
A Summary of the Theory of Evolution

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What is “Evolution”?

- ❖ What does the term *evolution* mean?
- ❖ The word has three meanings that are relevant here:
 1. Evolution as *change in time*:
 - ❖ The fossil record shows that in the past many species existed that do not exist now.
 - ❖ Populations of organisms have changed through time.
 - ❖ Evolution as minor variations (*genetic change*) that occur in species in a short time.
 - ❖ This type of evolution is called *microevolution*.

What is “Evolution”?

2. Some people use the term *evolution* to refer to the cause or mechanism of change.
- ❖ Generally they refer to the mechanism of *natural selection*.
 - ❖ It is assumed that the mutation / natural selection mechanism is capable of generating new genetic information and new organisms—however, this has not been proved.
 - ❖ This type of evolution is called *macroevolution*.
3. Evolution as descent from a common ancestor: the origin of all organisms can be traced to a common ancestor that lived many millions of years ago.
- ❖ In his book *The Origin of Species* Darwin referred to definitions 1 and 2.
 - ❖ Darwin defended definition 3, the idea that all organisms can be traced back to a common ancestor in the distant past.

Evolution Before Darwin

- ❖ The idea of evolution of living beings wasn't original to Darwin.
- ❖ Different ideas of evolution already existed amidst the ancient Greek philosophers.
 - ❖ They did not call it 'evolution'.
 - ❖ They had a philosophical notion of descent with modification.
 - ❖ Several Greek philosophers proposed different concepts of origins, some arguing that everything originated from water or air.
 - ❖ Another common idea was that everything descended from a central and guiding principle.
 - ❖ Aristotle suggested a transition between the living and non-living.
 - ❖ He speculated that in everything there was a desire to move from low to high, finally becoming divine.

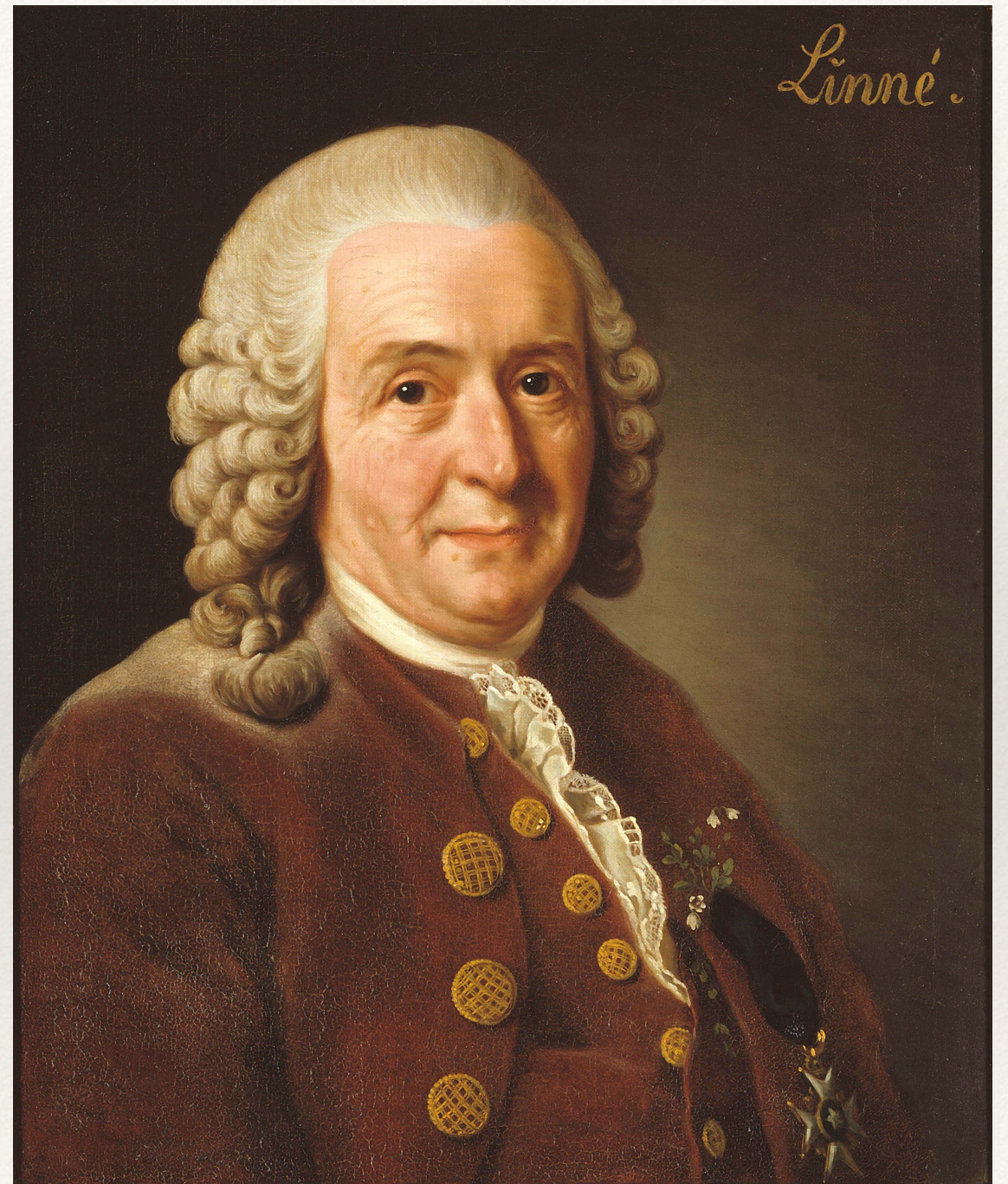
- ❖ During medieval times the idea of evolution was not popular.
- ❖ The idea of *fixism* and the Biblical theory of special creation were predominant:
 - ❖ Life was the result of divine creation.
 - ❖ The different life forms have not changed since the time of creation (fixism).
 - ❖ Belief in spontaneous generation: organisms may appear spontaneously and entirely formed from organic matter or matter in decomposition.

Inmanuel Kant (1724-1804)

- ❖ He developed a concept of descent that was relatively similar to the concept in the Modern era (Modernism).
- ❖ He anticipated the Darwinist thought.
- ❖ Based on similarities between organisms, Kant speculated that species could have originated from a common ancestral type.
- ❖ He suggested that "an orangutan or chimpanzee can develop organs that are used to walking, grasping objects and speak short sentences." (IEP 2010).

Carl Linnaeus (1707-1778)

- ❖ Considered the father of modern taxonomy for his work in the hierarchical classification of the species.
- ❖ The fact that organisms can be classified into natural groups indicates order in diversity.
- ❖ This order reveals divine origin and purpose.
- ❖ To Linnaeus the fact of taxonomic hierarchy indicated divine purpose.



- ❖ At first, he believed in the fixed nature of species, but later, based on hybridization experiments on plants, became convinced that new species could arise.
- ❖ However, he maintained his belief in special creation in the Garden of Eden, consistent with the Biblical doctrine, to which he was quite dedicated.
- ❖ He believed that the new species created by hybridization of plants are part of God's plan and he never considered the idea of open evolution unmediated by divinity.

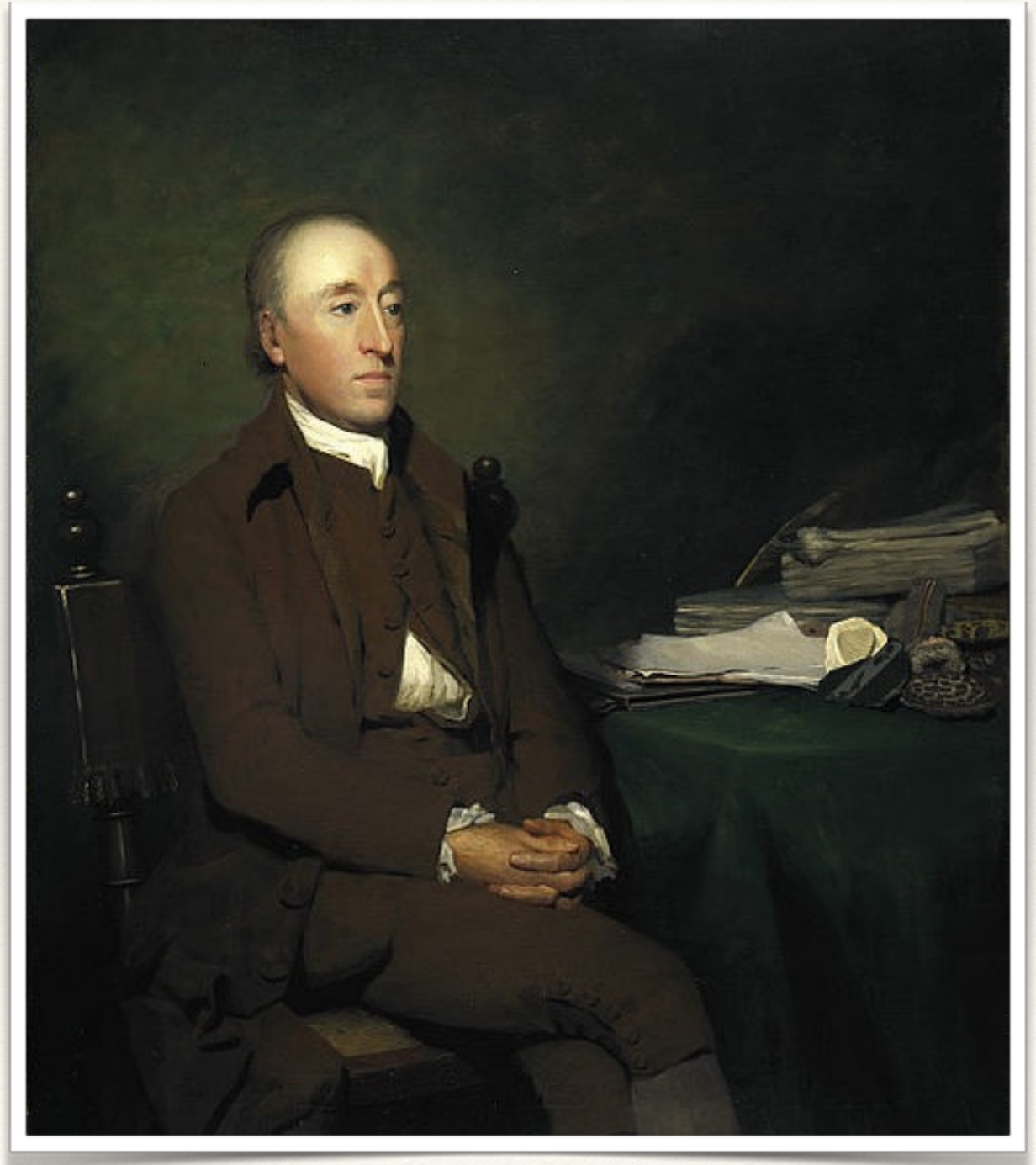
Lamarck (1744-1829)

- ❖ He proposed the theory of *inheritance of acquired characteristics*
- ❖ The biological changes acquired in life are passed onto the next generation.
- ❖ As organisms adapt to the environment also they are increasing in complexity and diversity.
- ❖ Life originated spontaneously.



James Hutton (1726-1797)

- ❖ He proposed the idea of *gradualism* in geological processes.
- ❖ The observed changes in topography may be explained by mechanisms acting gradually in the present earth.
- ❖ *Uniformitarianism*: The same processes that are operating today shaped the land in the past.
- ❖ Geological processes are slow.
- ❖ Therefore Earth must be very old.



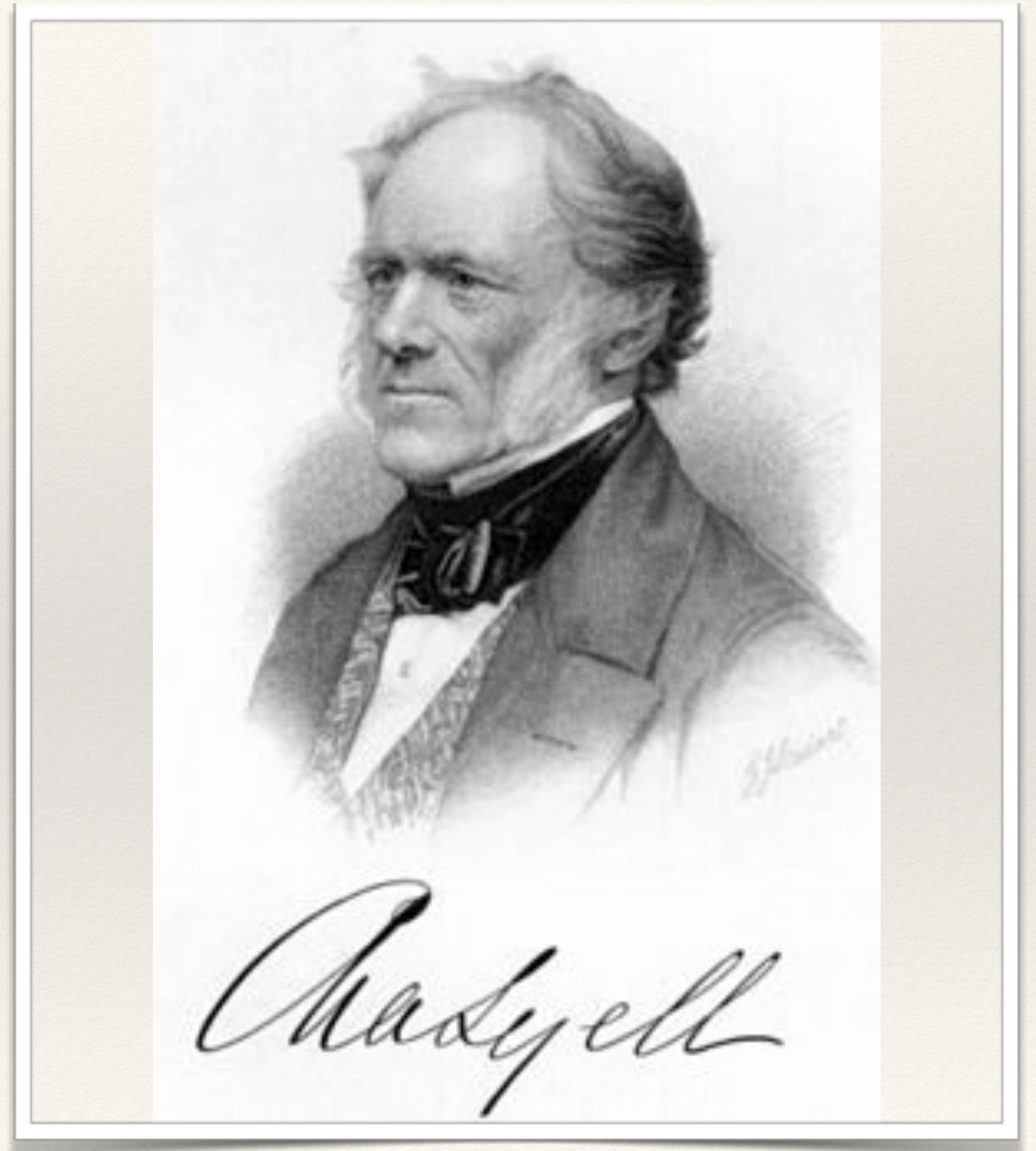
George Cuvier (1769-1832)

- ❖ He proposed the idea of multiple local disasters that have caused catastrophic extinctions.
- ❖ There would have been restocking of life forms after each local extinction.
- ❖ Fossils of the rocks would match the different extinctions.
- ❖ He opposed the idea of evolution that Lamarck and other contemporaries proposed.



Charles Lyell (1797-1875)

- ❖ He incorporated the geological uniformitarianism and gradualism of Hutton in biology.
- ❖ The slow processes acting on the surface of the earth have not changed over millions of years.
 - ❖ How they act.
 - ❖ The rate at which they act.
- ❖ He held the idea that the present is the key to interpret the past.



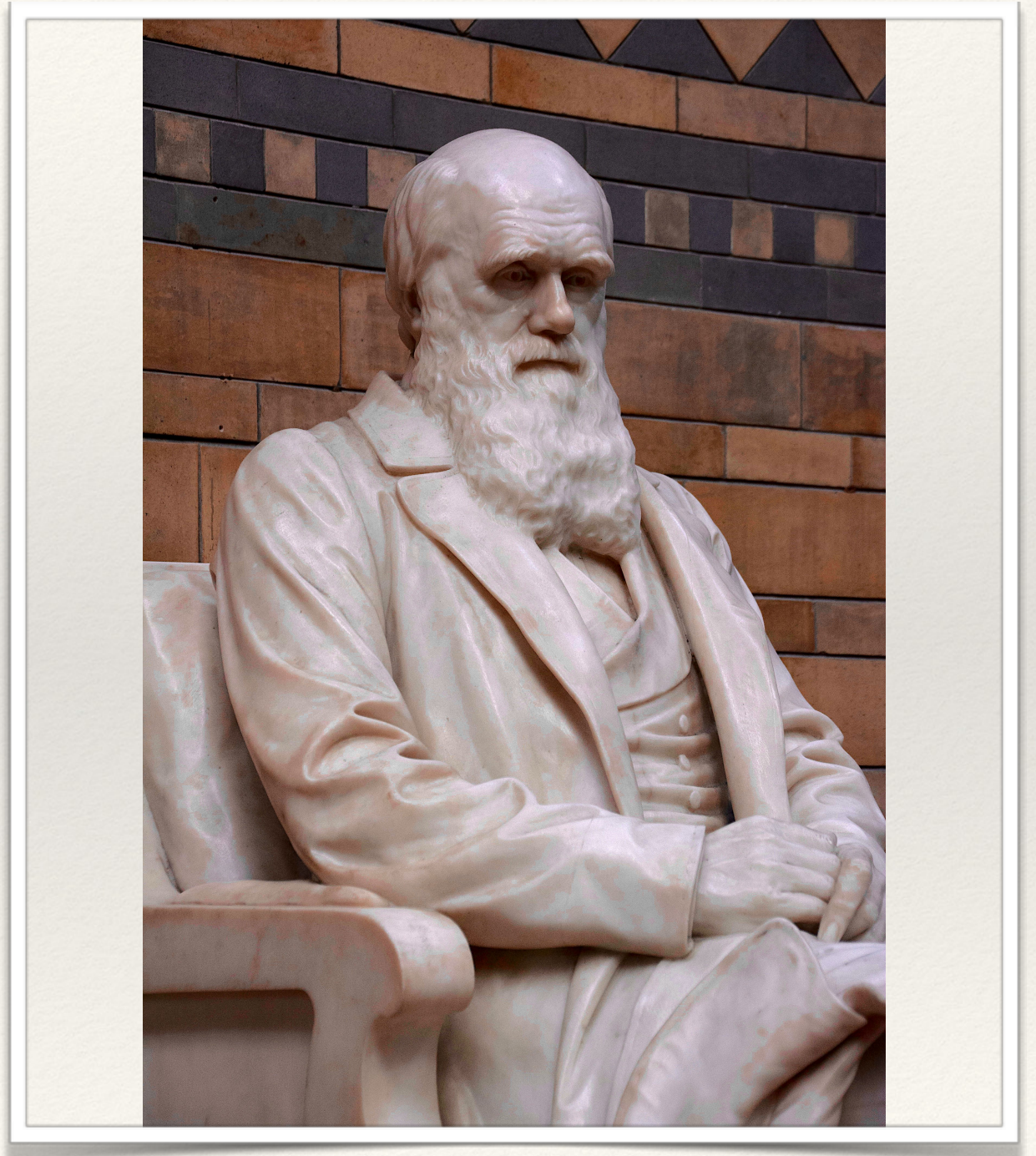
Malthus (1766-1834)

- ❖ He wrote the influential book *Essay on Population* (1798).
- ❖ Human population shows a steady trend to increase.
- ❖ The increase is faster than the increase of food resources.
- ❖ Food shortages lead to struggle for survival.



Charles Darwin (1809-1882)

- ❖ He published *On the Origin of Species by Natural Selection* (1859).
- ❖ He adopted the principle of Malthusian overpopulation in the regulation of the dynamics of animal populations.
- ❖ Universality of reproductive sex drive.
- ❖ More offspring than ecosystems can sustain.
- ❖ Struggle for survival.
- ❖ The fittest survive.



- ❖ What Darwin proposed was a concept of biological evolution based on two main ideas:
 - ❖ All organisms derive from a common ancestor (*universal common descent*).
 - ❖ Biological diversity is rooted in the variability of traits and *natural selection*.

Synthetic Theory of Evolution

- ❖ After Darwin the theory of evolution incorporated the findings of genetics, resulting in the so-called *synthetic theory of evolution* or modern evolutionary synthesis.
 - ❖ It led to a revision of the original theory of Darwin.
 - ❖ "Synthetic theory" or "*neo-Darwinism*" emerged in the 1930s.
 - ❖ It incorporated the findings of genetics, molecular biology, and complicated mathematical models.
 - ❖ But still it maintained as the fundamental evolutionary engine the random variations (mutations) preserved by natural selection.
 - ❖ Despite the initial positive reception, the synthetic theory proved to have as many problems as classic Darwinism and in the following years many scientists, especially in Europe, decided to look for alternatives.

Darwinism

- ❖ The synthetic theory of evolution consists of five main points:
 1. VARIATION—organisms are not stable but change over time.
 - ❖ Genetic variation occurs.
 - ❖ Species disappear and become extinct. The world is not constant, but changes.
 - ❖ For these points Darwin could find evidence in the fossil record.
 - ❖ Darwin, who used the term "evolved" only once in *On the Origin of Species*, called this point "*descent with modification*."

2. The change (or variation) is gradual, slow and genetically transmitted.

- ❖ New life forms arise from the division of a lineage of descendants into two or more lineages.
- ❖ Also a lineage may slowly change over time without splitting.
- ❖ Although this process is very slow and imperceptible to the human eye, leading to increased diversity in a certain period of time.
- ❖ This principle is called "*speciation*"

Speciation

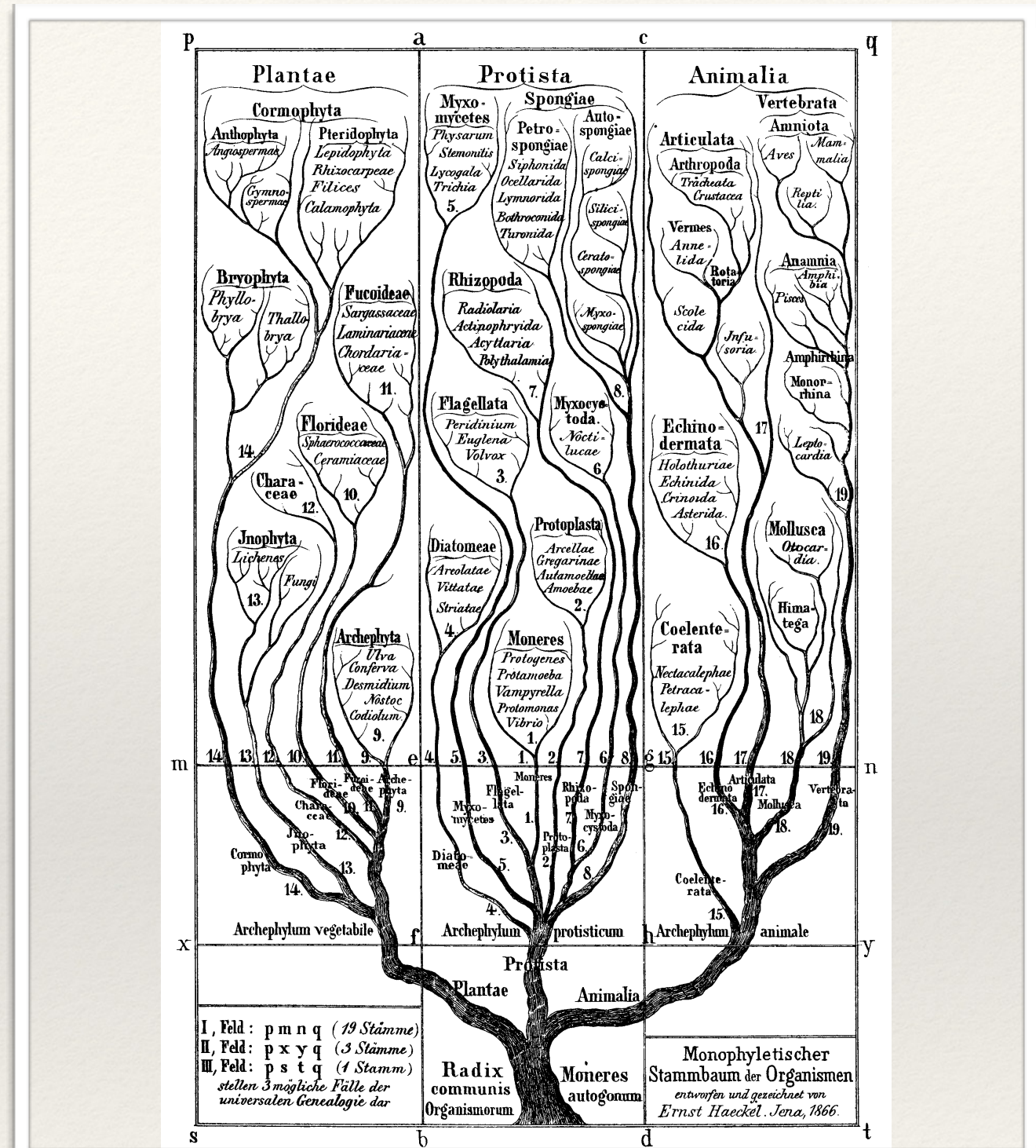
- ❖ Since Darwin, two modes of speciation have been suggested:
- ❖ *Gradualism*: evolution occurred through small successive changes over millions of years .
- ❖ *Saltationism*: evolution occurred in jumps, or episodes of rapid change in short periods of time followed by long periods of little change and adaptation (*stasis*).

Darwinism

3. All organisms derive from a *common ancestor*.

- ❖ Over time, populations are divided into different species that carry different characteristics, although they are related because they share similar features and are descended from a common ancestor.
- ❖ Thus, the similarities between organisms are due to their common origin.

- ❖ Darwin imagined life story as a tree.
- ❖ Life would have arisen from a single-cell organism that would have developed and changed over many generations resulting in more and more complex forms.
- ❖ This point of view is called *monophyletic (tree of life)*.
- ❖ Others believe that life has a polyphyletic origin.



Tree of Life. Ernst Haeckel. *Public dominion*

4. Overpopulation and struggle for survival occur in nature (following Malthus)

- ❖ More individuals are born than can survive.
- ❖ There is a struggle for food resources and space.

5. Only the fittest survive:

- ❖ The mechanism of evolutionary change is natural selection (or survival of the fittest) acting in populations.
- ❖ Natural selection is a slow and gradual process that occurs over successive generations.
- ❖ Some organisms carry genes that provide some advantage in their adaptation and survival.
- ❖ Thus these organisms are better equipped than others and produce more offspring than the less gifted adapted organisms.
- ❖ Their lineage survives.

Presuppositions

- ❖ The theory of evolution assumes these presuppositions:
 - ❖ Abiogenesis: the origin of life from inorganic matter.
 - ❖ Genetic variation.
 - ❖ Overpopulation.
 - ❖ Struggle for survival.
 - ❖ Survival of the fittest (natural selection).
 - ❖ The more favorable characters are passed onto the next generation.
 - ❖ New species arise from the continued survival and reproduction of individuals that are better adapted to their environments.

Summary—What Is Necessary for Evolution?

- ❖ Ingredients for evolution:
 - ❖ DNA (heritable genetic material).
 - ❖ A mechanism for change (mutations).
 - ❖ A pushing force (natural selection or survival of the fittest).
 - ❖ Enough time for change.

The Evidence for Evolution

- ❖ Textbooks present several arguments for evolution from a common ancestor.
 - ❖ Order and sequence of appearance of fossils in the geologic column.
 - ❖ Alleged intermediate or transitional fossil forms.
 - ❖ Anatomical and molecular homology.
 - ❖ Comparative embryology
 - ❖ Biogeography: geographical distribution of organisms in the present and the past.
 - ❖ (Radiometric dating): indicates long time, but not necessarily evolution.

- ❖ These arguments can be refuted.
- ❖ There are solid arguments from multiple lines of evidence that suggest that evolution as common ancestry is not true.
- ❖ The sciences of molecular biology, genetics, paleontology, chemistry, etc. provide evidence that show that life must have been designed by a Creator.

References

- ❖ IEP (Internet Encyclopedia of Evolution), 2010, <http://www.iep.utm.edu/evolutio/>. Accessed 7 / oct / 2012.