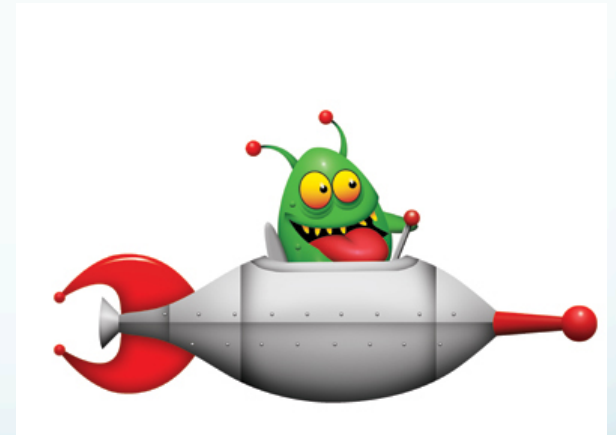


Early Theories of the Origin of Life



- What was life's first form? We do not know, and the best we can do is to make intelligent guesses about its characteristics.
- Where did it come from? We do not know this answer either, although most people have wondered about it at one time or another.
- Even people who know nothing about or disbelieve in the theory of evolution ask themselves how life first appeared on the Earth.

1. Stories of creation found in the Bible

- other cultures, too, have their stories of the creation of life
- these stories share two features in common :
 - they were created long before we had gained any knowledge of the physical, chemical, and biological principles that are the basis of life (i.e. natural laws)
 - they invoke divine intervention in the creation of life and thus fall outside the scope of scientific inquiry
- scientists assume that the forces governing the world can be known, that these forces act uniformly at all times and in all places, and that their effects can be predicted, at least in a statistical way
- while this faith may be ill-founded, it is the only basis on which scientists can work
- if their experiments are subject to unique, supernatural, or unpredictable intervention, there is no point in performing scientific work
- in fact, if some unrepeatable result is detected, the scientist assumes that it is due to faulty equipment and/or some observational error



2. Theory of spontaneous generation

- **J.B. Van Helmont** (17th C) – wheat and a dirty shirt was the perfect recipe for life – created adult mice
- **Francesco Redi** (1668) – no maggots appeared in meat when flies were prevented from laying eggs
- **John Needham** (~1745) - everyone knew that boiling killed microorganisms, so he proposed to test whether or not microorganisms appeared spontaneously after boiling
 - he boiled chicken broth, put it into a flask, sealed it, and waited - sure enough, microorganisms grew
 - Needham claimed victory for spontaneous generation



- **Lazzaro Spallanzani** (~1767) – was not convinced, and he suggested that perhaps the microorganisms had entered the broth from the air after the broth was boiled, but before it was sealed
 - he modified Needham's experiment - he placed the chicken broth in a flask, sealed the flask, drew off the air to create a partial vacuum, then boiled the broth
 - no microorganisms grew → proponents of spontaneous generation argued that Spallanzani had only proven that spontaneous generation could not occur without air (which contained a 'vital force' that could bring life to lifeless objects)

- **Louis Pasteur** (~1860) – similar to Spallanzani's experiments, Pasteur used heat to kill the microbes, but left the end of the flask open to the air
 - in a simple, but brilliant modification, the neck of the flask was heated to melting and drawn out into a long S-shaped curve, preventing the dust particles and their load of microbes from ever reaching the flask
 - after prolonged incubation the flasks remained free of life and ended the debate for most



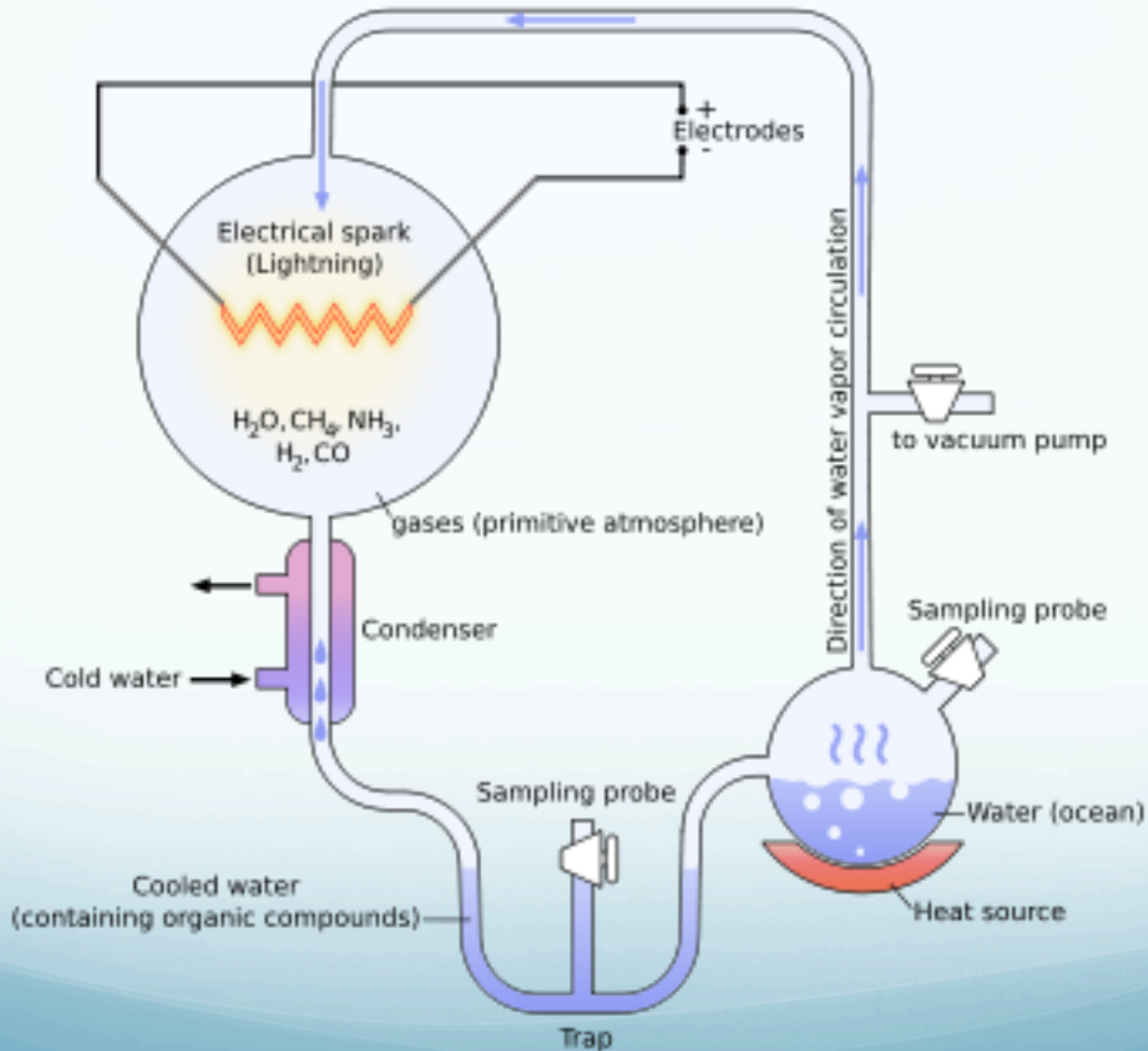
3. Oparin and Haldane

- Russian biochemist **Alexander Oparin** and British biologist **J.B.S. Haldane**, mid 1930s
- independently proposed the theory of **primary abiogenesis**, that the first living things on Earth arose from non-living material
- they reasoned that the first complex chemicals of life must have formed spontaneously on a primordial Earth, and at some point, arranged themselves into cell-like structures with a membrane separating them from the outside environment
- this theory depends on the Earth's being somewhat different than it is now – lots of methane, ammonia, water vapour, UV light, heat from volcanoes, electrical discharge from lightning, and very little oxygen gas
- this theory was not widely accepted at first, mostly due to the lack of an effective way to test it and the lack of support for spontaneous generation

4. Miller and Urey

- American astronomer **Harold Urey** and his student **Stanley Miller**, 1953
- constructed an apparatus filled with water, methane, ammonia, hydrogen, and NO oxygen
- kept it circulating by continuous boiling and condensing
- at the end of one week of continuous operation, Miller and Urey observed that as much as 10–15% of the carbon within the system was now in the form of organic compounds
- two percent of the carbon had formed amino acids that are used to make proteins in living cells
- sugars, lipids, and some of the building blocks for nucleic acids were also formed
- repeated by others using different mixtures of substances, but achieving similar results

- Miller-Urey Experiment



5. Panspermia Hypothesis

- life originated elsewhere and traveled to Earth
- critics say that this hypothesis merely shifts the problem of life's origin to some remote location even harder to study!
 - life originated on another planet within our solar system, was dislodged by a meteor impact, and carried through space on a chunk of debris
 - life originated in another solar system and traveled to Earth through interstellar space – requires achieving escape velocity and surviving radiation
 - “directed” panspermia – Earth's founding microbes were sent here intelligently, aboard a spacecraft, by intelligent extraterrestrials bent on seeding the galaxy with life



After life started on earth - Evolution

- Biology was dominated by **Natural Theology**, the philosophy dedicated to discovering God's plan by studying nature
- Since God created each species for a particular purpose, if we classify species can we figure out God's plan?

Leonardo da Vinci (~end 15th C.)



- Pondered numerous sea shell remains far away from any sea
- Formed in an ancient ocean?
- Earth's surface has changed dramatically over time

Carl Linnaeus (~1750)



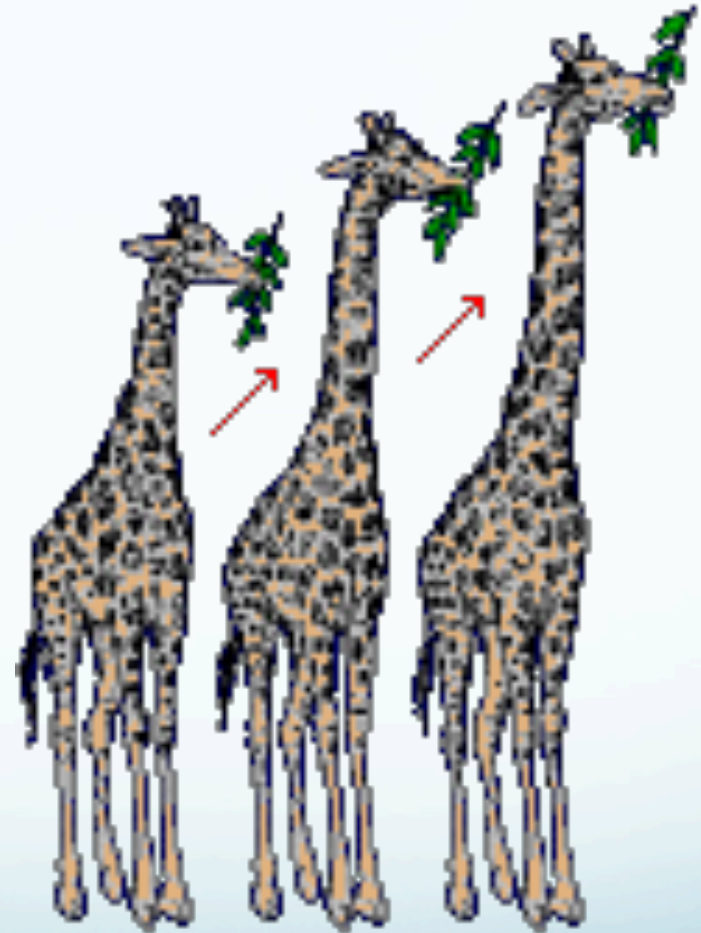
- Father of taxonomy
- Grouped categories based on shared similarities
- Implied no evolutionary kinship
- Believed species were permanent creations (a divinely created scale of life)
- “God creates, Linnaeus classifies”

George Buffon (~late 1700s)

- Actually said that living things do change through time, speculating it was somehow a result of influences from the environment or even chance
- Believed that the earth must be much older than 6000 years (at least 75,000 – no evidence)
- Also suggested that humans and apes are related
- Hid his radical views to avoid broad public criticism
- Was an early advocate of the Linnaean classification system, a quiet pioneer in asserting that species can change over generations, but he publicly rejected the idea that species could evolve into other species
- One of his most significant contributions to the biological sciences was his insistence that natural phenomena must be explained by natural laws rather than theological doctrine

Jean Lamarck (1809)

- Although remembered most for being incorrect in his mechanism of evolution, he suggested :
 - species like microscopic organisms arose continually from non-living sources
 - a species could adapt to their environment then pass it on to their offspring (*theory of acquired characteristics*)
 - species never went extinct
 - if you didn't use something you lost it (*theory of use and disuse*)
- Believed that microscopic organisms appear spontaneously from inanimate materials and then transmute, or evolve, gradually and progressively into more complex forms through a constant striving for perfection - the ultimate product of this goal-oriented evolution was thought to be humans
- However, he was instrumental in forming the link between the organism and its environment (**habit modifies form**)



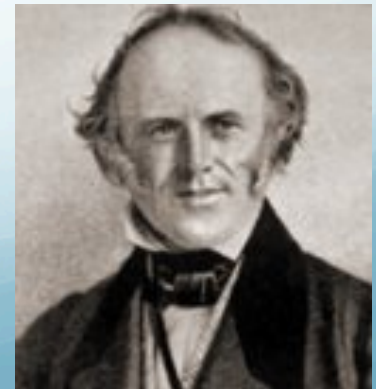
George Cuvier (~1800)

- Theory of **catastrophism**
- Founded paleontology
- Realized the history of life was recorded in strata containing fossils, i.e., the deeper (the older) the stratum, the more dissimilar the fossils are from modern life
- Knew about extinction but was an opponent to evolution
- Believed catastrophic extinctions explained the unique sets of fossil species between successive strata
- New forms in younger strata resulted from immigration
- Could not account for the progressive complexity of species since he thought all species had been divinely created at the same time

Charles Lyell (1830)

- Theory of **uniformitarianism**
- Theory to contrast Cuvier's catastrophism
- Geologist; knew that the Earth had always undergone slow and steady changes, just like those happening now, i.e. processes that build mountains are eventually balanced out by erosion
- Based on data, estimated that the Earth was many millions of years old, a very significant claim

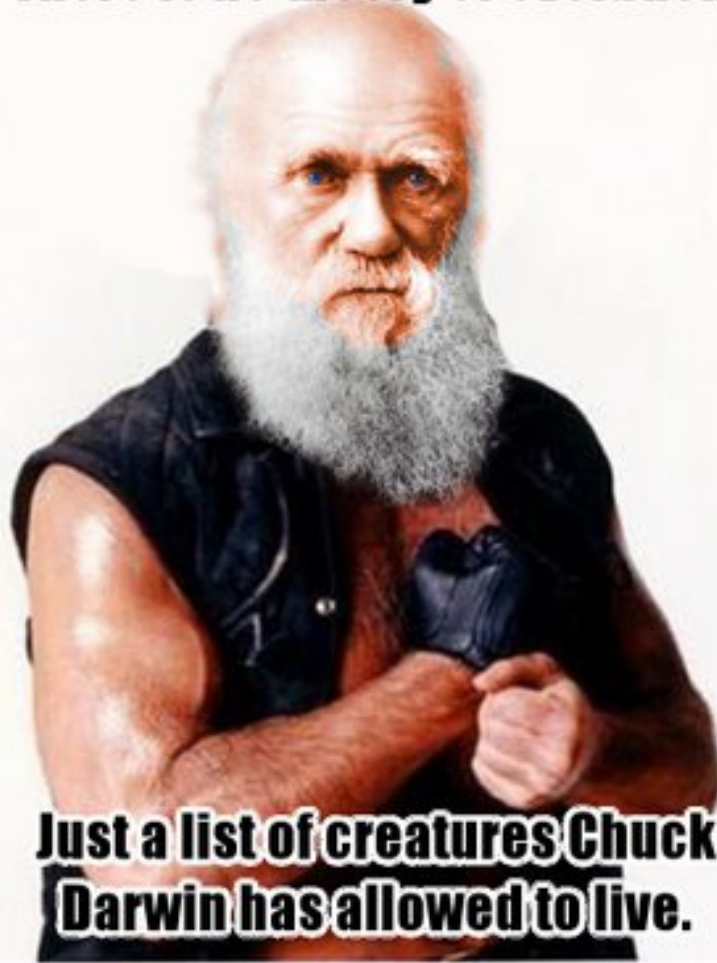
- Today, we know that our planet has been shaped by occasional catastrophic events, such as bombardment of large meteors, in addition to the comparatively slower natural processes suggested by uniformitarianism; all of these events have potentially affected the rate and direction of biological evolution
- Both Cuvier and Lyell rejected the idea of biological evolution; however, neither man accepted a traditional Biblical account of creation and a young earth (Cuvier did not live long enough to learn about Charles Darwin's proof of evolution, but Lyell did, and came to accept this proof in the early 1860s along with most leading scientists of that time)



- THE STAGE WAS NOW SET FOR A YOUNG MAN TO CHANGE THE COURSE OF BIOLOGY FOREVER... HIS ORIGINAL INTENTION WAS TO GATHER EVIDENCE TO SUPPORT BIBLICAL CREATION BUT SOMEWHERE ALONG THE WAY IT CHANGED...
- Charles Robert Darwin (1809-1882), one of the greatest figures in the history of human thought, forever changed the way we look at nature and at ourselves.
- More to follow in the next few days...



There is no theory of evolution.



**Just a list of creatures Chuck
Darwin has allowed to live.**