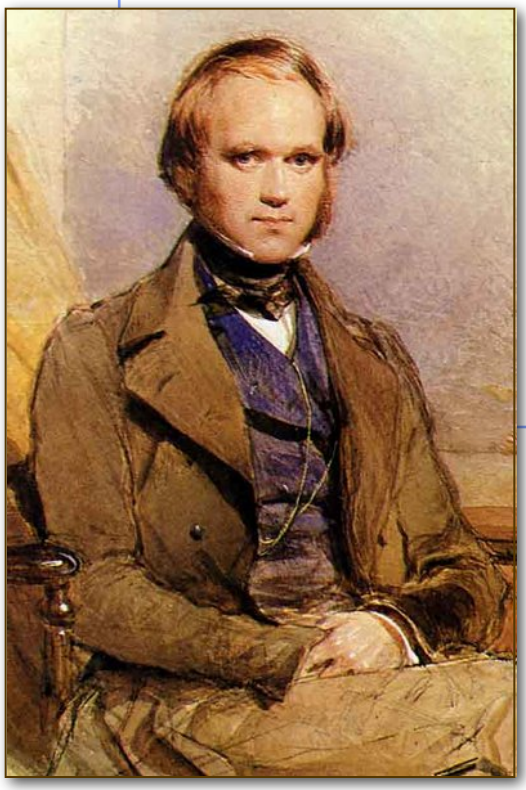
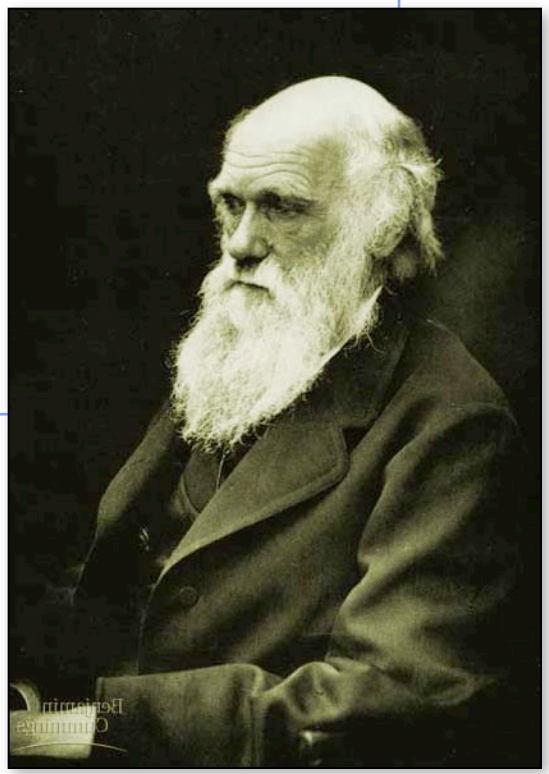
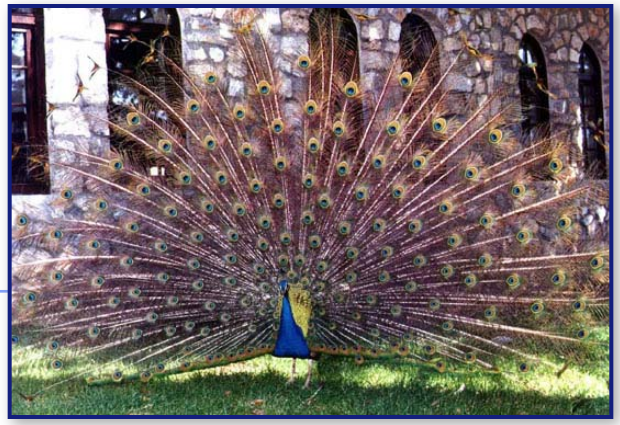
evolution

a journey into where we're from
and where we're going

Descent with Modification
- *Evolution* -
by
Natural Selection







"Nothing in biology makes sense except in the light of evolution."

-- Theodosius Dobzhansky
March 1973

Geneticist, Columbia University

What did he mean?

Evolution explains the unity and diversity of organisms on Earth

Man has always sought to explain the world around him
Such pursuits have led to Religion and science.

Christianity teaches that God created all living creatures as they are today.

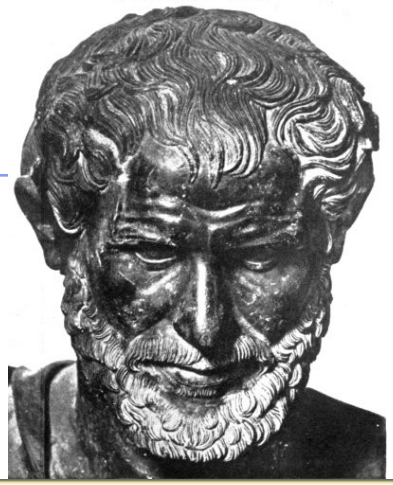
Before Darwin, two ideas about life prevailed:

1. **Species do not change**
2. **Earth was less than 10,000 years old and relatively unchanging**

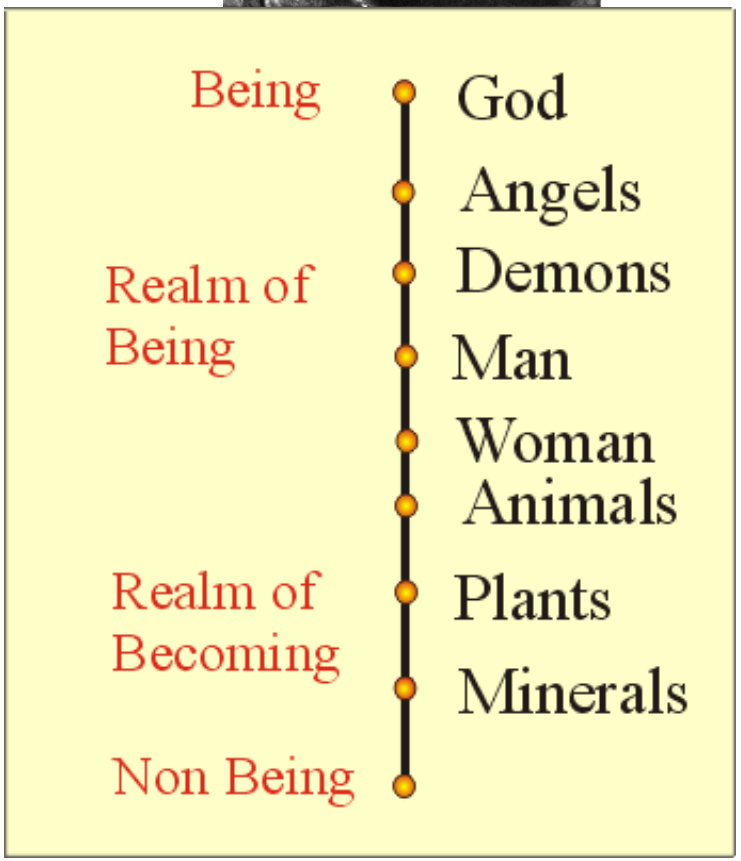
TINTORETTO The Creation of the Animals 1550

DOCTRINE

Aristotle (384 - 322 B.C.)



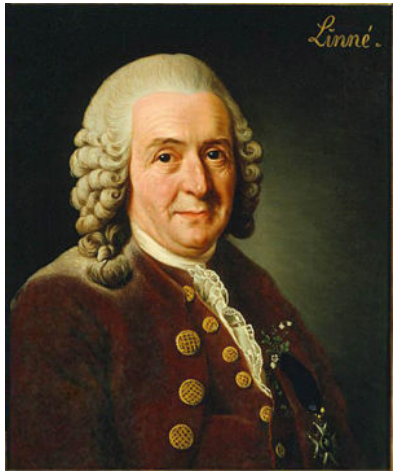
- **Arranged life forms on a scale of increasing complexity called the Scala Naturae.**
  - **Believed all species are permanent, fixed, perfect, and unchanging.**



AP

Carolus Linnaeus (1707 - 1778)

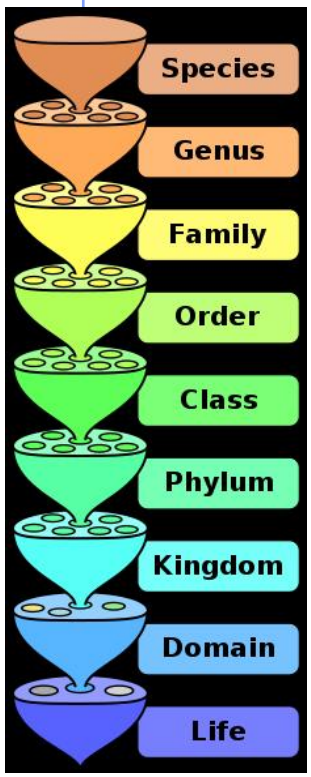
- Swedish physician constructed not a linear, but a nested binomial (two part) classification system
  - Grouped similar species into increasingly general categories
    - System still in use today
      - The concept behind this naming system played a central role in Darwin's argument in favor of evolution later
- Attributed the resemblance among species NOT to evolutionary relationship, but to the will of their creator.

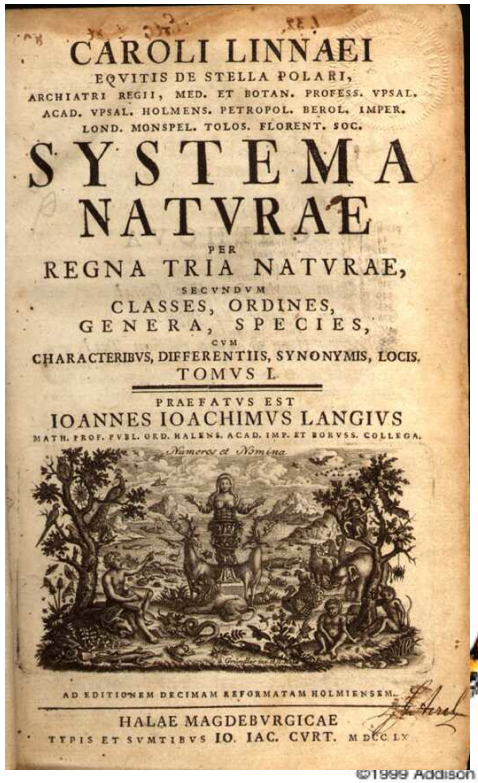


Modern Classification systems

"Dear King Philip Came Over For Great Spaghetti."

- **This Linnean binomial classification system is still in use today**
  - **The modern system uses the seven categories shown here.**




CAROLI LINNAEI
EQVITIS DE STELLA POLARI,
ARCHIATRI REGII, MED. ET BOTAN. PROFESS. VPSAL.
ACAD. VPSAL. HOLMENS. PETROPOL. BEROL. IMPER.
LOND. MONSPEL. TOLOS. FLORENT. SOC.

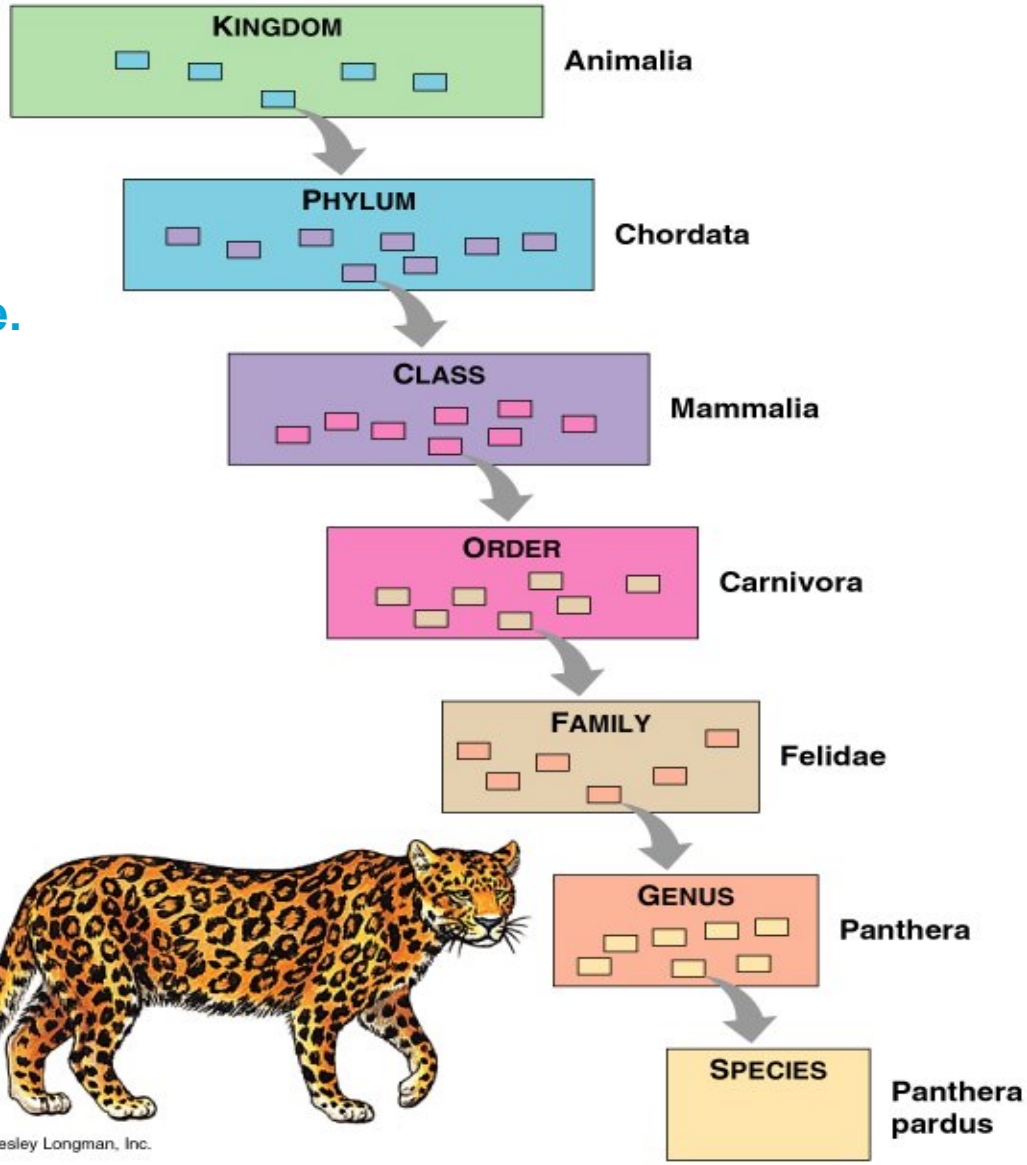
SYSTEMA NATVRAE

PER
REGNA TRIA NATVRAE,
SECVNDVM
CLASSES, ORDINES,
GENERA, SPECIES,
CVM
CHARACTERIBVS, DIFFERENTIIS, SYNONYMIS, LOCIS.
TOMVS I.

PRAEFATVS EST
IOANNES IOACHIMVS LANGIVS
MATH. PROF. FVBL. ORD. HALENS. ACAD. IMP. ET BORVSS. COLLEGA.

AD EDITIONEM DECIMAM REFORMATAM HOLMIENSEM.

HALAE MAGDEBVRGICAE
TYPIS ET SVMTIBVS IO. IAC. CVRT. MDCC LV



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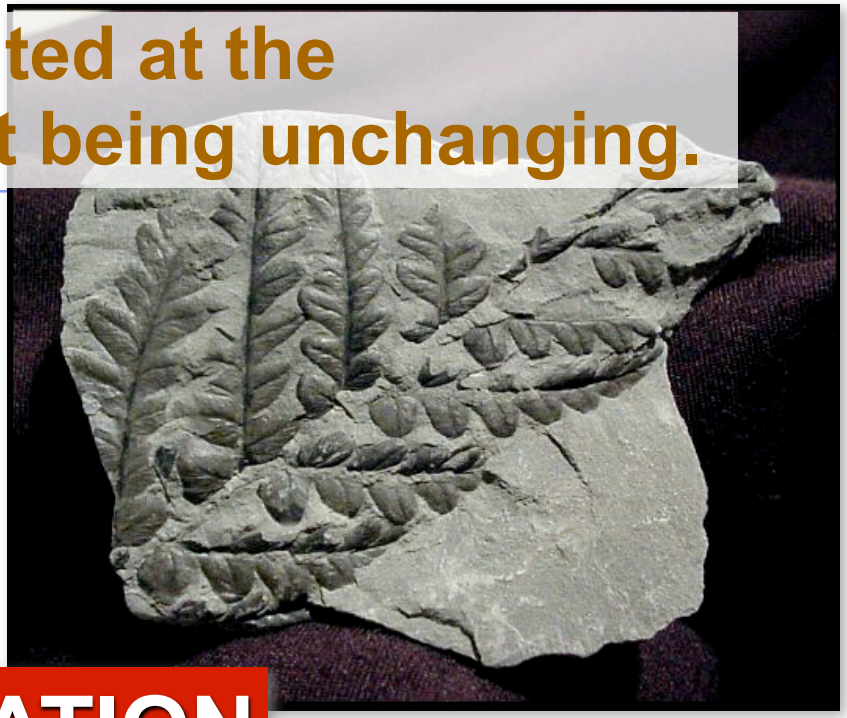
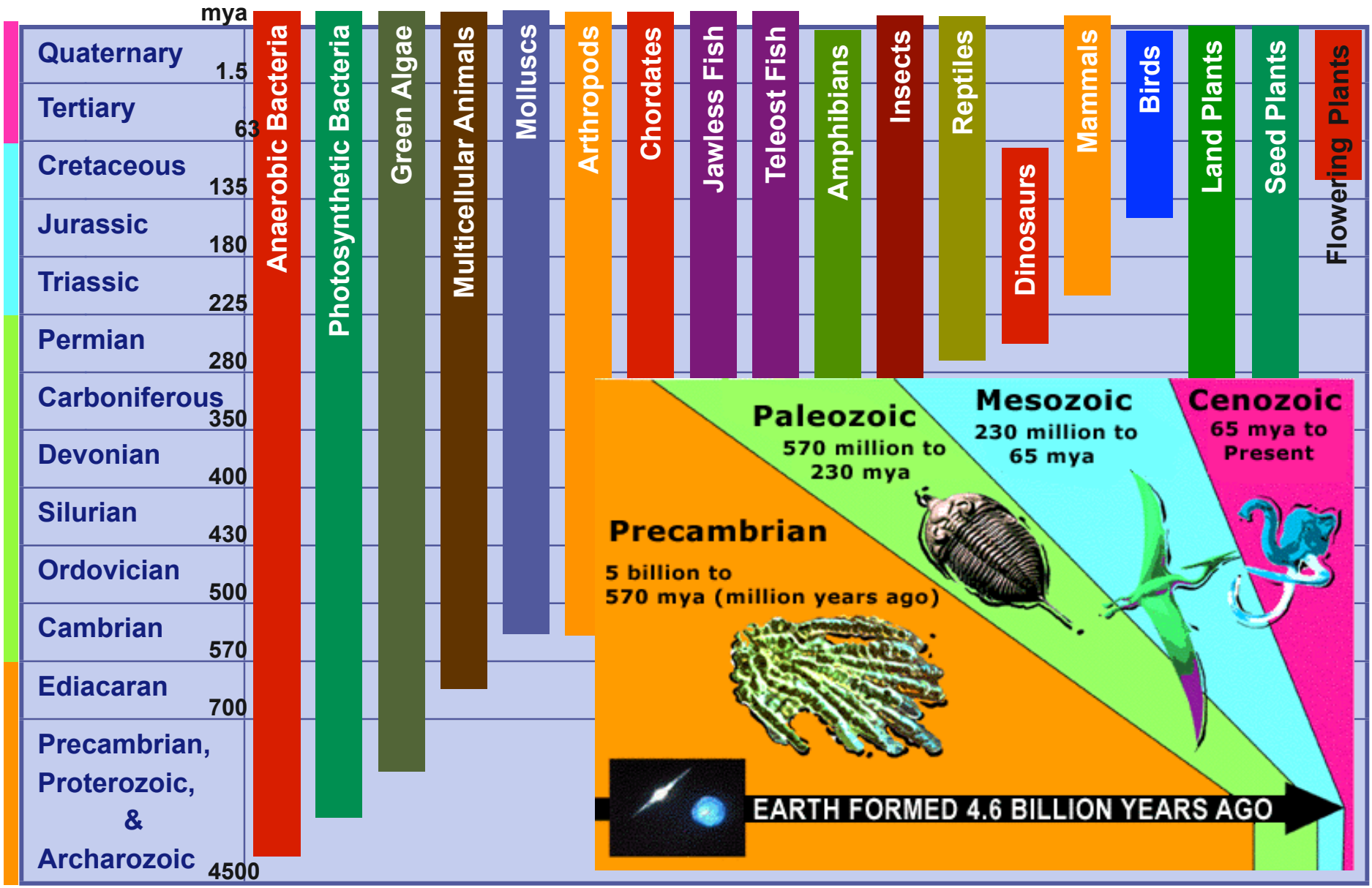
But the Fossil record hinted at the possibility of species not being unchanging.



OBSERVATION

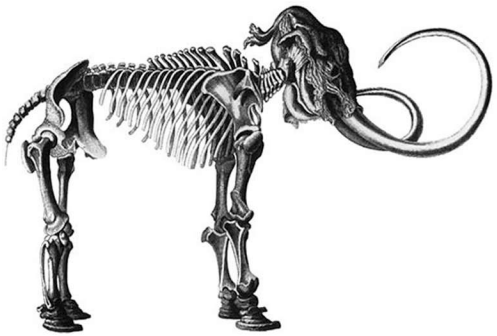
- **Studies of fossils in the 1700s by French Naturalist Georges Buffon suggested that Earth might be much older than a few thousand years.**
  - ***He also observed that fossils and living animals were similar but not exactly the same.***

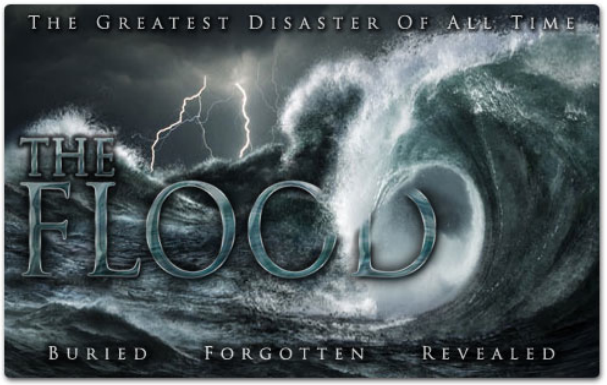


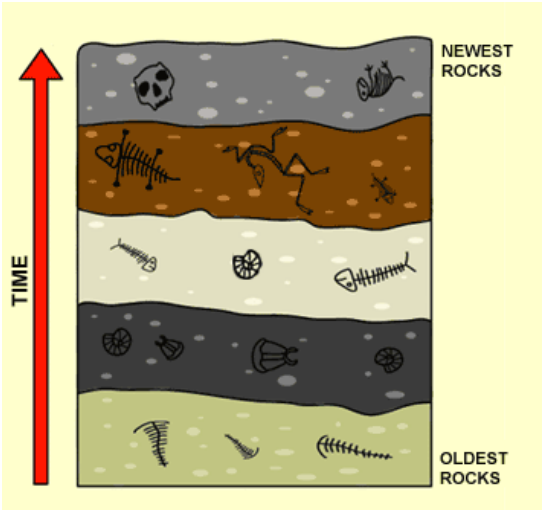
Life's Natural History is a record of Successions & Extinctions

Catastrophism

- Geoge Cuvier (1769 - 1832) developed the field of paleontology, the study of fossils.
  - Noticed that the older the strata *(sedimentary rock layer)* in which a fossil was found, the less similar that fossil was to current modern life forms.
  - Noticed too that from one stratum to another, some species appeared and others disappeared.
- Advocated catastrophism
  - Catastrophic events that occurred suddenly *(through supernatural means)* shaped the earth and caused massive extinctions and that these events no longer operate

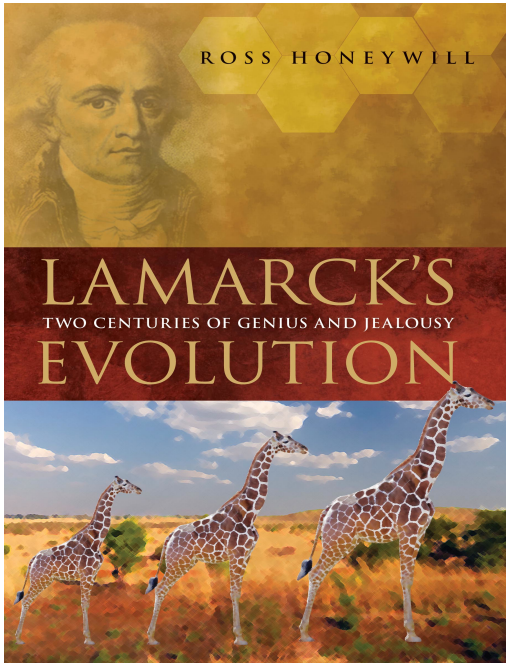






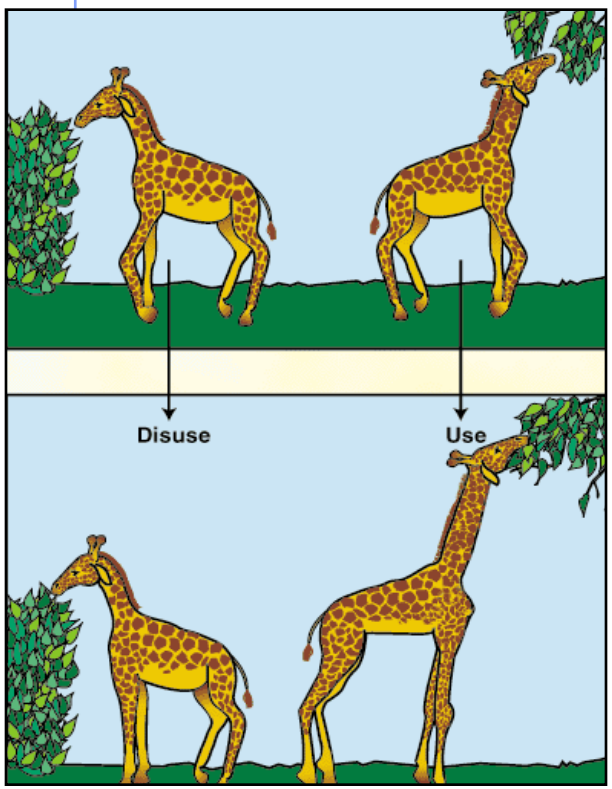
Jean Babtiste de LaMarck (1744 - 1829)

- PROPOSED THAT LIFE CHANGES
- Proposed a theory of evolution through passing on of acquired traits
  - Noted how well-adapted organisms were to their environments, and believed that fossils could be understood as less perfect forms, which had perished in the struggle for increasing perfection.
  - He explained adaptation as a result of change caused by environmental pressures.
    - Adaptation = An inherited characteristic that improves an organisms ability to survive and reproduce in a particular environment
  - He believed populations adapted to their environments by acquiring traits



Jean Babtiste de LaMarck (1744 - 1829)

- **Proposed a theory of evolution based on the passing on of acquired traits**
  - **Environmental pressures push organisms to acquire new traits through the....**



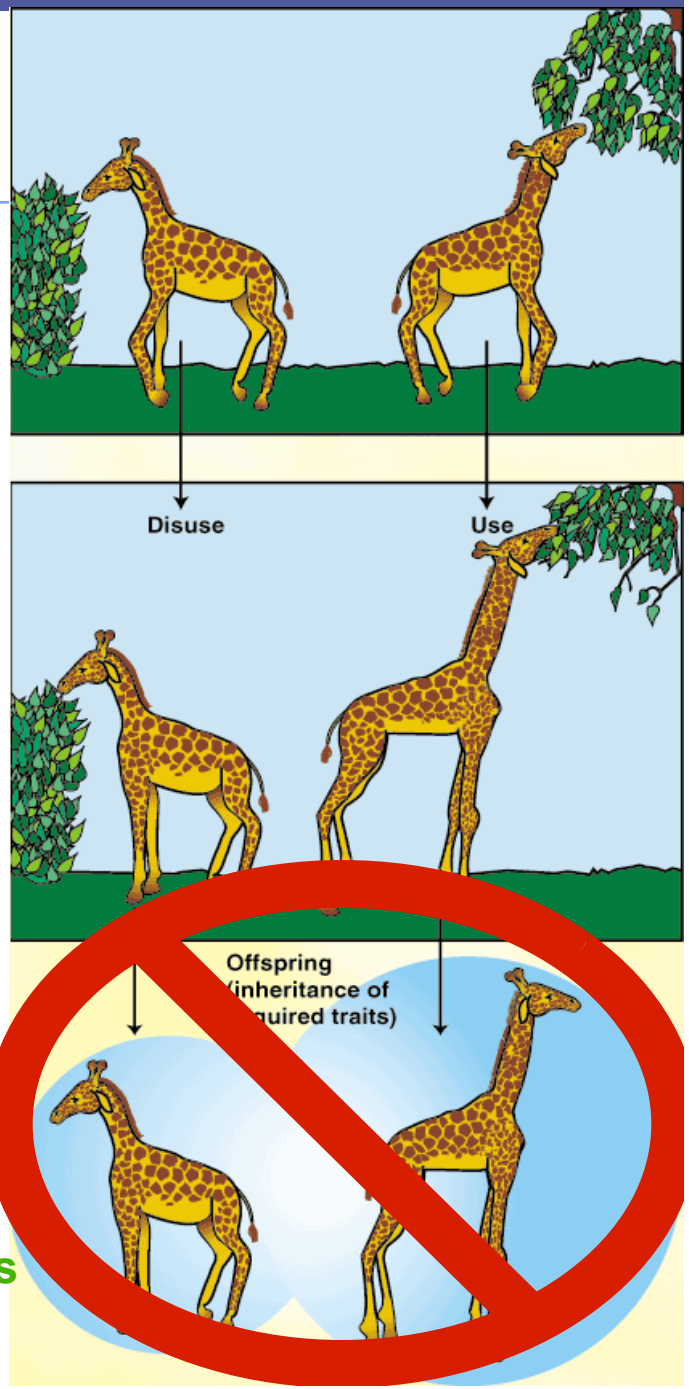
✓ **Principles of Use and Disuse**

1. **Principle of Disuse:**
   - organisms lost parts because they did not use them
     - like the missing eyes & digestive system of the tapeworm
2. **Principle of Use:**
   - the constant use of an organ leads that organ to increase in size
     - like the muscles of a blacksmith or the large ears of a night-flying bat

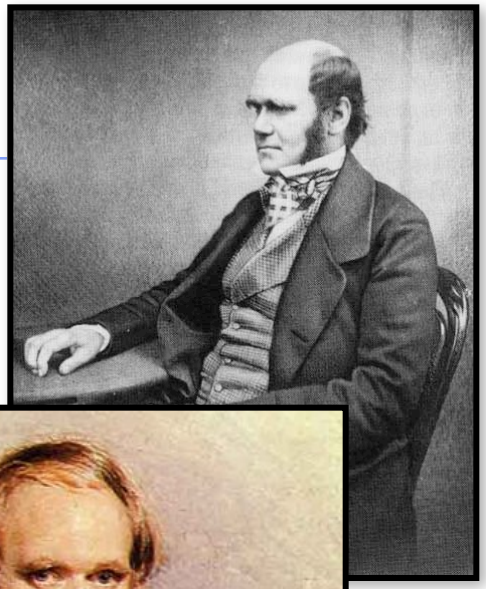
The key to Lamarckan Evolution

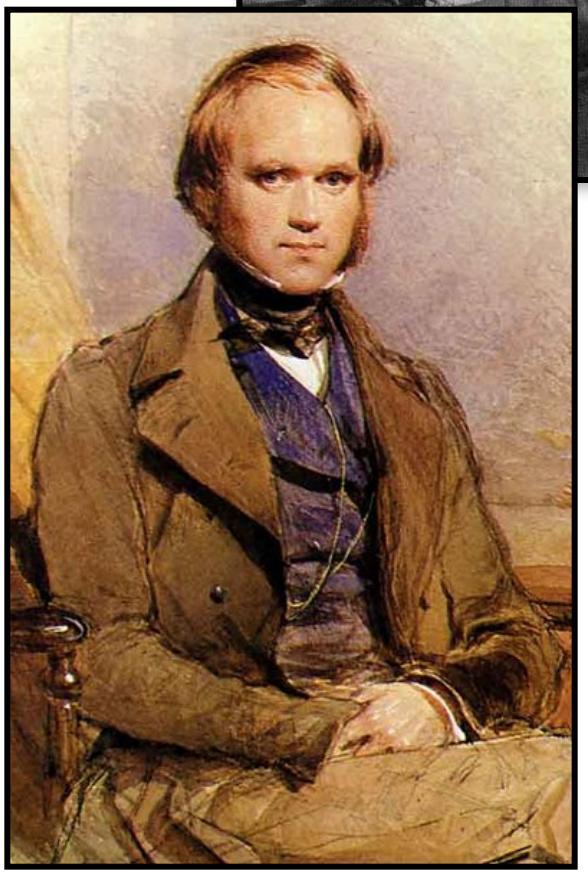
- ★ **Principle of inheritance of <u>acquired characteristics</u>**
  - **Organisms are able to transmit <u>acquired characteristics</u> *(acquired in a life time)* to next generation**
    - **Anything sound fishy to you?**
- ◆ **There was just ooooone teeny problem…**
  - **Acquired characteristics are <u>NOT</u> inherited.**
  - **DNA is not changed because of acquiring a characteristic in a lifetime**

Ex: A light skinned woman who acquires a dark sun tan, will not have a darker baby unless the baby inherits darker skin alleles of skin genes



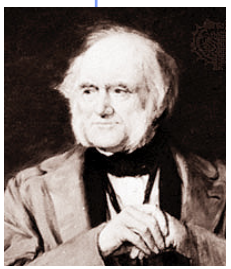
But then came Charles Darwin…



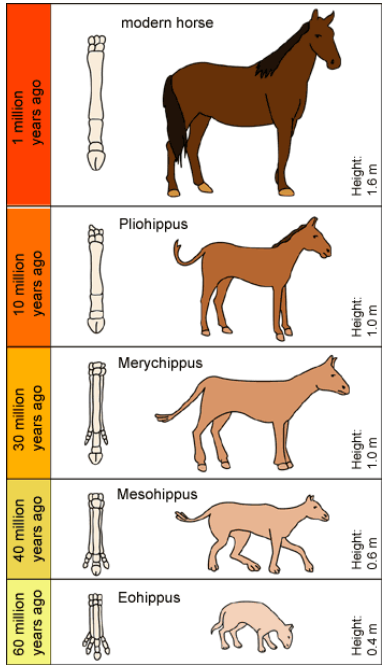


- British Naturalist (1809-1882)
- Considered the father of Modern Evolutionary Theory
  - The idea that organisms living on Earth today are descendants of ancient organisms no longer living.
    - Core theme of biology.
  - Proposed the idea of evolution by natural selection
    - Collected clear evidence to support his idea
    - Provided a clear mechanism for evolution

Age of Earth: Observations led some to propose that Earth was MILLIONS of years old, not thousands

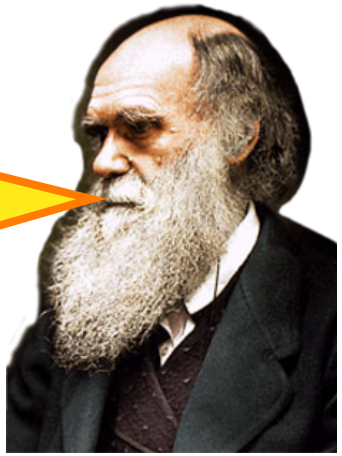


- Geologist James Hutton (1726 - 1797)
  - Proposed a theory of gradualism, stating that geological features could be explained by gradual mechanisms still operating today
- Geologist Charles Lyell (1797 - 1875)
  - Principle of uniformitarianism, mechanisms of geological change are slow and constant over time and still operating today at the ***same rate*** as before.

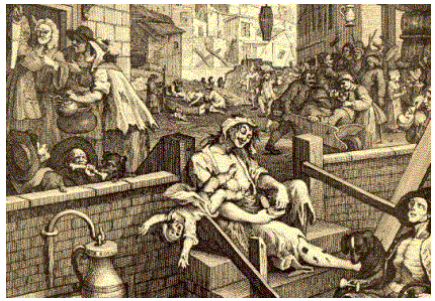


Charles Darwin extended these ideas into the biological sciences.

Why can't earth living diversity be explained through the accumulations of many minor changes in traits over long periods of time?



Thomas Malthus (1766-1834)



- Political economist
  - Wrote about how population growth would always overpower food supply through growth, creating perpetual states of hunger, disease, and struggle.
    - So...there existed a natural, ***ever-present struggle for survival***
  - Charles Darwin would later read Malthus' work and begin to apply his thoughts to biology

If there exists a struggle for survival, why do some organisms in nature survive better and what might be the consequences be?