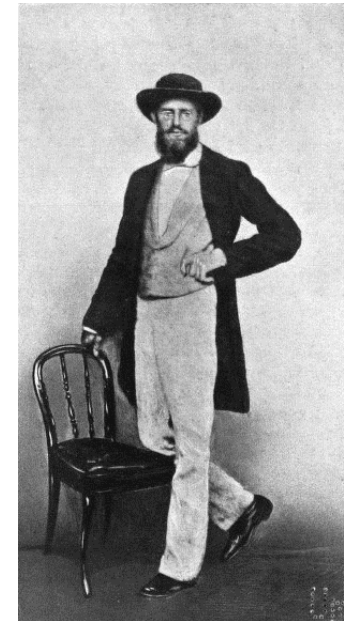
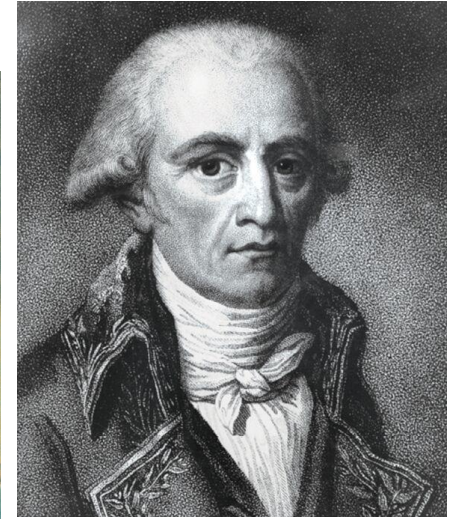


# CHAPTER 2. From Natural Philosophy to Darwin: A Brief History of Evolutionary Ideas



# Pre-Darwin European Views

Just before Darwin came along many of these world views were changing...

- 1. People thought species were “fixed in form”!**
- 2. People thought the earth was young**
- 3. People thought the physical characteristics of the earth were a result of catastrophic events (catastrophism)**
- 4. People thought species were perfect and so could not go extinct**

*Where did each of these ideas come?*

*Who began to question each idea or chip away at each idea?*

# **1. People thought species were “fixed in form”!**

Where did this idea come from?



# Plato and Aristotle

species were **fixed in form**

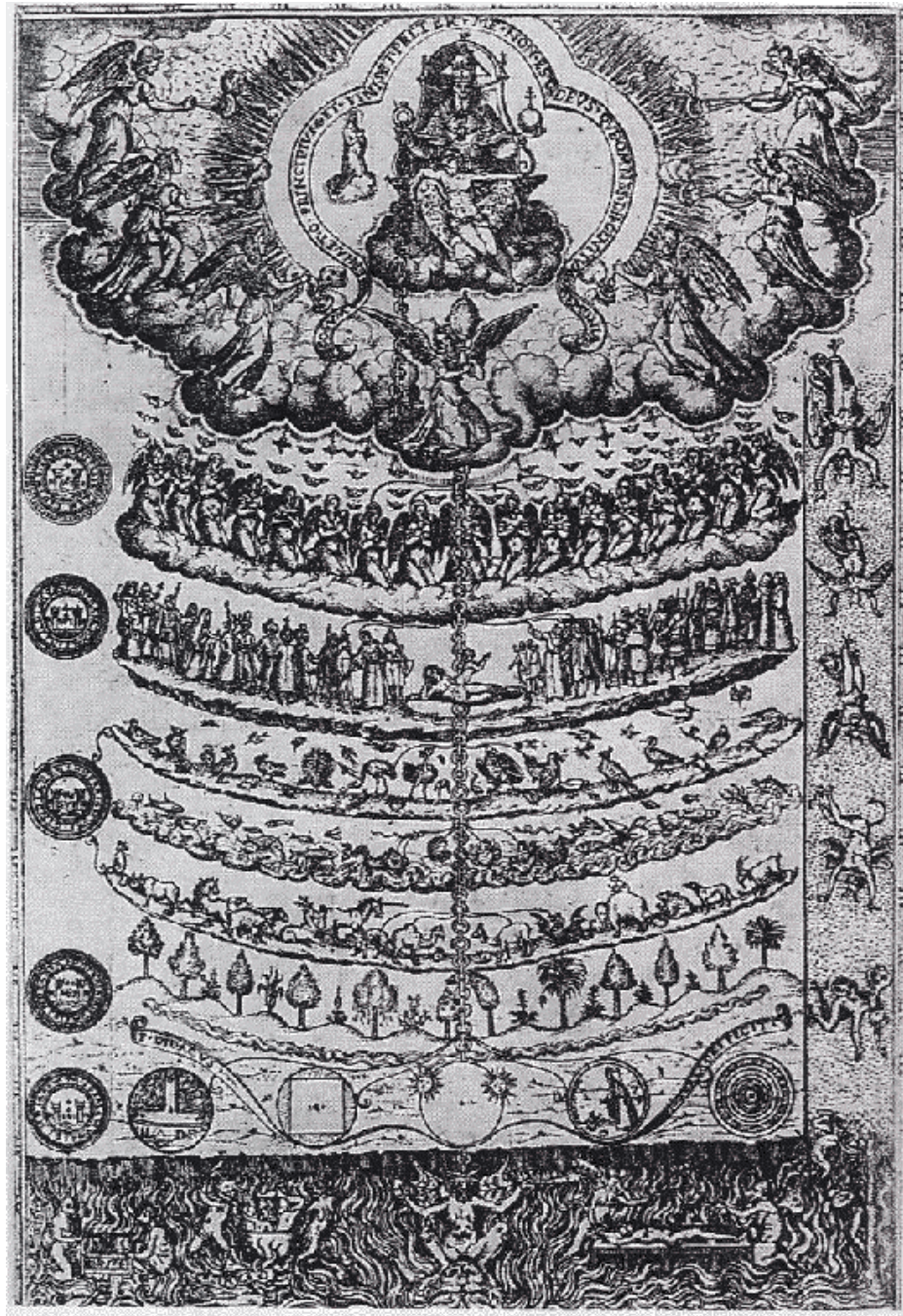


Ideal or unique forms

Unchanging essences

Essentialism

“Great Chain of Being”



1579 drawing from Didacus Valades, *Rhetorica Christiana*

**Not only were they fixed in form but there was a ranking system....**

Sean Nee (Nature 2005 435:429):

For centuries the "great chain of being" held a central place in Western thought. This view saw the Universe as ordered in a linear sequence starting from the inanimate world of rocks. Plants came next, then animals, men, angels and, finally, God. It was very detailed with, for example, a ranking of human races; humans themselves ranked above apes above reptiles above amphibians above fish.



A newer  
interpretation of  
the Great Chain of  
Being!



<https://twitter.com/curaffairs/status/1294005161686454272?lang=es>

We also thought species are **fixed in form** because they are

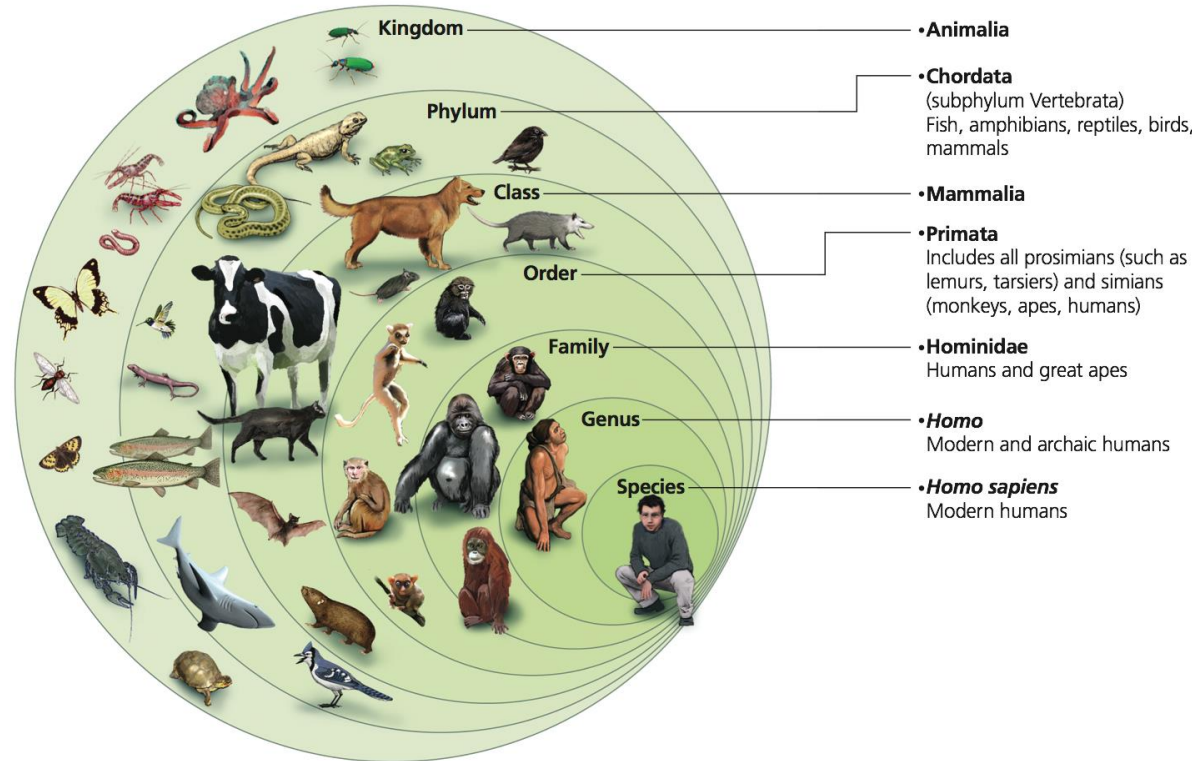
“specially created”

What does that mean?

Created for special purposes by God

Variation implies imperfection!





Q3. What was **Linnaeus'** contribution? What did he base his sorting scheme on?



**Linnaeus** ....also thought species were fixed in form

Studied natural world to reveal the Divine Order of God's Creation (Natural Theology)

One path to God was through the contemplation of his works (e. g. study and classify the natural world)

People that did this were called Naturalists

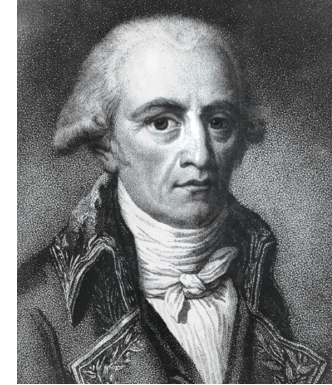
## **Review**

1. People thought species were “fixed in form”

Where did this idea come from..

Aristotle+Plato, created for special purposes by  
God, Linnaeus

Who “chipped away” at this idea that species were **fixed in form**?



## 1. Lamarck!

Known for “inheritance of acquired characteristics”  
(used to explain adaptation)

This could lead to “**transmutation** of species” (idea that one species could change in form or shape over time – maybe into something very different)

So...He was the first to think about one species changing into another (transmutation of species=evol)



Who else “chipped away” at this idea that species were **fixed in form**?

## **2. Buffon**

Also really thought through this idea of species changing in form or shape (morphology) over time.

Thought species changed over time when they arrived in a new habitat!

# **A quick side tour of other of Lamarck's thinking...**

Life was continuously being generated spontaneously as microbes

Microbes were simply recently generated organisms

Species could move from one rung of ladder to another (due to internal urges), turning from one species into another.

Complex species descended from simple microbes

What does this remind you of???

## He imagined...

“It was an innate quality of nature that organisms constantly 'improved' by successive generation, too slowly to be perceived but observable in the fossil record.

Mankind sat at the top of this chain of progression, having passed through all the previous stages in prehistory.

However, this necessitated the principle of spontaneous generation, for as a species transformed into a more advanced one, it left a gap: when the simple, single-celled organisms advanced to the next stage of life, new protozoans would be created (by the Creator) to fill their place.”

<http://www.victorianweb.org/science/lamarck1.html>



## **Lamarck related questions from Reading Guide....**

**Q7. Who was Lamarck?** Did he believe that species were “fixed in form” or unchanging?

How did he think this change came about?

**Q8. What did Lamarck believe about microorganisms (really small “simple” organisms)?**

**Q9. Look through Box 2.1. How has “Lamarckian evolution” come back in a way? What is epigenetics?**

*(we will cover this in the next section of the course...check that it makes sense to you?)*

# Pre-Darwin European Views

**1. People thought species were “fixed in form”!**

We will address the next two together..

**2. People thought the earth was young**

**3. People thought the physical characteristics of the earth was a results of catastrophic events (catastrophism)**

# Why did they think the earth was young and events were always catastrophic? Where did that idea come from?

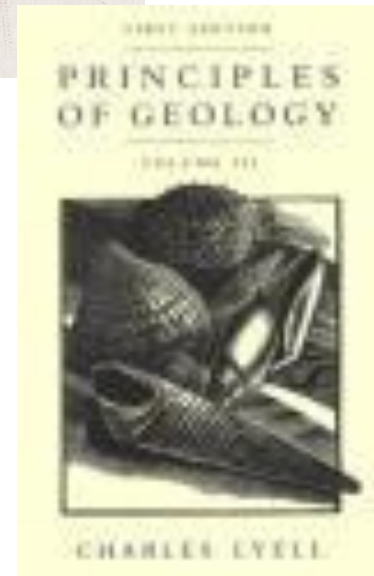
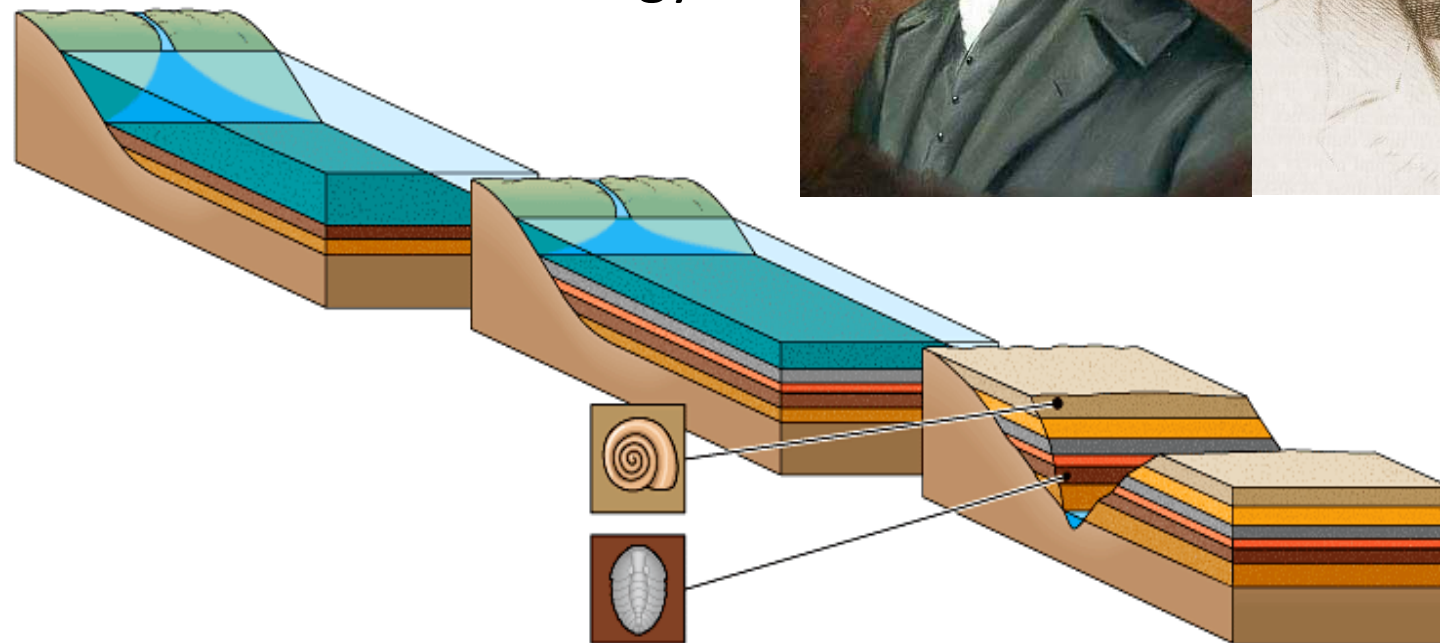
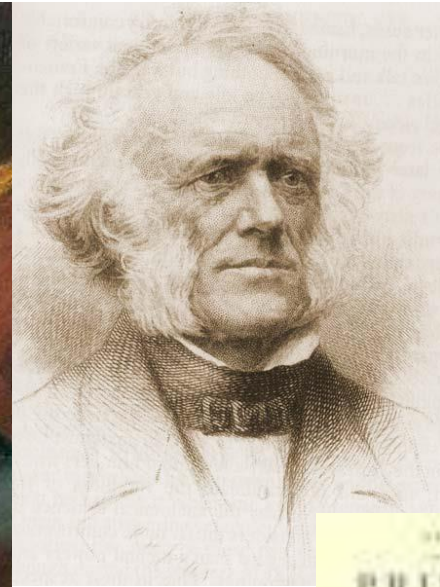
Remember: Today we know that mountain ranges rise slowly and rivers erode slowly, but at the time they could only imagine big scary events...  
They had trouble imagining dramatic landscapes could be a result of slow change over loooooong periods of time!





**Hutton and Lyell** established the earth was old!  
Gradualism and Uniformitarianism  
No supernatural catastrophic events needed!

Hutton  
founder of  
modern  
Geology.



## **4. People also thought species are “perfect” so cannot go extinct**

Where did this idea come from? Why did people think that species could not go extinct?

“If God had created all of nature according to a divine plan at the beginning of the world, it would seem irrational for Him to let some parts of that creation die off.”

UCMP Berkley

Remember...Extinction implies imperfection

# Cuvier (founder of paleontology) introduced the idea of extinction!

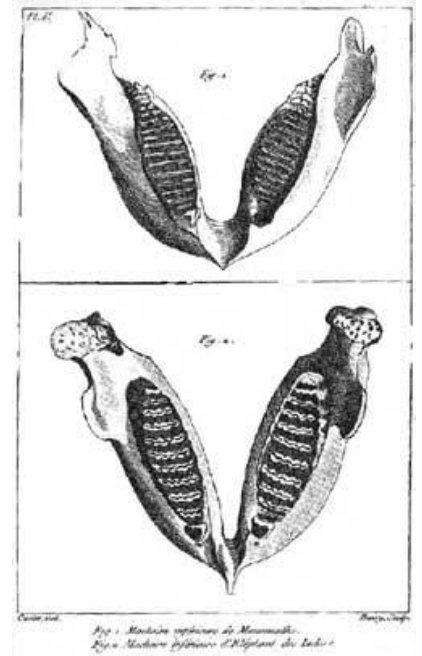
- studied elephant fossils found near Paris
- proclaimed that they were a separate species that had vanished from the earth!



Indian Elephant

vs

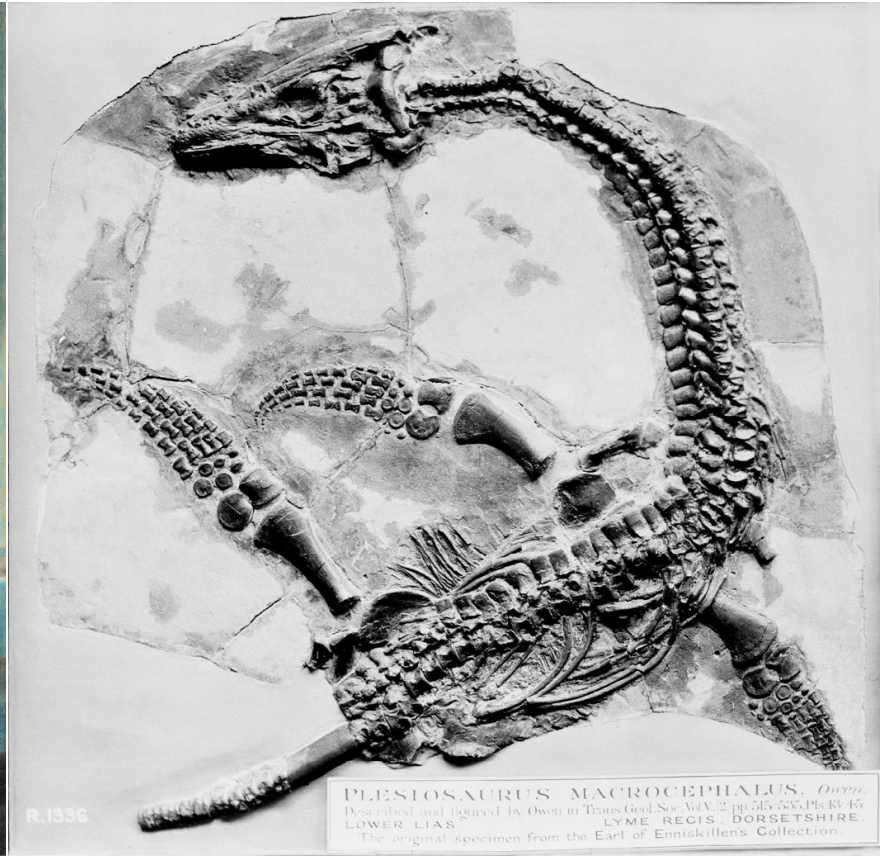
Mammoth jaws





# Anning

She explored coastlines discovered several species of clearly extinct marine reptiles!

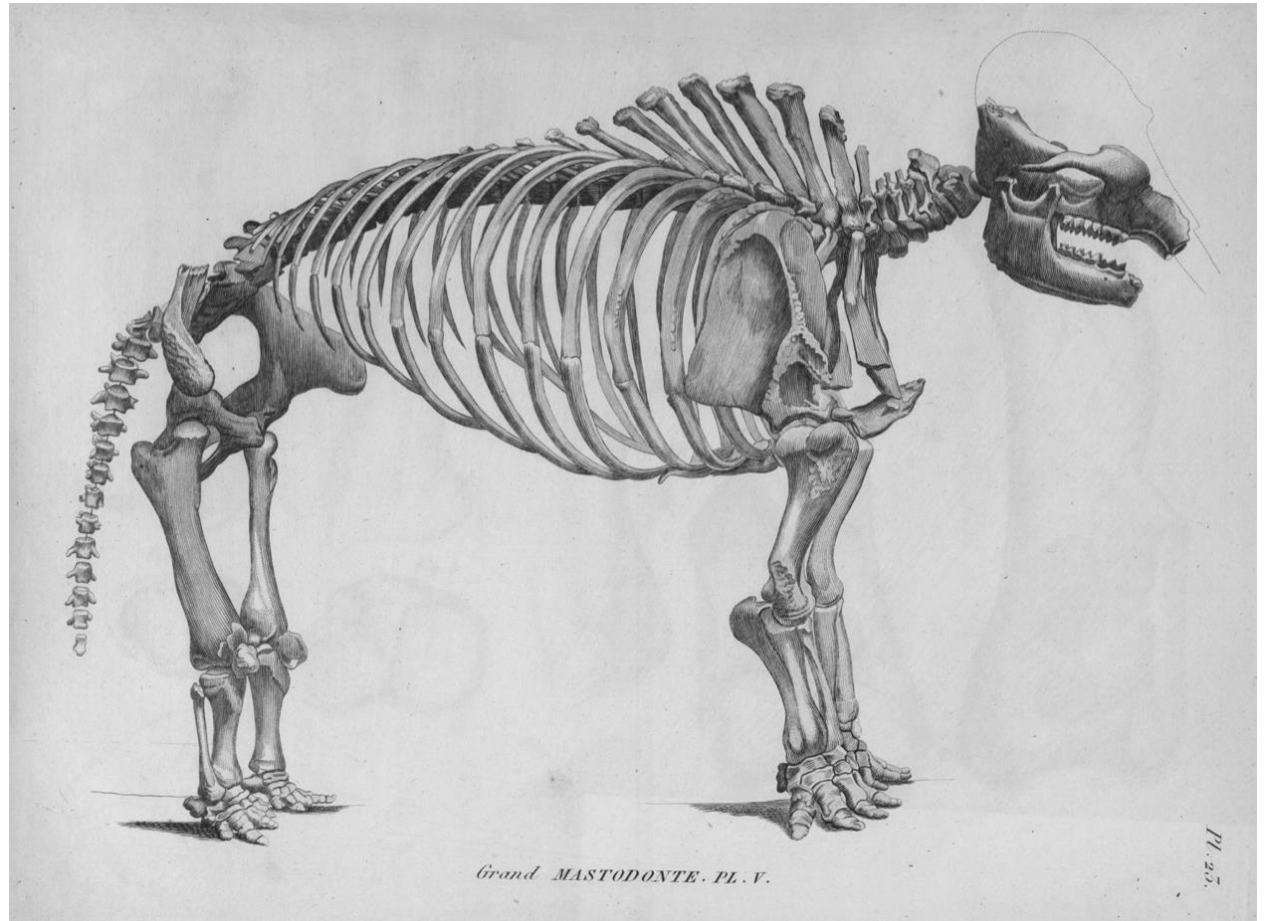


**PLESIOSAURUS MACROCEPHALUS.** Owen.  
Described and figured by Owen in Trans. Geol. Soc. Vol. V. 2. pp. 515, 516. Pl. R. 15.  
LOWER LIAS. LYME REGIS, DORSETSHIRE.  
The original specimen from the Earl of Enniskillens Collection.

“By the end of the 1700s, paleontologists had swelled the fossil collections of Europe, offering a picture of the past at odds with an unchanging natural world.”

UCMP Berkeley

In other words..species must change form over time (evolve) and clearly go extinct.

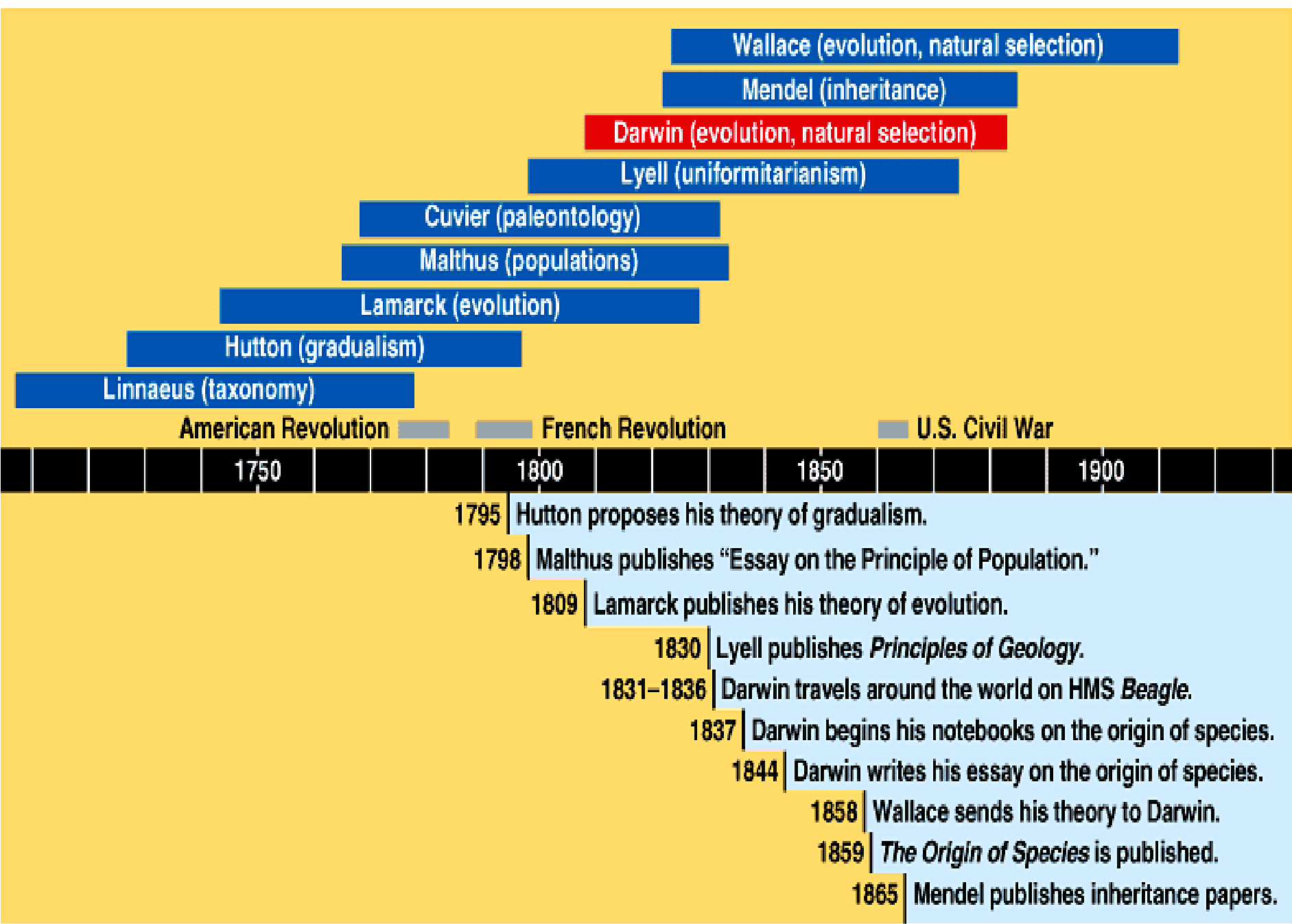






© The Trustees of the Natural History Museum



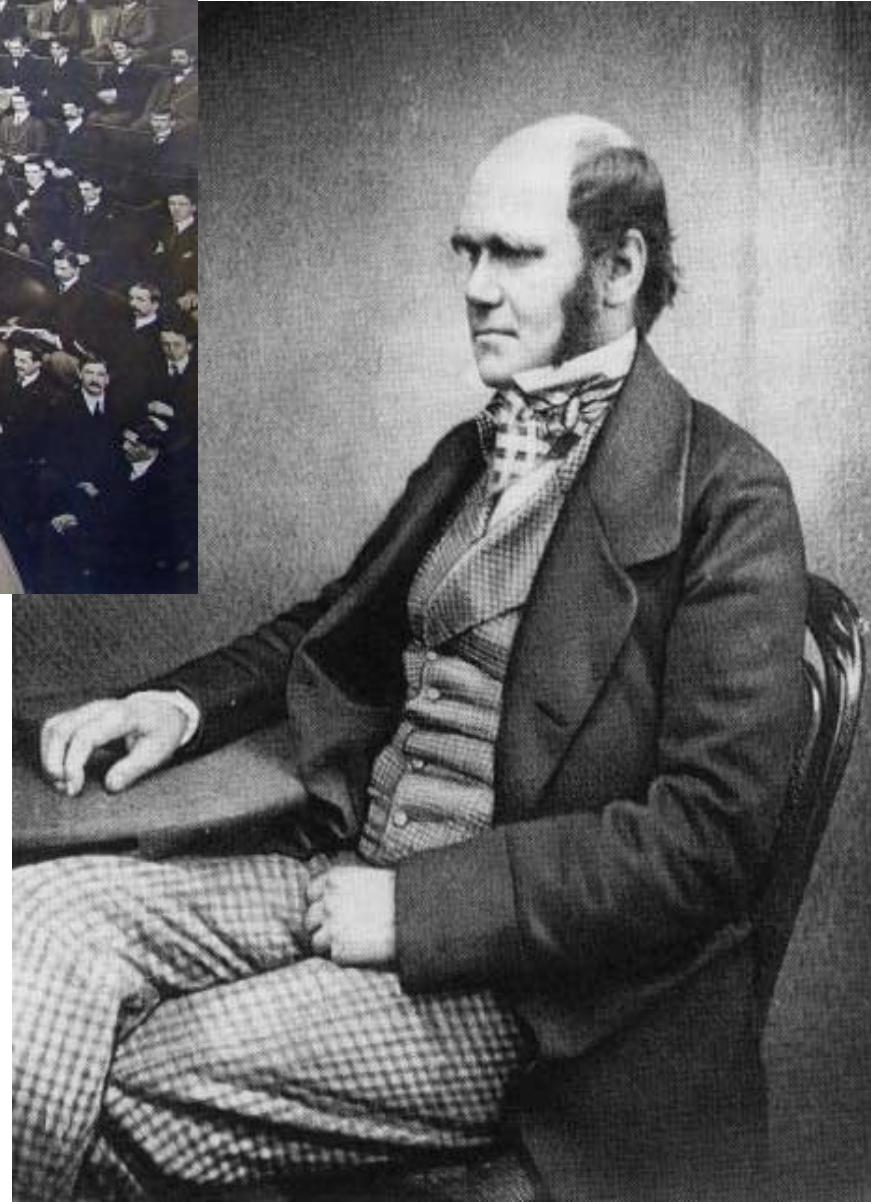


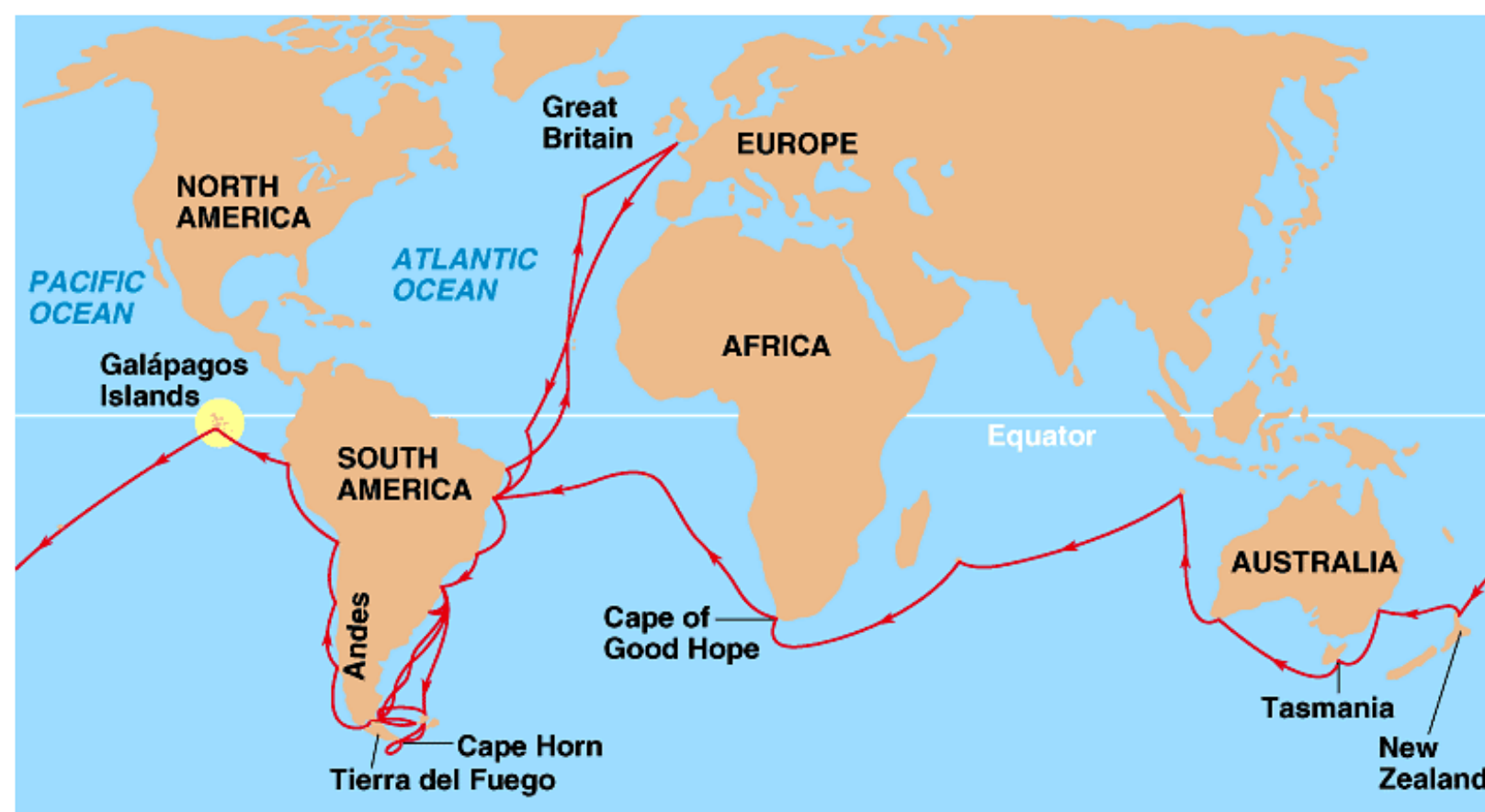




# Darwin

## Life



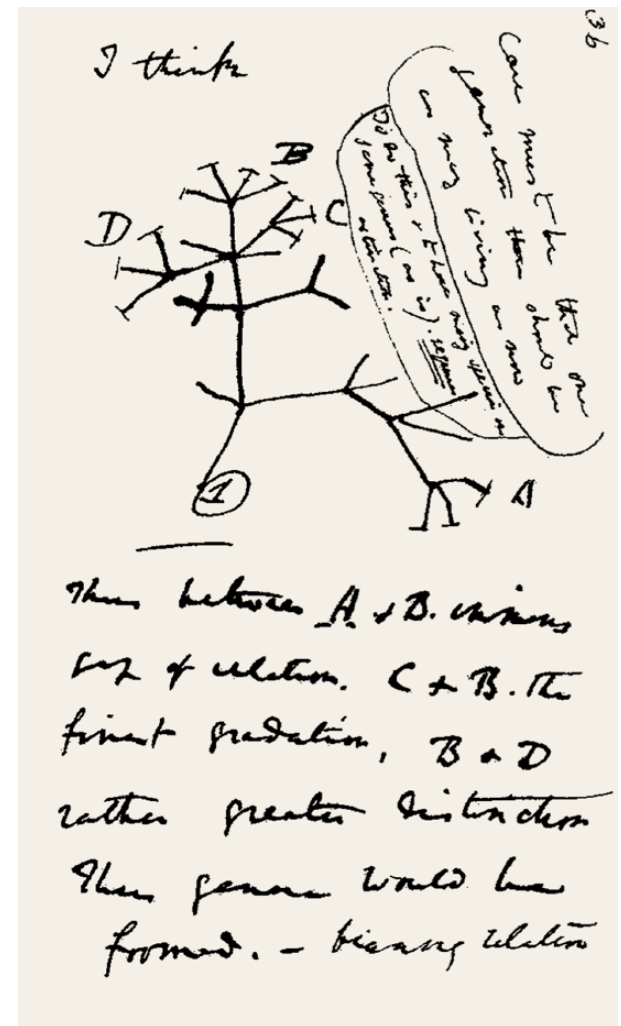


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Voyage of Beagle  
(left 1831-5yr trip)  
Took Lyell's book  
Did not believe in Lamarck's  
idea that species could change







Q11. Did Darwin recognize while he was in the Galapagos that all the birds he collected were finches?



Reads Malthus and waits 20 years.

## **Who was Malthus?**

- Social reformers thought “ills of man” (suffering, poverty, starvation) could be prevented.

- Malthus said these “ills” are inevitable because poverty and famine are natural outcomes of population growth and food supply.

- Said there is a “struggle for existence”



Early to mid 1800' s was a time of great poverty  
in many new urban areas

Great potato famine in Ireland occurred around  
this time.

*Illustrated London News*

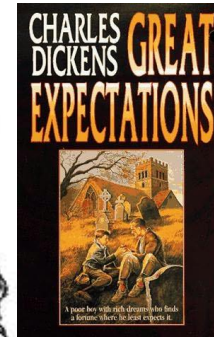
[mbbnet.umn.edu/doric/icons/potato2.jpeg&imgrefurl](http://mbbnet.umn.edu/doric/icons/potato2.jpeg&imgrefurl)



ATTACK ON A POTATO STORE.



BEGGAR-WOMAN AND CHILDREN.



CONNAMARA CABIN.



THE FAMINE IN IRELAND.— FUNERAL AT SKIBEREE.— FROM A SKETCH BY MR. H. SMITH, CORK.

"In October 1838, that is, fifteen months after I had begun my systematic inquiry, I happened to read for amusement Malthus "On Population", and being well prepared to appreciate the struggle for existence which everywhere goes on from long- continued observation of the habits of animals and plants, it at once struck me that under these circumstances *favourable variations would tend to be preserved, and unfavourable ones to be destroyed*. The results of this would be the formation of a new species. Here, then I had at last got a theory by which to work".

Charles Darwin, from his autobiography (1876)

Darwin applied this to organisms in general

1. Species are capable of over-reproducing  
(for ex. a single pair of elephants could  
theoretically produce 19 million elephants in  
750 years)

2. But populations always tend to eventually  
run out of something.. whether it is food or  
nesting spots

together this means that there must be a

“STRUGGLE FOR EXISTENCE”

a term Malthus used for humans

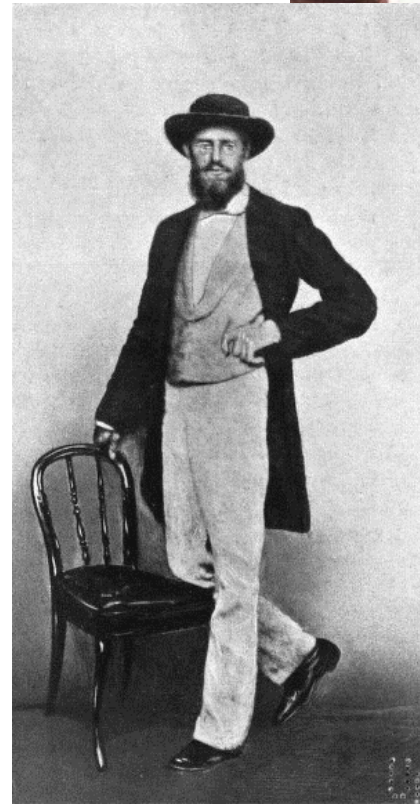
Darwin concluded some live some die... and therefore some “favorable variations would tend to be preserved and unfavorable ones destroyed” ...



# A note from Wallace

## Who was Wallace?

- Not well off
- Left school at 14 to work
- Became a commercial collector, dragging his brother with him to South America



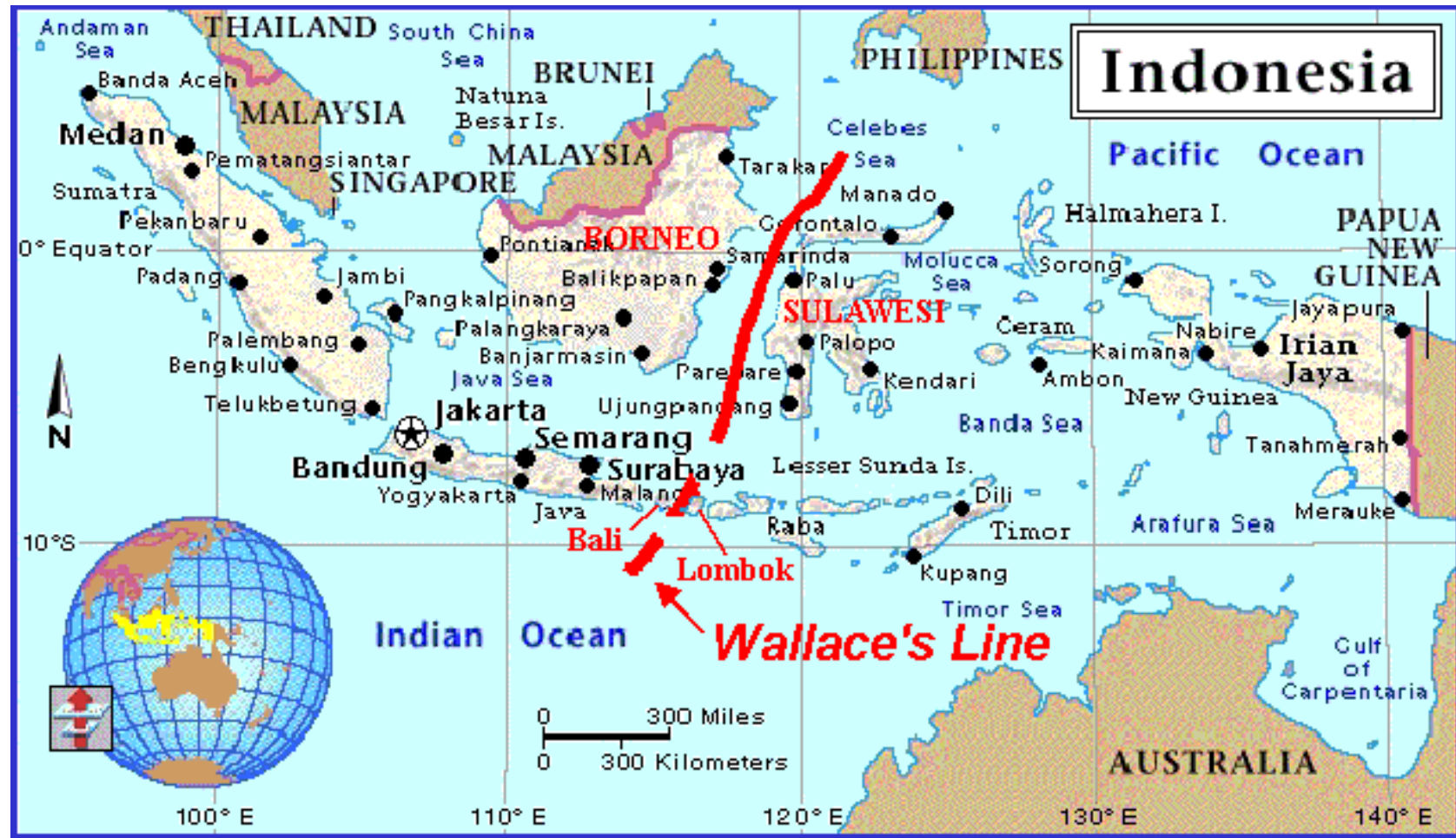
**By early 1852 Wallace was in ill health and in no condition to proceed any further. He decided to quit South America, and began the long trip back down the Rio Negro and Amazon to Pará. When he finally reached the town on the 2nd of July, he found that his younger brother Herbert had died of yellow fever.**

**Within a few days he set out for England. Unfortunately, on the 6th of August the brig on which he was sailing caught fire and sank, taking almost all of his possessions--including some live animals--along with it. For ten days Wallace and his comrades struggled to survive in a pair of badly leaking lifeboats, then were sighted and picked up by a passing cargo ship also making its way back to England. As luck would have it this vessel was also old and slow, and itself nearly foundered when hit by a series of storms. In all, Wallace's ocean crossing took eighty days**

Several years later on another collecting trip

Indonesia/South Pacific

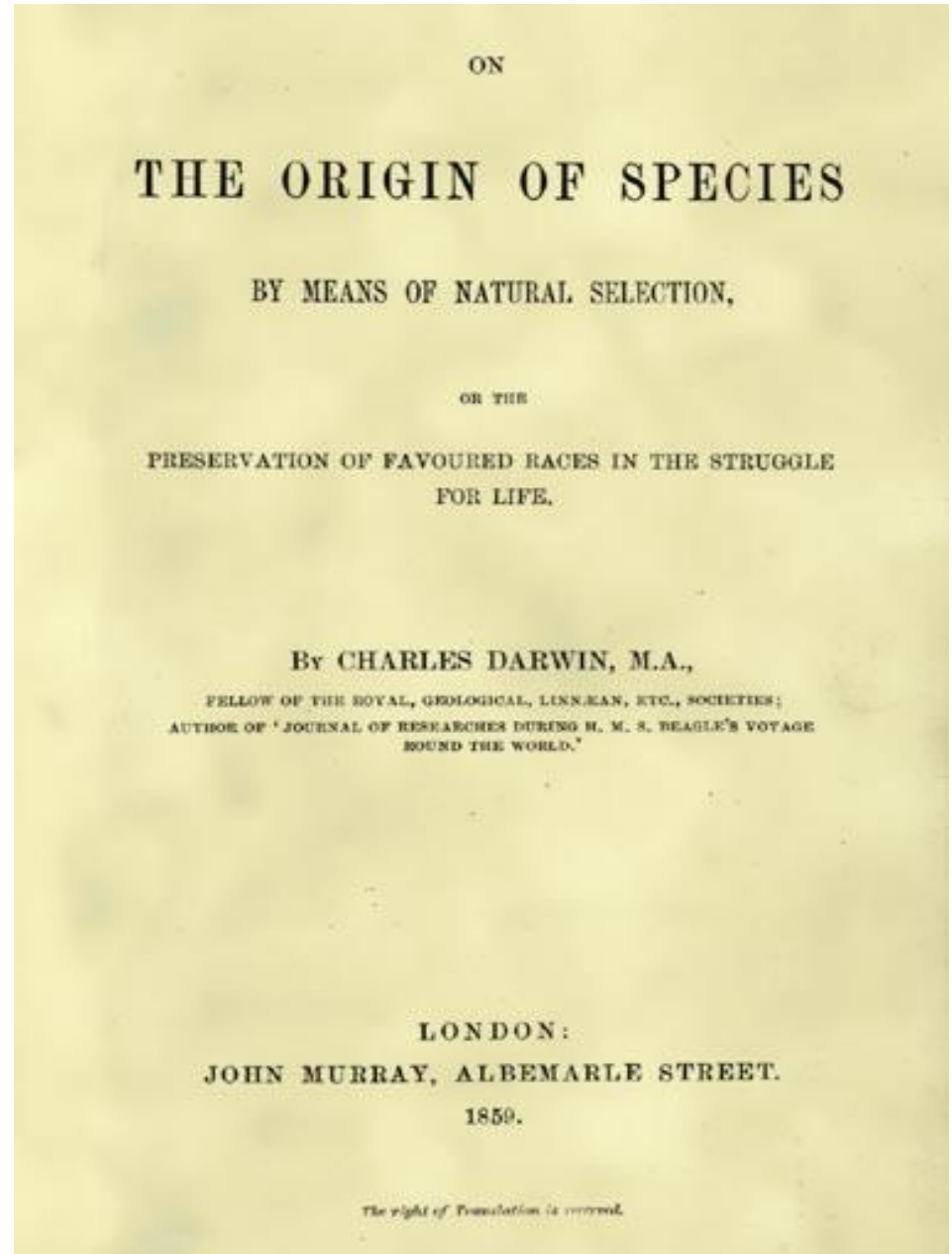
Malarial fever- "flash of insight"



Both papers were presented at the Linnaean  
Society of London

Within a year (1859)

Darwin publishes...



Compare and contrast Darwin and Wallace.

Thoughts on .....Why do we know Darwin's name better than Wallace's????



# What is the difference between evolution and natural selection?

## **Evolution is .....**

- A change in gene/allele frequencies in a population over time
- A change in form/trait/behavior/protein production in a population over time (trait has a genetic basis or be heritable).
- Darwin called it “descent with modification” and “transmutation of species”

## **Note issue of Scale**

# **Natural selection is.....**

- The mechanism or engine of evolution
- Differential success in reproduction as a result of traits that are genetically based

# Reception of Darwin's idea-



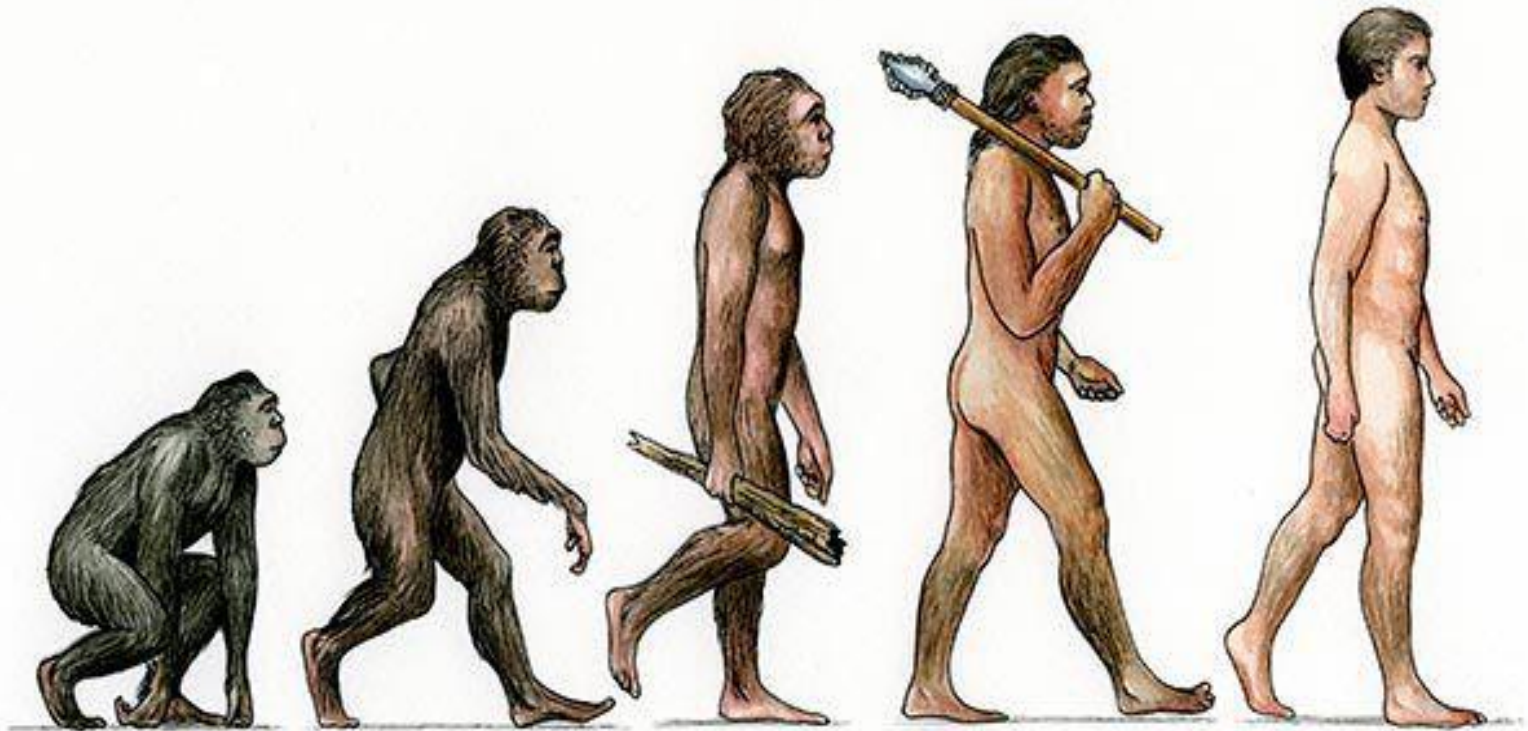
**Natural Selection** - generally not accepted  
“problem of inheritance” (which we will get to-  
wait for Mendel!)

**Evolution** or “**transmutation of species**” *was generally accepted by scientists*

Species seem to be able to change from one thing  
into another!

But there was a persistent misconception....  
Any thoughts?

Concerns with this image?





*Life is a copiously branching bush,  
continually pruned by the grim reaper of  
extinction, not a ladder of predictable  
progress. ....Hence we continually make  
errors inspired by unconscious allegiance to  
the ladder of progress, even when we  
explicitly deny such a superannuated view of  
life.*

Stephen Jay Gould from Wonderful Life

# Which of these are “bush-ish”?

# Which are “ladder-ish”?

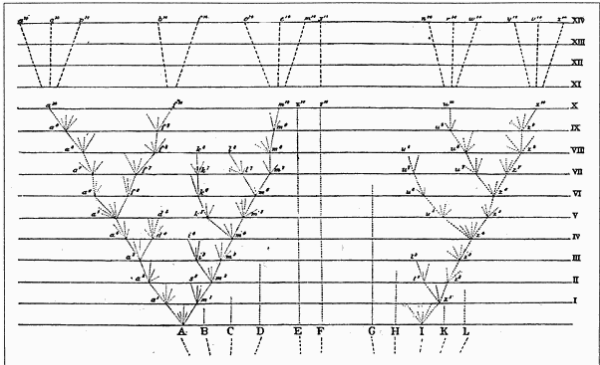
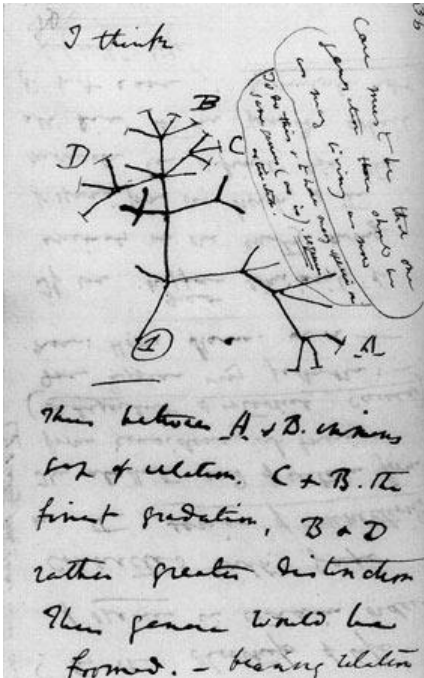
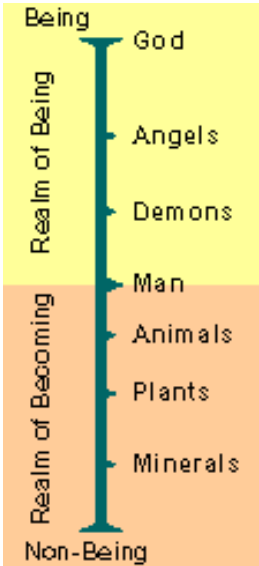
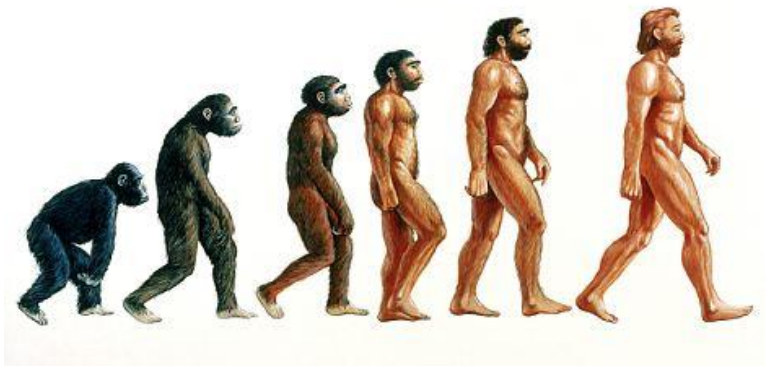
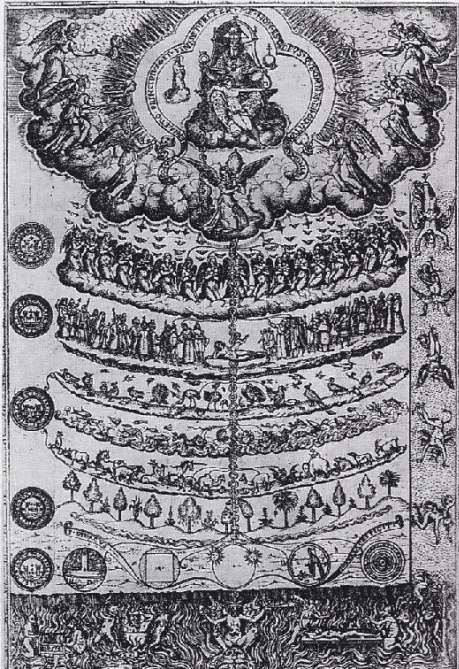
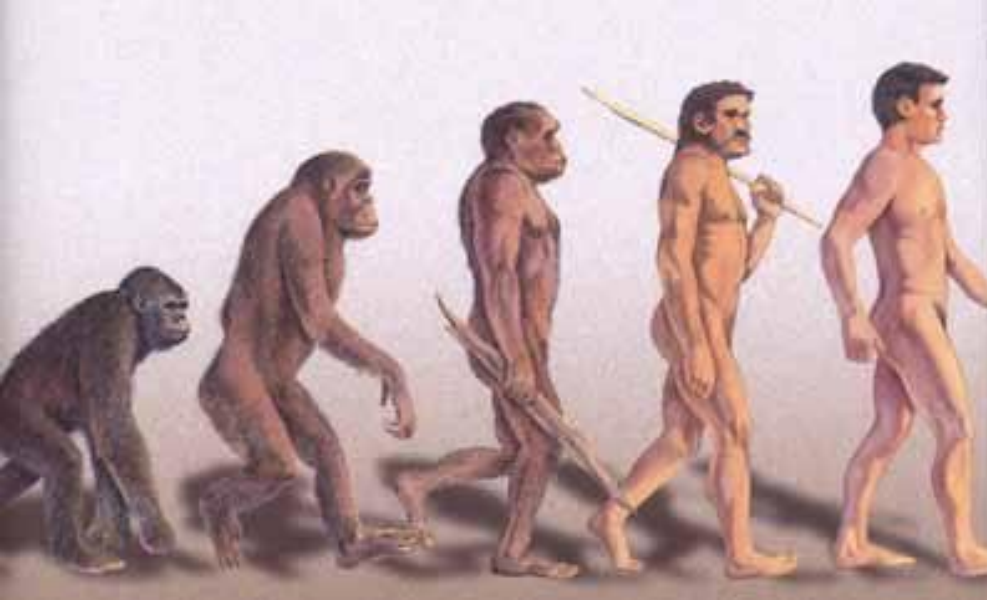
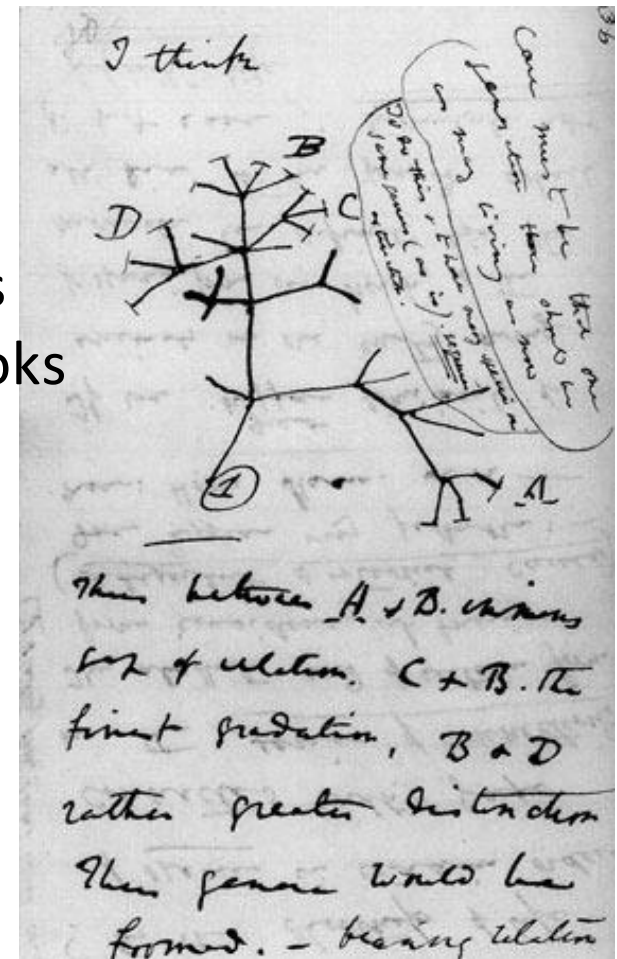


FIGURE 3-1 Darwin's Tree of Life.

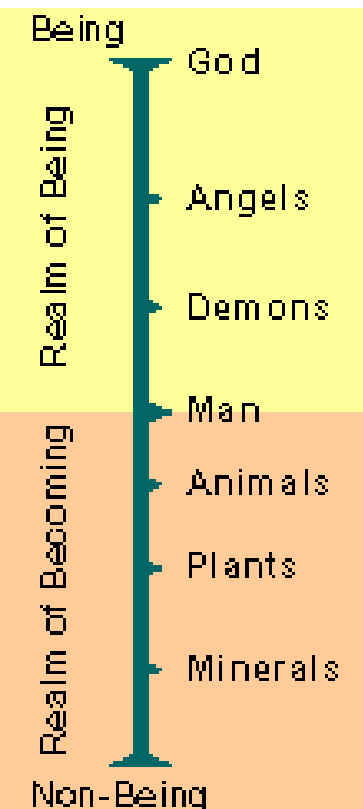




From  
Darwin's  
Notebooks



VS



From  
Berkeley  
Evol Site

From  
Origin of  
Species

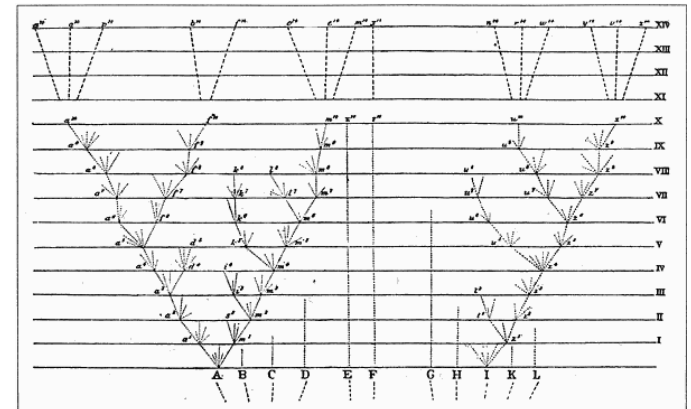


FIGURE 3-1 Darwin's Tree of Life.

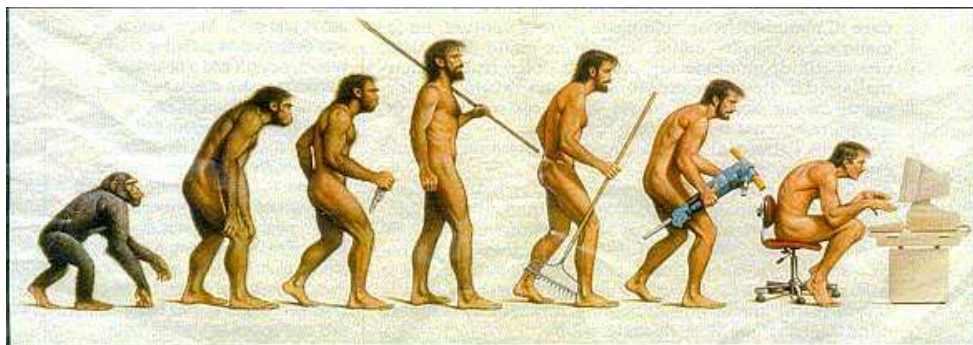
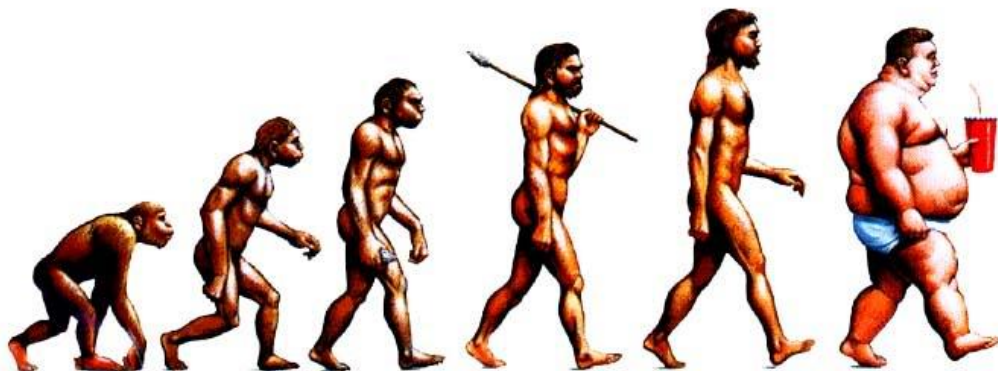
People got hung up on the idea that evolution was progressive....

Which of the comments below is ladder-ish and which is bush-ish

“We evolved from a chimp”

“Share a common ancestor”





[www.corante.com/loom/evolve.jpg&imgrefurl](http://www.corante.com/loom/evolve.jpg&imgrefurl)

