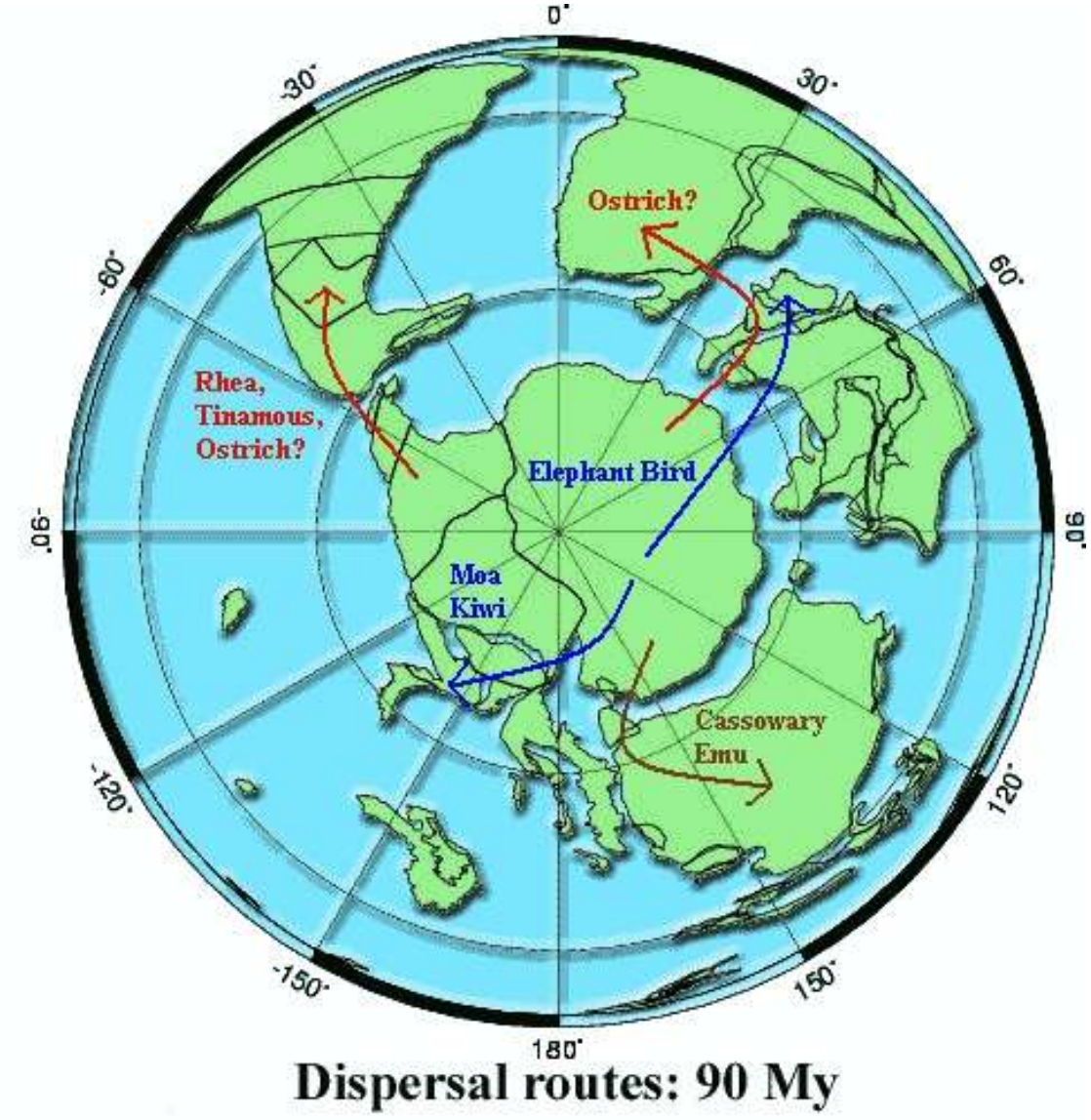

JAPAN
CHINA
MONGOLIA
SIBERIA
RUSSIA
KAZAKHSTAN
IRAN
GREENLAND
(DENMARK)
CANADA
UNITED
STATES
ALGERIA
LIBYA
EGYPT
TURKEY
SAUDI
ARABIA
MEXICO
VENEZUELA
NIGER
CHAD
NIGERIA
SUDAN
ETHIOPIA
COLOMBIA
BRAZIL
PERU
CONGO
BOLIVIA
ANGOLA
ZAMBIA
INDIA
TIBET
(CHINA)
ARGENTINA
BOTSWANA
SOUTH
AFRICA
CHILE
ANTARCTICA
AUSTRALIA

Plate Tectonics – Continental Drift - Alfred Wegener

Wegener relied heavily on biogeographical evidence for defending his controversial continental drift theory

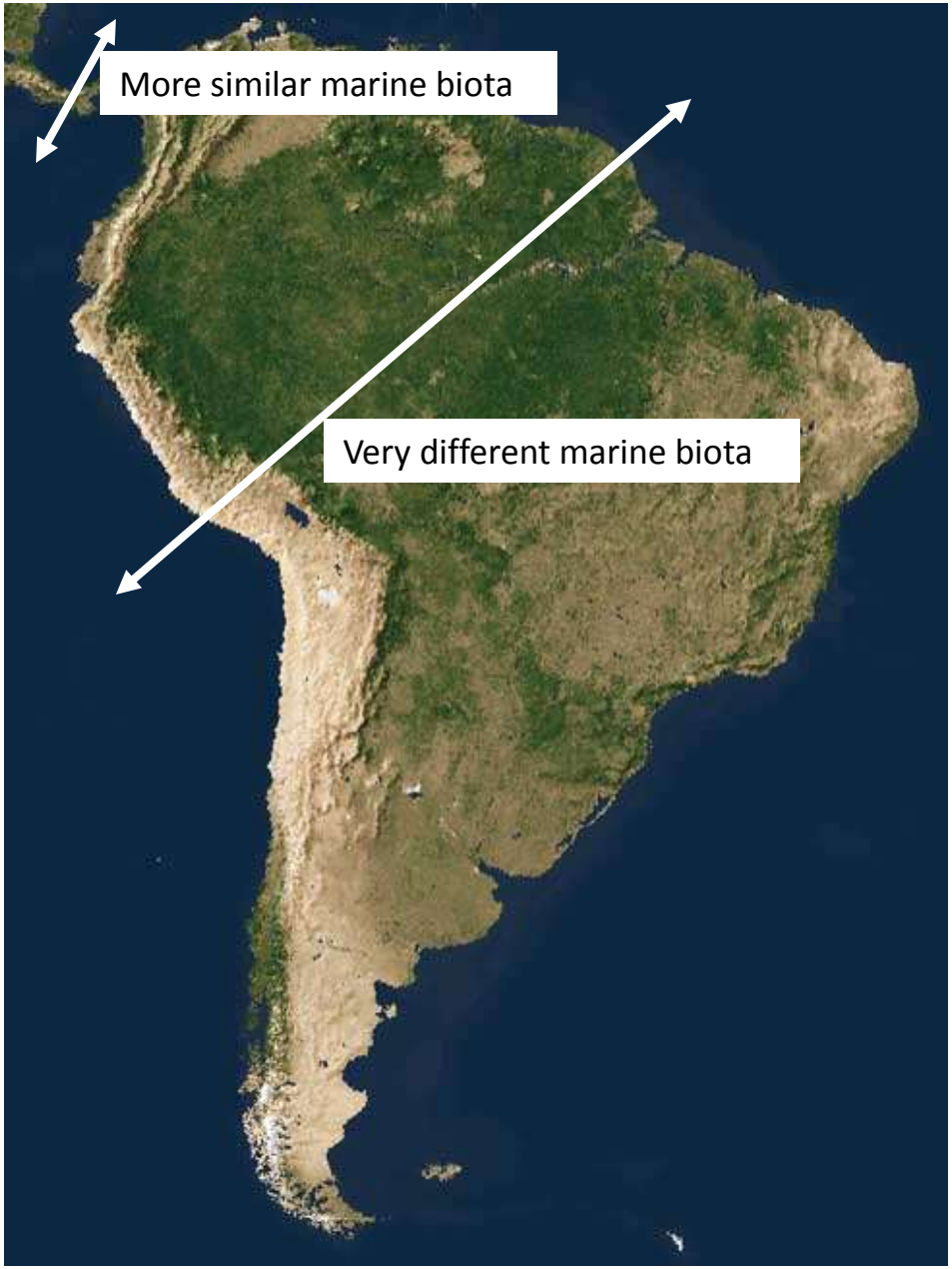


Dispersal of Ratites in Gondwanaland



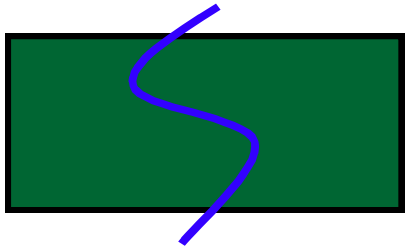
Dispersal routes: 90 My

Geographic Barriers and Distinct Biota



Vicariance vs. Dispersal
similar pattern, different process

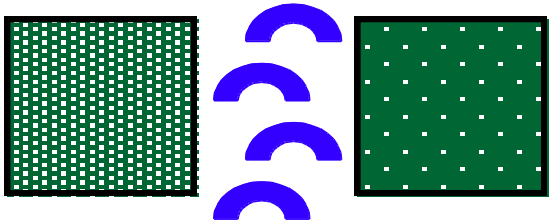
Vicariance



Widespread species
Continuous continental area

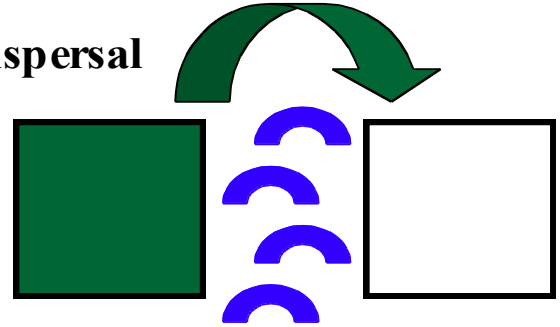
Erection of ocean barrier

Divergence in isolation



Disjunct (vicariad) species
Disjunct continental areas

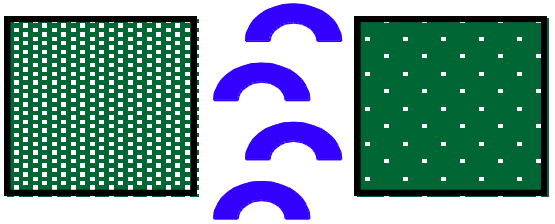
Dispersal



Species limited to one area
Disjunct continental areas

Dispersal across ocean barrier

Divergence in isolation



Disjunct species
Disjunct continental areas

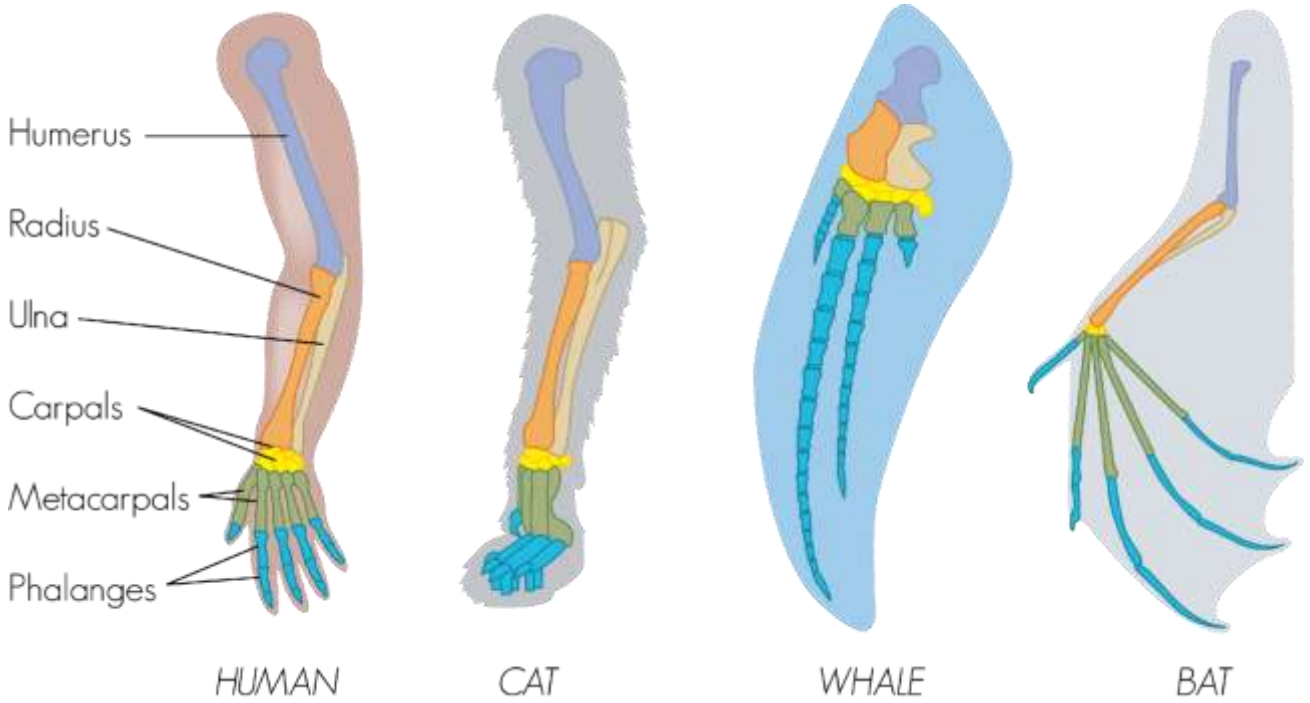
Courtesy of K.J. Sytsma

Comparative Anatomy: Homologous Structures

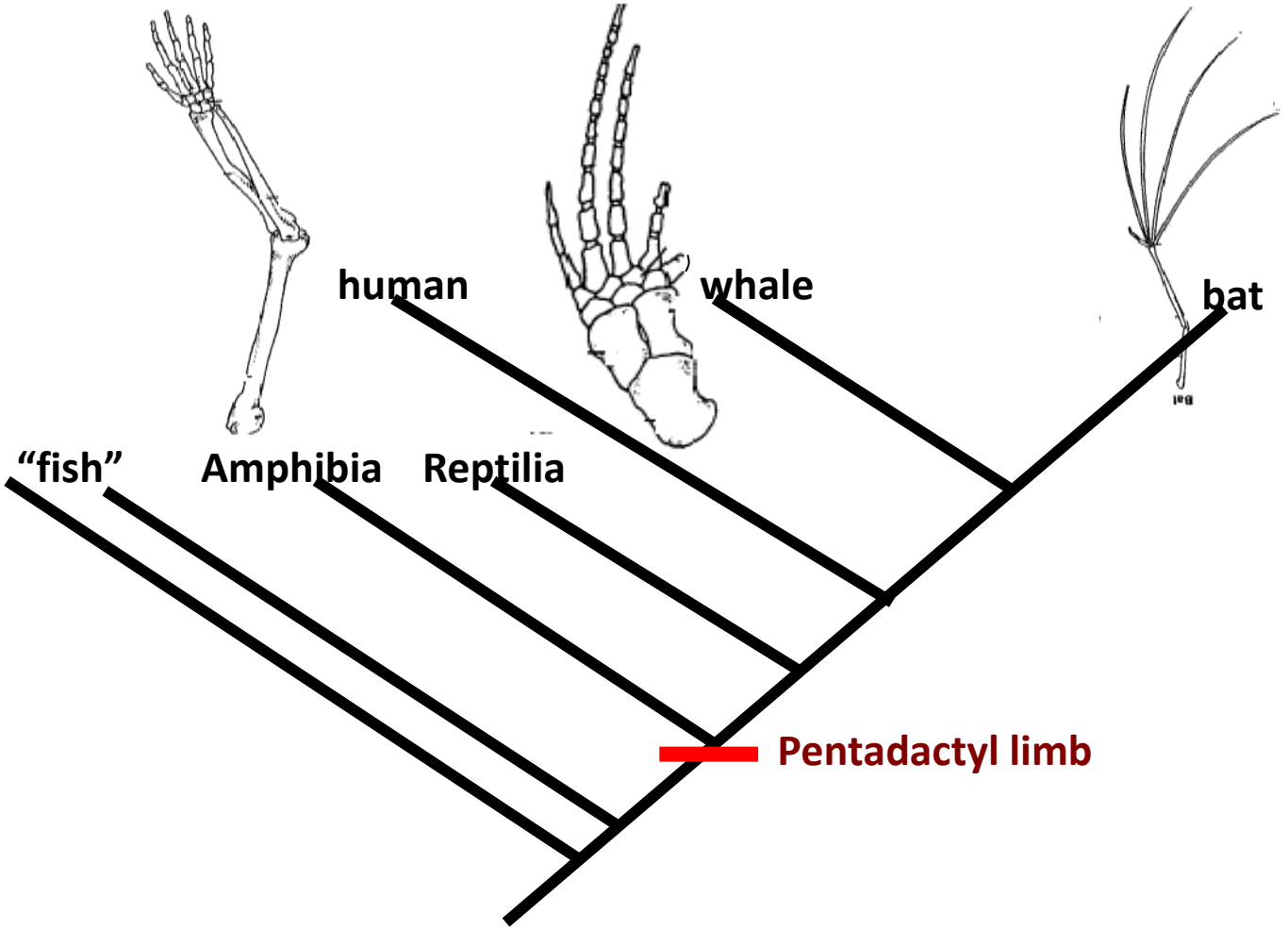
Structures that are similar in related organisms because they were inherited from a common ancestor.

Hands of several different mammals all have the same basic pattern of bones.

They inherited this pattern from a common ancestor. However, their forelimbs now have different functions



Homology: Similar because derived from common ancestor

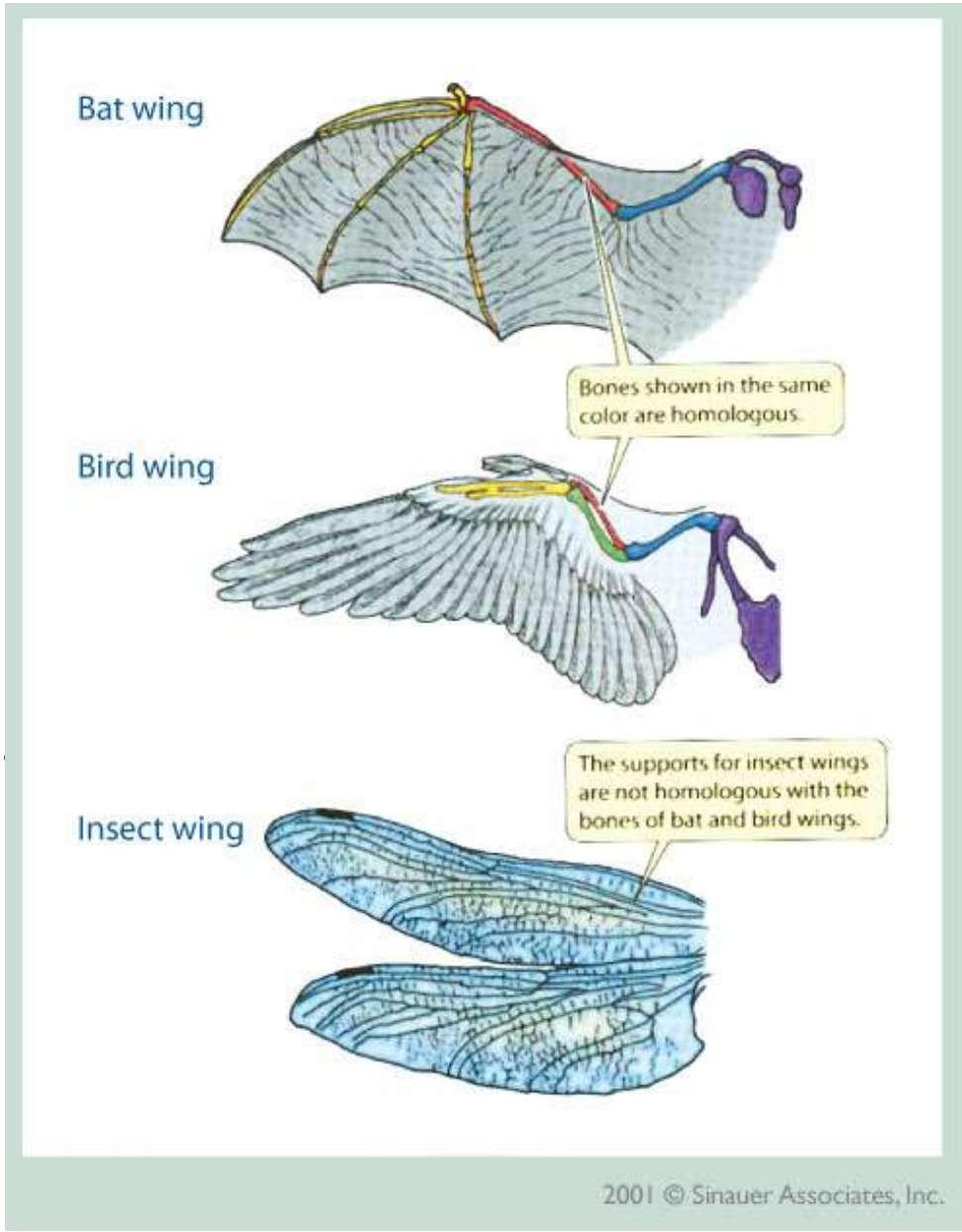


Analogous Structures

Structures that are similar in unrelated organisms. The structures are **similar because they evolved to do the same job**, not because they were inherited from a common ancestor.

For example, the wings of bats and birds look similar on the outside. They also have the same function. However, wings evolved independently in the two groups of animals.

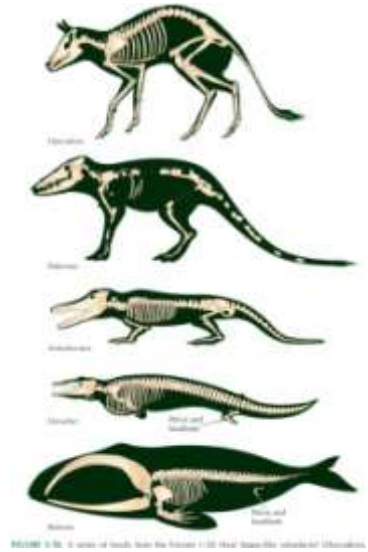
This is apparent when you compare the pattern of bones inside the wings



Vestigial Organs – Use and Disuse (Chapter 14)

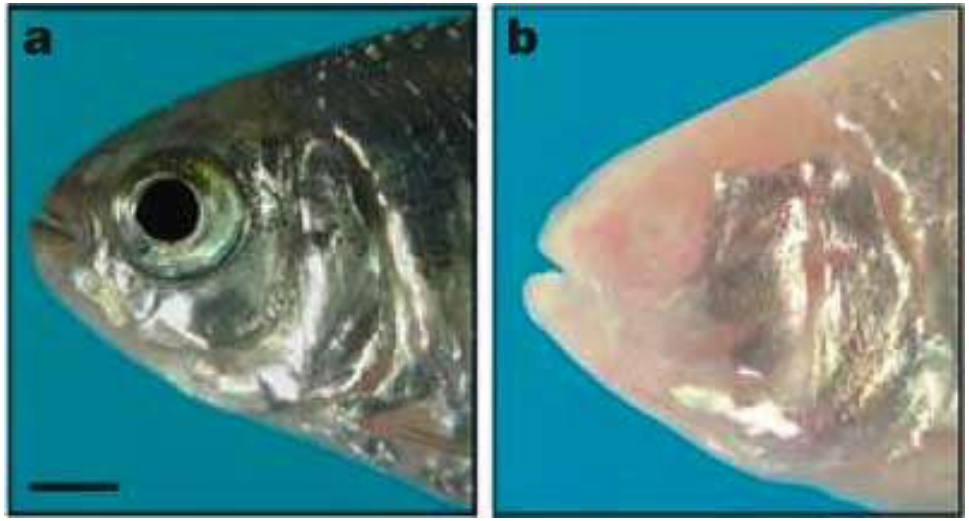
Vestigial Organs – structures that have lost some or all of the functions that their earlier ancestors had.

Suggests life has a history, that organisms have structures that are modified from pre-existing structures



In July 1919 a humpback whale was caught by a ship operating out of Vancouver that had legs 4 ft 2 in (1.27 m) long

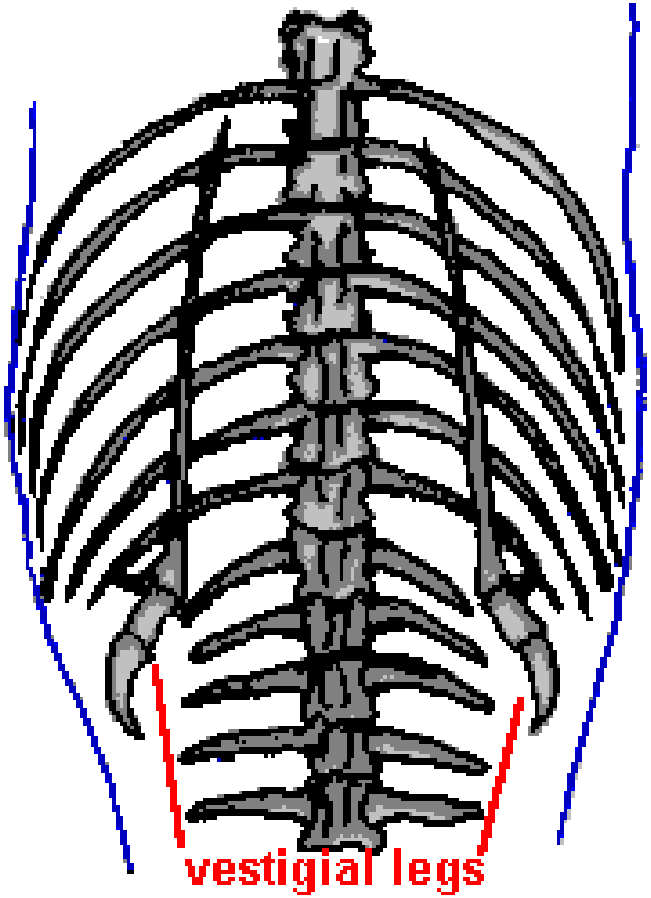
Vestigial Organs



Mexican cave fish (b) with its surface dwelling ancestor (a)

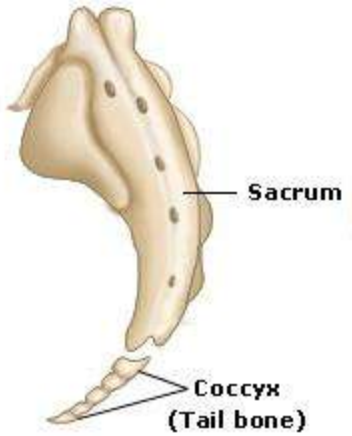
Blind cave salamander with vestigial eye

Vestigial structures: Snake pelvis and leg bones

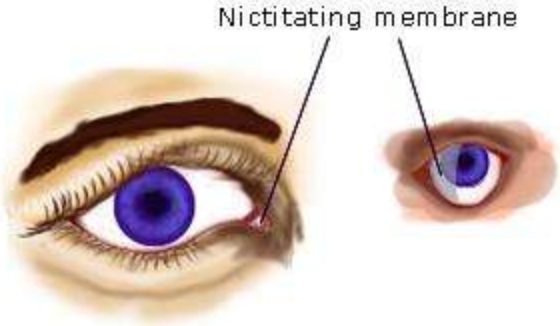


Vestigial organs in humans

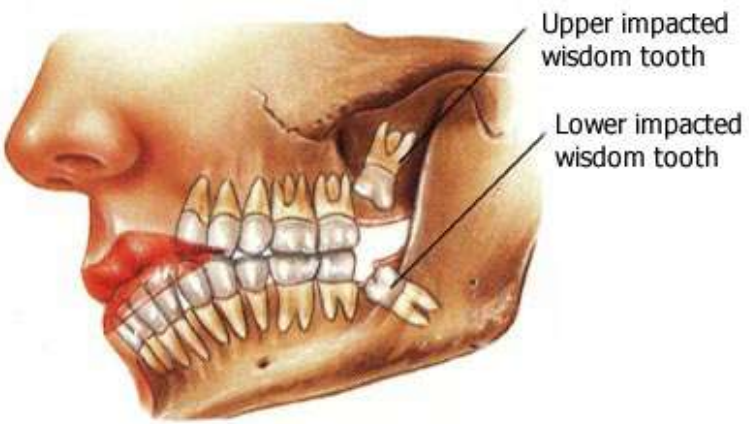
appendix, bump on the ear, ear muscles, wisdom teeth, tail bone, eye, nictitating membrane, goose bumps, etc.

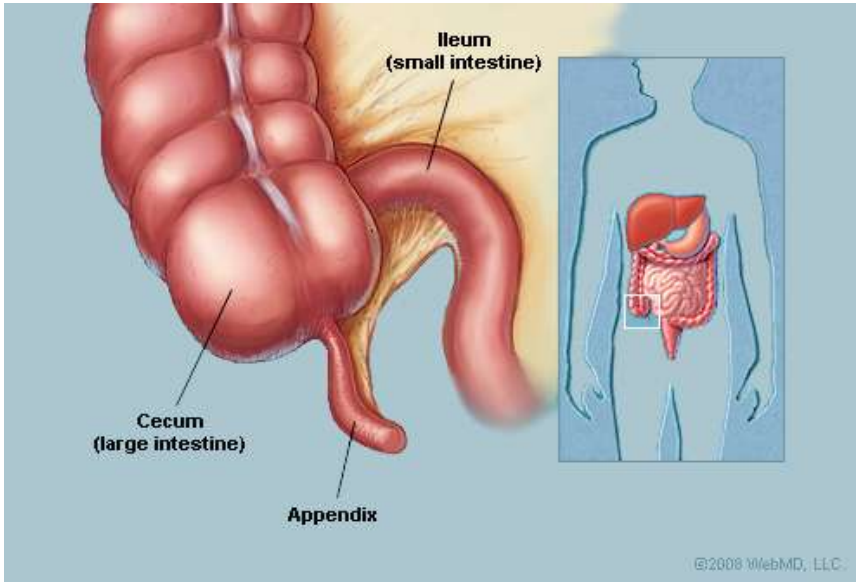


Tail bone in human being



Nictitating membrane in the eyes of man(Left) and ape(Right)



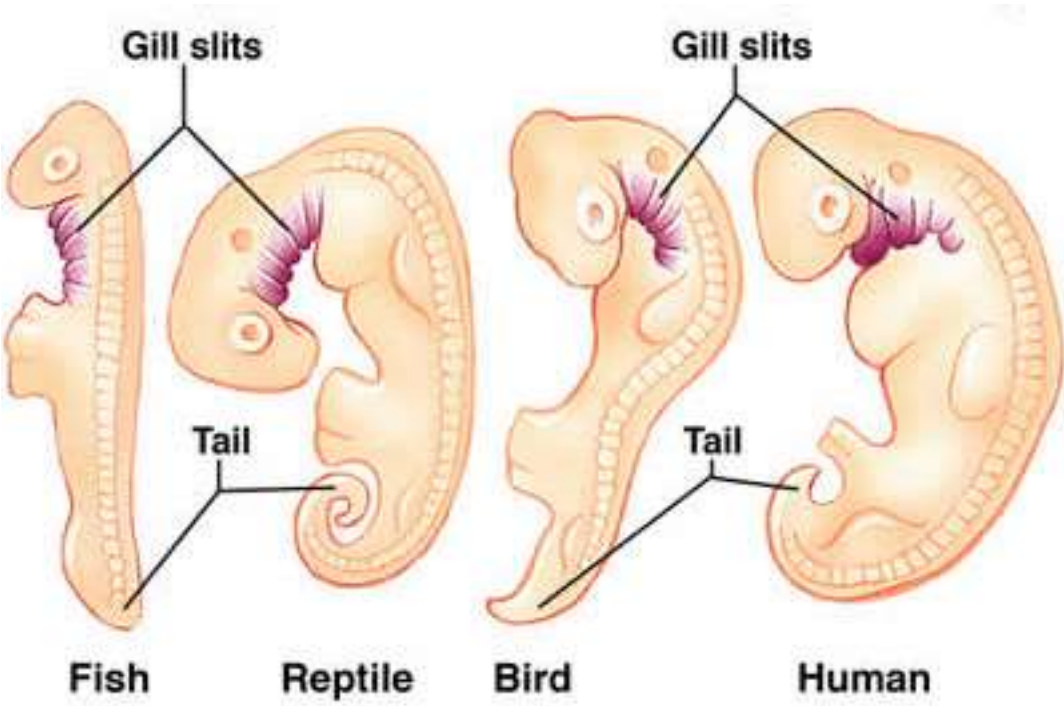


Comparative embryology

There is an obvious similarity between embryos of fish, amphibians, reptiles, birds and mammals.

All have tail and rudimentary "gill slits," even though slits do not remain later in life, except in fish.

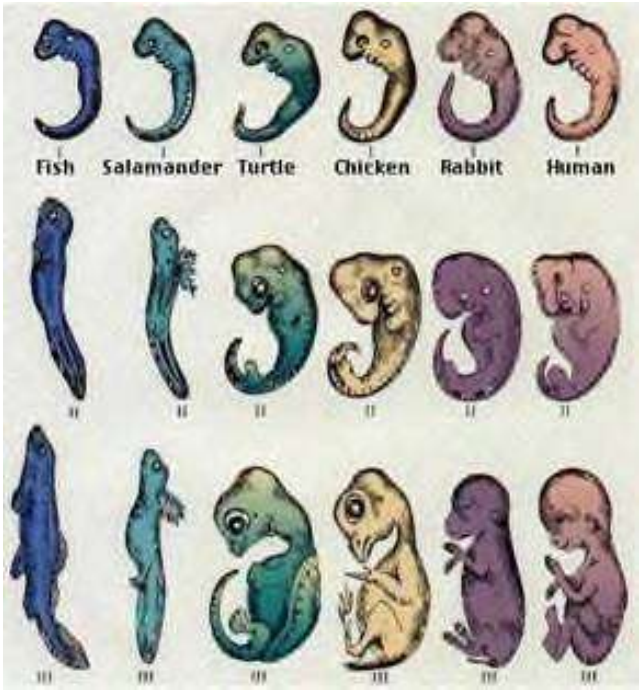
This may indicate a fundamental step that is common to all vertebrates and supports the idea of a common ancestor.

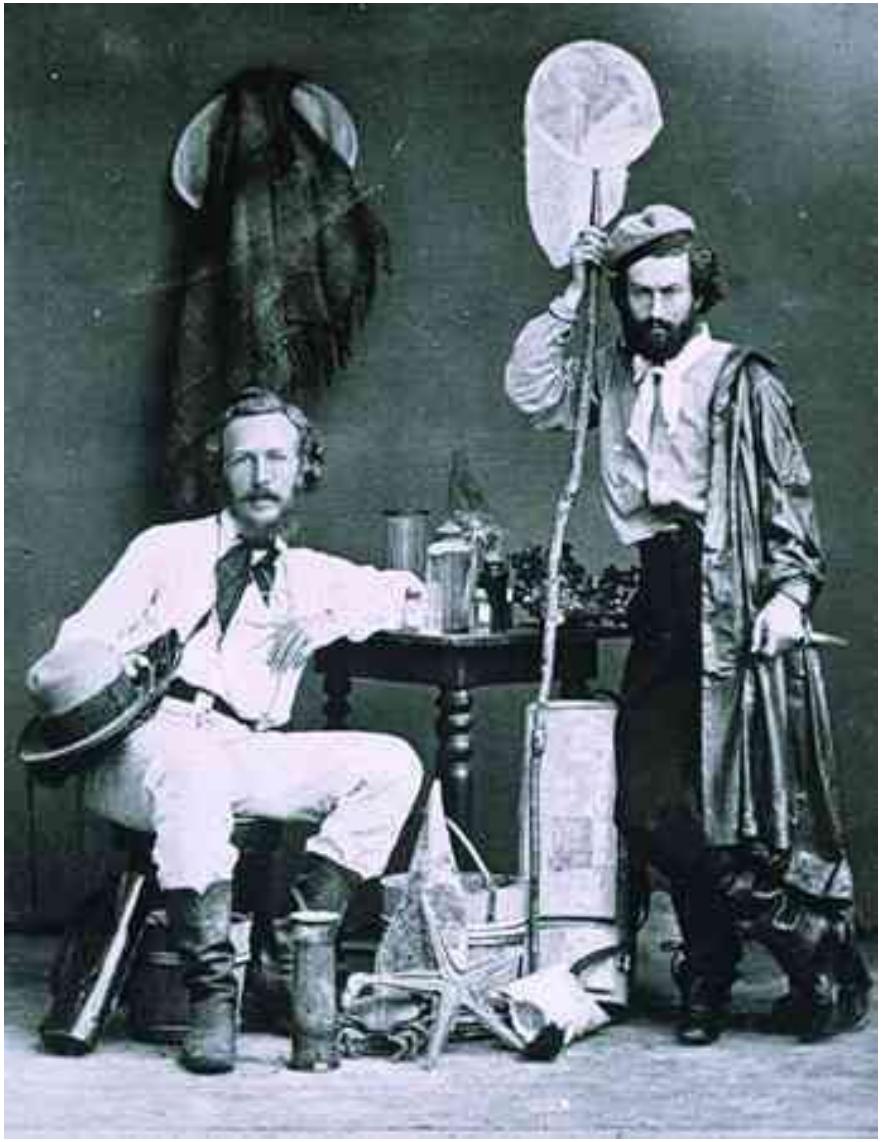


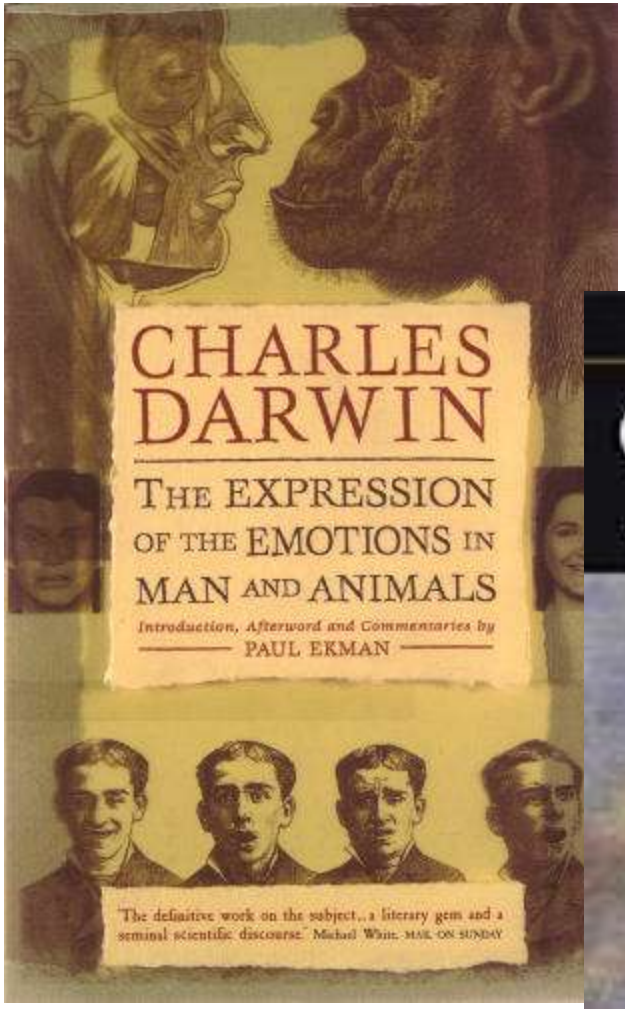
Ernst Haeckel - 1860s

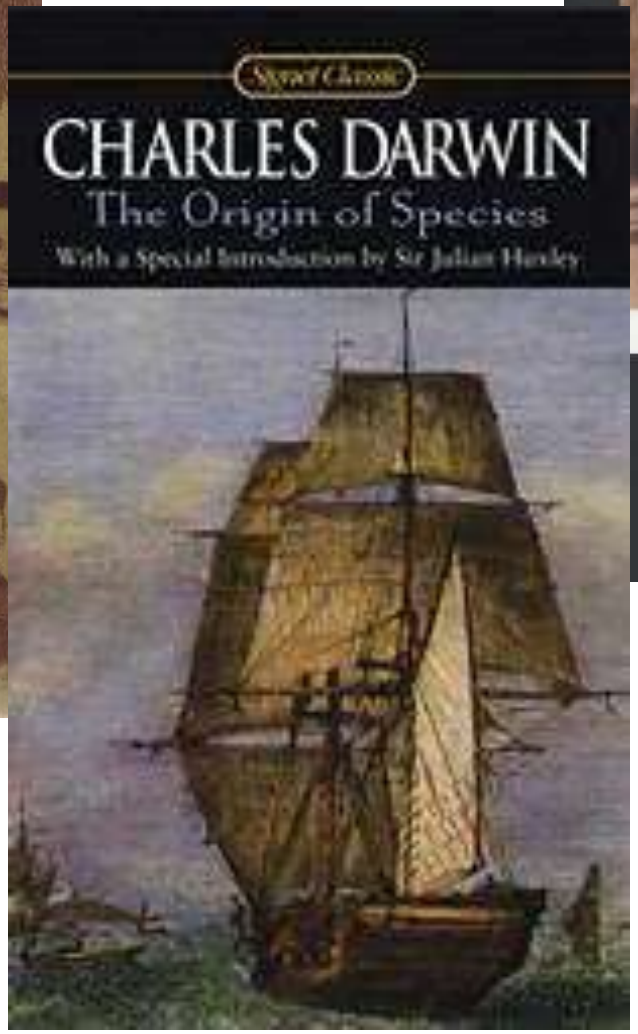
Phylum, Phylogeny, Ecology

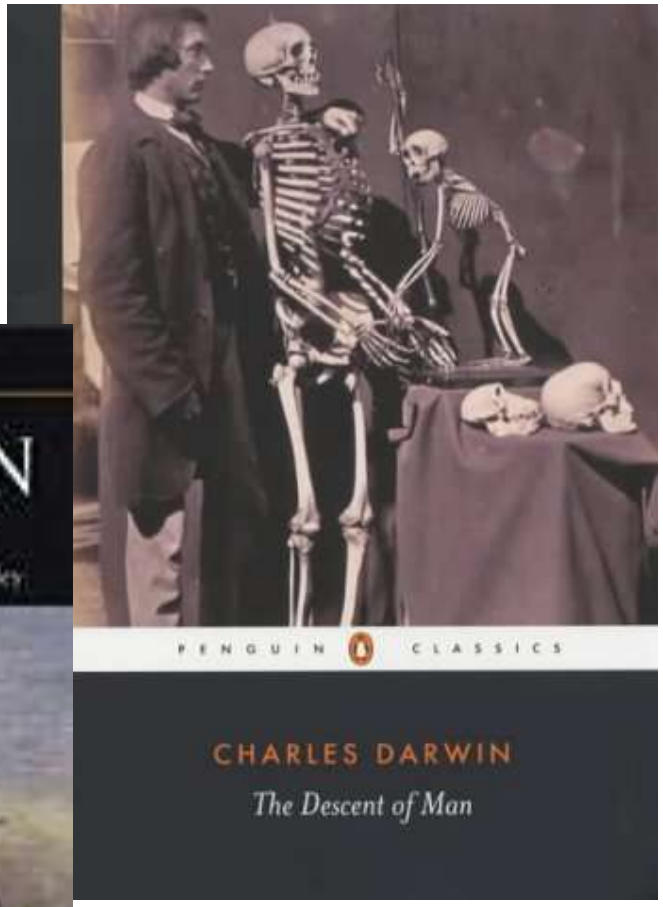
Proposed Biogenetic Law - “ontogeny recapitulates phylogeny”







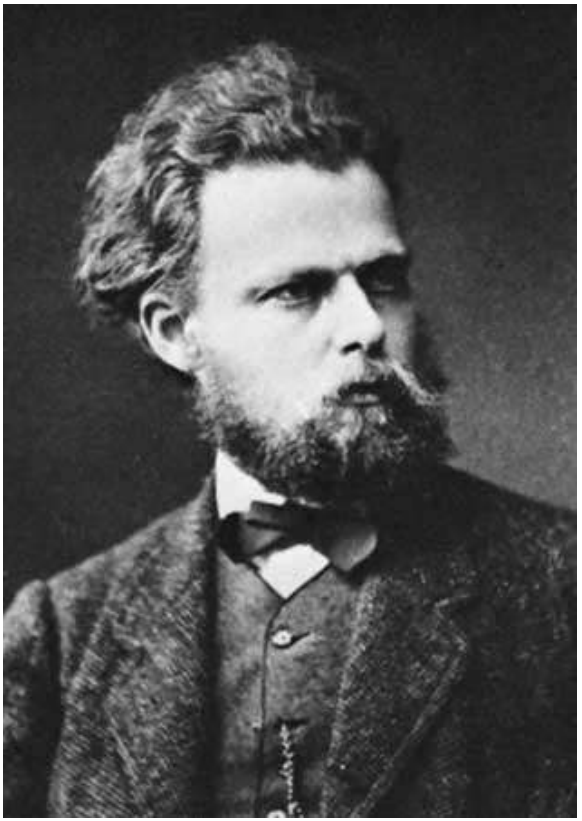




PENGUIN CLASSICS

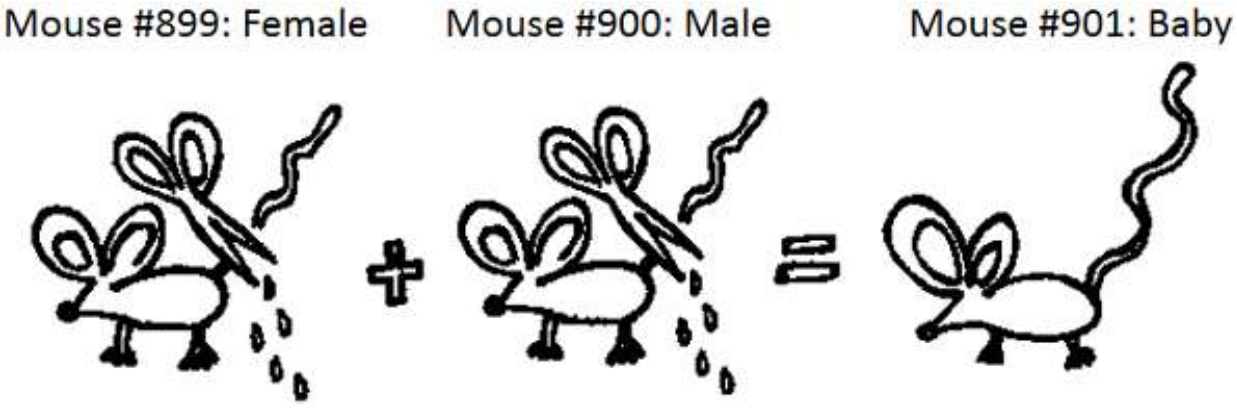
CHARLES DARWIN

The Descent of Man



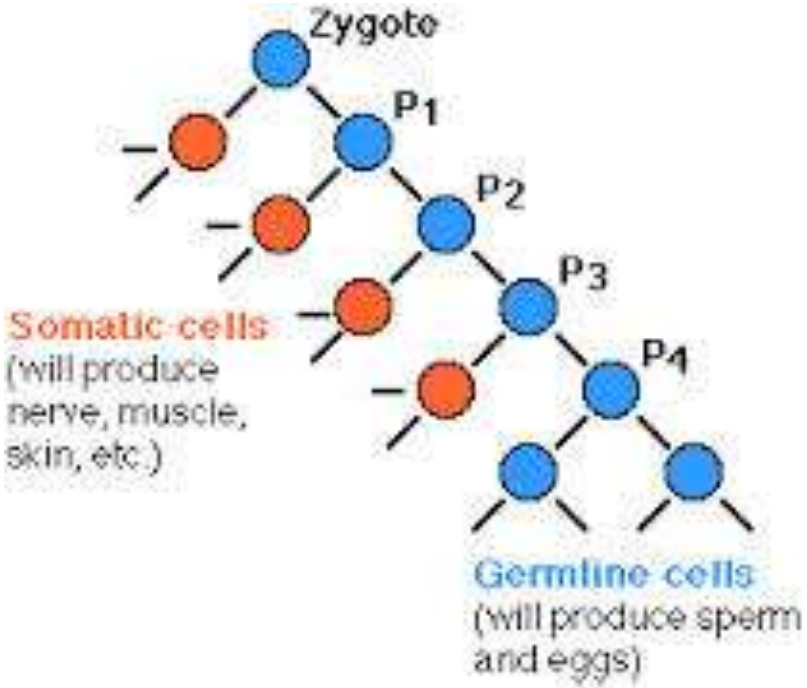
The Germ Line Theory

August Weismann (1834-1914)
German Cytologist
Performed experiments in which he cut the tails off of successive generations of mice, came to the conclusion that "acquired characters" simply were not inherited, thus significantly undermining the theory of Neo-Lamarckism.



"Seriously, Weismann. Enough is enough!"

The Germ Line Theory



Two types of cells in the human body

somatic cells of the body, that could be altered in the course of our lives

germ cells, that contained the essence of life that would be passed on to form the next generation.

This latter, he argued, were not influenced by “acquired characters”.

Weismann, *Germ-Plasm Theory of Inheritance*

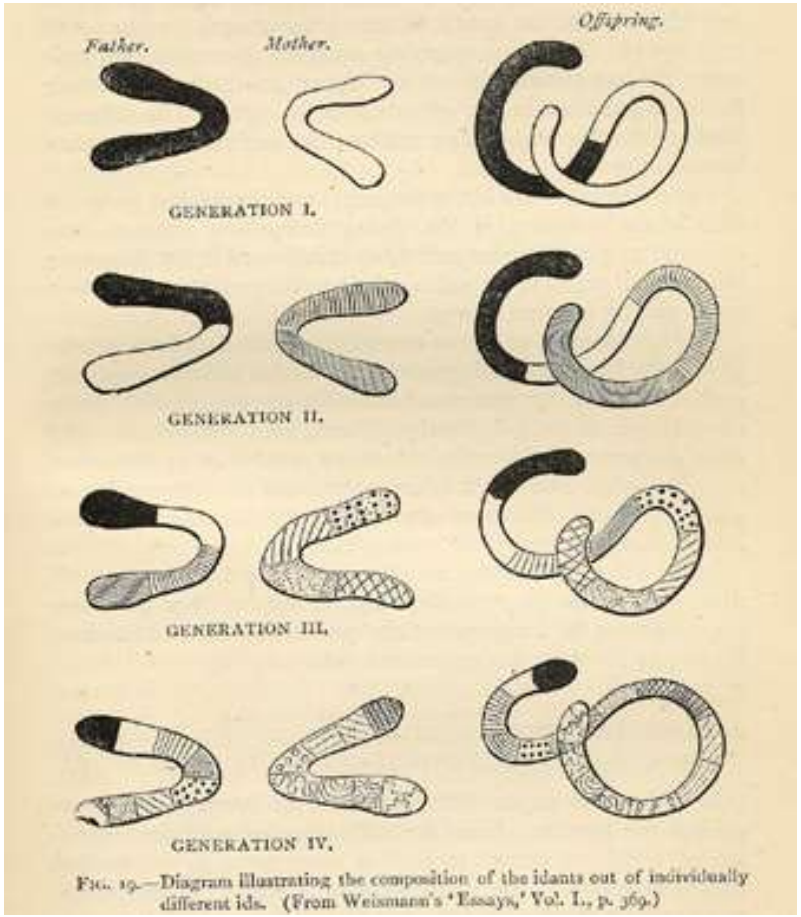


FIG. 19.—Diagram illustrating the composition of the idants out of individually different ids. (From Weismann's 'Essays,' Vol. I., p. 369.)

In this illustration, German biologist August Weismann showed how the heritable substance, which he placed in the chromosomes, combined in the cell's nucleus during sexual reproduction to produce offspring.

Though he supported Darwin's theory of natural selection, Weismann did not accept Darwin's explanation of inheritance. Weismann proposed that the heritable substance was distinct from, and unaffected by, the rest of the organism's body.

This view would later underlie the genetic theory of inheritance.

The Germ-Plasm: A Theory of Heredity. W. N. Parker, trans. London: Walter Scott, [1892] 1893.

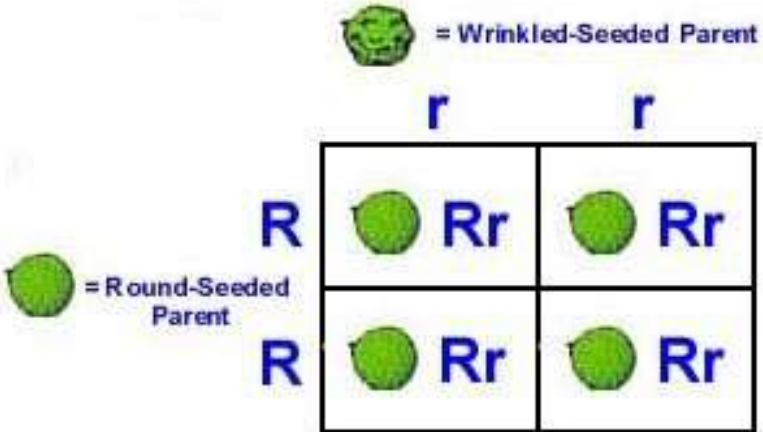
Rediscovery of Mendel's work (1900)

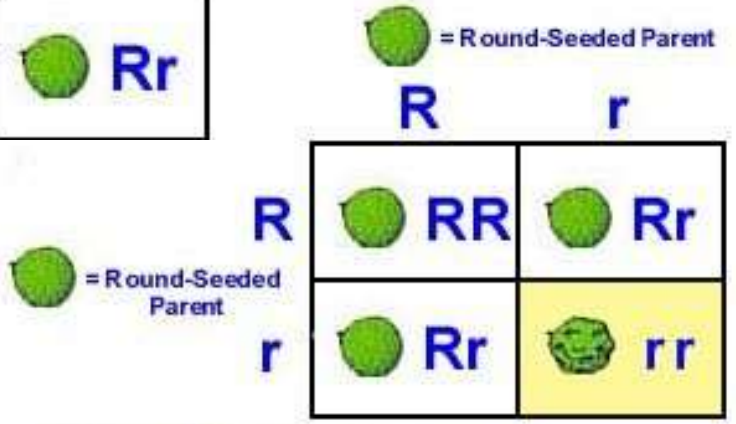
E. von Tschermak-Seysenegg

H. DeVries

C. Correns

In 1900, only fourteen years after his death, Mendel's work was simultaneously rediscovered by three different geneticists – Carl Correns, Erich Tschermak, and Hugo de Vries – working in three different countries. They each realized that Mendel's particulate theory of inheritance fit patterns of inheritance they were observing.



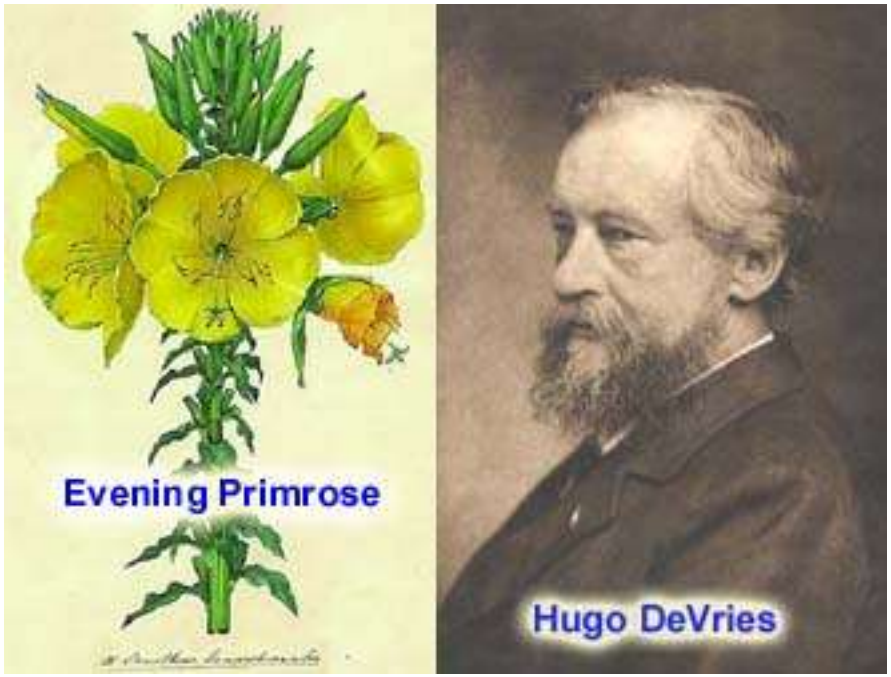


Each trait due to a **pair of hereditary fact**
which **segregate during gametogenesis**
Multiple sets of hereditary factors **assort independently**

Mendel's work with peas showed that the "blending" explanation was wrong

A copy of the journal containing Mendel's paper was found in Darwin's library at Down House, but it had apparently not been opened or read.

Evolution by Large Mutations?



The rediscovery of Mendel's work led geneticists to reject natural selection as the mechanism for evolution, in favor of mutations. Hugo de Vries proposed that large mutations occurring in just one generation were the primary "engine" of evolutionary change. He did his pioneering work in genetics using the evening primrose (*Oenothera lamarkiana*), which is now known for having sudden, large mutations (called "macromutations") in its overall phenotype.

The Modern Synthesis: 1920s – 1950s
Ronald Fisher, J.B.S. Haldane, Sewall Wright

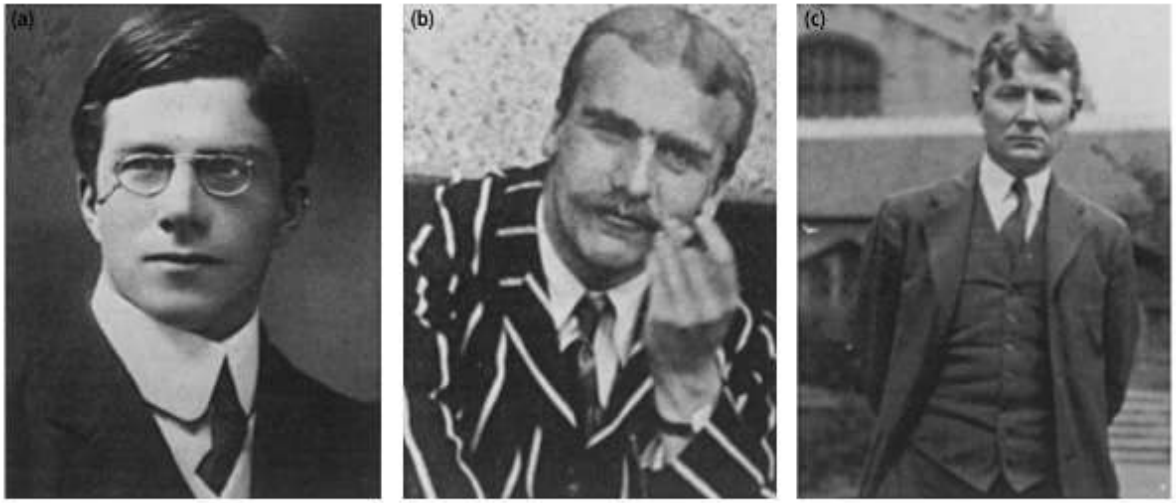
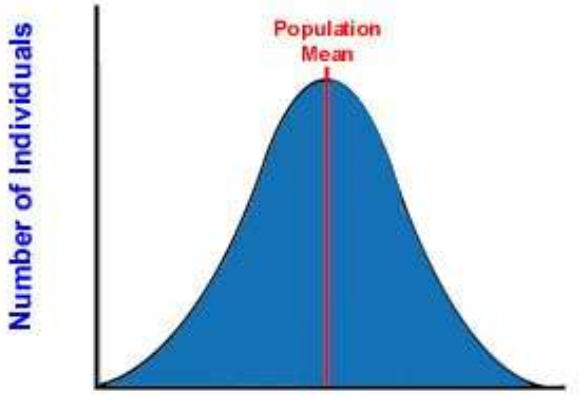


Figure 1.8
(a) Ronald Aylmer Fisher (1890–1962) in 1912, as a Steward at the First International Eugenics Conference.

(b) J.B.S. Haldane (1892–1964) in Oxford, UK in 1914.
(c) Sewall Wright (18
of Chicago.

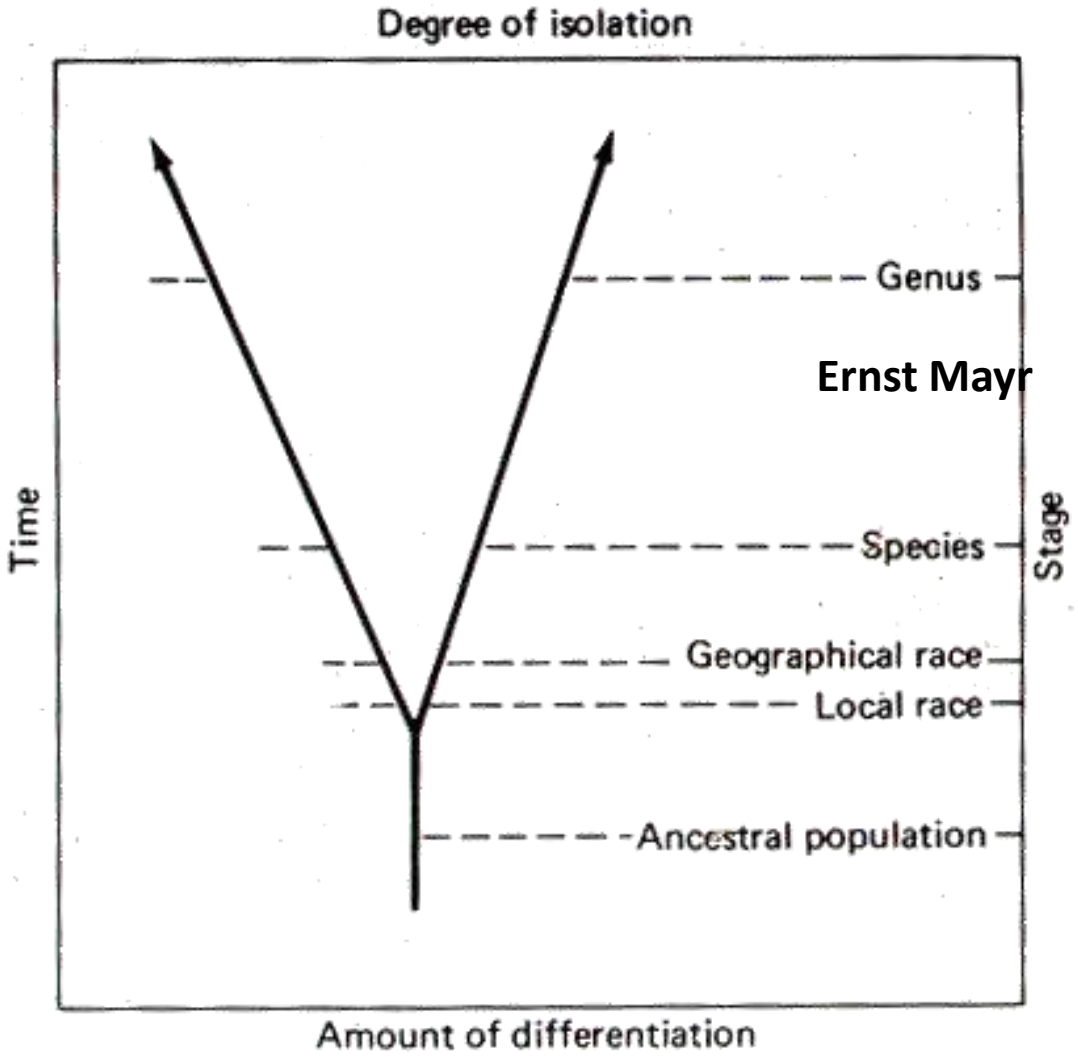
Worked out the statistical foundation of population genetics



Normal Population Distribution

Ernst Mayr

Investigated the question of how species originate ,and importance of geographical isolation



George Gaylord Simpson

One of the most influential paleontologists of the 20th century

Expert on Mesozoic, Paleocene, and South American mammals

Leading developer of the modern synthesis.

Argued that the evidence in the fossil record was consistent with the population genetic mechanisms of the modern synthesis.

Horse evolution was not linear.

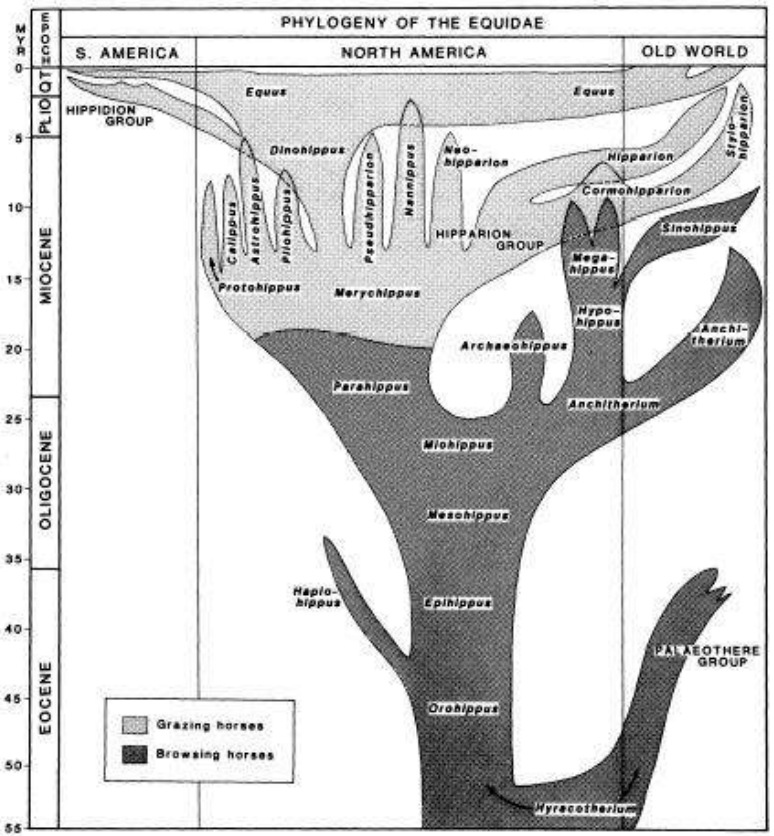
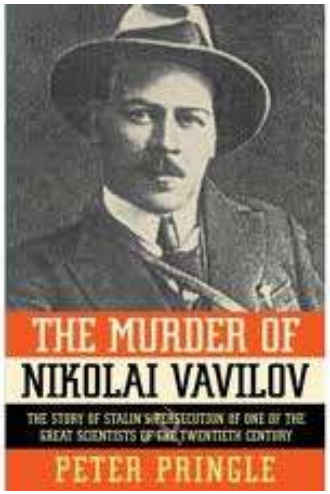


FIGURE 1. Current phylogeny of the Equidae, with particular emphasis on the North American taxa.

The Modern Synthesis: 1920s – 1950s

The synthesis included evidence from biologists, trained in genetics, who studied populations in the field and in the laboratory. These studies were crucial to evolutionary theory. The synthesis drew together ideas from several branches of biology which had become separated, particularly genetics, cytology, systematics, botany, morphology, ecology and paleontology.

Trofim Lysenko – Lysenkoism – State Sponsored Lamarckism



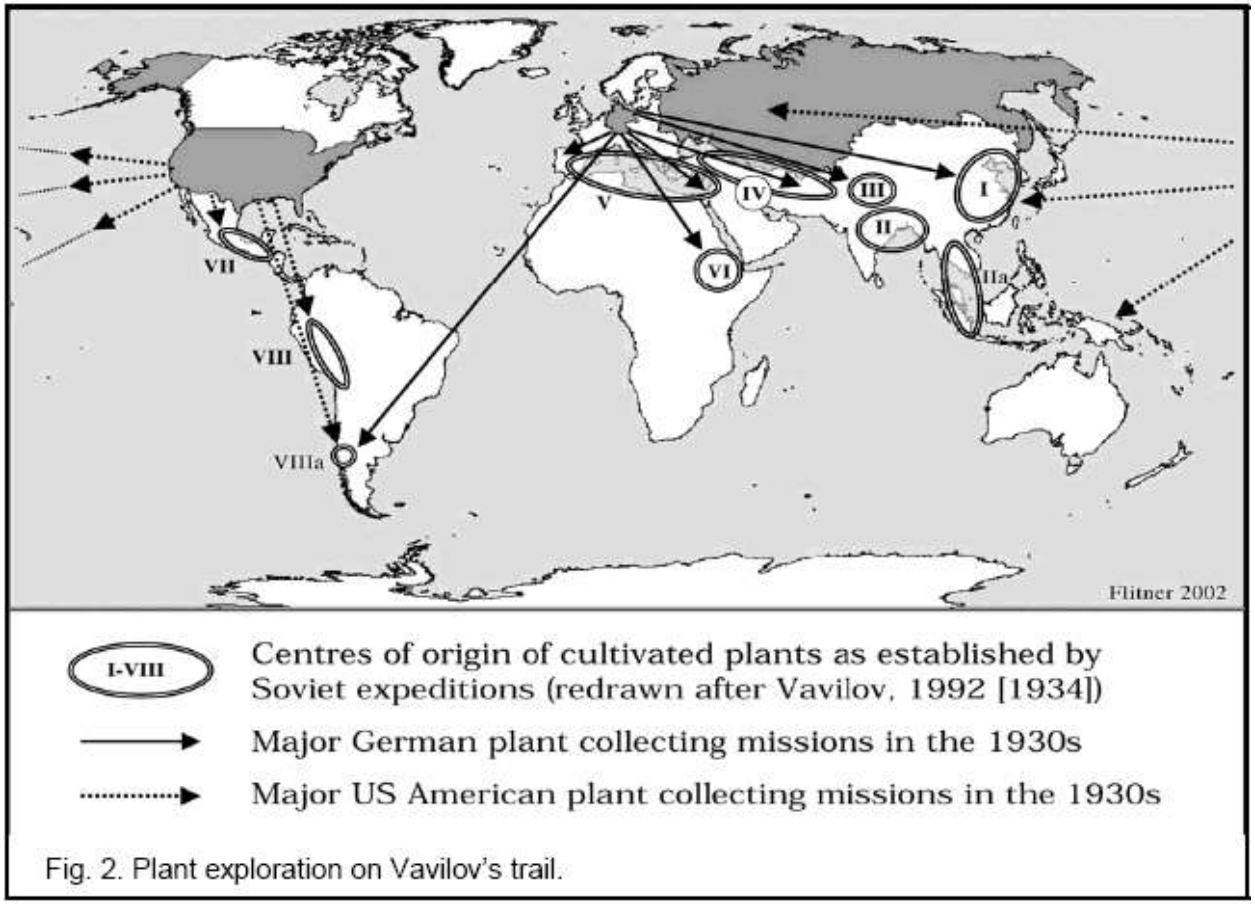


Fig. 2. Plant exploration on Vavilov's trail.

The Soviet Union was the world leader in plant collecting during the 1920s and 1930s. N.I. Vavilov and his aids travelled around the globe on more than 40 expeditions, with an additional 140 trips covering the vast territory of the Soviet Union. Large missions were carried out in Iran (1914), Afghanistan (1924), in North, Central and South America (1921, 1930, 1932/3), in China, Taiwan, Japan and Korea (1929) and around the Mediterranean Sea (1926/7) (Vavilov, 1997). It was on a collecting mission to Ukraine that Vavilov, fallen in disgrace, was arrested in August 1940 (Adams, 1978).

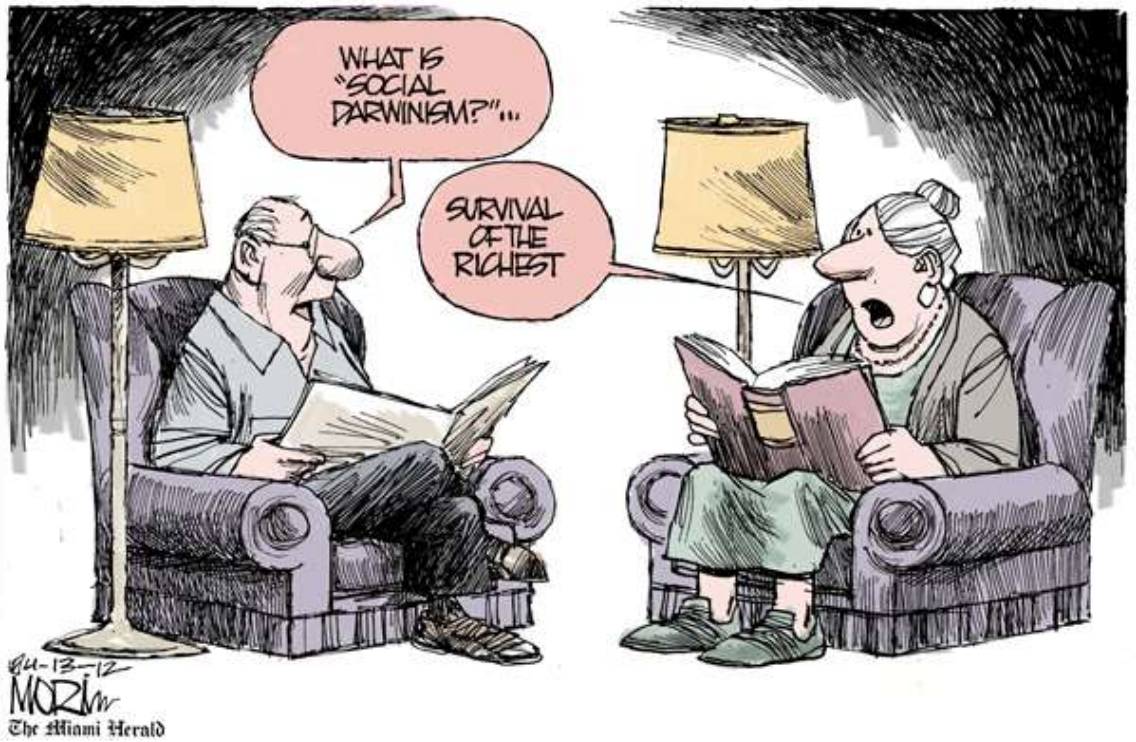
Social Darwinism

Darwin's theory seemed to justify business practices of the day.

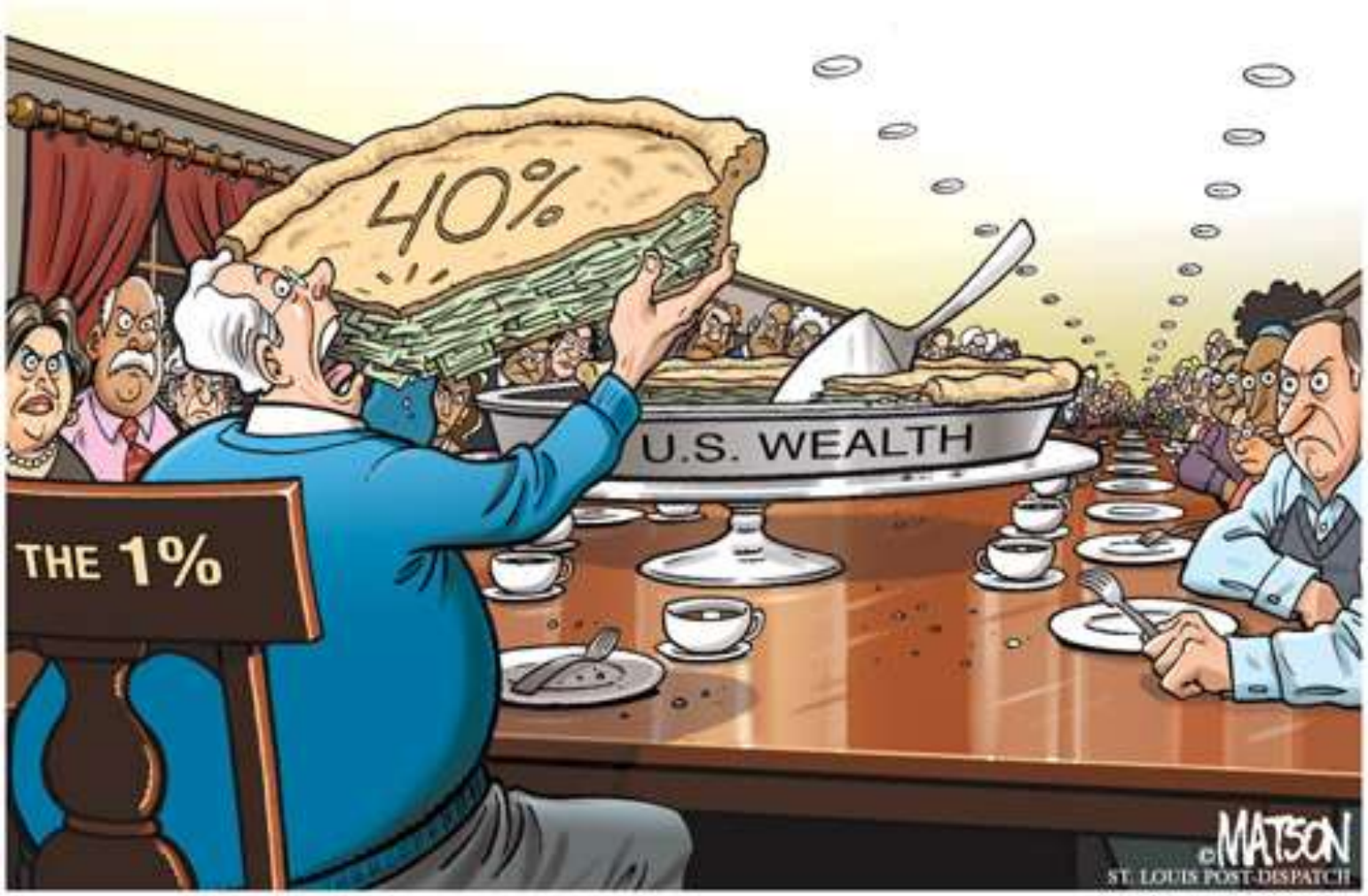
The strongest and most capable survive and prosper. The weak do not.

Herbert Spencer – coined phrase "survival of the fittest"

Used as justification for rich-poor divide, Capitaism, etc. etc.



Ethics in Society, Distribution of Wealth



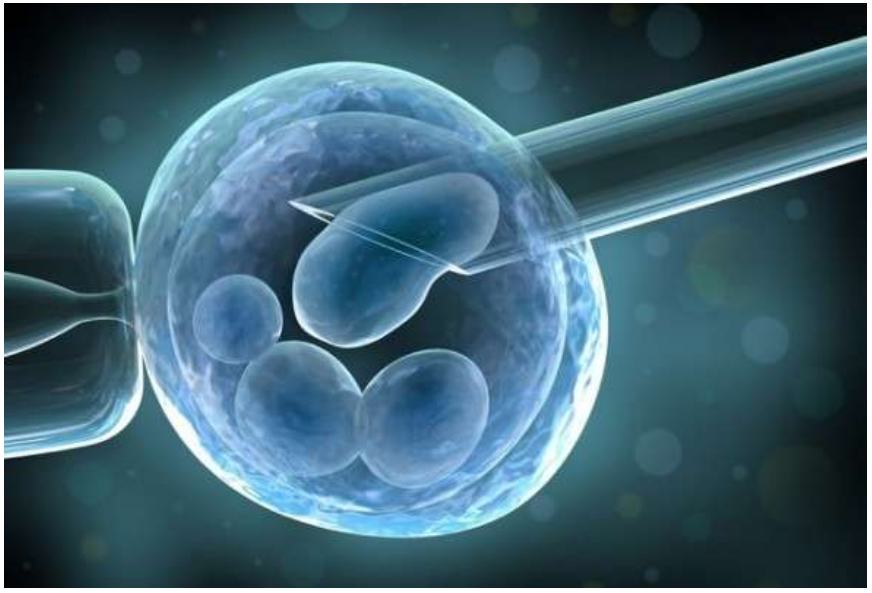
"WHAT?"

Eugenics Movement – stop genetic disease?

London poster, 1930s

Eugenics Education, Kansas

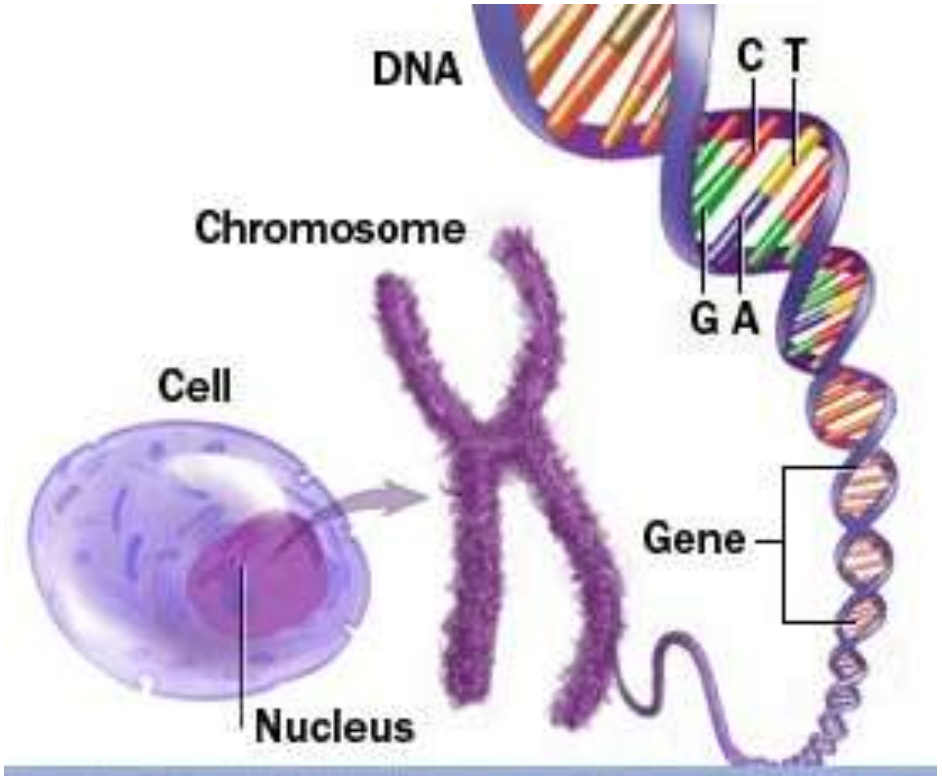

DISCOVER YOUR DNA
ADDITIONAL LAB FEE REQUIRED - SEE BACK FOR DETAILS
PATHWAY GENOMICS INSIGHT
DISCOVER YOUR DNA
LEARN
REVEAL
DETECT
Your Genetic Risks for:
Obesity
Prostate Cancer
Diabetes
Heart Disease
Multiple Sclerosis
EASY-TO-USE SALIVA COLLECTION KIT ENCLOSED




FIBROSIS
EARLY ONSET
ALZHEIMER'S
DISEASE
SYNDROME

Watson and Crick - DNA

The molecular systematics era begins



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