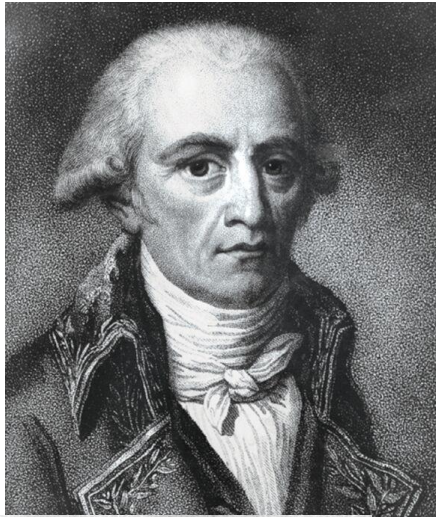


CHAPTER 2. From Natural Philosophy to Darwin: A Brief History of Evolutionary Ideas



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?

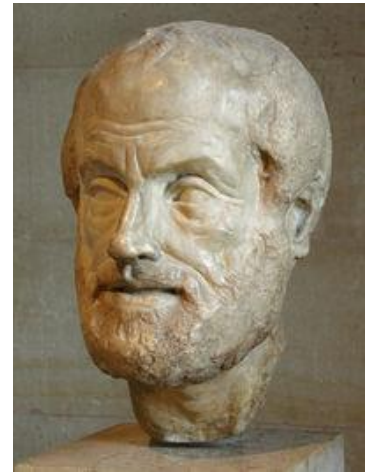
1. People thought species were “fixed in form”!

Where did this idea come from?

Plato and Aristotle

species were **fixed in form**

- Ideal or unique forms or shapes
- Unchanging essences
- Essentialism



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.

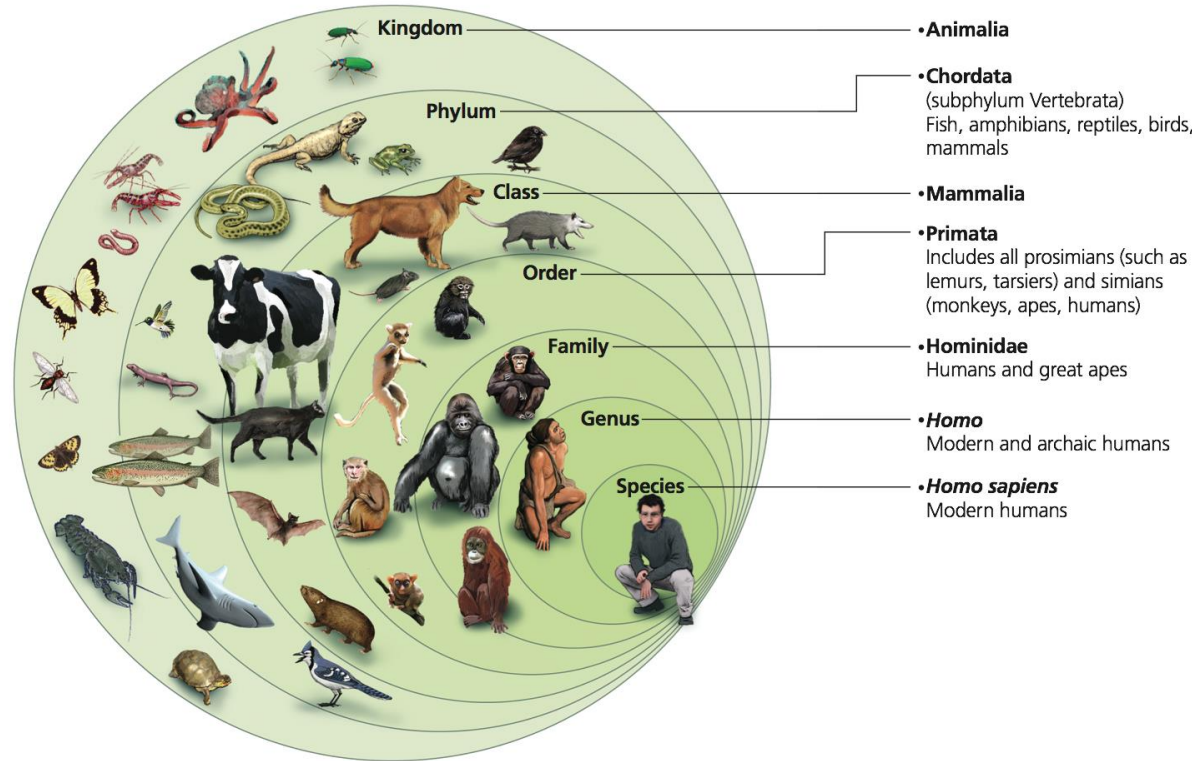
We also thought species are **fixed in form** because they are

“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?

Linnaeusalso 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

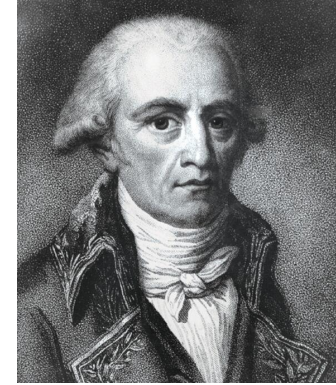
Review

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” (giraffes and long necks?) (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**?

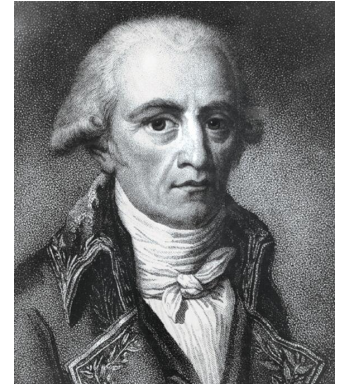
2. Buffon

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 epigenetics 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 were a result of catastrophic events (catastrophism)

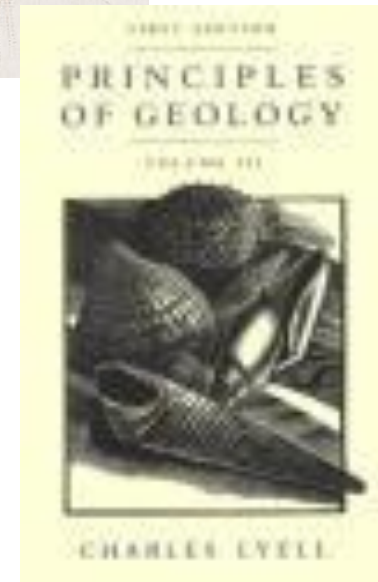
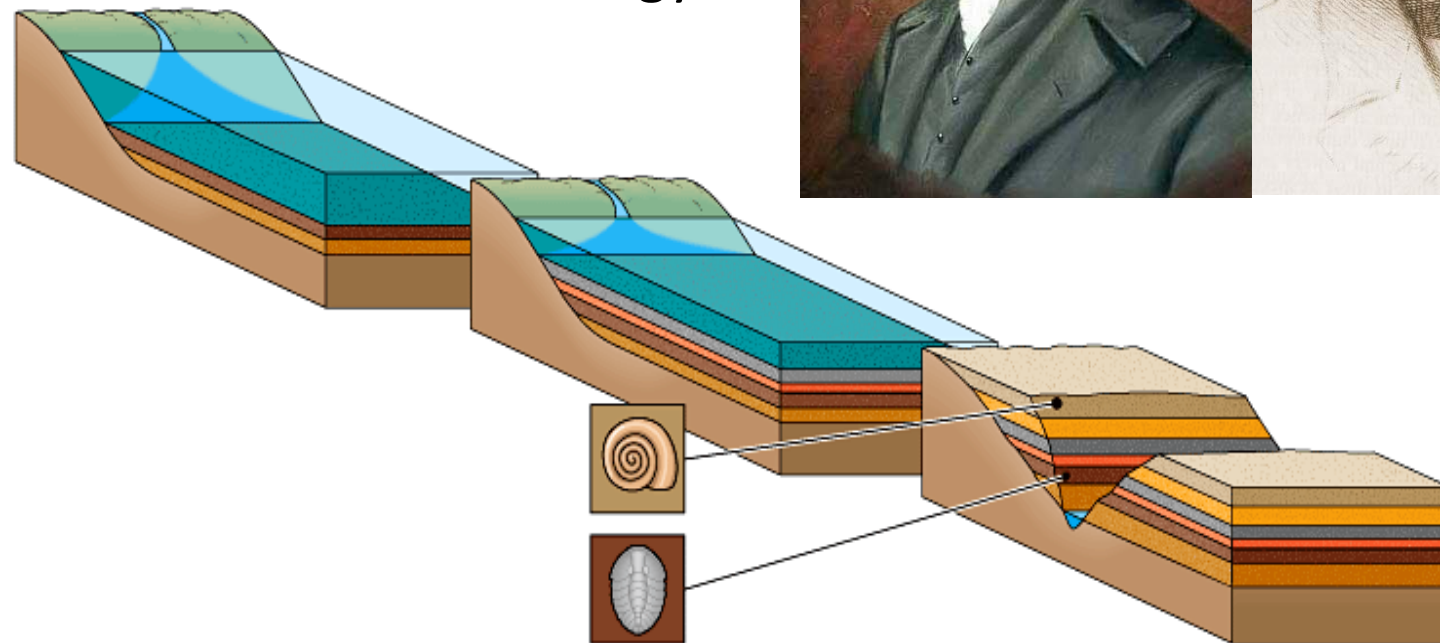
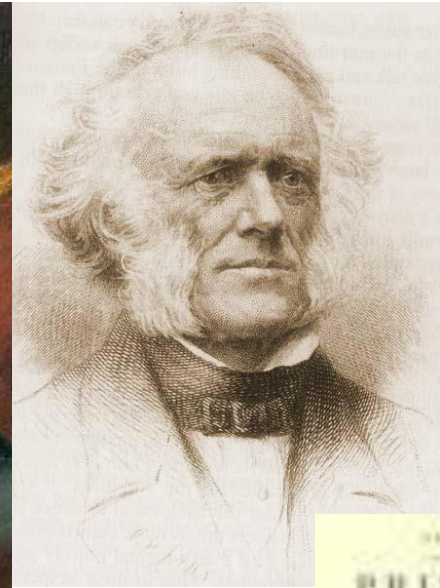
Why did they think the earth was young and events were always catastrophic? Where did that idea come from?

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!

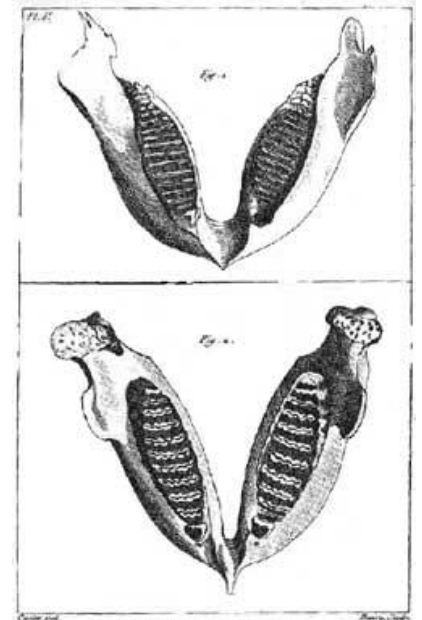
- studied elephant fossils found near Paris
- proclaimed that they were a separate species that had vanished from the earth!



Indian Elephant

vs

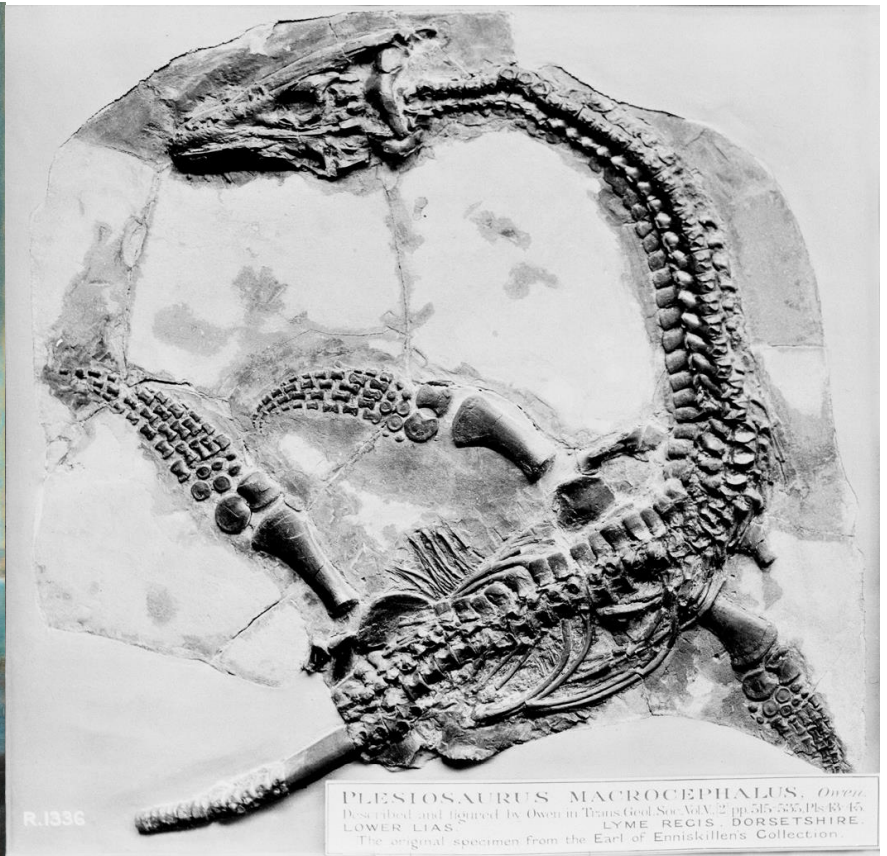
Mammoth jaws



*Fig. 1. Mandibule inférieure de l'éléphant.
Fig. 2. Mandibule inférieure d'un éléphant des Indes.*

Anning

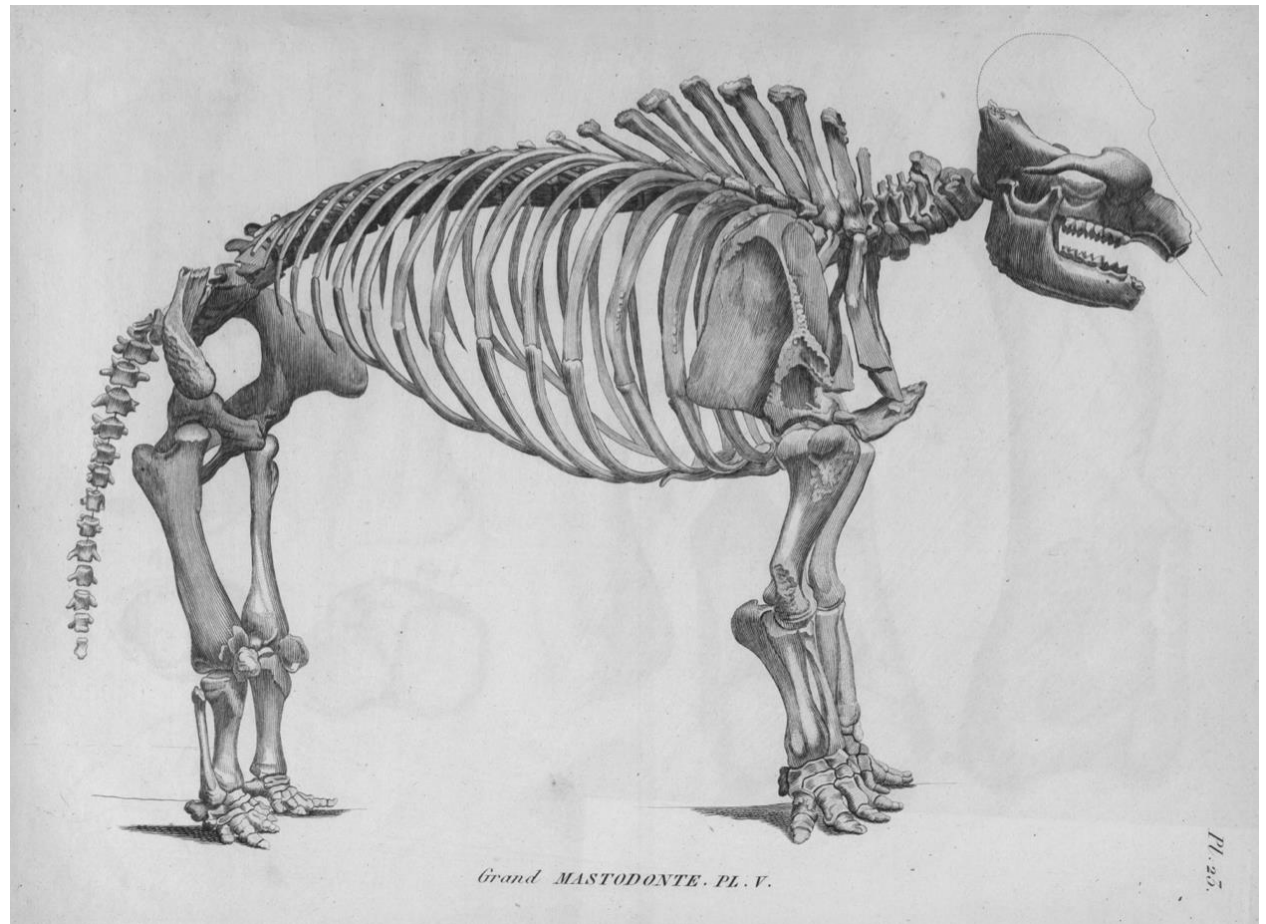
She explored coastlines discovered several species of clearly extinct marine reptiles that no longer existed on the earth!

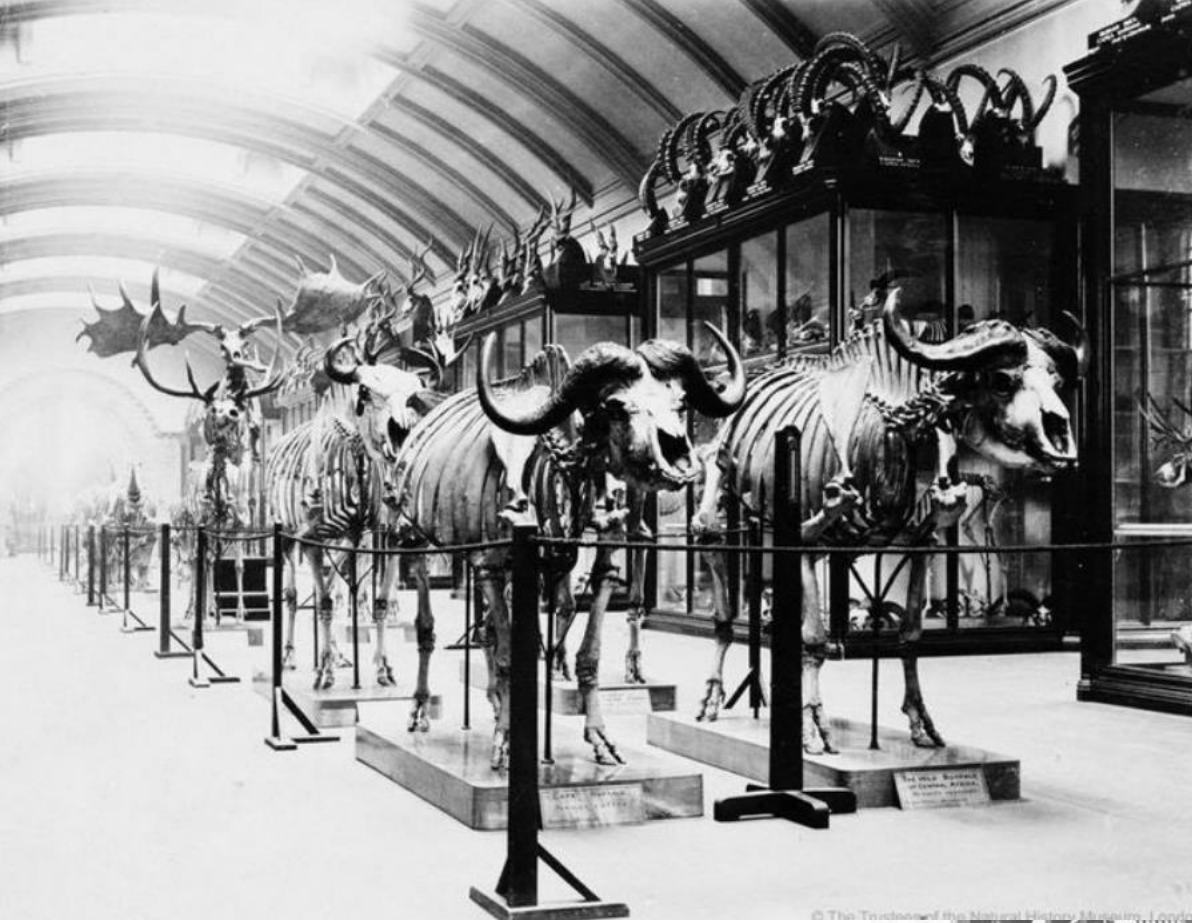


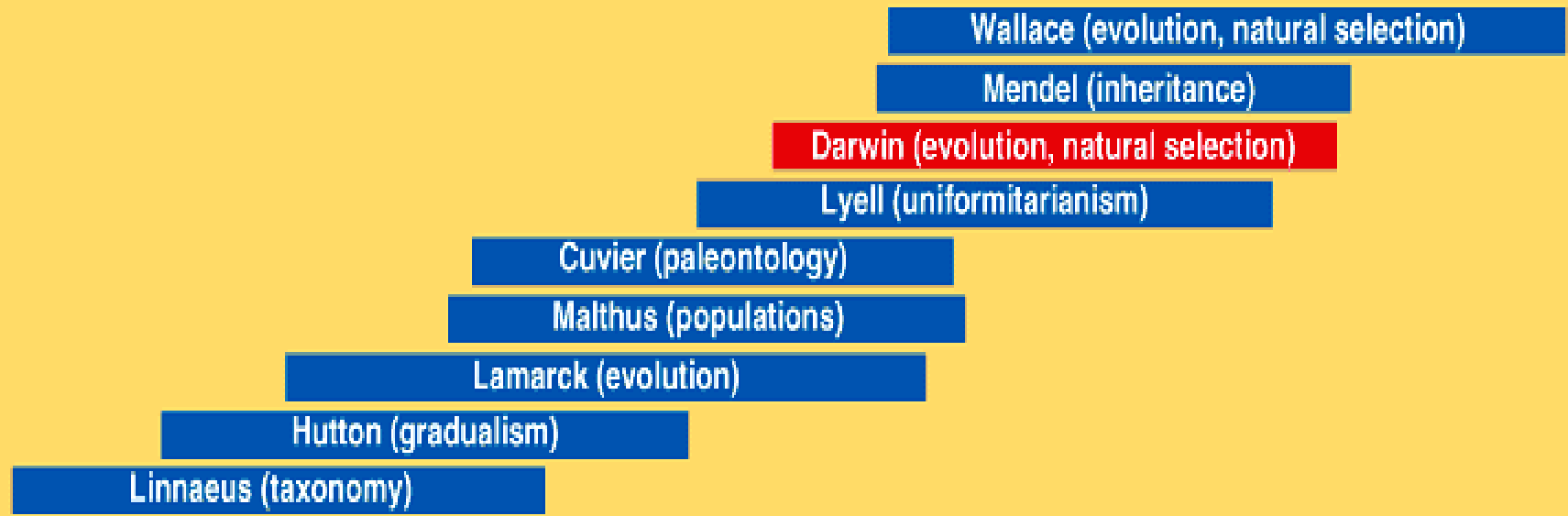
“By the end of the 1700s, paleontologists had swelled the fossil collections of Europe, offering a picture of the past at odds with an unchanging natural world.”

UCMP Berkeley

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







American Revolution French Revolution U.S. Civil War

1750 1800 1850 1900

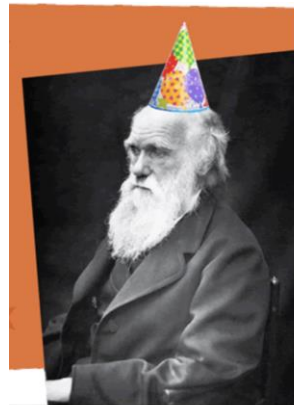
- 1795 | Hutton proposes his theory of gradualism.
- 1798 | Malthus publishes "Essay on the Principle of Population."
- 1809 | Lamarck publishes his theory of evolution.
- 1830 | Lyell publishes *Principles of Geology*.
- 1831–1836 | Darwin travels around the world on HMS *Beagle*.
- 1837 | Darwin begins his notebooks on the origin of species.
- 1844 | Darwin writes his essay on the origin of species.
- 1858 | Wallace sends his theory to Darwin.
- 1859 | *The Origin of Species* is published.
- 1865 | Mendel publishes inheritance papers.



Darwin

Life

HAPPY BIRTHDAY
Darwin!

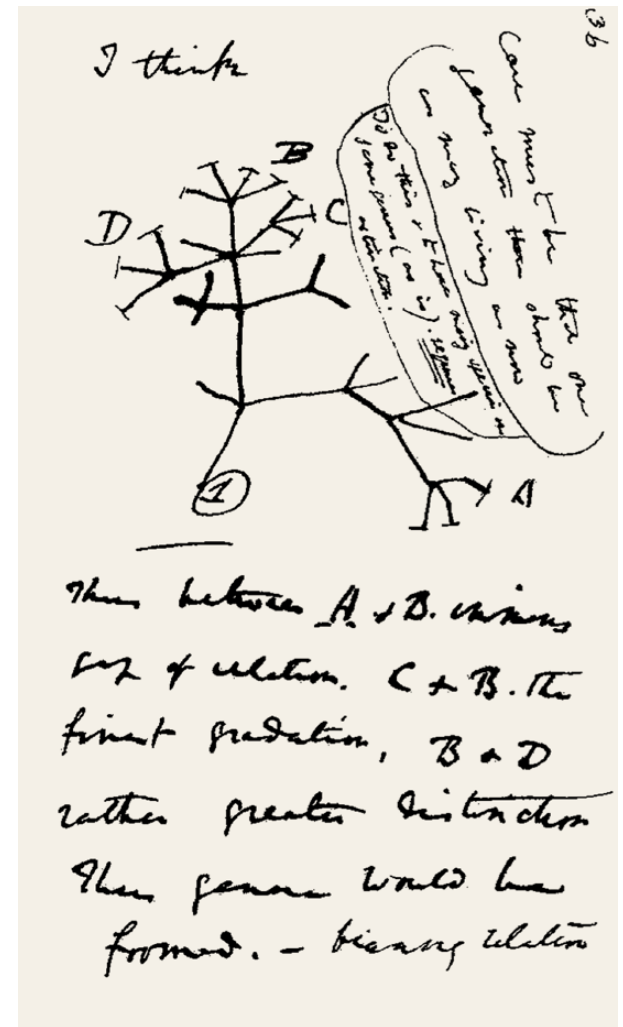




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Voyage of Beagle
(left 1831-5yr trip)
Took Lyell's book
Did not believe in Lamarck's
idea that species could change





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”

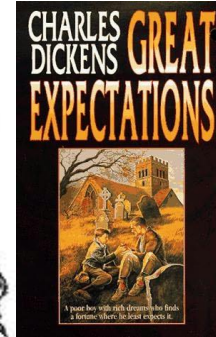


Early to mid 1800's was a time of great poverty in many new urban areas

Great potato famine in Ireland occurred around this time.

Illustrated London News

mbbnet.umn.edu/doric/icons/potato2.jpeg&imgrefurl



BEGGAR-WOMAN AND CHILDREN.



CONNAMARA CABIN.



ATTACK ON A POTATO STORE.



THE FAMINE IN IRELAND.— FUNERAL AT SKIBERREEN.— 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”

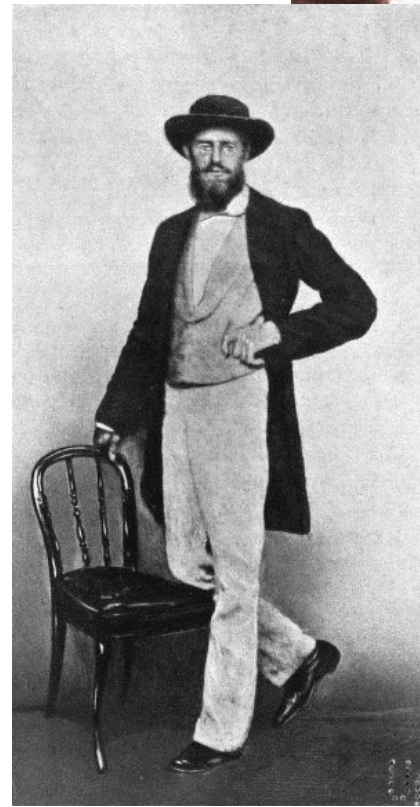
a term Malthus used for humans

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 wealthy!
- Left school at 14 to work
- Became a commercial collector, dragging his brother with him to South America



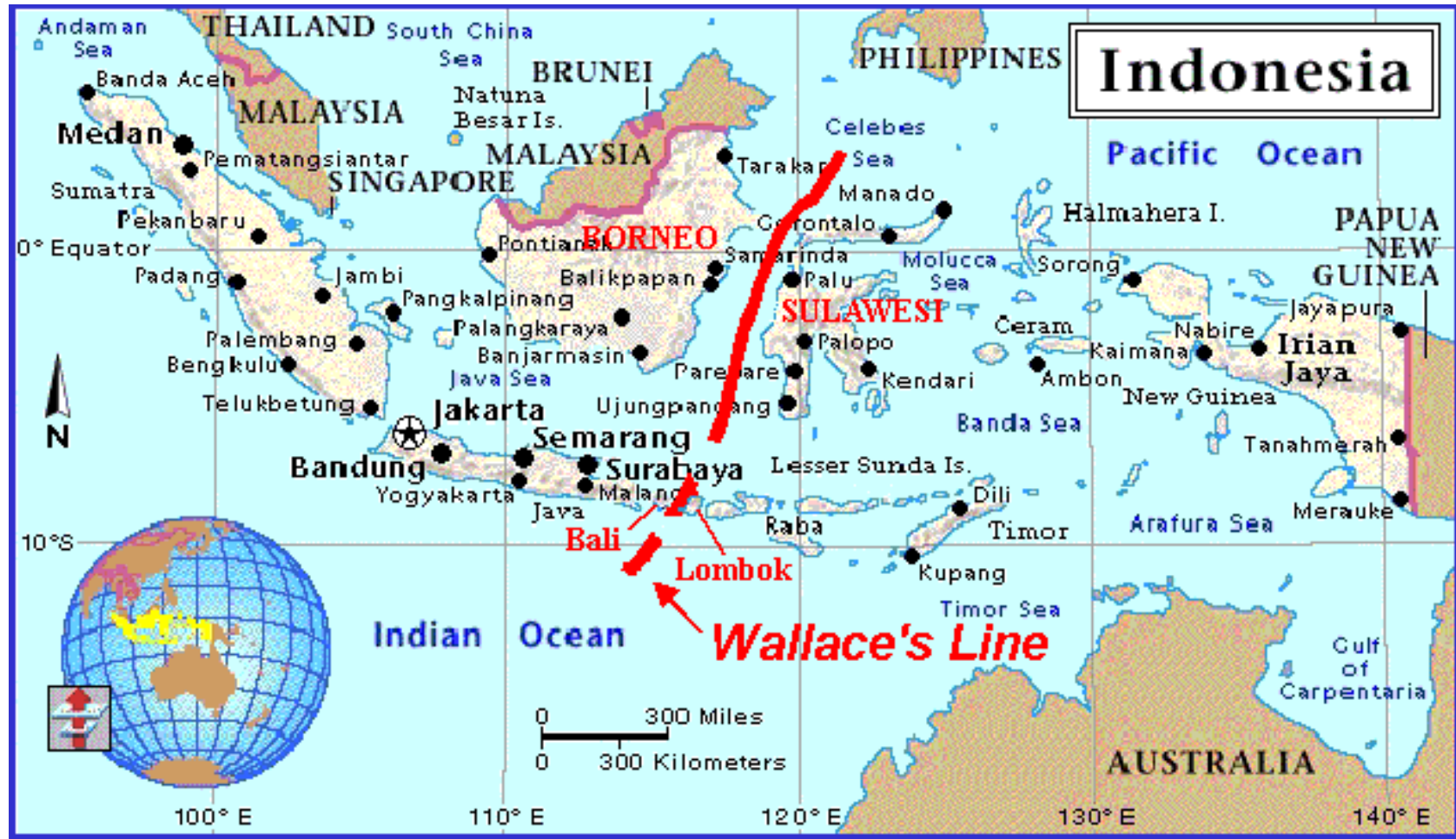
By early 1852 Wallace was in ill health and in no condition to proceed any further. He decided to quit South America, and began the long trip back down the Rio Negro and Amazon to Pará. When he finally reached the town on the 2nd of July, he found that his younger brother Herbert had died of yellow fever.

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

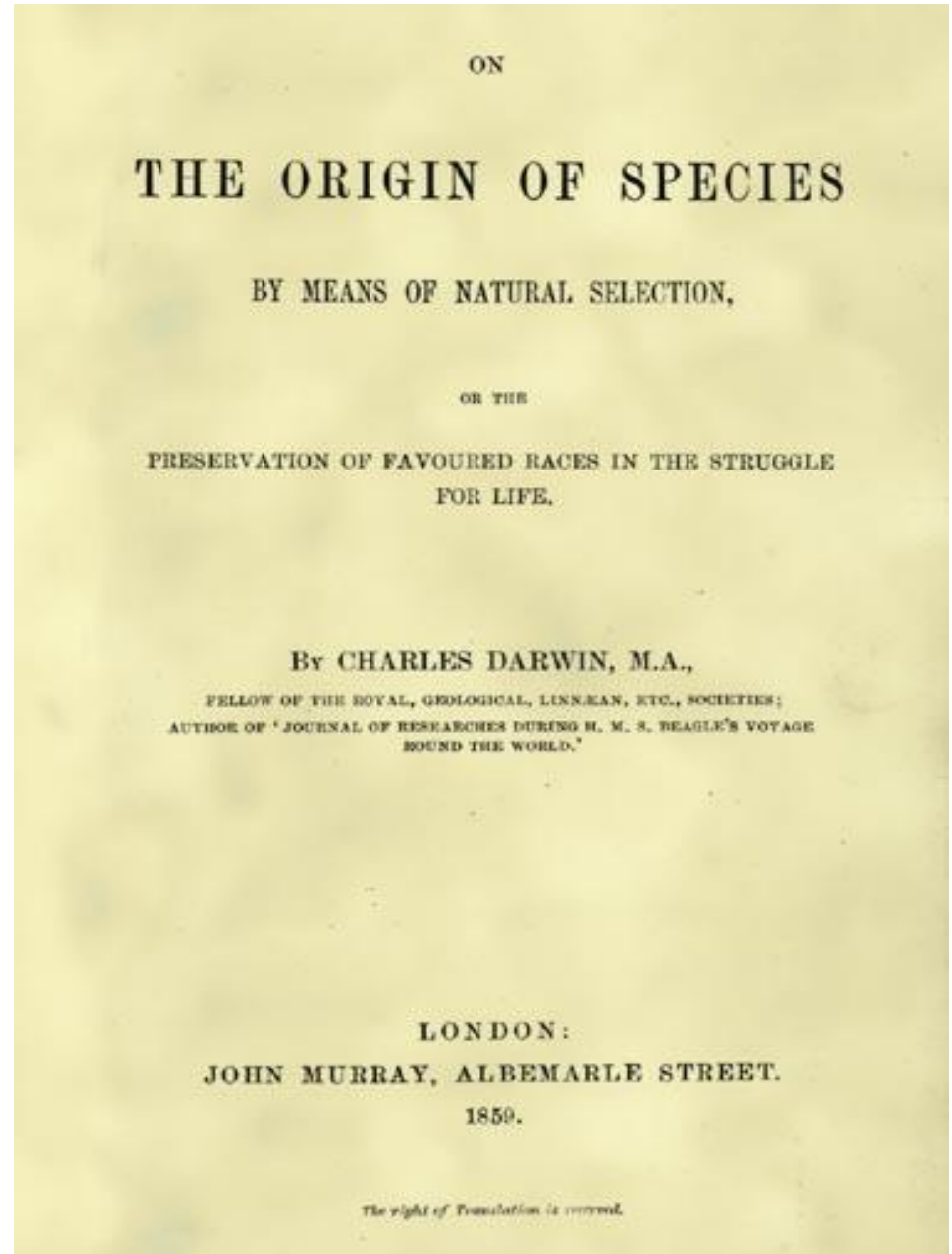
Malarial fever- "flash of insight"



Both papers were presented at the Linnaean
Society of London

Within a year (1859)

Darwin publishes...



Compare and contrast Darwin and Wallace.

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

Remember these Pre-Darwin European Views?

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

Darwin’s ideas on Natural Selection and Evolution really relied on each of these ideas being challenged.

Now we will think about how Darwin’s Ideas were received...

Reception of Darwin's idea - Church

Darwin sent a copy of his book to one of the leading members of the Church of England, the Rev. Charles Kingsley.

Kingsley wrote back to Darwin: "It's just as noble a conception of God to think that he created animals and plants that then evolved, that were capable of self-development, as it is to think that God has to constantly create new forms and fill in the gaps that he's left in his own creation."

So at the time, the idea of Evolution was not particularly controversial for the Church.

<https://www.npr.org/2009/11/24/120692695/at-150-darwins-origin-stirs-even-more-debate>

Reception of Darwin's idea – Scientists

Split Darwin's ideas into two parts-

- **Evolution**
- **Natural Selection**

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.
- The mechanism that causes the change over time (in gene frequencies, morphology etc..)
- Differential success in reproduction as a result of traits that are genetically based (are heritable).

Reception of Darwin's idea- Scientists

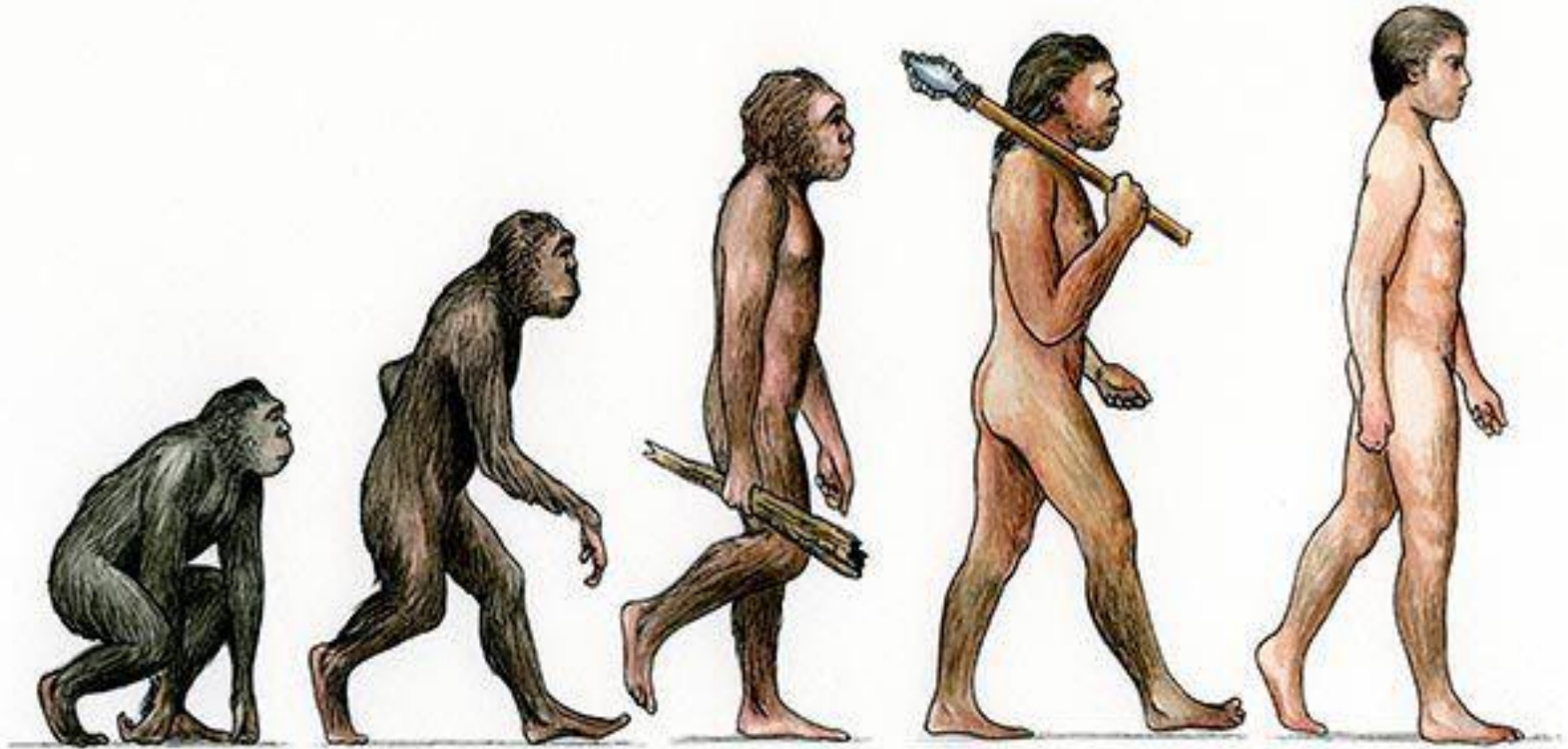
- **Natural Selection** - generally not accepted
“problem of inheritance” (which we will get to-wait for Mendel!)
- **Evolution** or “**transmutation of species**” was generally accepted by scientists



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

BUT there was a persistent misconception....

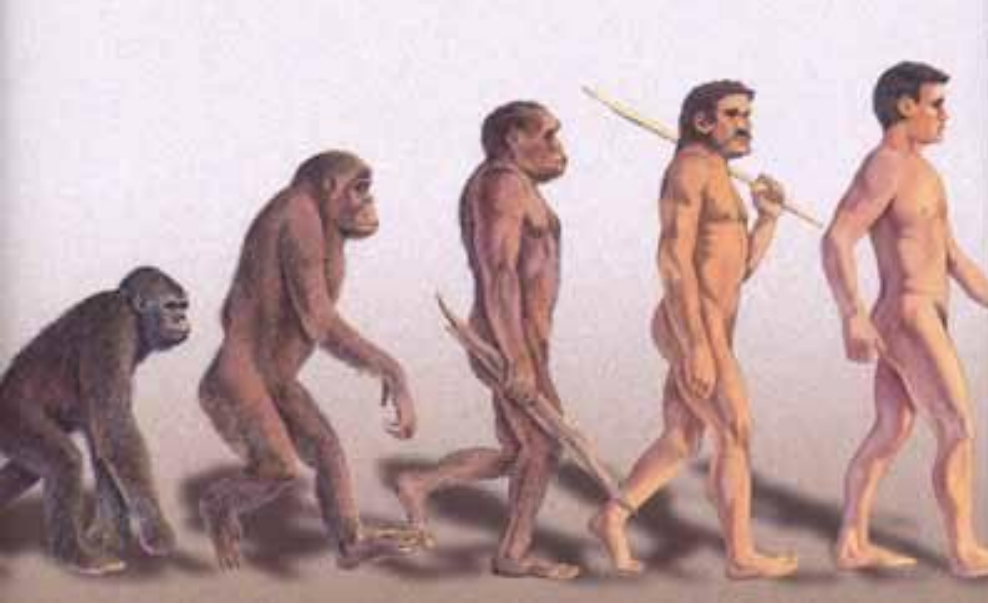
This is kind of what they were thinking of when they heard the word evolution....



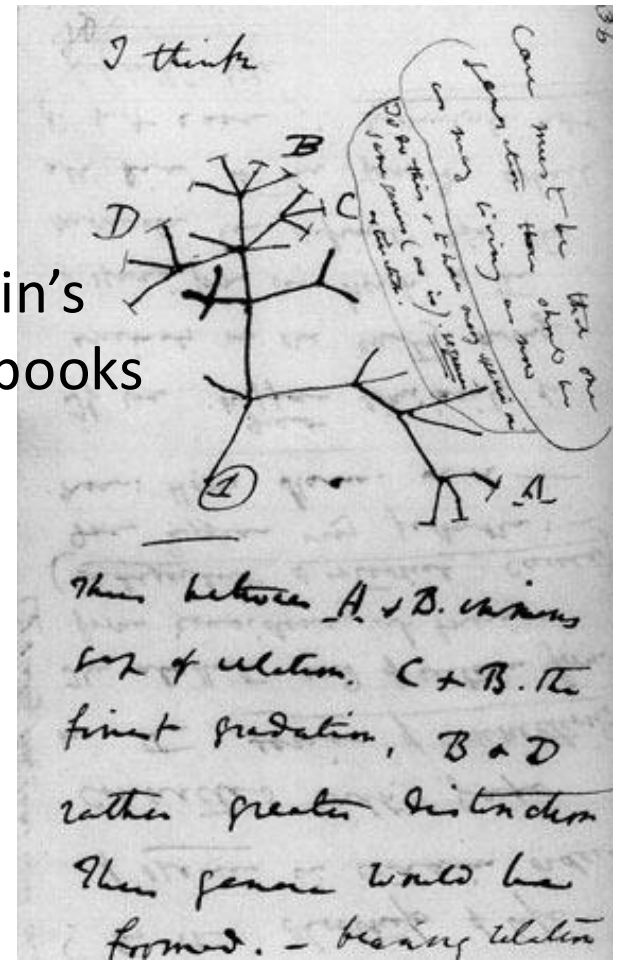
Thoughts?

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.

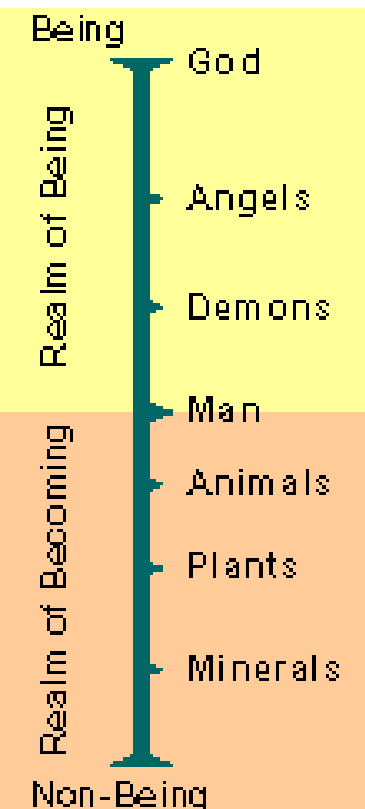
Stephen Jay Gould from *Wonderful Life*



From Darwin's Notebooks



VS



From Berkeley Evol Site

From Origin of Species

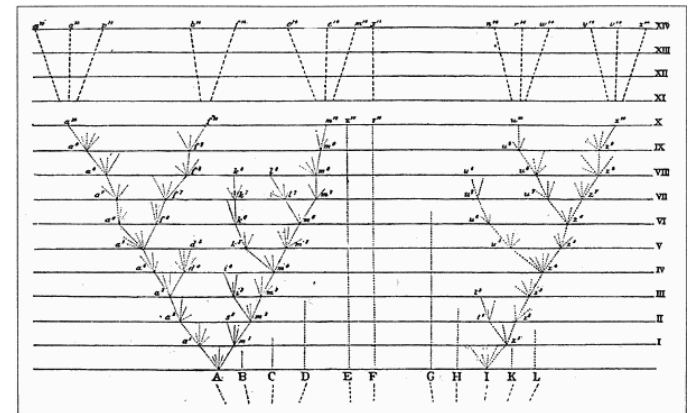
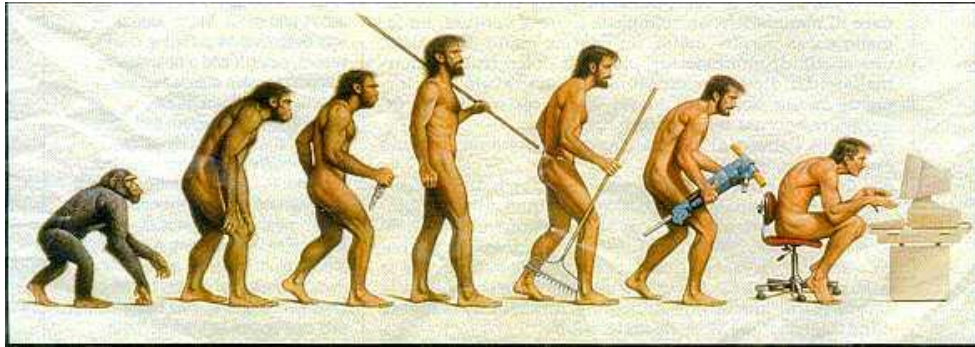
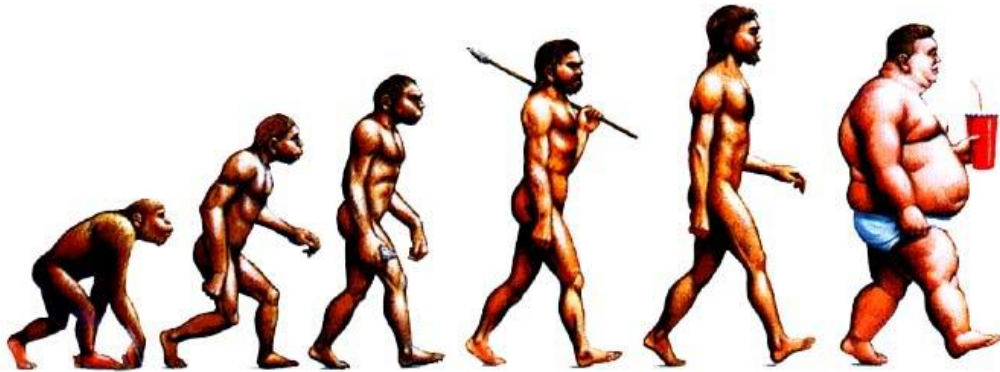


FIGURE 3-1 Darwin's Tree of Life.

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

