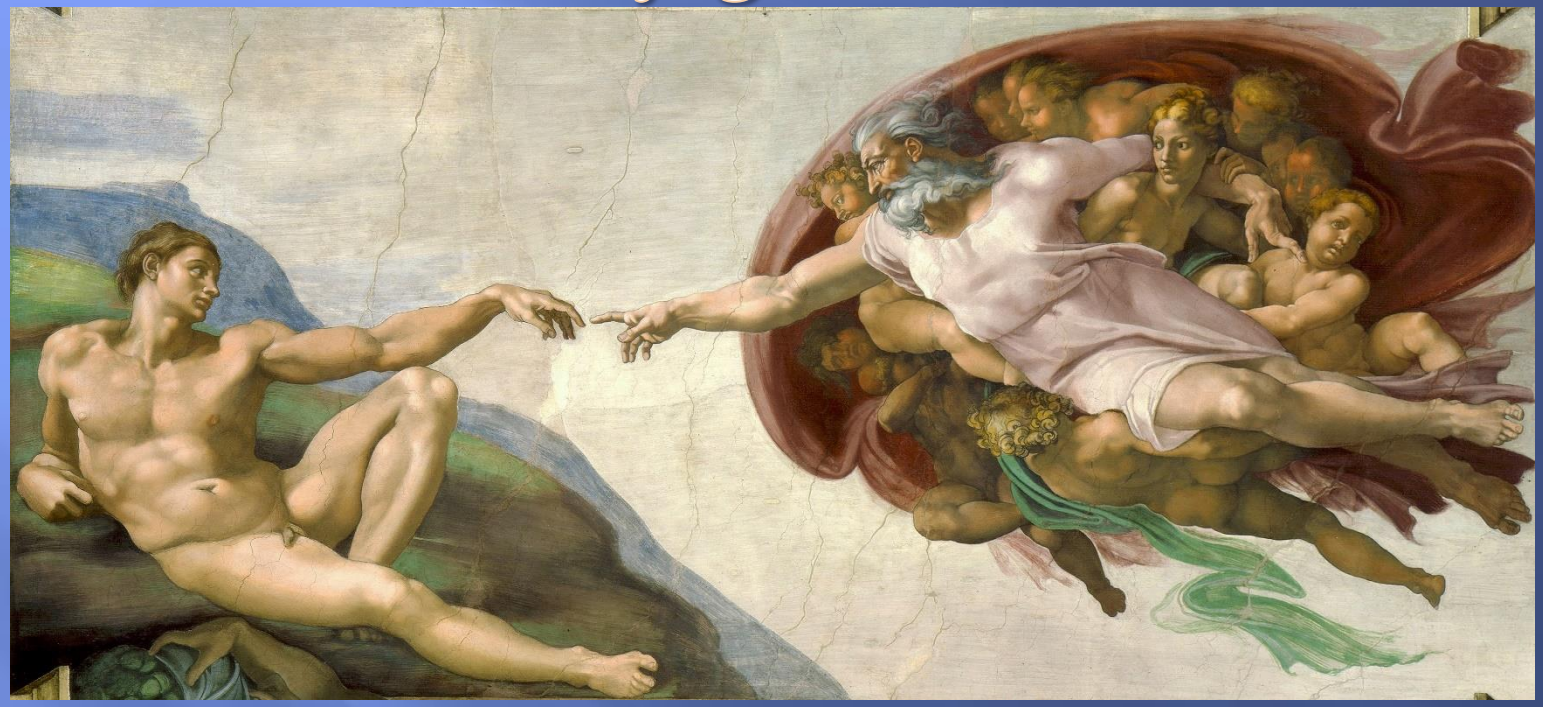
Updating Darwinian Evolution Part III:
Evolutionary Theory Before Darwin

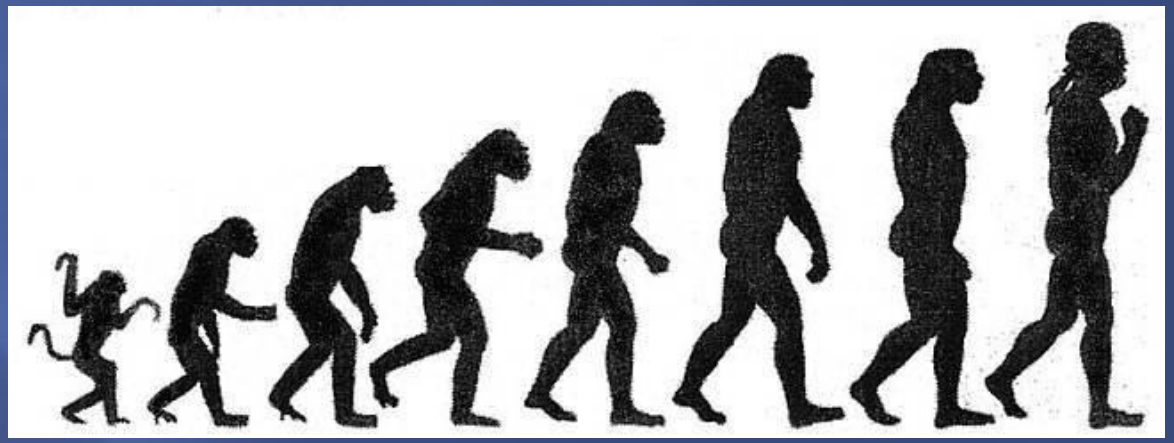
Science Circle
October 12th 2019

Stephen Gasior, Ph.D.
a.k.a. Stephen Xootfly
Reformed College Biology Instructor

Updating Darwin

Did we really go from this to evolution?





Updating Darwin

Natural Selection

Organisms within a species vary in their genes

Reproductive capacity always hits limits of environment, and predation and disease remove some

Best reproducers (with their more fit genes) leave more offspring (with those fit genes)

Over time, favorable traits accumulate in the population

Different enough to be distinct species

Charles Darwin, 1849

1859 *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life.* London: Murray. [1st ed.]

Before Darwin

Vitalism

"living organisms are fundamentally different from non-living entities because they contain some non-physical element or are governed by different principles than are inanimate things“ ➔ Elan

Organisms emerge by the actions of a *vis essentialis* (an organizing, formative force). Which is has a “preformed” template

Theoria Generationis (1759), Caspar Friedrich Wolff (1733–1794) ie **homunculus**

Before Darwin

PreFormation

From Nicolaas Hartsoeker, *Essay de dioptrique*, Paris: Jean Anisson, 1694

que la tête ſeroit peut-être plus grande à proportion du reſte du corps, qu'on ne l'a deſſinée icy.

ART. XC. Ce que c'eſt que l'œuf de la femme, & comment un enfant vient ordinairement au monde.

Au reſte, l'œuf n'eſt à proprement parler que ce qu'on appelle *placenta*, dont l'enfant, aprés y avoir demeuré un certain temps tout courbé & comme en peloton, briſe en s'étendant & en s'allongeant le plus qu'il peut, les membranes qui le couvroient, & poſant ſes pieds contre le *placenta*, qui reſte attaché au fond de la matrice, ſe pouſſe ainſi avec la tête hors de ſa priſon; en quoi il eſt aidé par la mere, qui agitée par la douleur qu'elle en ſent, pouſſe le fond de la matrice en bas, & donne par conſequent d'autant plus d'occaſion à cet enfant de ſe pouſſer dehors & de venir ainſi au monde.

L'experience nous apprend que beaucoup d'animaux ſortent à peu prés de cette maniere des œufs qui les renferment.

ART. XCI. Que l'on peut pouſſer bien plus loin cette nouvelle penſée de la generation, & comment.

L'on peut pouſſer bien plus loin cette nouvelle penſée de la generation, & dire que chacun de ces animaux mâles, renferme lui-même une infinité d'autres

Updating Darwin

Classification of Organisms

John Ray (1686) "In order that an inventory of plants may be begun and a classification established, we must try to discover criteria of some sort for distinguishing what are called "species." …distinguishing features that perpetuate themselves in propagation from seed."

Carl Linnaeus (1751) "that at the beginning of the world there was created only a single sexual pair of every species of living things" … except hermaphrodites in which case only 1 was made.

invented binomial nomenclature

→ Species are constant

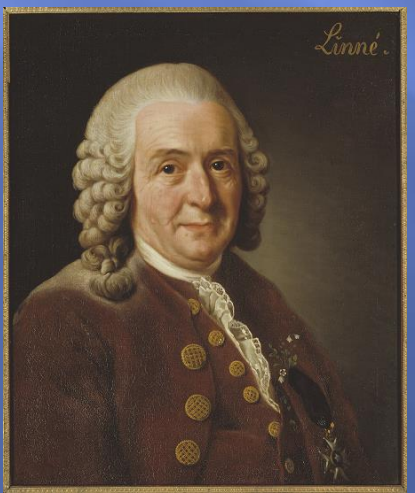
Before Darwin

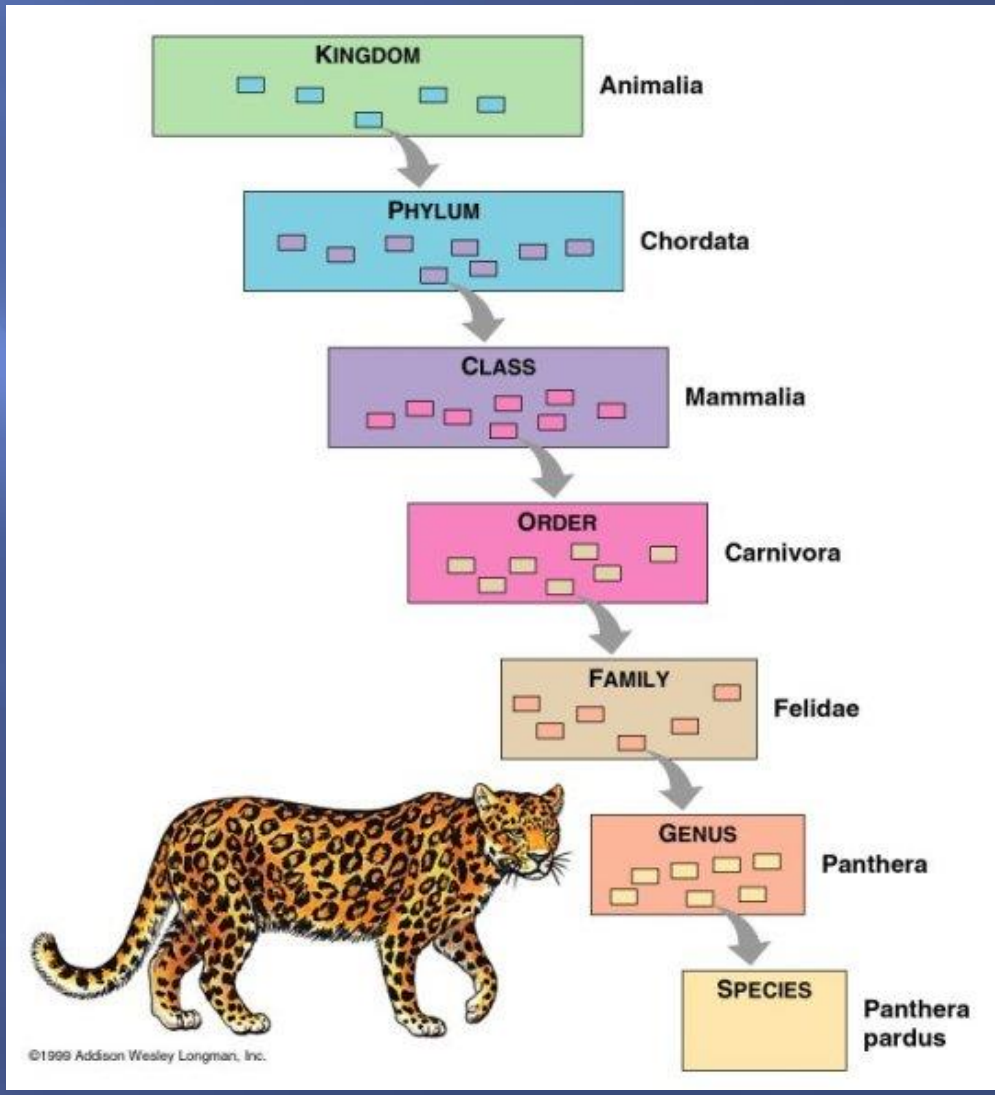
More on Taxonomy

Systema Naturae (1735)

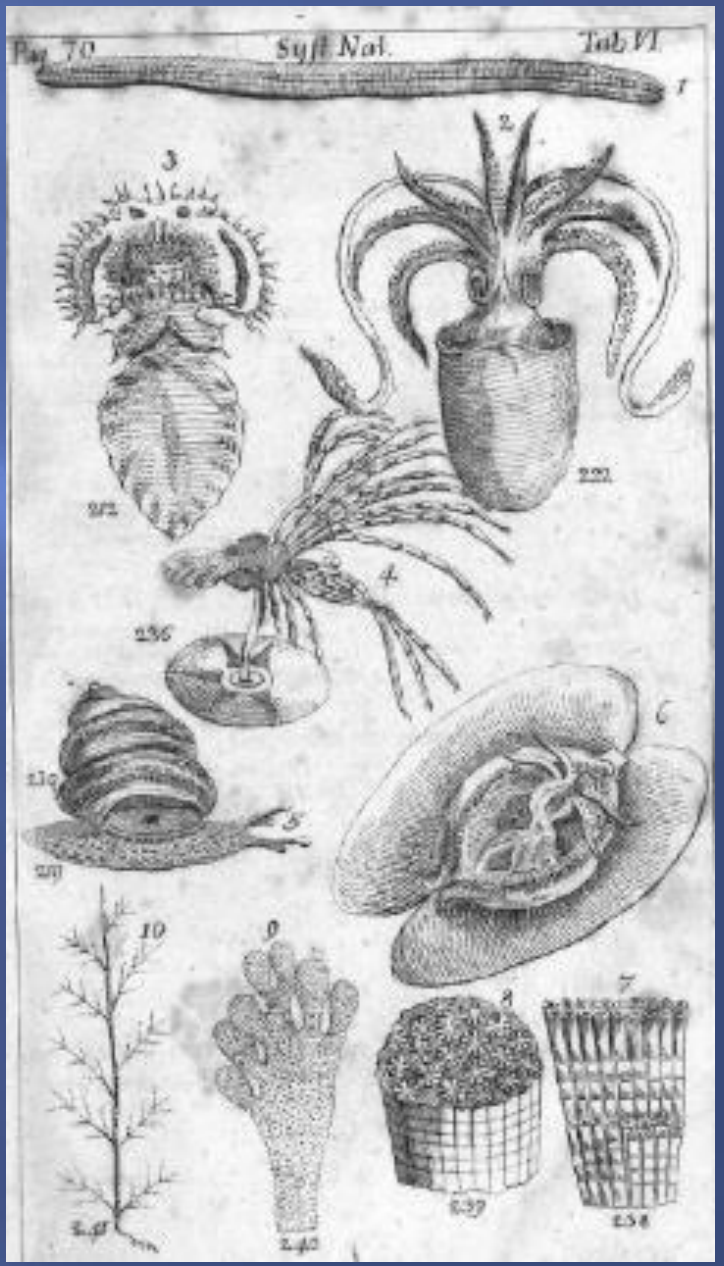
6,000 plants and 4,236 animals.

- Mammalia
- Aves
- Amphibia
- Pisces
- Insecta
- Vermes





Before Darwin



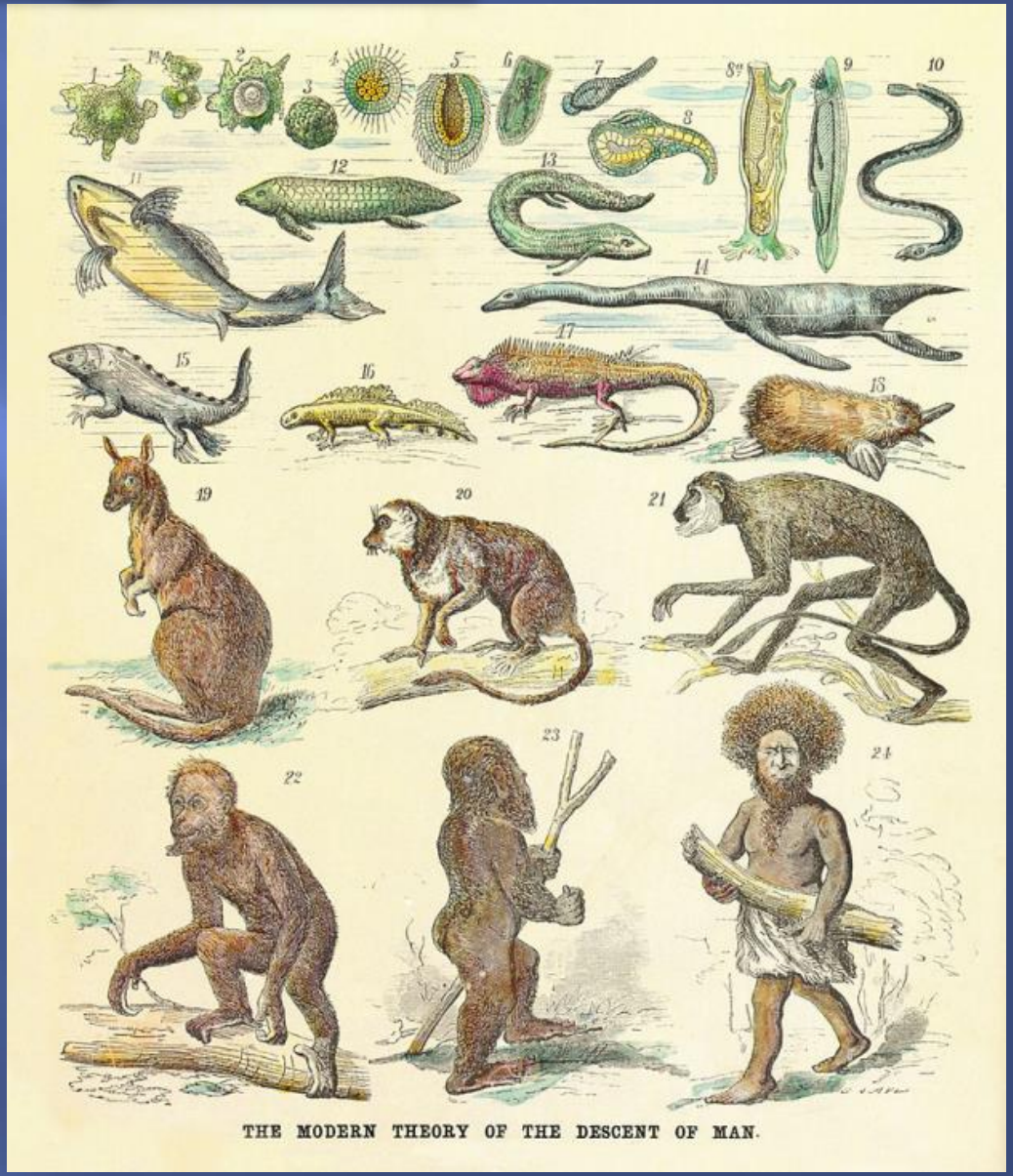
Updating Darwin

Scala naturae

Chain of being from lowest to highest

Strictly followed increasing complexity order established by

- Vermes
- Insecta
- Pisces
- Amphibia
- Aves
- Mammalia
- Humans



Before Darwin

Georges-Louis Leclerc, Comte de Buffon (1707-1788)

Histoire Naturelle (36 quartos)

along with numerous other works, formed the basis for modern biological classification.

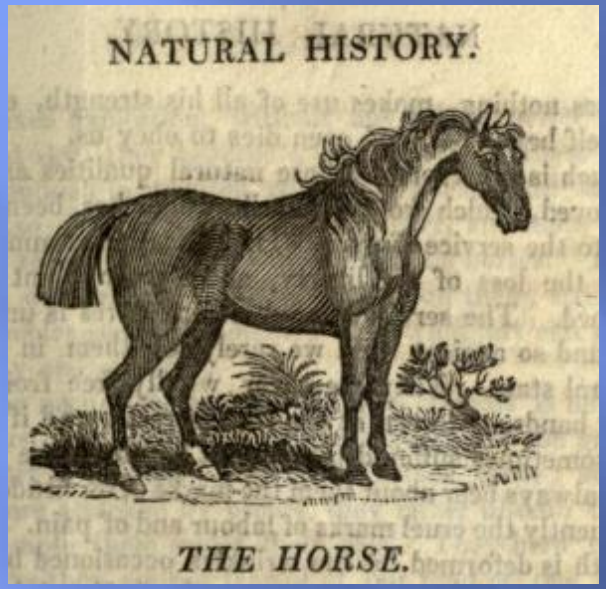
-pointed out the continuity between species and established the donkey/horse infertile offspring criterion for distinct species "Unity of Type"

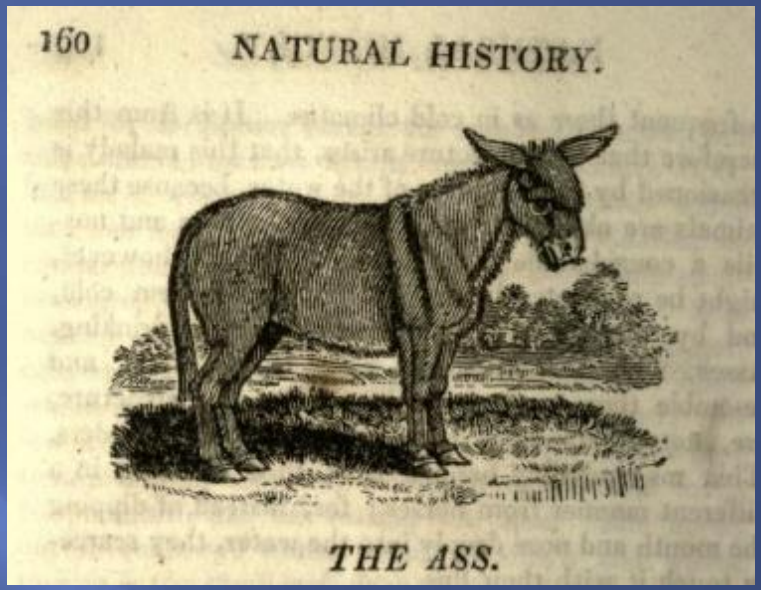
-argued for improvement and degeneration of species

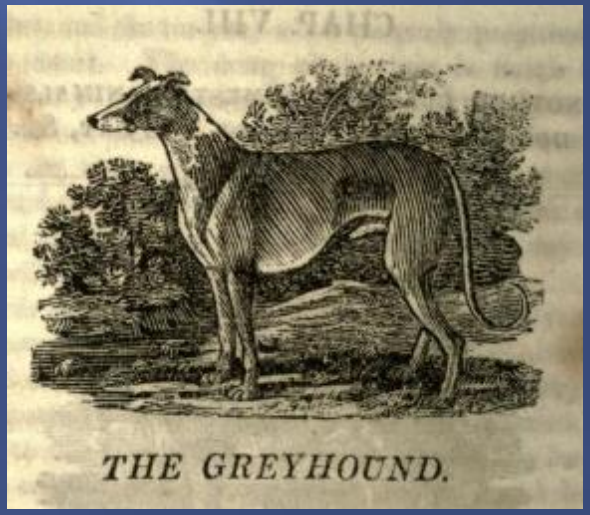
-among first to incorporate aged earth

-broke from *scala naturae* tradition by categorizing organisms into higher groups but not by not ranking them according to increasing complexity

Before Darwin







Before Darwin

Georges-Louis Leclerc, Comte de Buffon (1707-1788)

Histoire Naturelle (36 quartos)

-proposed a theory of "epigenetics" that ran counter to the prevailing theory of pre-existence: "that there exists in Nature an infinite number of living organic particles, that organized beings are composed of these organic particles, [and] that their production costs Nature nothing, since their existence is constant and invariable"

-still relied on an "interior mold"

2 Generations Before Darwin

Erasmus Darwin (1731–1802)

- *Zoonomia* (1794–1796) "warm-blooded animals have arisen from one living filament, which THE GREAT FIRST CAUSE endued with animality, with the power of acquiring new parts, attended with new propensities, directed by irritations, sensations, volitions, and associations; and thus possessing the faculty of continuing to improve by its own inherent activity, and of delivering down those improvements by generation to its posterity, world without end!"

2 Generations Before Darwin

Erasmus Darwin (1731–1802)

- *Zoonomia* (1794–1796) “the strongest and most active animal should propagate the species, which should thence become improved.”
- "three great objects of desire" for every organism: "lust, hunger, and security."

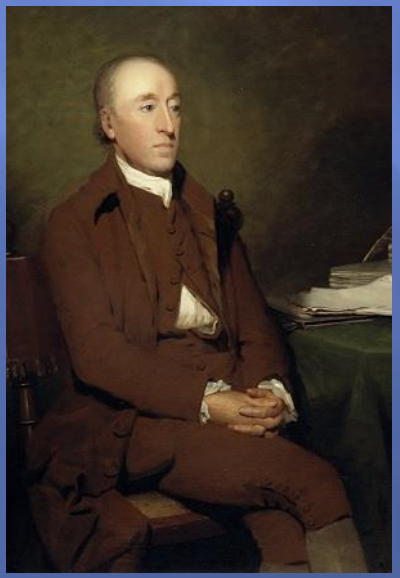
Right Before Darwin

James Hutton (1726 - 1797)

- Geologist
- *Investigation of the Principles of Knowledge* (1794)

Principle of Variation

- "...if an organised body is not in the situation and circumstances best adapted to its sustenance and propagation, then, in conceiving an indefinite variety among the individuals of that species, we must be assured, that, on the one hand, those which depart most from the best adapted constitution, will be the most liable to perish, while, on the other hand, those organised bodies, which most approach to the best constitution for the present circumstances, will be best adapted to continue, in preserving themselves and multiplying the individuals of their race."



- In context, he was still a creationist

Updating Darwin

Geology Interlude

Age of the Earth

Commonly held belief to be ~6000 yo. (Bishop Ussher calculated by generations in Genesis)

Created perfect and as is and unchanging

Coming of Geology

Basalt is ancient lava

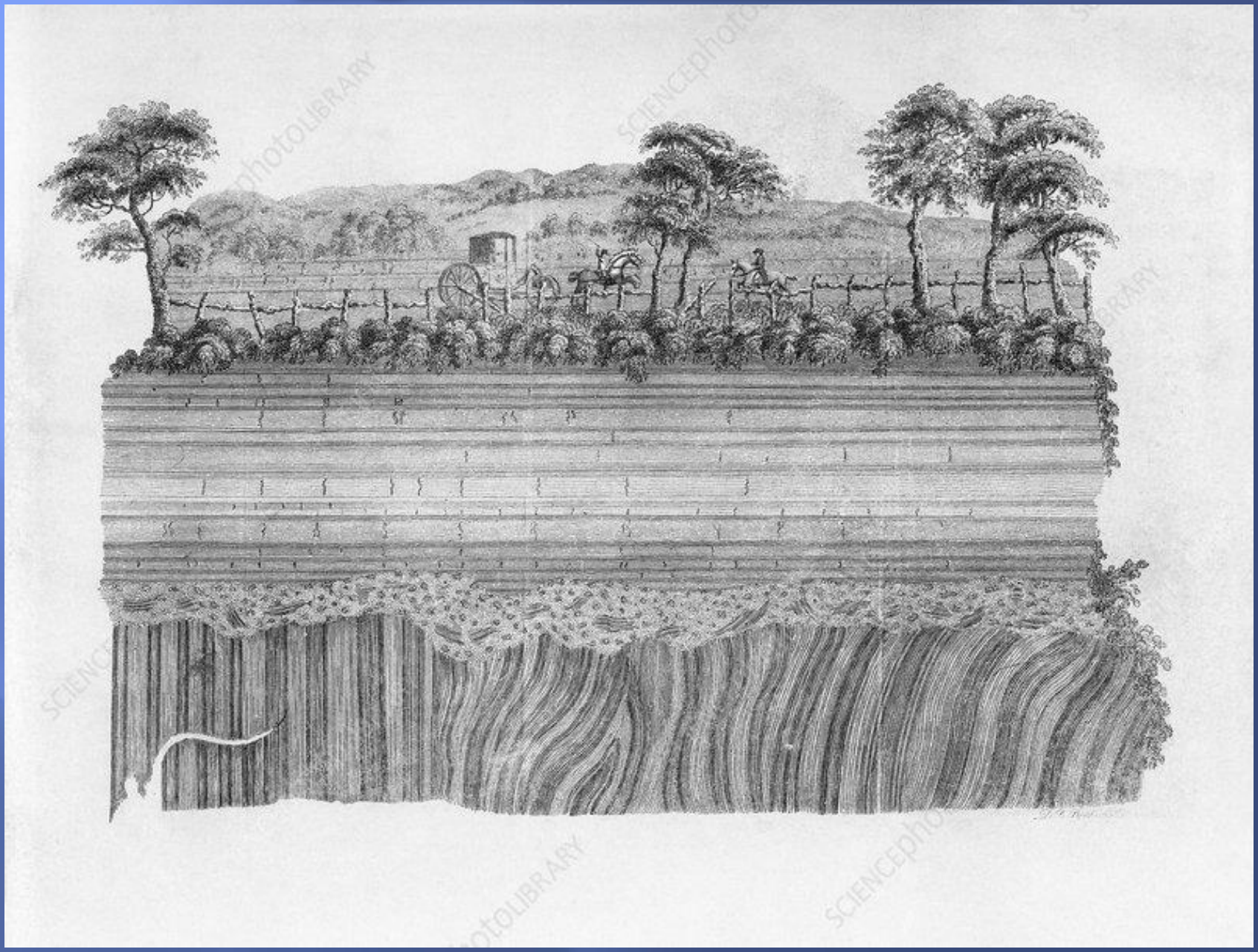
Geological strata are sedimentary deposits

- Buffon (1779) earth is at least 168,000 years old
- Fossils are dead animals

Lyell-uniformitarianism: the geology of the earth can change

Hutton dated earth as millions of years old

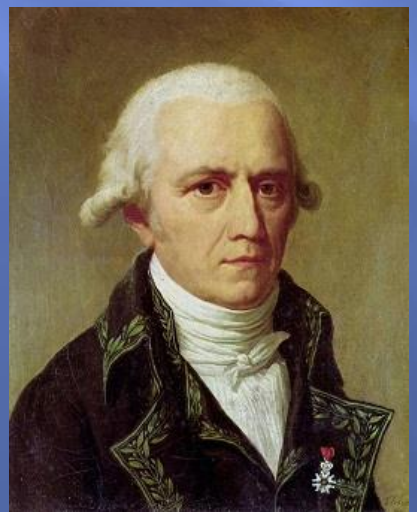
Right Before Darwin



Right Before Darwin

Jean-Baptiste Lamarck (1744 – 1829)

- *Philosophie Zoologique* (1809) Theory of Inheritance of Acquired Characteristics "Lamarckism".
- first cohesive theory of biological evolution
  - alchemical complexifying force drove organisms up a ladder of complexity, and
  - a second environmental force adapted them to local environments through use and disuse of characteristics



Right Before Darwin

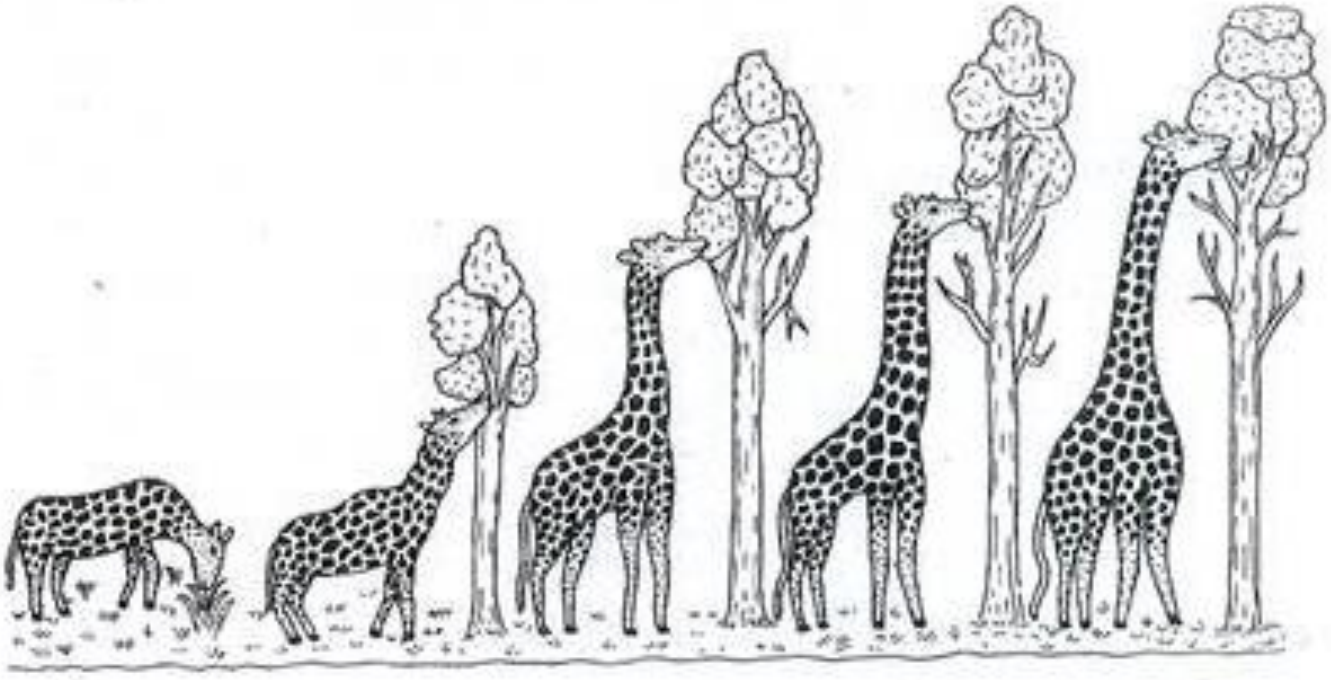
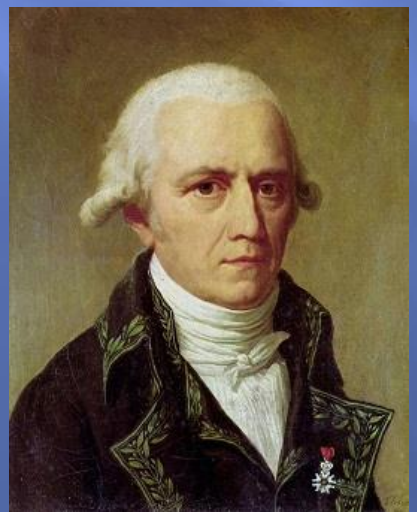


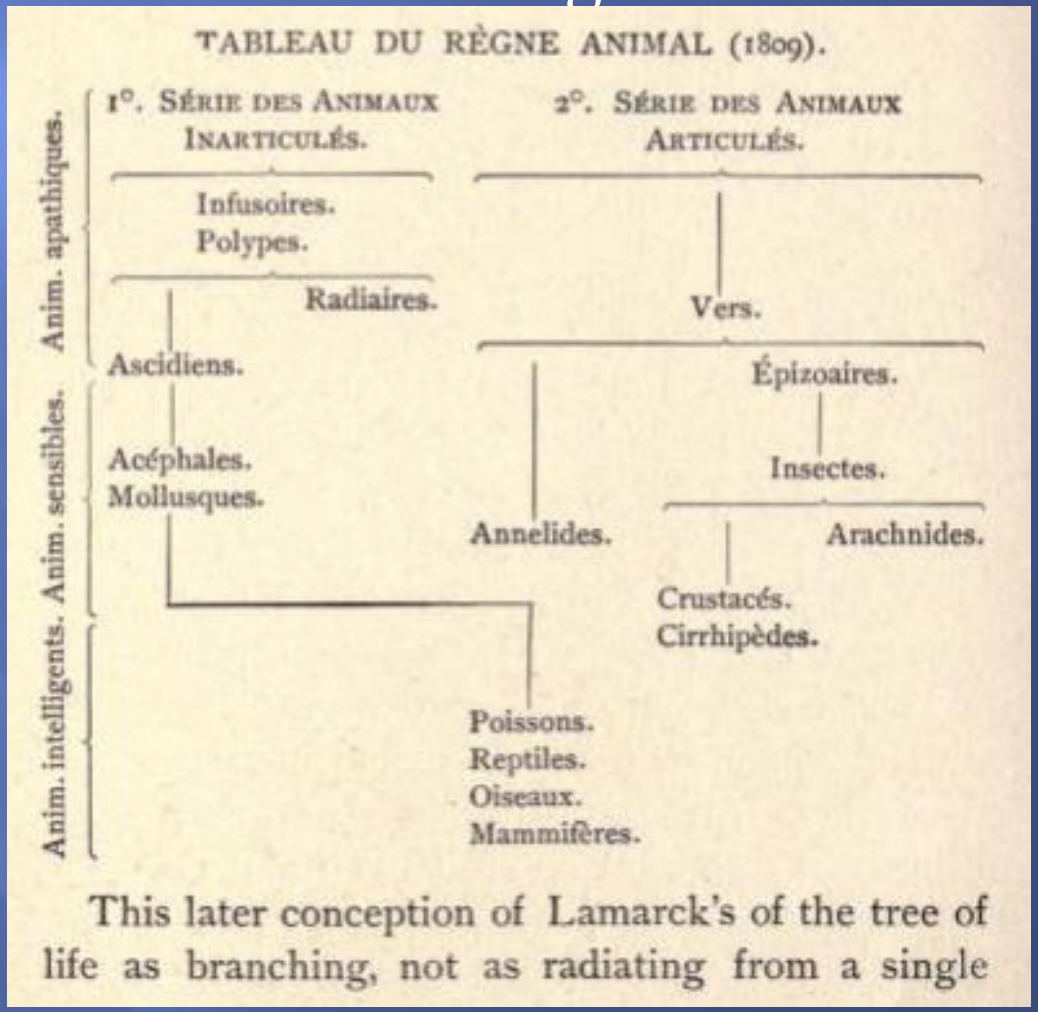
Diagram showing elongation of neck in giraffe according to Lamarck.



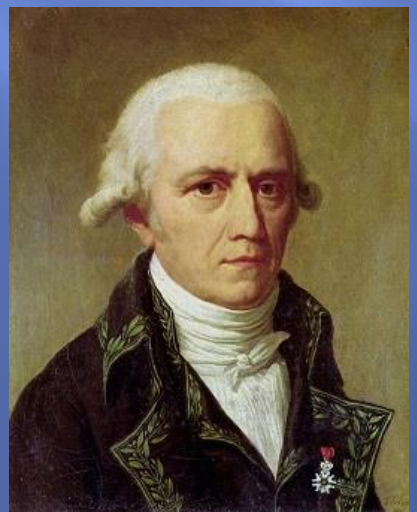
Adaptive variation: interaction with environment was driving force for variation

Right Before Darwin

Believed in branching evolution



This later conception of Lamarck's of the tree of life as branching, not as radiating from a single



Nonetheless, believed the origin of species was spontaneous generation

Right Before Darwin

Georges Cuvier (1769 – 1832)

- Studied strata of geologic formations
- Included fossils in taxonomy
- *Essay on the Theory of the Earth* (1813)
  - periodic catastrophic flooding events →extinctions
  - named the mastodon, Pterodactylus

- Fierce ANTI-Evolutionist
  - In fact, similar species in different periods were not related, just similarily recreated each time

Right Before Darwin

Georges Cuvier (1769 – 1832)

- Cuvier's Principle of Correlation of Parts
  - The characters of an animal are interrelated
  - The important essentials of some traits can tell you more about the rest of the animal's characters: teeth!
  - Distinguished homology (identity of parts by descent) versus analogy by what's now called convergent evolution (similarity of parts for functionality: wings!)

Cuvier categorized into four embranchments and argued against steady increase in complexity

vertebrates–mollusks–articulates–radiates

Contemporary to Darwin

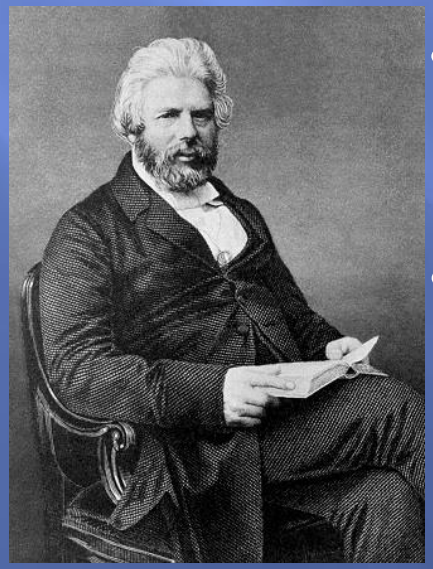
Franz Unger (1800 – 1870)

- *Attempt of the History of the Plant World* (1852)
- Plants derived from the germ of thallophytes (algae)
- Plant species originate from other plant species
- The whole plant kingdom becomes an organic unit

Contemporary to Darwin

Robert Chambers (1802–1871)

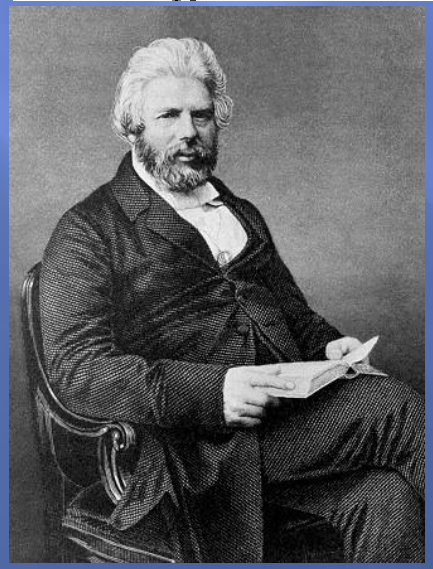
- *Vestiges of the Natural History of Creation* (1844)
  - outsold Origin of Species in 1st 10 years, 24,000
- Principle of Progressive Development
  - Fauna have evolved through time
  - Catastrophes are unnecessary to explain life
    - Unity of bodily organization seen in taxonomy is ancient body plans that have progressed to modern forms
    - Embryonic development reflects ancient body types (von Baer)
    - Not a scientist: so professionals criticized his details and thoughts without recognizing the big picture ((could only imagine his twitter feed…))

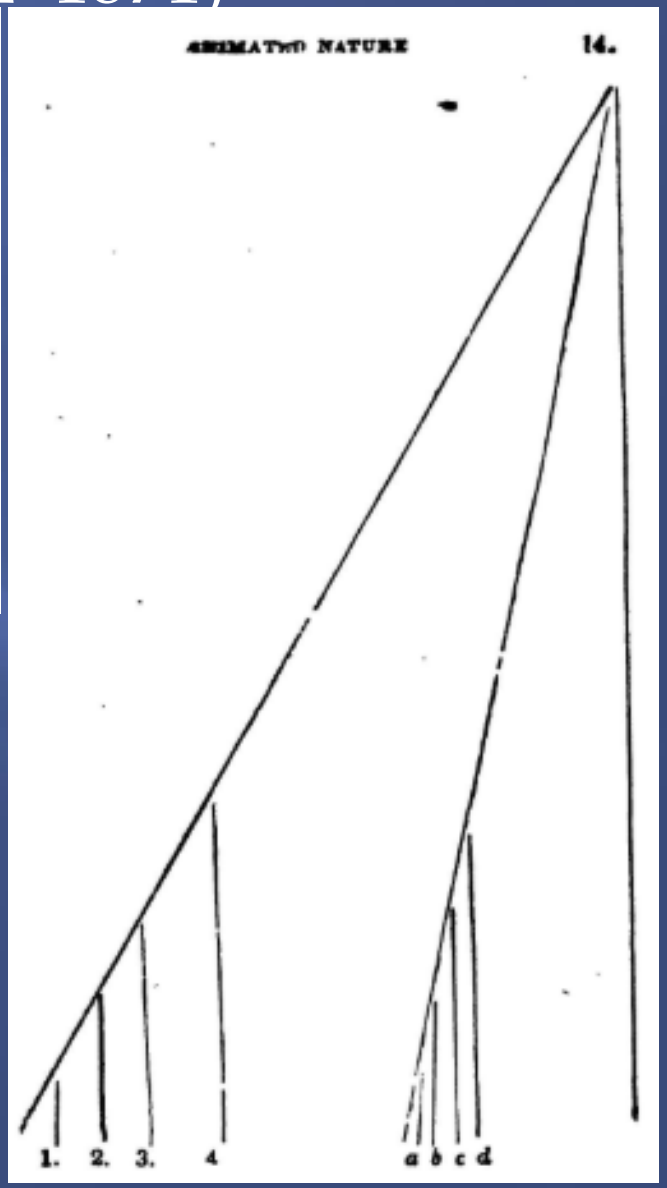


Contemporary to Darwin

Robert Chambers (1802–1871)

Here the upright lines, 1, 2, 3, 4, 5, may represent the comparative height and grade of organization of both the five sub-kingdoms, and the five classes of each of these; 5 being the vertebrata in the one case, and the mammalia in the other. The difference between the height of the line 1 and the line 5 gives an idea of the difference of being the head type of the aves (corvidæ,) and the head type of the mammalia (bimana;) *a*, *b*, *c*, *d*, 5, again, represent the five groups of the first order of the mammalia; *a*, being the organic structure of the highest simia, and 5, that of man. A set of tangent lines of this kind may yet prove one of the most satisfactory means of ascertaining the height and breadth of the psychology of our species.





Updating Darwin

Darwin Did Not Have to start from: Garden of Eden was just a story

- Species are well adapted to their environments
- offspring are consistently formed
- Variation within species
- Species are related to each other
  - Wolves—Canidae—Mammals
  - Progression with variation of body plans
- Extinct species are related to extant species
- Calamities pressure populations (the Malthus angle)

Updating Darwin

Darwin, by clarifying the mechanism of speciation, reinforced the structure of evolutionary theory. Analogous to Watson and Crick:

structure →

clarifies mechanism →

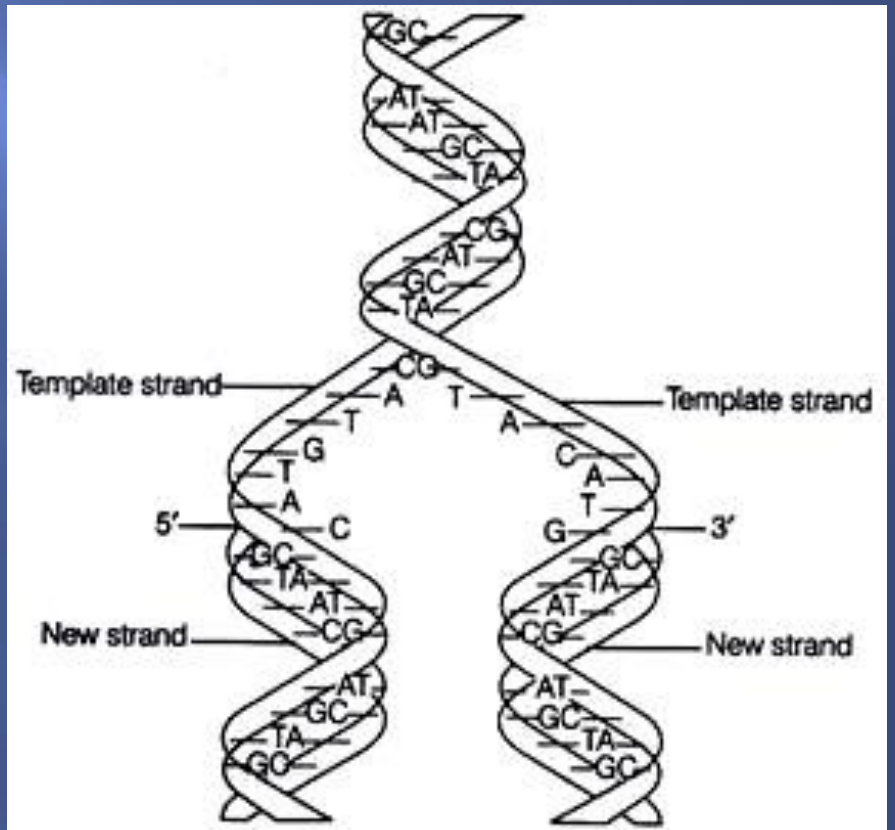


Fig. 6.6 Watson-Crick model for semiconservative DNA replication

Thank you!

Further reading and references

Wiki entries for scientists

https://en.wikipedia.org/wiki/Carl_Linnaeus
https://en.wikipedia.org/wiki/Caspar_Friedrich_Wolff
https://en.wikipedia.org/wiki/Georges-Louis_Leclerc,_Comte_de_Buffon
https://en.wikipedia.org/wiki/Erasmus_Darwin
https://en.wikipedia.org/wiki/James_Hutton
https://en.wikipedia.org/wiki/Georges_Cuvie
https://ucmp.berkeley.edu/history/lamarck.html
https://en.wikipedia.org/wiki/Franz_Unger
https://en.wikipedia.org/wiki/Robert_Chambers_(publisher,_born_1802)

Works on Archive.org

https://archive.org/details/systemofnaturalh01buffiala/page/n6
https://archive.org/details/essayontheoryea00jamegoog/page/n11
https://archive.org/details/darwin-online_1794_Zoonomia_A967.1/page/n3
https://archive.org/details/SystemaNaturae/page/n8
https://archive.org/details/LamarckPZ/
https://archive.org/details/cu31924024760799/page/n8 *(english Lamarck)*
https://archive.org/details/vestigesnatural03chamgoog/page/n7
https://www.ratiocination.org/2015/06/16/james-huttons-investigation-of-the-principles-of-knowledge/
https://archive.org/details/fromgreekstodarw00osboiala/page/n6

Misc

https://evolution.berkeley.edu/evolibrary/home.php
https://www.thoughtco.com/people-who-influenced-charles-darwin-1224651
https://en.wikipedia.org/wiki/Systema_Naturae
https://www.scienceprofonline.com/evolution/pre-darwinian-evolutionary-theory-lamark-cuvier-hutton-lyell.html
https://en.wikipedia.org/wiki/History_of_evolutionary_thought
https://en.wikipedia.org/wiki/Vestiges_of_the_Natural_History_of_Creation
https://plato.stanford.edu/entries/evolution-before-darwin/