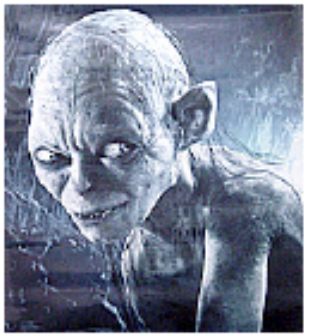


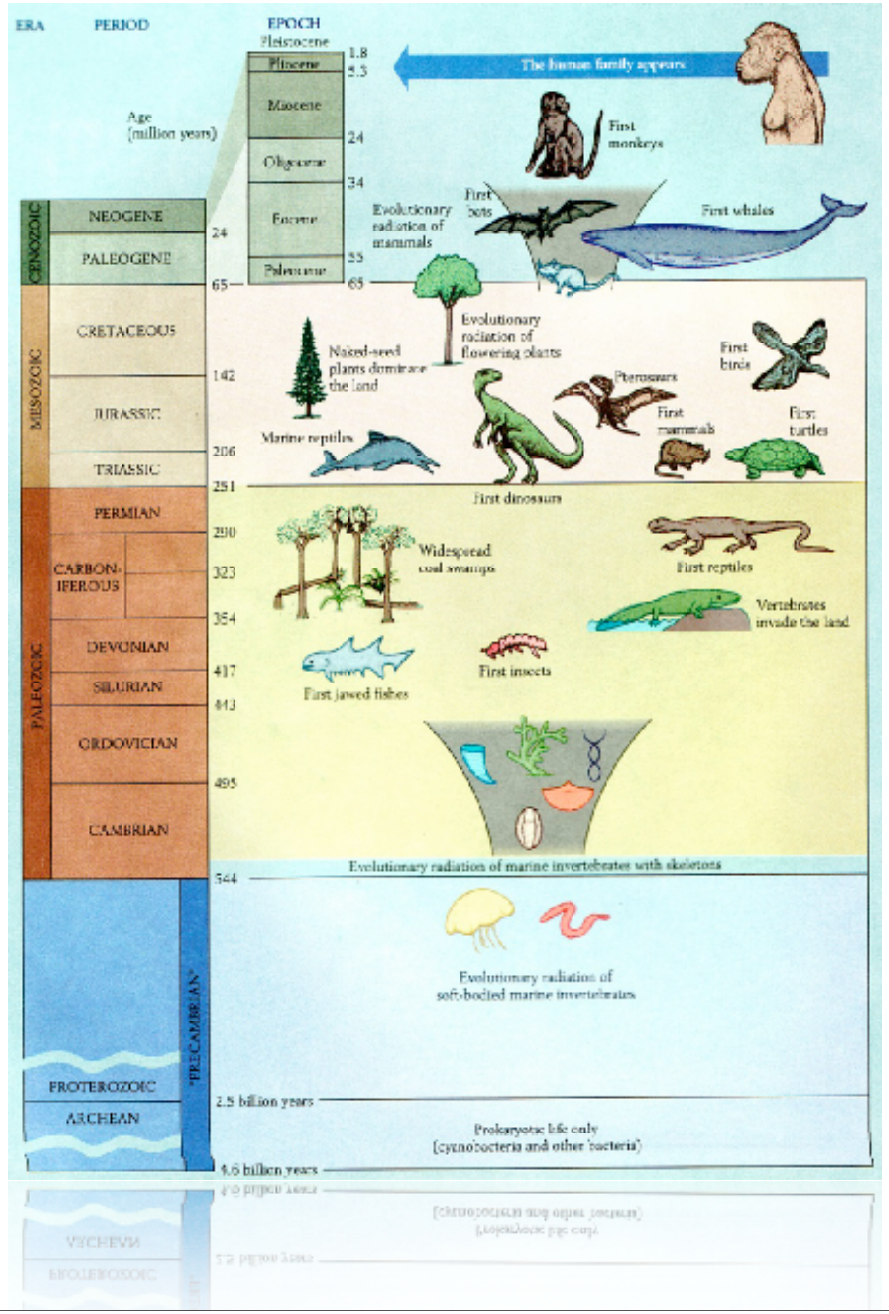
Historical Geology II - GEOL 30143
Lectures & Lab for Spring, 2009
Dr. Arthur B. Busbey III

Class:	Tuesday & Thursday, 8:00 AM- 9:20 AM
Lab:	Tuesday 1 to 3:20 or thereabouts
Instructor:	Dr. Arthur B. Busbey III Email: a.busbey@tcu.edu
Prerequisite:	Geology 30133 or Permission of Insructor
Office:	SWR 254
Office Hours:	Officially MW 1-1:50 but feel free to come in at any time.
Contact:	817-257-7301 Office, 370-6006 Home, Email: a.busbey@tcu.edu, AIM/iChat:abusbey, SKYPE: a.busbey
Required text:	Evolution of the Earth, 7th Ed. (2004), Dott & Prothro, McGraw Hill.
Website:	http://geo1.tcu.edu/faculty/historical2

Historical II

- Focus on actual history
- Start with a few lectures on theory
- Lectures focus on history of earth and life on earth
- Labs focus on learning a variety of marine invertebrate fossils
- You will need to purchase a 'lab notebook'. In this you will take notes, make sketches, answer questions. You can use these notes (not my handouts) in lab exams so you should take some time to make sure they are complete.

- Most labs are hands-on with fossils.
- Many labs may take more than the scheduled lab time to finish. As such, though the labs are on Tuesday, the lab notebook will not be due until the Monday of the next week.
- Since it is not easy to make up a lab you should do your best to be there ON TIME.
- Make SURE you have no conflicts with the scheduled field trip. 25% of your lab grade is based on a report on the fossils collected and you will not be able to duplicate the trip after it has happened.

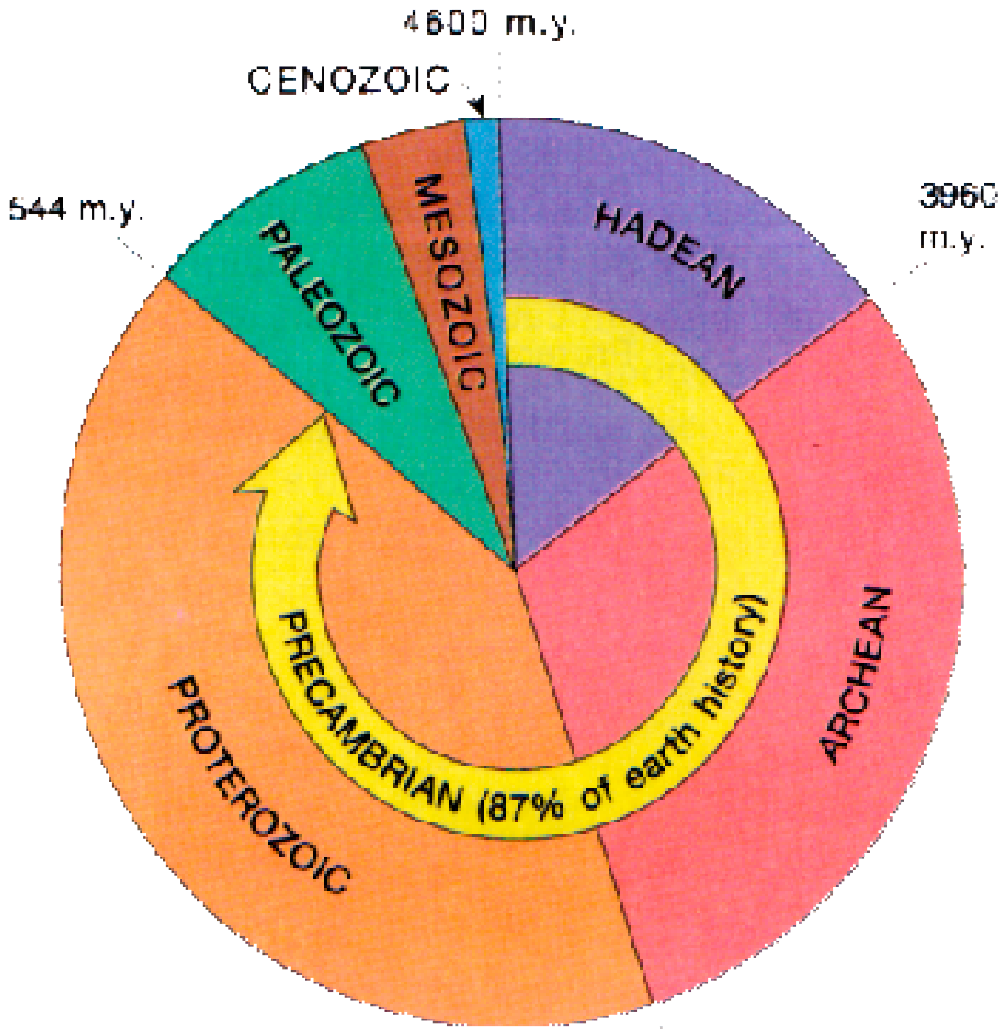


Geologic Time Scale

A MUST KNOW!

Eons, Eras, Periods and Cenozoic Epochs.

Dates associated with the boundaries.


4600 m.y.
CENOZOIC
544 m.y.
MESOZOIC
PALEOZOIC
HADEAN
3960
m.y.
PRECAMBRIAN (87% of earth history)
PROTEROZOIC
ARCHEAN
2500

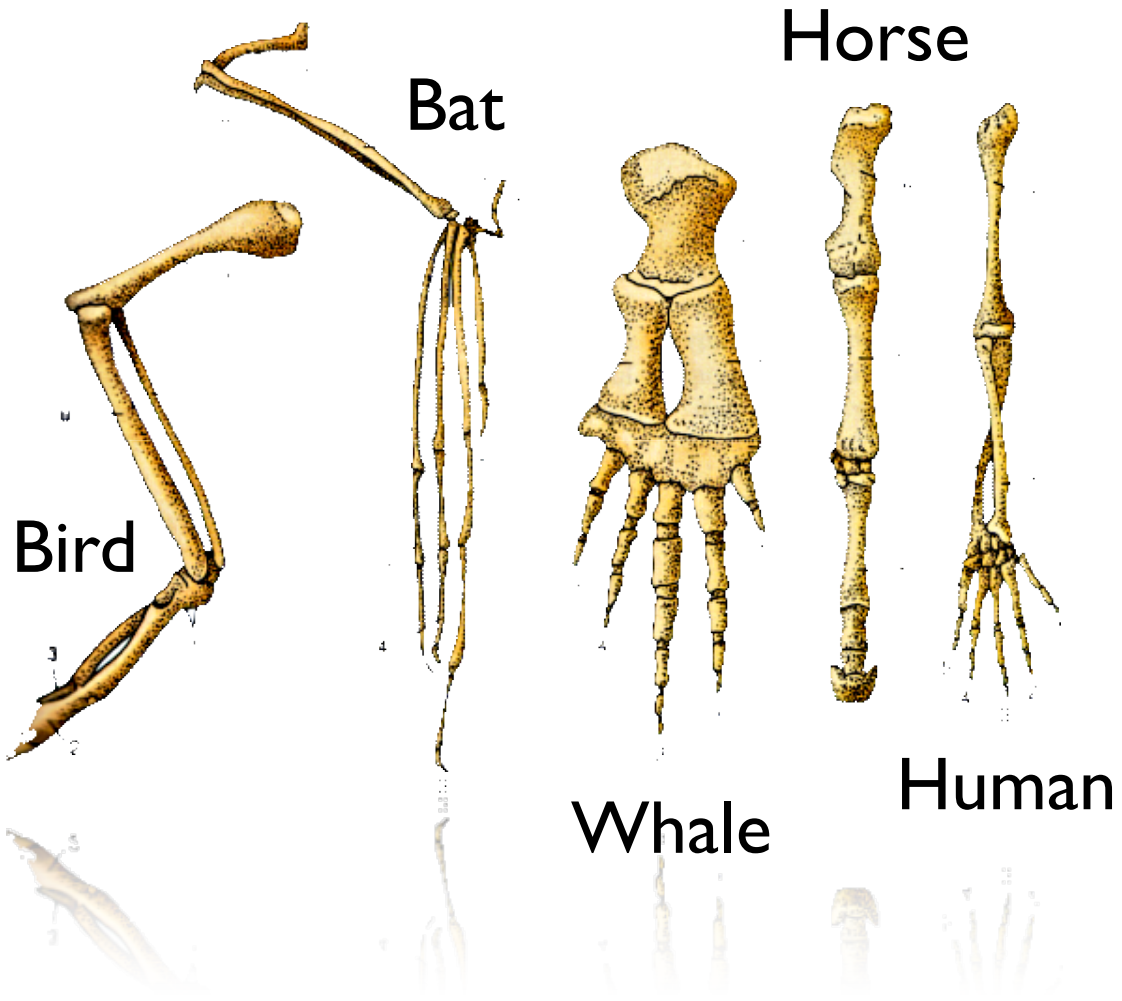
Evolution

Organic Change Through Time

Who came up with Evolution?

- NOT Darwin - the concept predated Charles Darwin by nearly 200 years
- Many naturalists began to realize that there must have been some kind of transitions of organisms as they began to study them.
- There were 'gradients' of similarity that suggested some constant continuity of life.
- The term 'Evolution' was coined before Darwin by Jean Baptist Lamark.

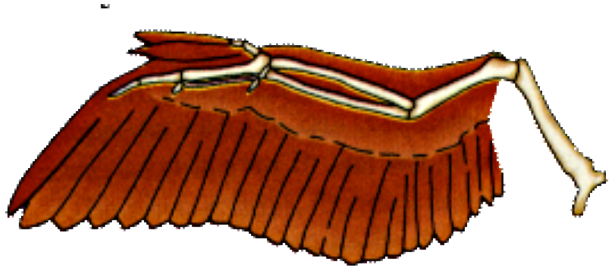
Evolution



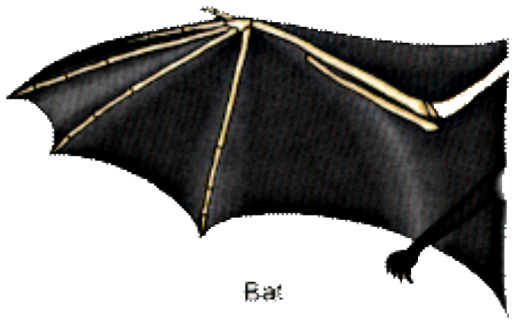
Comparative Anatomy

Evolution

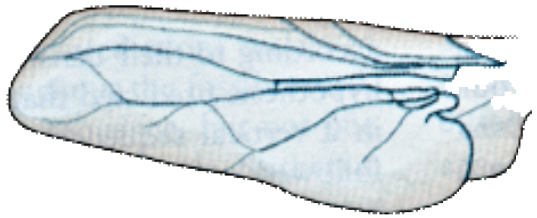
Homologous



Bird

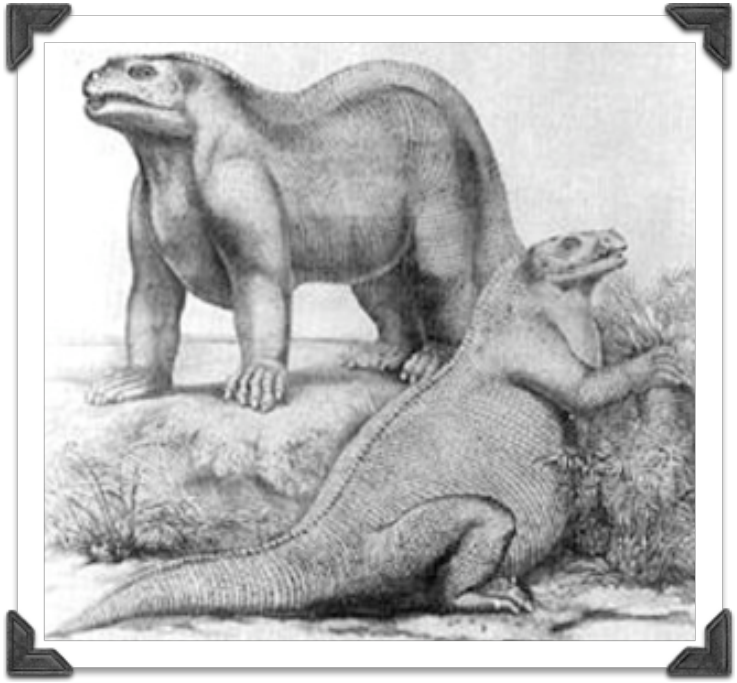


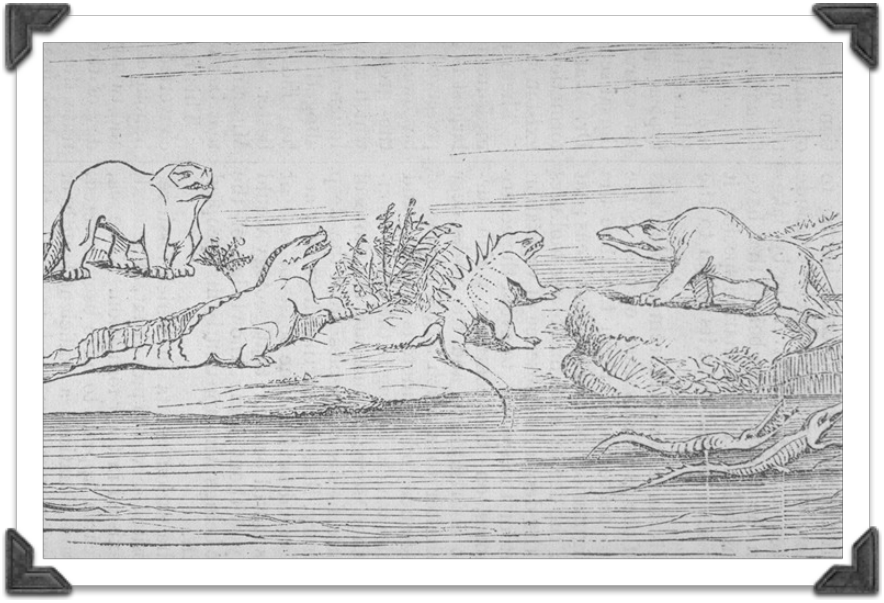
Bat



Fly

Analogous

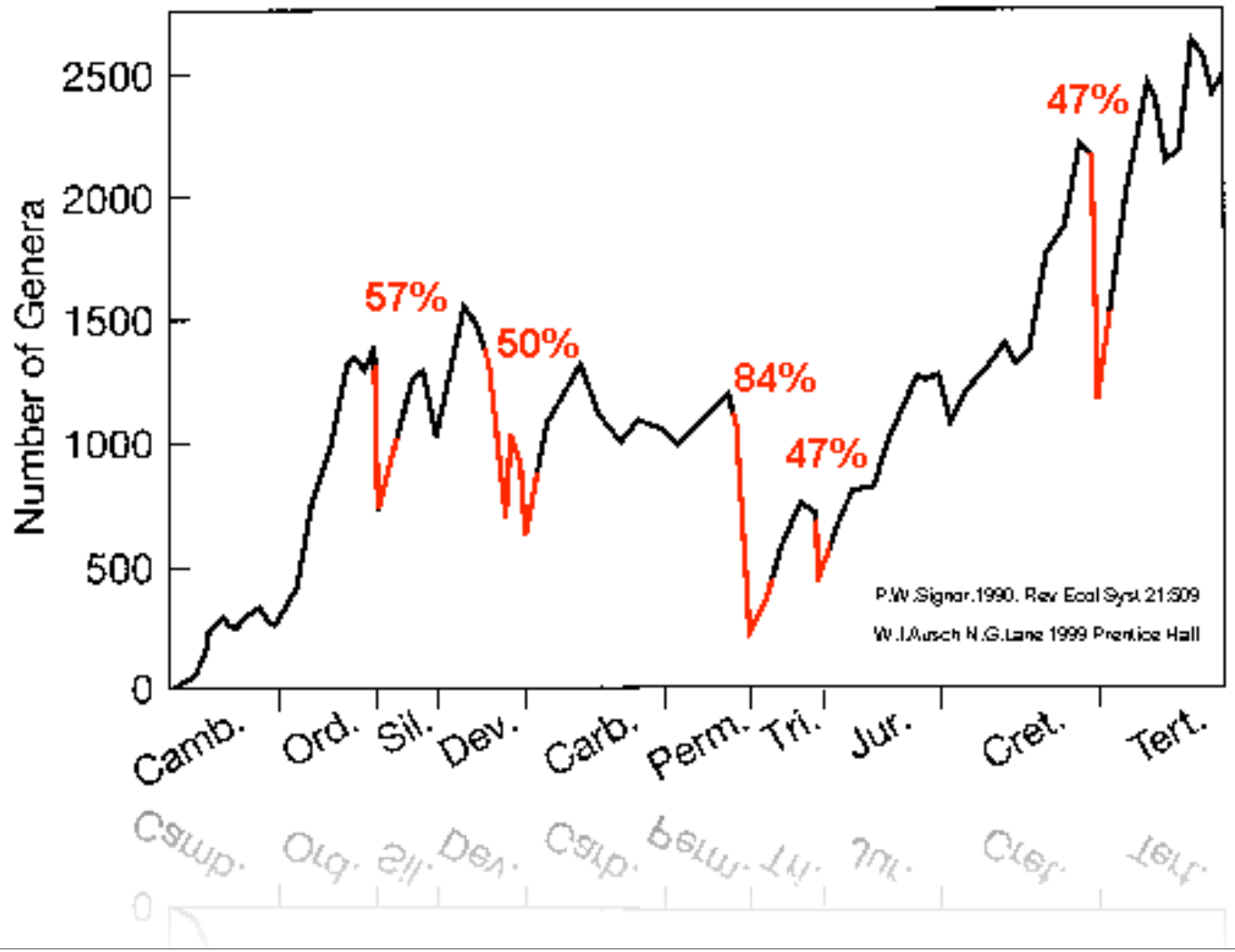




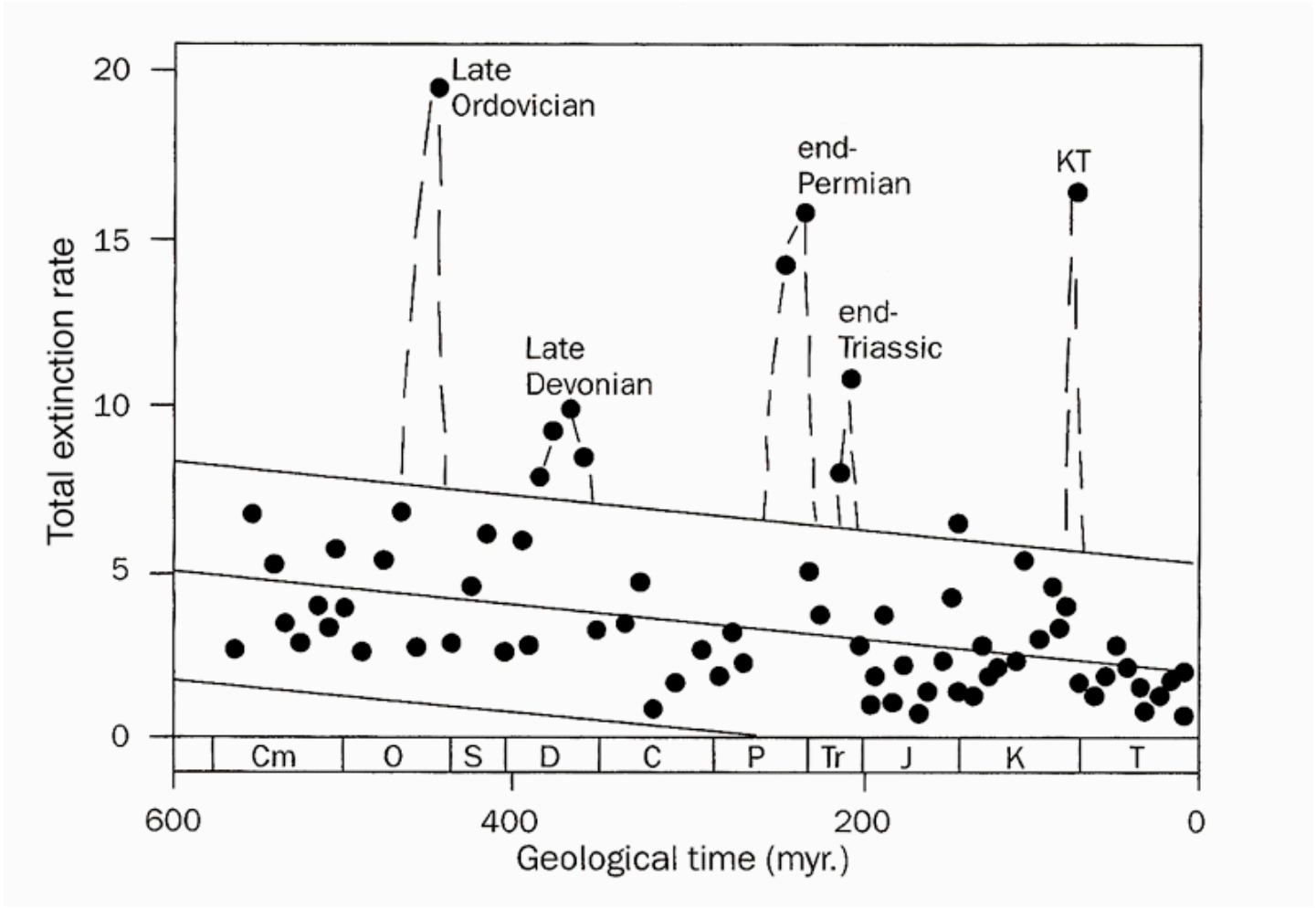
Early naturalists, as they began to look at fossils in detail, also began to realize that major groups of organisms were no longer around. They were 'extinct'.

Evolution

Extinction

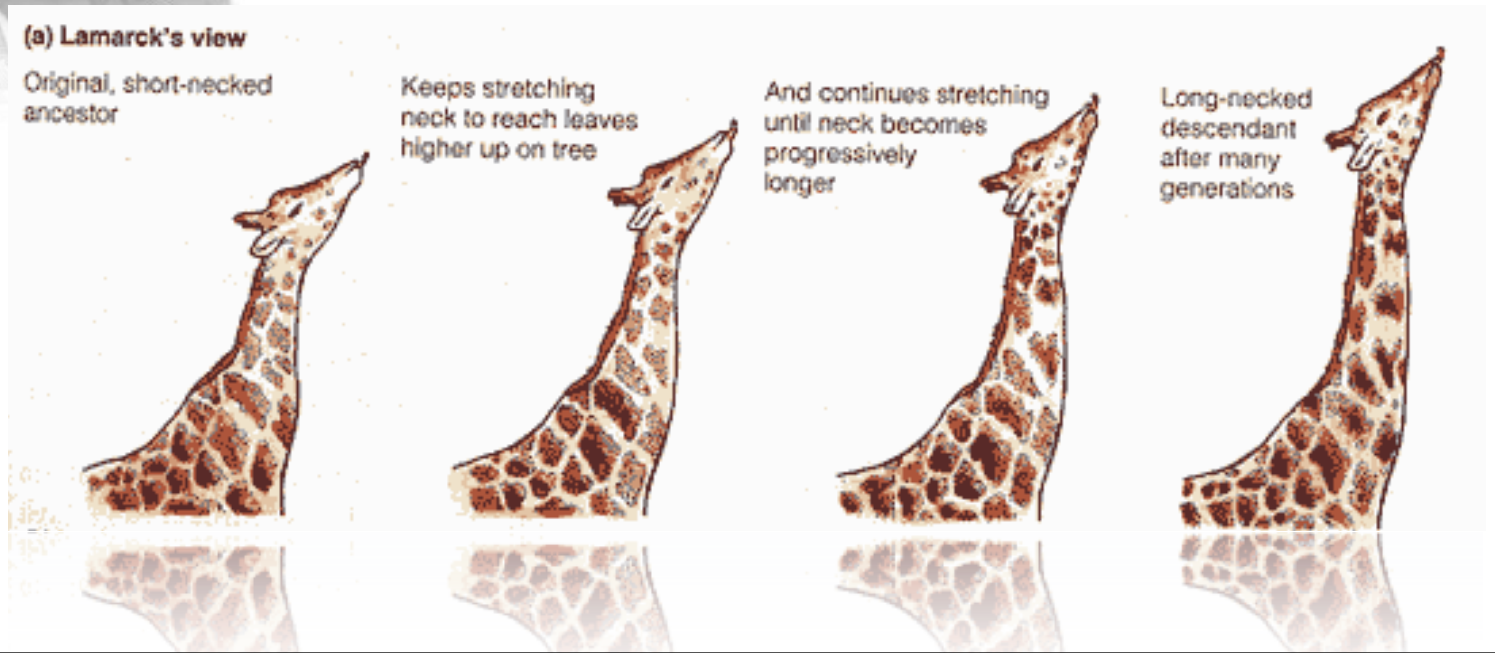


Mass Extinctions



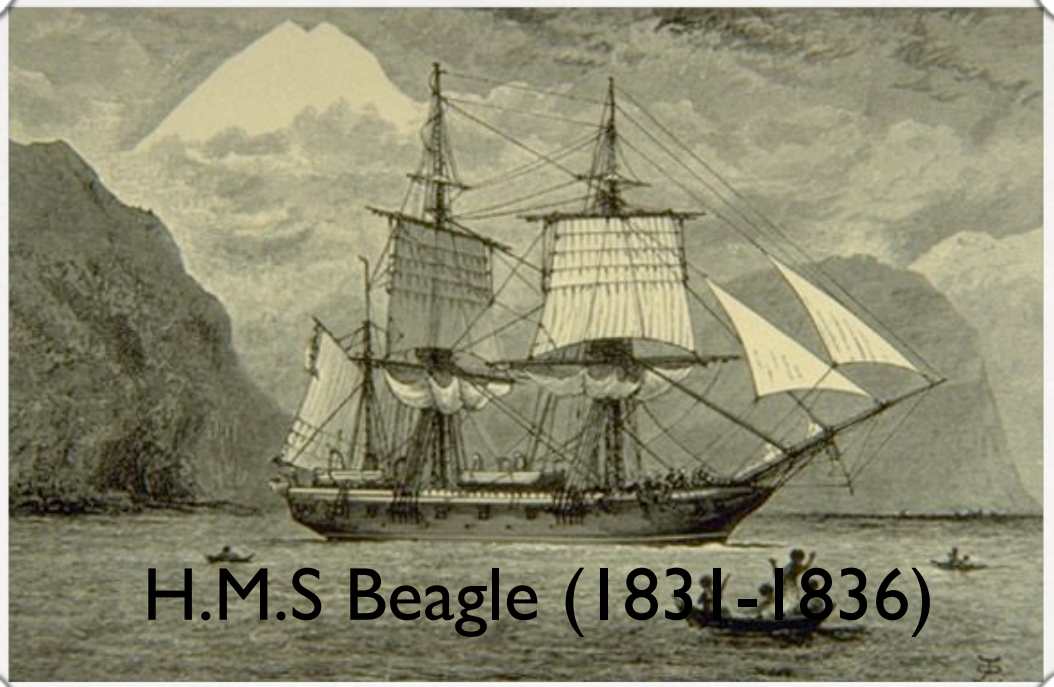
Evolution

Jean Baptist de Lamark (1744-1829)
Evolution by Inheritance of Acquired Characters

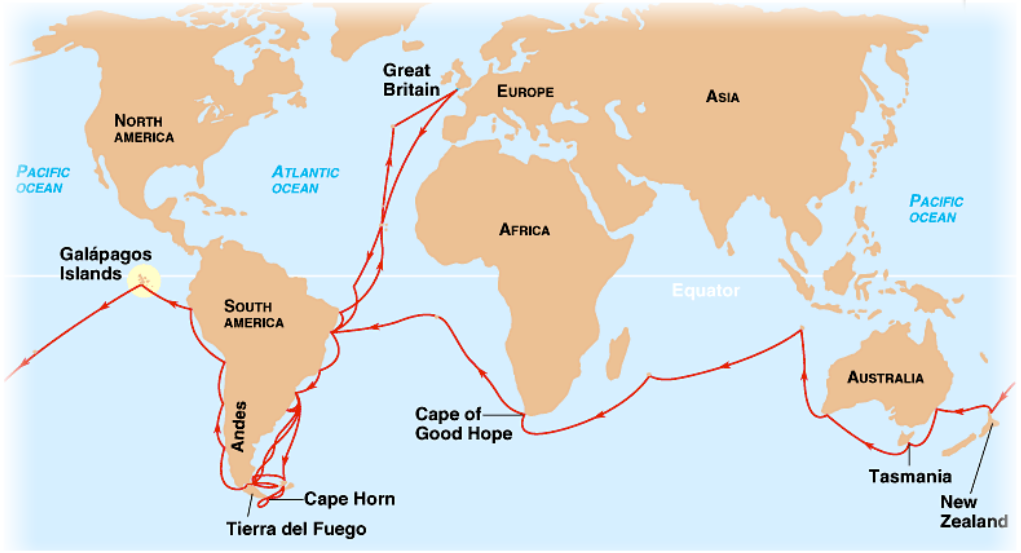


Evolution

22 when Darwin started



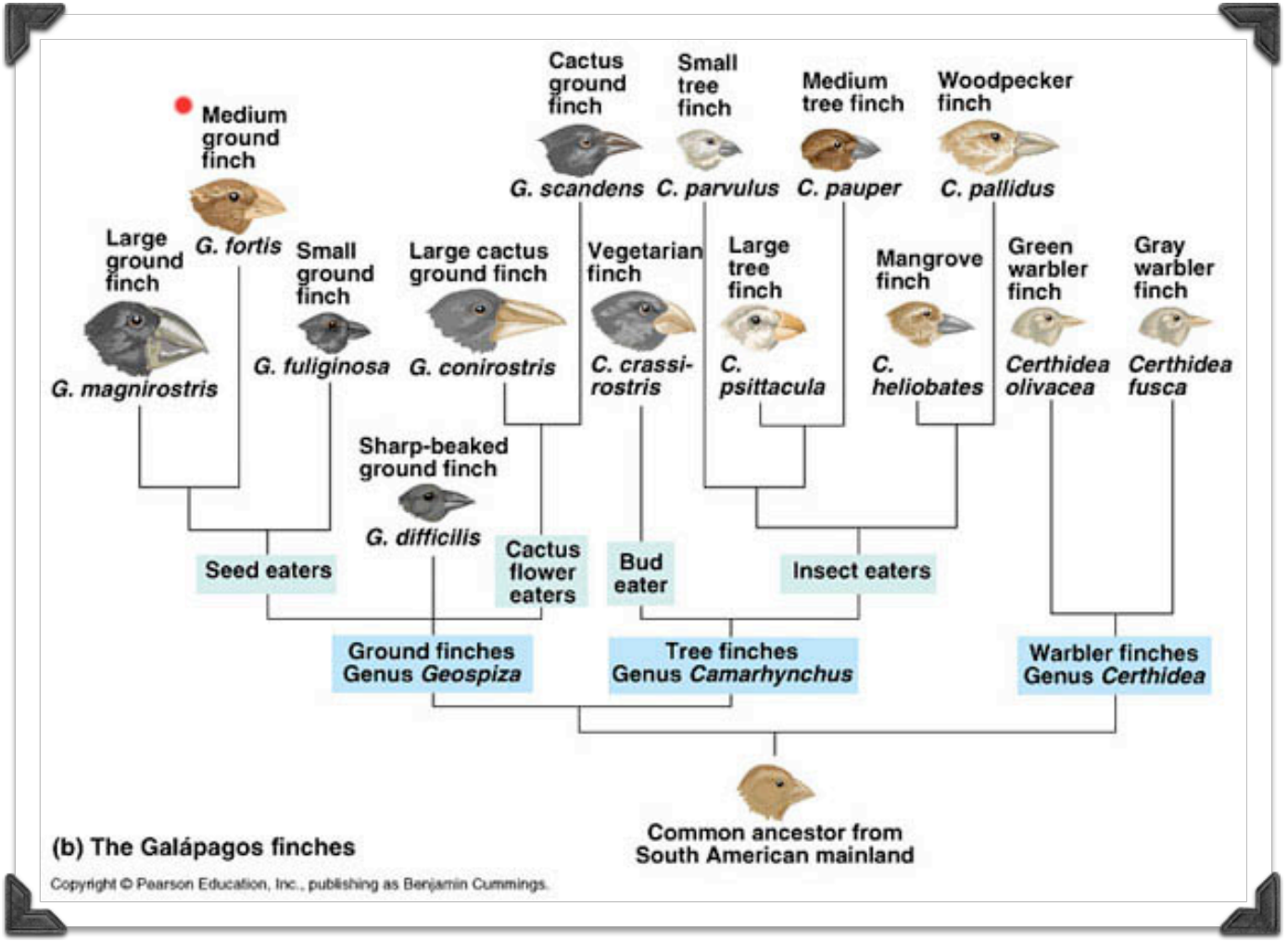
H.M.S Beagle (1831-1836)



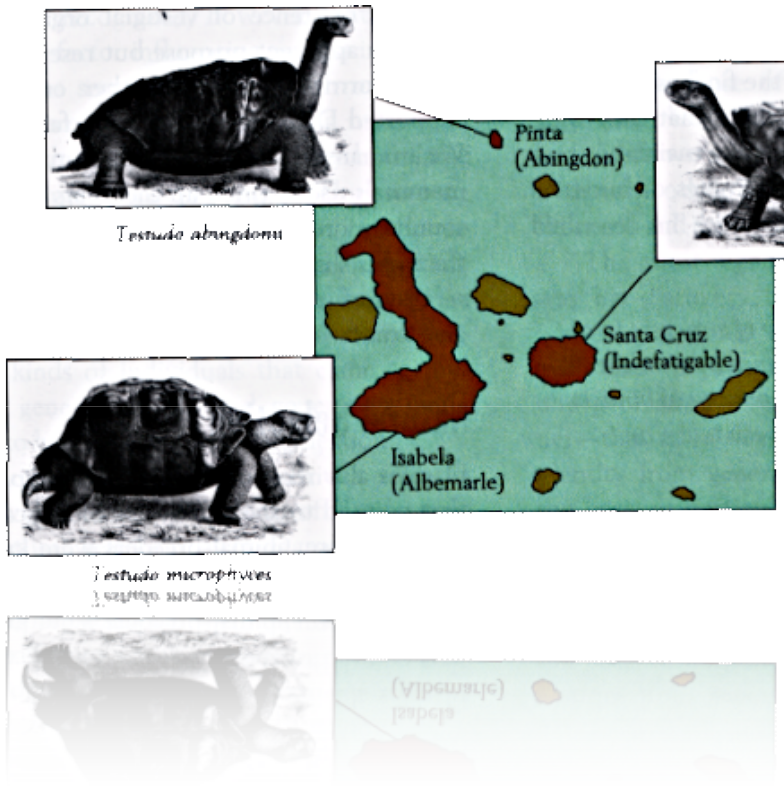
Evolution

Darwin's Finches

Evolution


Medium ground finch
G. fortis
Large ground finch
G. magnirostris
Small ground finch
G. fuliginosa
Cactus ground finch
G. scandens
Large cactus ground finch
G. conirostris
Small tree finch
C. parvulus
Vegetarian finch
C. crassi-rostris
Medium tree finch
C. pauper
Large tree finch
C. psittacula
Woodpecker finch
C. pallidus
Mangrove finch
C. heliobates
Green warbler finch
Certhidea olivacea
Gray warbler finch
Certhidea fusca
Sharp-beaked ground finch
G. difficilis
Seed eaters
Cactus flower eaters
Bud eater
Insect eaters
Ground finches Genus Geospiza
Tree finches Genus Camarhynchus
Warbler finches Genus Certhidea
Common ancestor from South American mainland
(b) The Galápagos finches
Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.

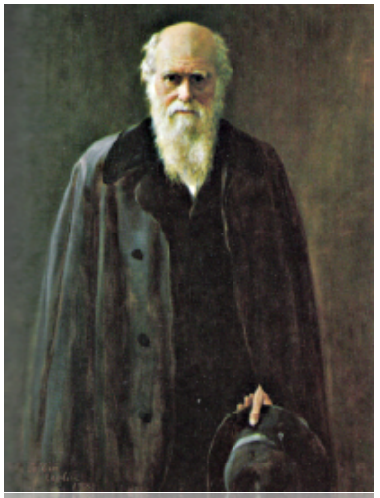
Evolution


Pinta
(Abingdon)
Santa Cruz
(Indefatigable)
Isabela
(Albemarle)

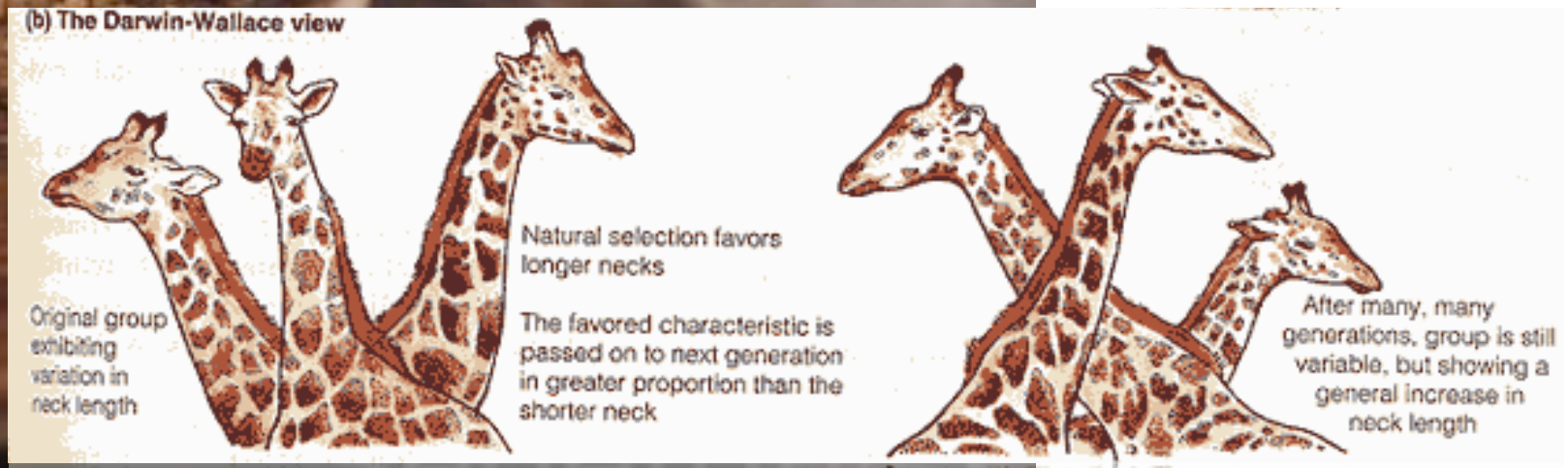
Evolution

Darwin/Wallace
Evolution by Natural Selection

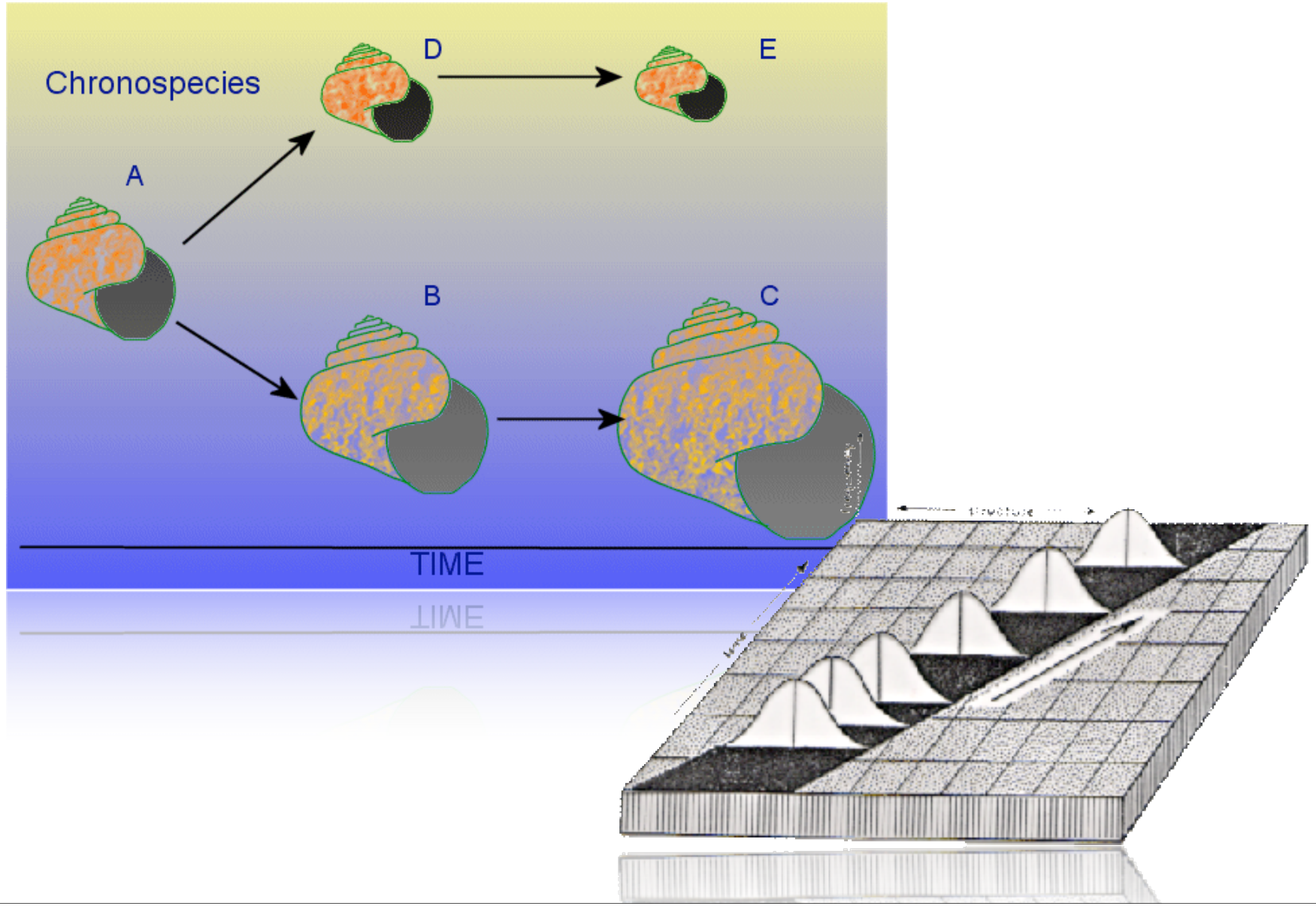
On the Origin of Species



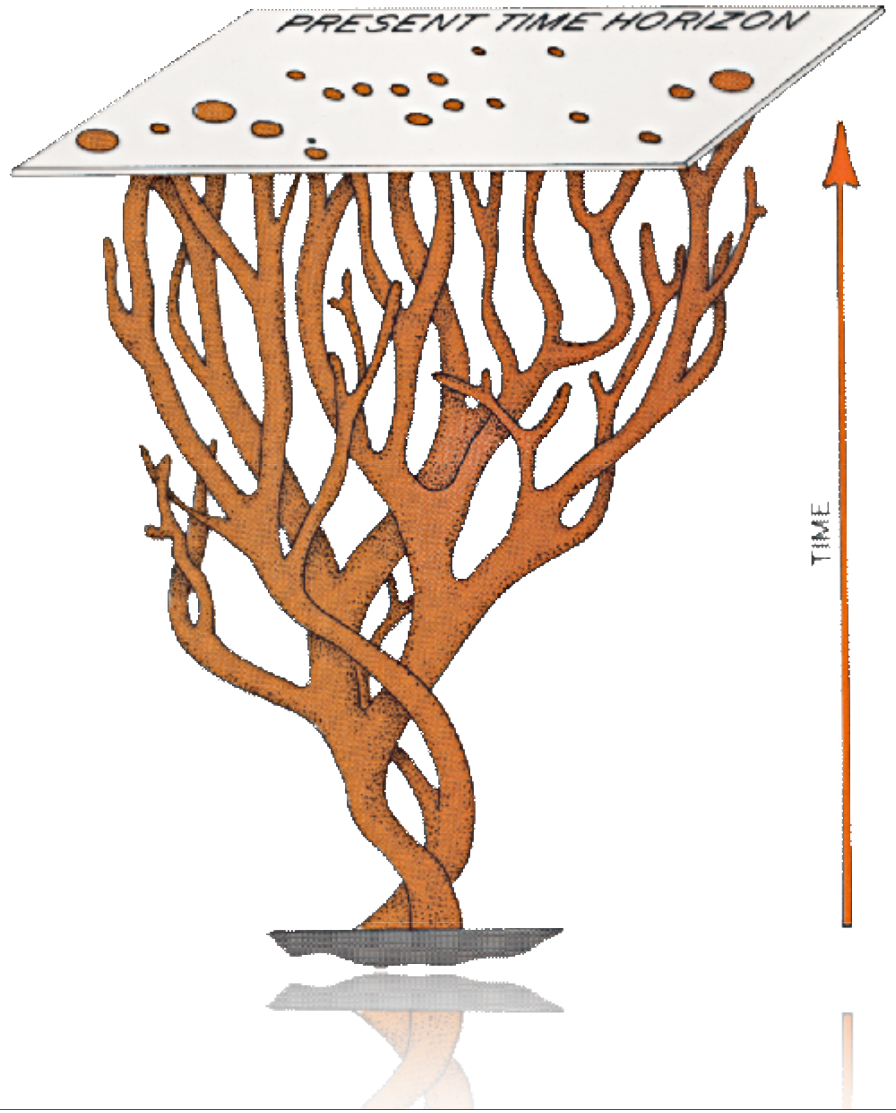
1859



Evolution



Evolution



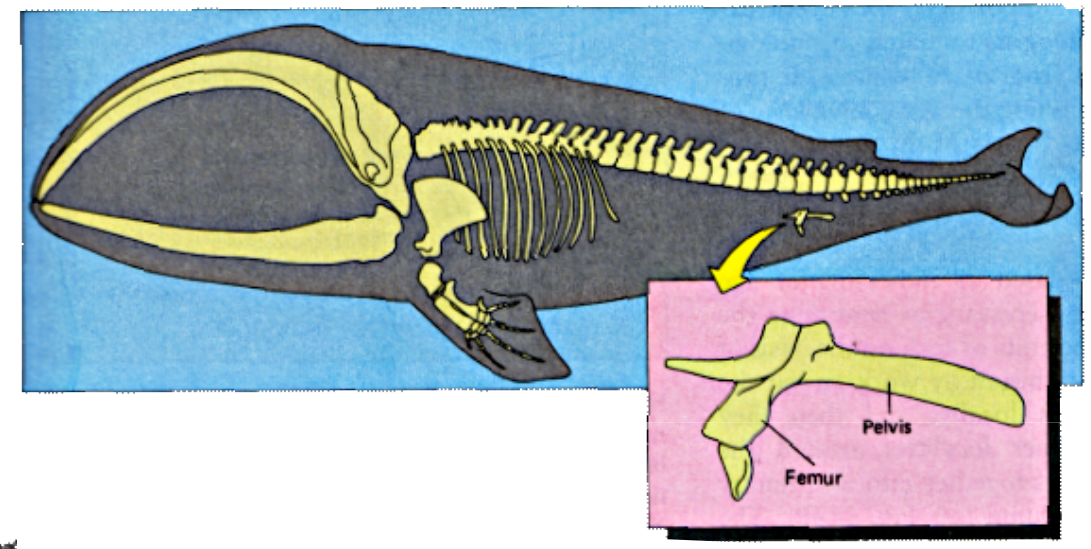
Evolution

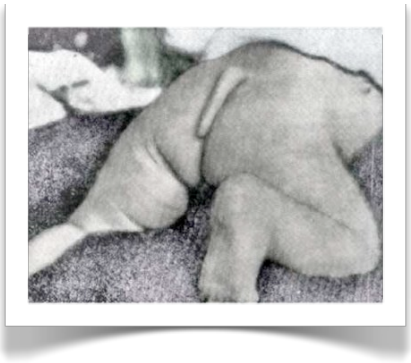
Lines of Evidence

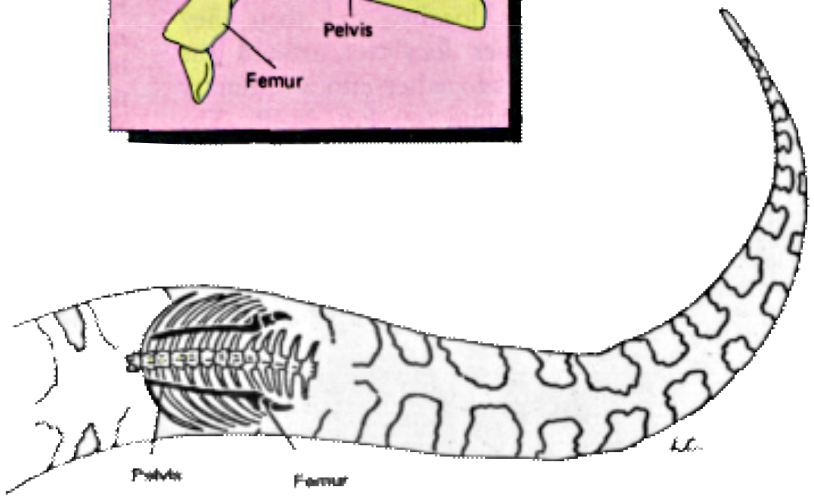
1. Comparative Anatomy

Evolution

Lines of Evidence







I. Comparative Anatomy - vestigial organs

Evolution

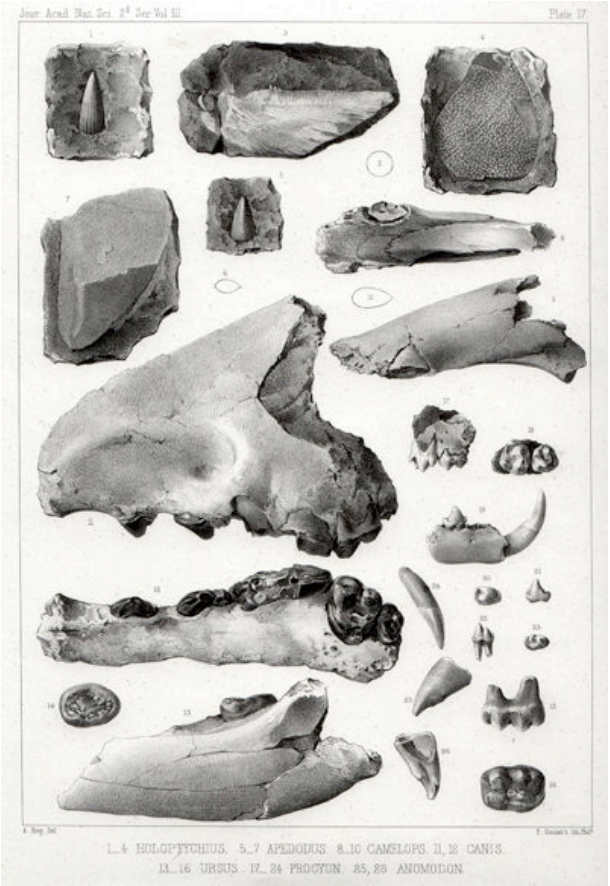
Lines of Evidence

Shark Salamander Turtle Chick Human

II. Embryology

Evolution

Lines of Evidence



III. Fossil Record

Evolution

Main Scientific Objections - mid 19th Century

- Fossil record not that good - seems to show new forms arriving with no predecessors.
- Not enough time for process to occur
- No way to inherit the random variation in characteristics that appear in each generation - (Blended Inheritance)

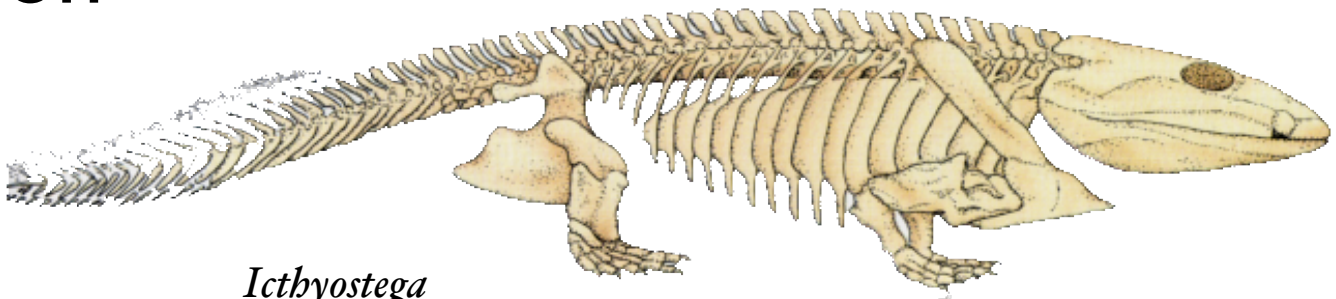
The 20th Century

Darwin was finally vindicated, on all counts, during the 20th century. Let us look at the evidence.

Evolution Now there are many transitional forms!

Archaeopteryx
oldest bird

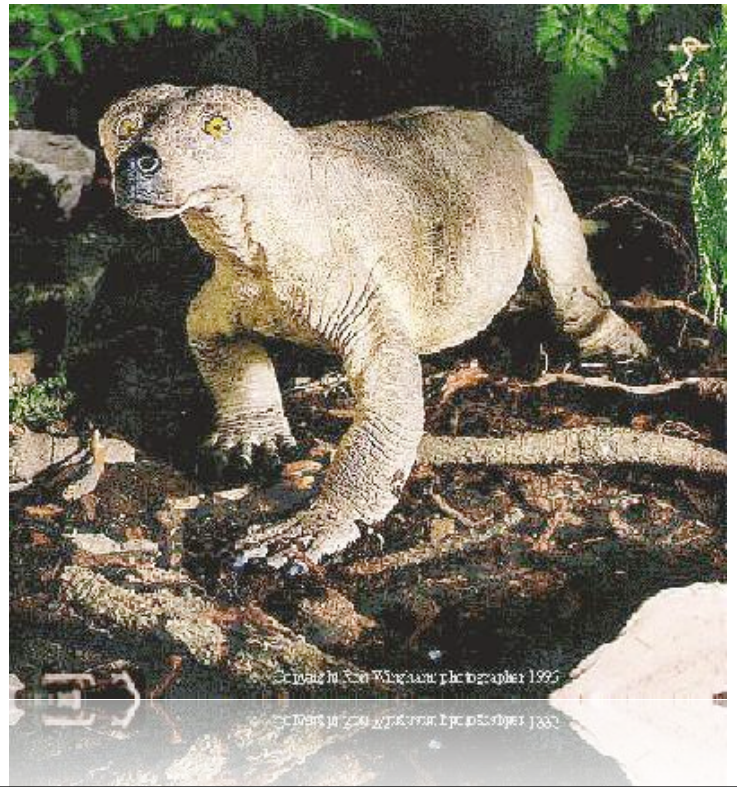
Evolution



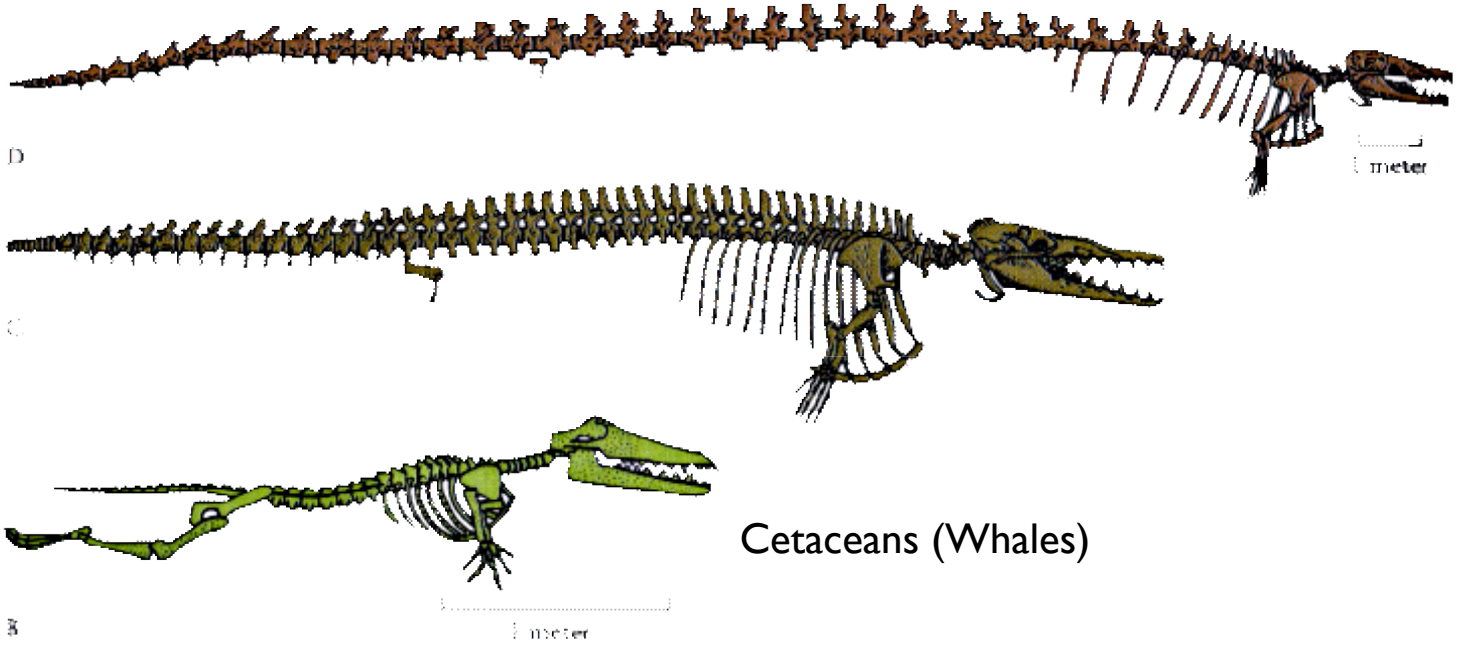
Icthyostega
oldest amphibian

‘Mammal-like reptiles’

Not really reptiles but called this in many books

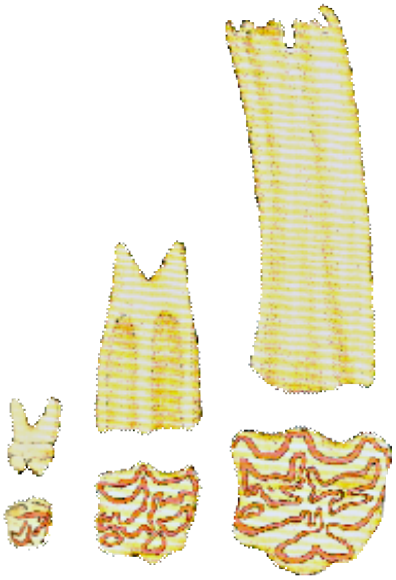


Evolution

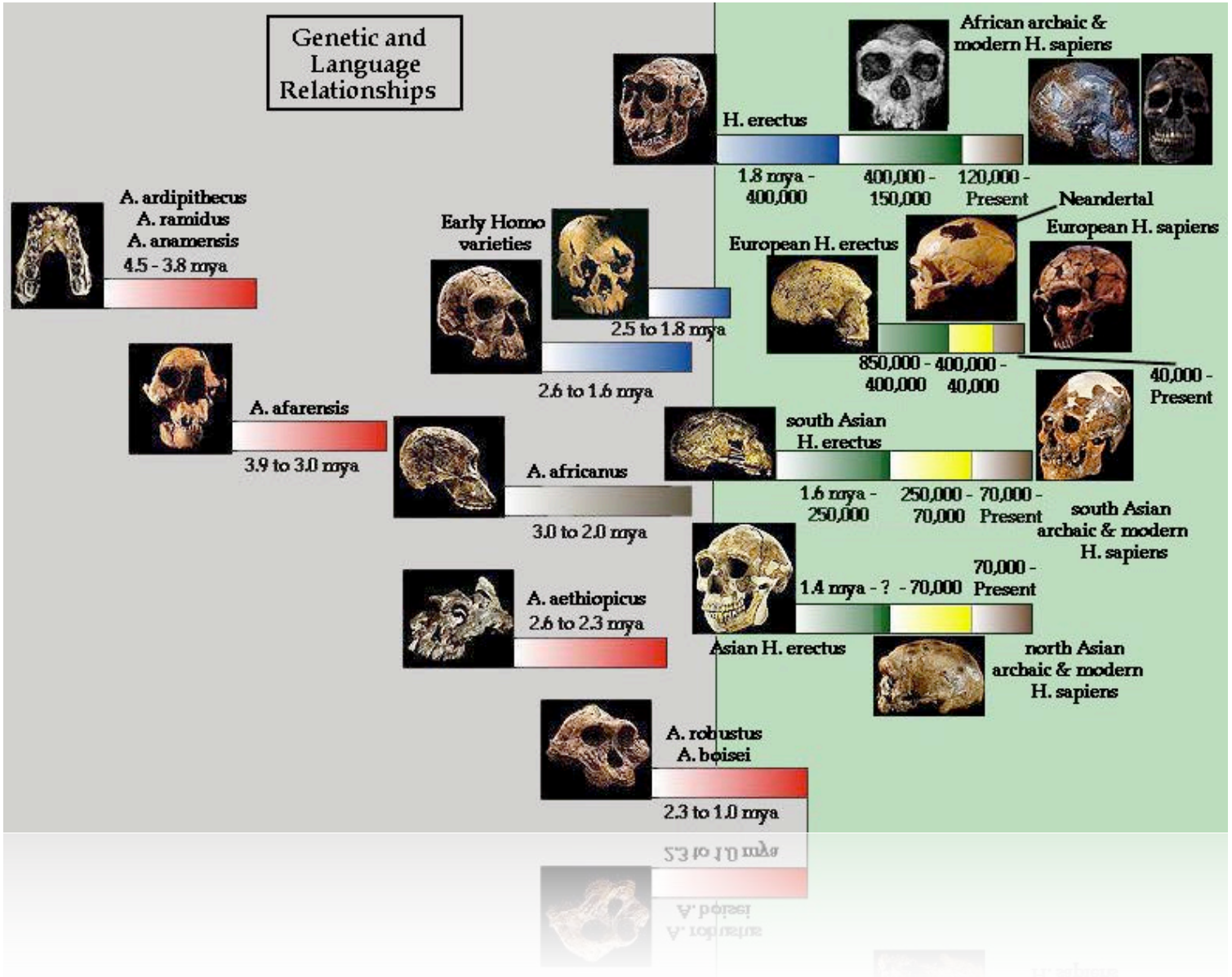


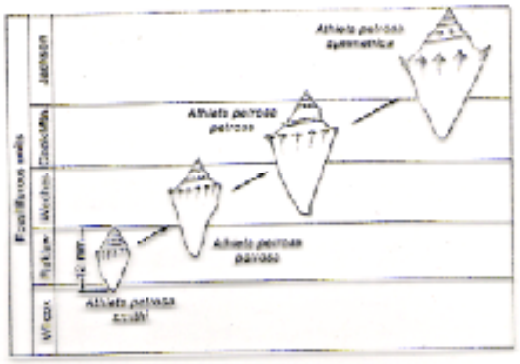
Cetaceans (Whales)

Transitional sequences

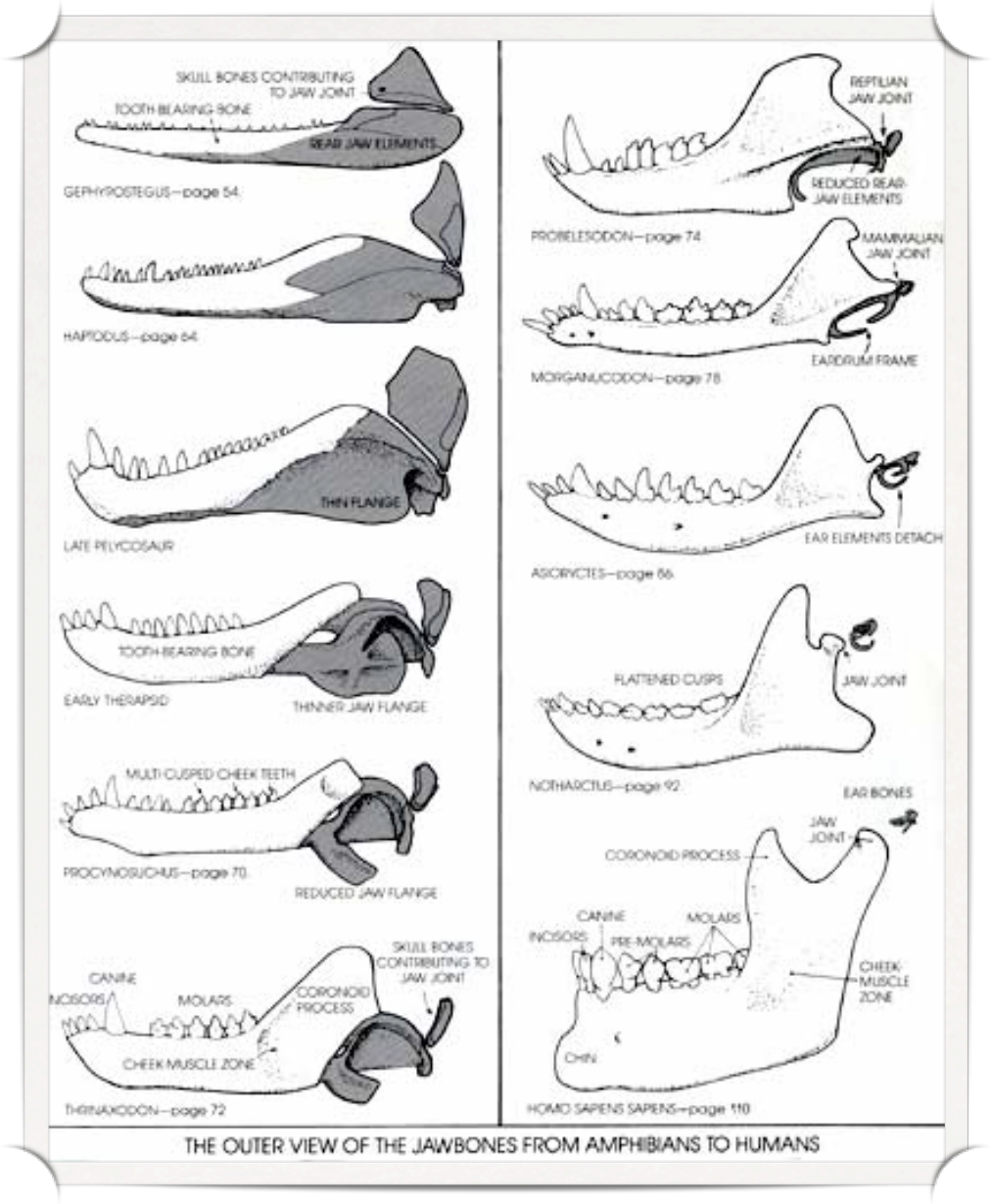


Equines (Horses)


Genetic and Language Relationships
African archaic & modern H. sapiens
H. erectus
1.8 mya - 400,000
400,000 - 150,000
120,000 - Present
Neandertal
European H. sapiens
European H. erectus
850,000 - 400,000
400,000 - 40,000
40,000 - Present
A. ardipithecus
A. ramidus
A. anamensis
4.5 - 3.8 mya
Early Homo varieties
2.5 to 1.8 mya
2.6 to 1.6 mya
A. afarensis
3.9 to 3.0 mya
A. africanus
3.0 to 2.0 mya
south Asian H. erectus
1.6 mya - 250,000
250,000 - 70,000
70,000 - Present
south Asian archaic & modern H. sapiens
A. aethiopicus
2.6 to 2.3 mya
1.4 mya - ? - 70,000
70,000 - Present
Asian H. erectus
north Asian archaic & modern H. sapiens
A. robustus
A. boisei
2.3 to 1.0 mya

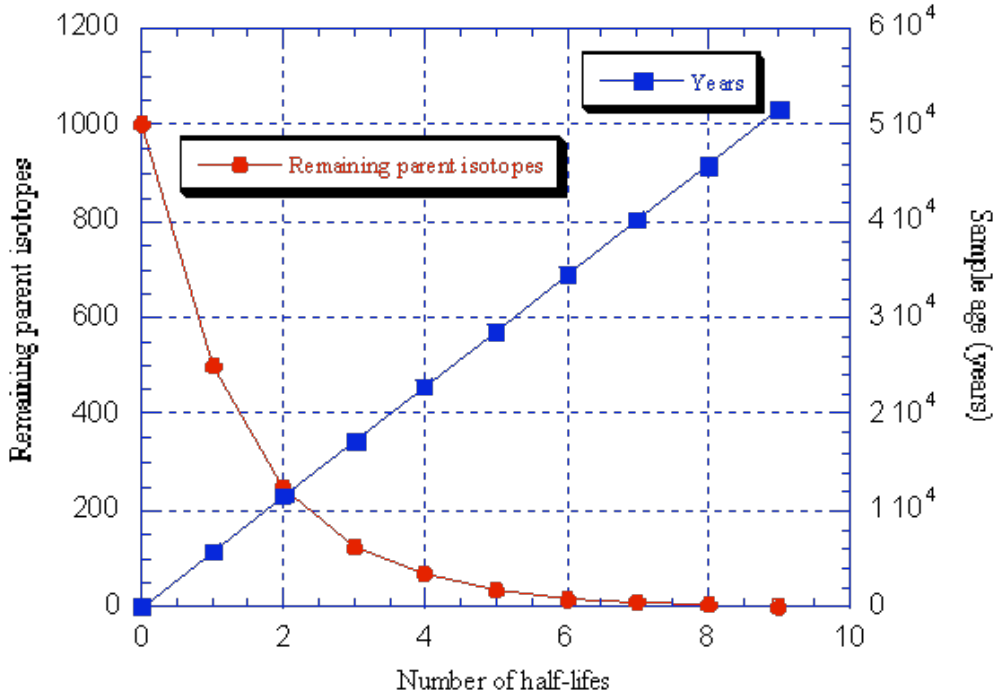


Transitional sequences



Evolution

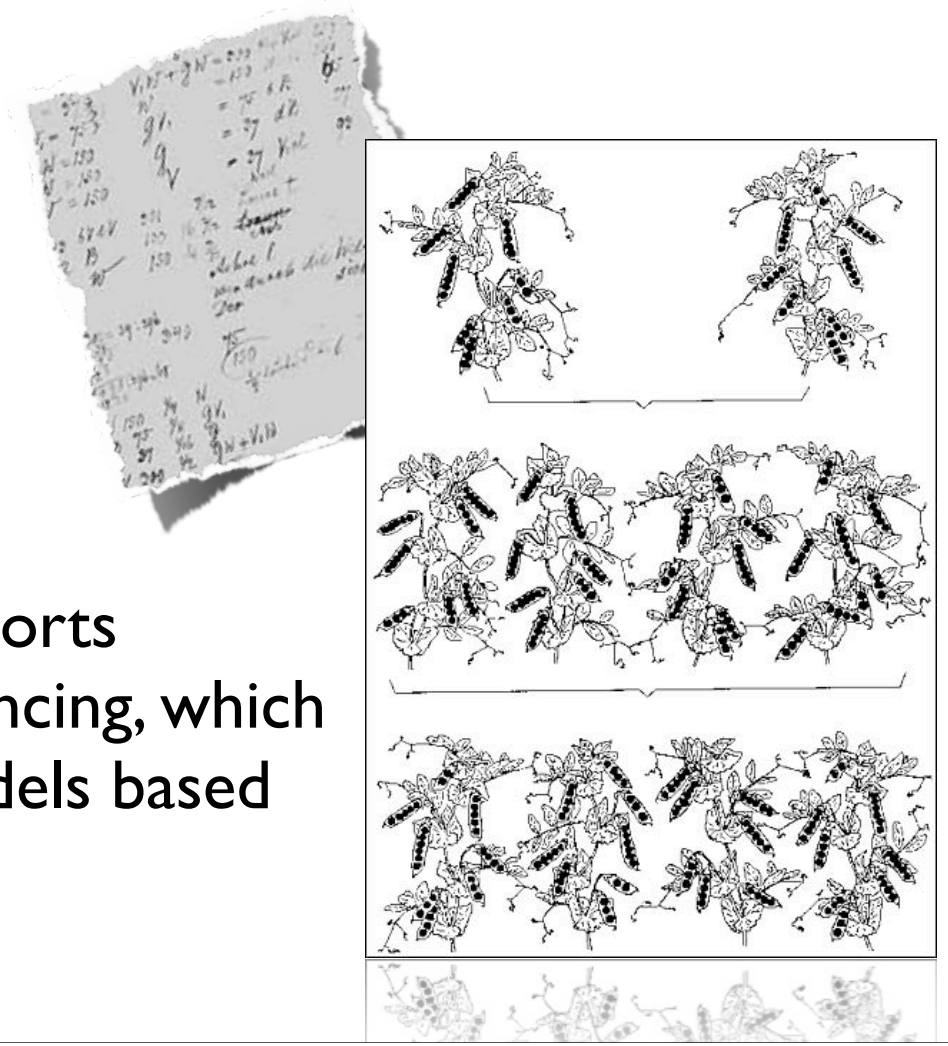
Now we know there is plenty of time for evolution to have occurred!



Evolution

Gregor Mendel

Now we know that inheritance is particulate - we can pass on known characters!



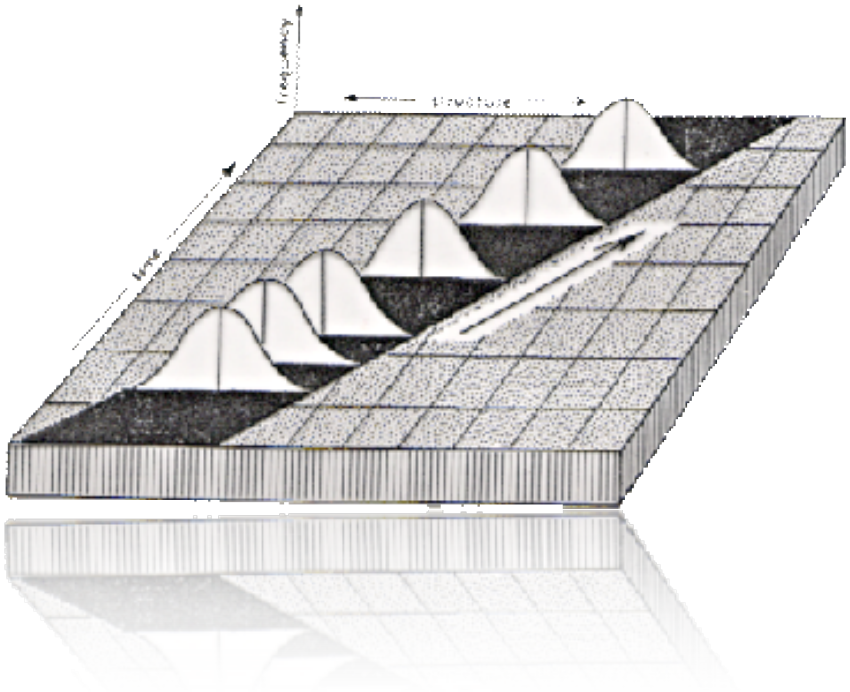
Modern genetics also supports evolution with gene sequencing, which supports evolutionary models based on anatomy!

Evolution

Sympatric Speciation

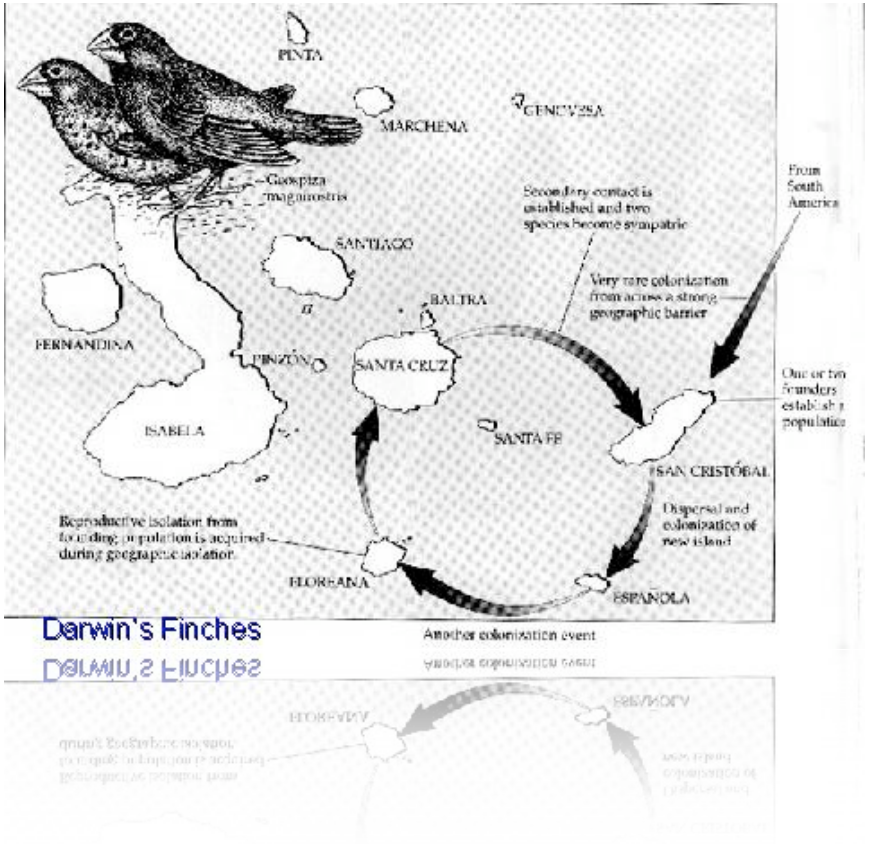
Entire gene pool changes in time.

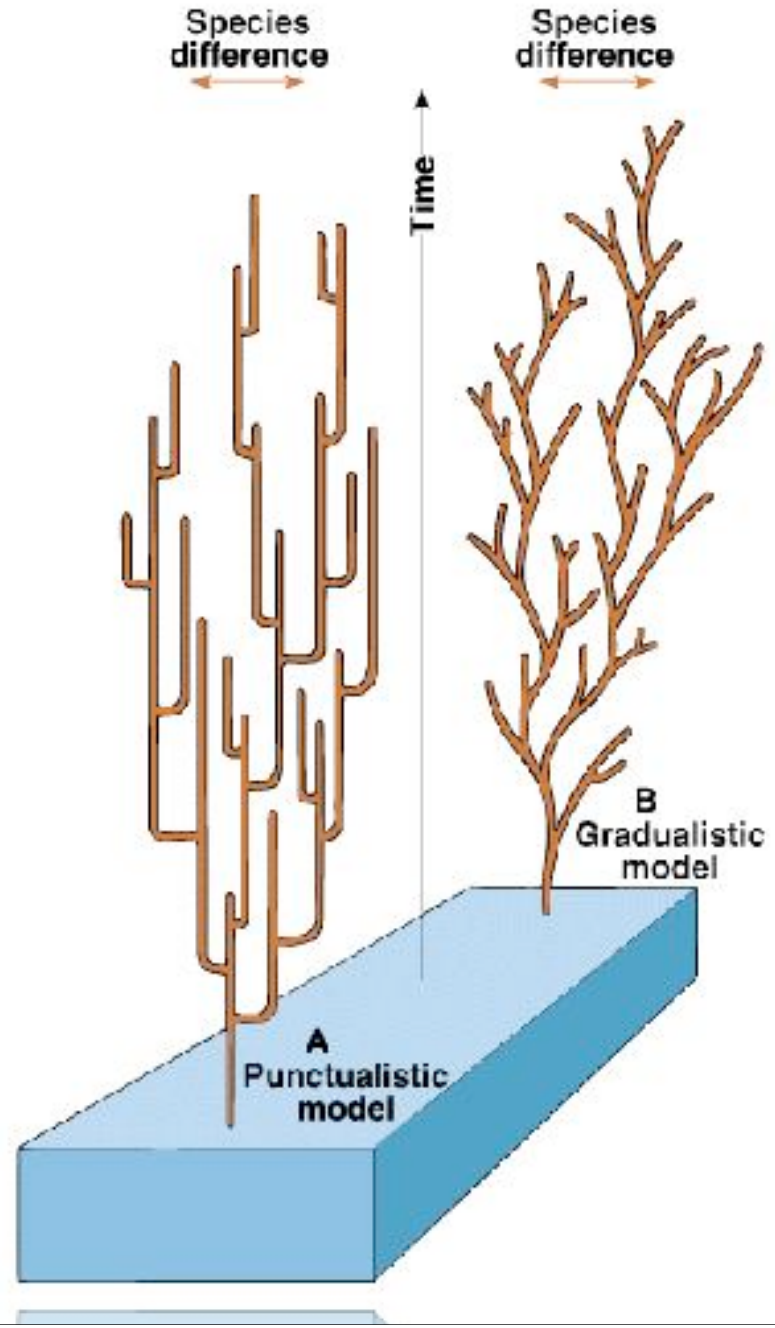
Chronospecies



Allopatric Speciation

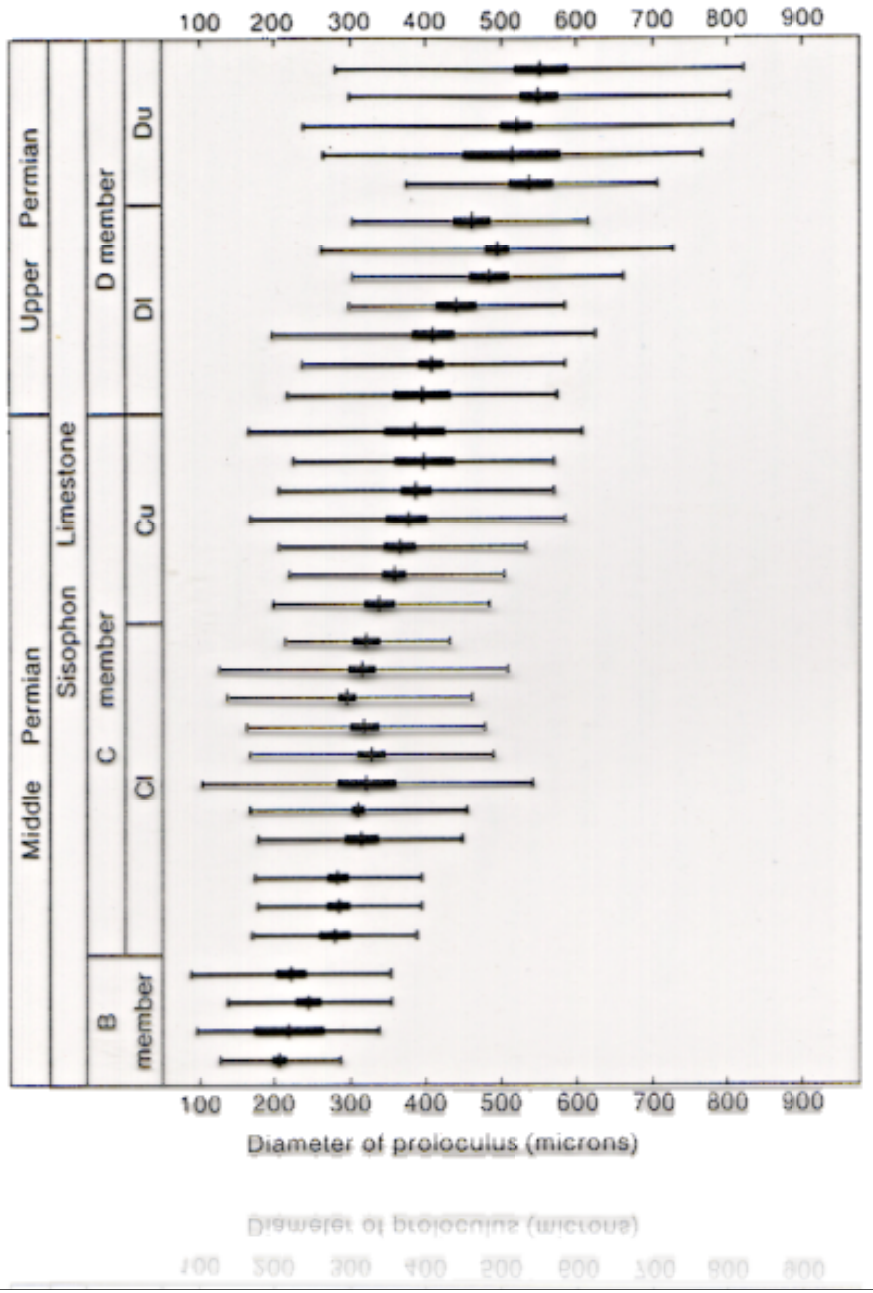
Gene pool isolates change in isolation.



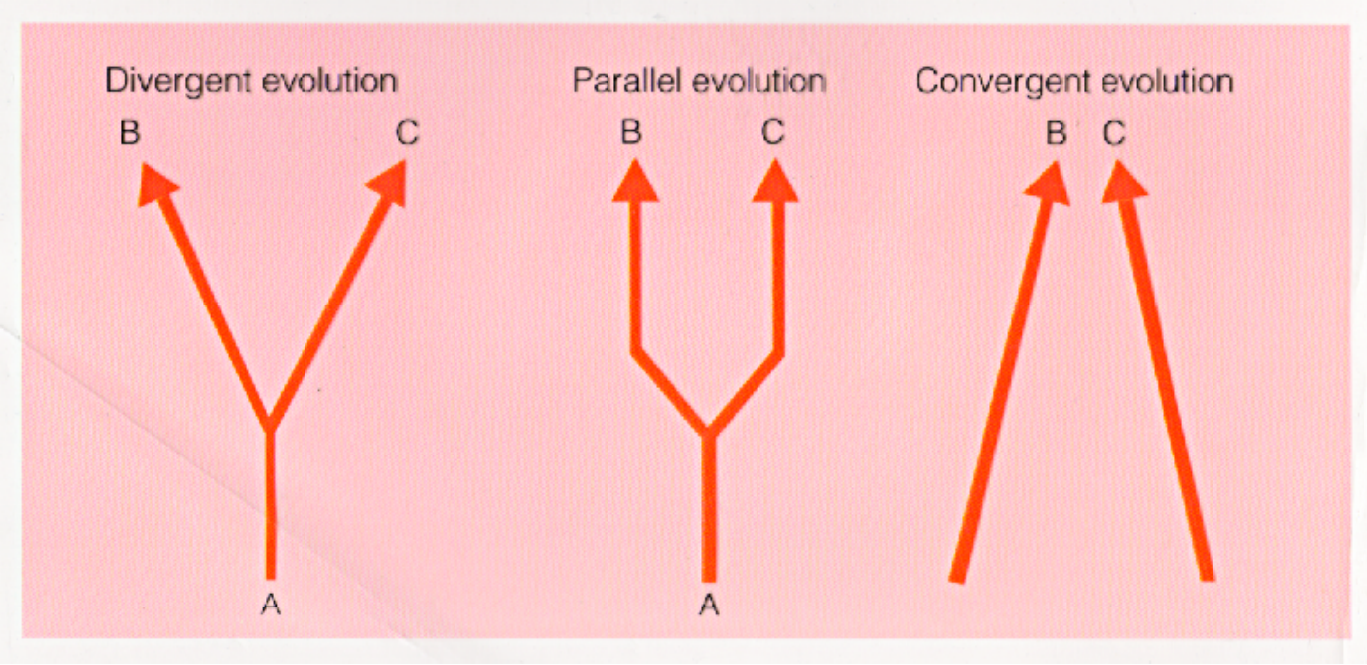


Patterns of Evolution

Evolution


100 200 300 400 500 600 700 800 900
Upper Permian
Middle Permian
Sisophon Limestone
D member
C member
B member
Du
Dl
Cu
Cl
100 200 300 400 500 600 700 800 900
Diameter of proloculus (microns)

Evolution

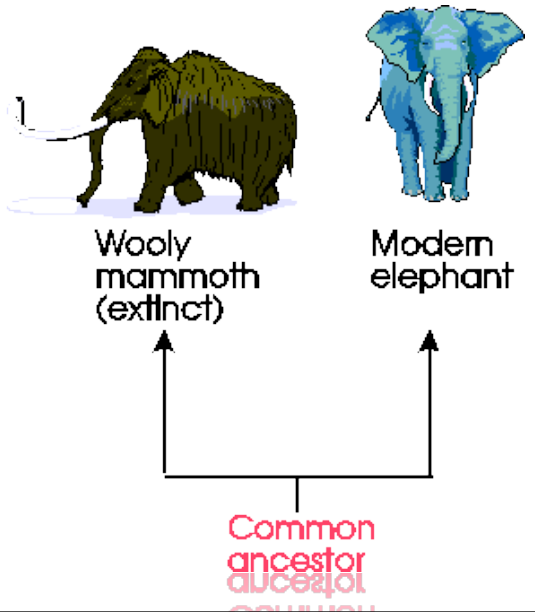


Divergent evolution is the development of different characteristics in sibling taxa.

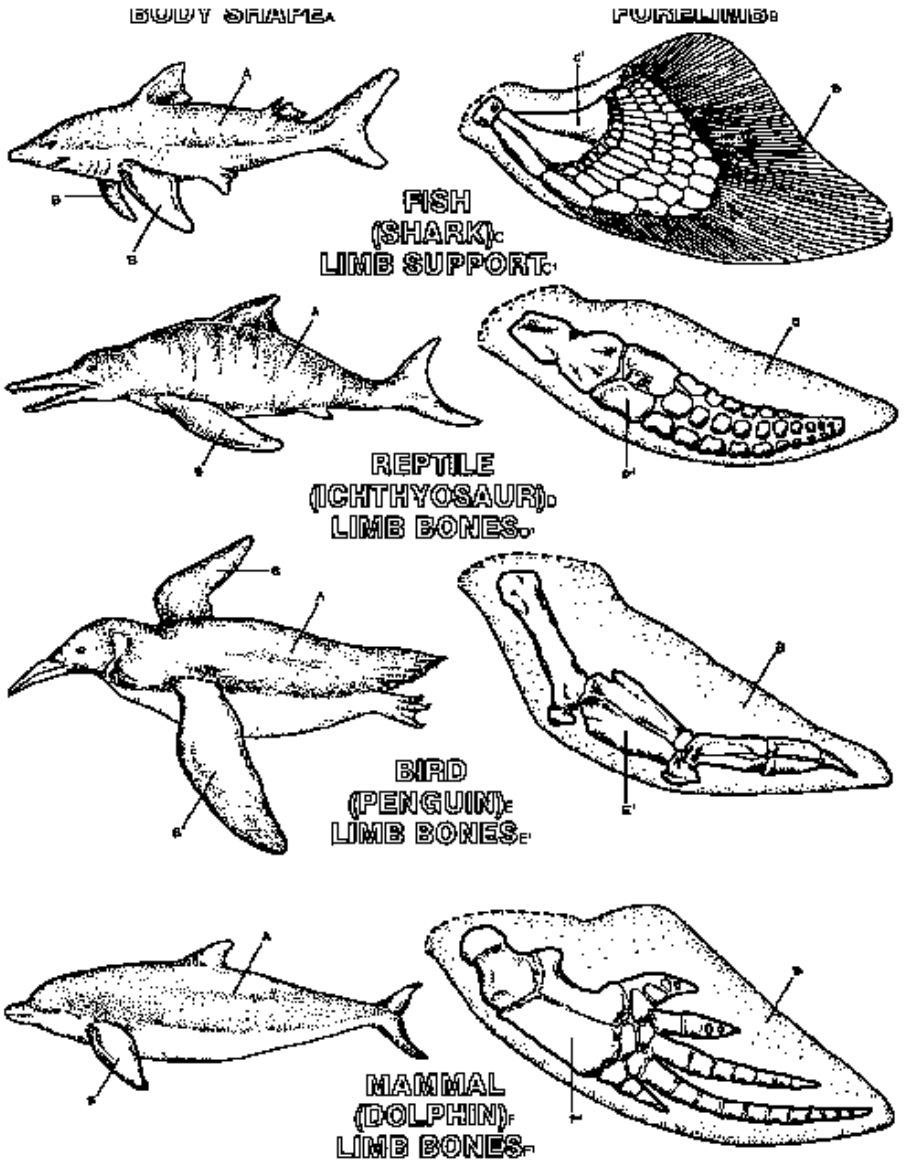
Parallel evolution is the development of similarities in separate but related evolutionary lineages through the operation of similar selective factors on both lines.

Convergent evolution describes the process whereby organisms not closely related independently acquire similar characteristics while evolving in separate and sometimes varying ecosystems

Parallel evolution



Convergent Evolution



Convergent Evolution