

# How the Theory Developed

The science of evolutionary biology begins in 1859 with the publication of Charles Darwin's *On the Origin of Species by Natural Selection*, but there is a long history of evolutionary thought before Darwin.

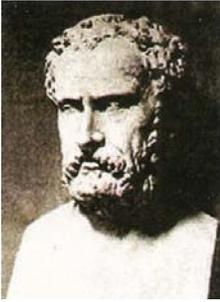
How the Theory

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Pre-Darwinian

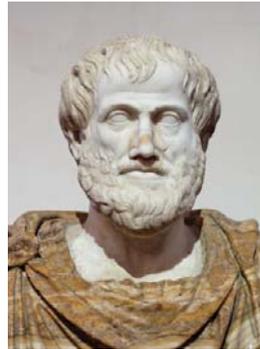
Post-Darwinian

## Pre-Darwinian



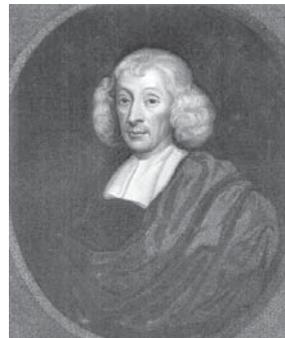
**Xenophanes of Colophon** (Greek, 490 BCE) was the first person known to have used fossils as evidence for a theory of the history of the Earth.

**Aristotle** (Greek, 384-322 BCE) placed all organisms on a fixed scale – the *Scala Naturae* – from simple to complex, creating one of the first systematic classifications.



**Titus Lucretius Carus** (Roman, 99-55 BCE) wrote, in his epic poem "On the Nature of Things," that organisms survive because of their strength, speed, or cunning (or because of their usefulness to people).

**John Ray** (English, 1682-1705) was considered the Father of Natural History in Great Britain. He was the first to divide flowering plants into two groups, the monocots and dicots.



**Pierre-Louis Moreau de Maupertuis** (French, 1698-1759) published his ideas about the formation of an embryo and heredity.

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*Pre-Darwinian*

*Post-Darwinian*

*binomial nomenclature* • The two-part scientific name – genus and species – for a plant or animal.

**Carolus Linnaeus** (Swedish, 1707-1778, also called Carl von Linné) is called the Father of Taxonomy. He published *Systema Naturae*, a catalog of all known species, sorted by similarity. He created the **binomial nomenclature** system for species naming.



**Georges-Louis Leclerc, Comte de Buffon** (French, 1707-1788), he published an encyclopedia of everything known at the time about the natural world, wrestled with the similarities of humans and apes, and even discussed common ancestry. He also suggested that the Earth is much older than the 6,000 years proclaimed by the church.

**Denis Diderot** (French, 1713-1784) was a philosopher and chief editor of the 17-volume *L'Encyclopédie*, which claimed to contain all human knowledge in a single set of books. He was thrown into jail for speculating that evolution might have taken place.



**James Hutton** (Scottish, 1726-1797) is called the Founder of Modern Geology. He recognized that the Earth is continually being changed by molten material and erosion, in the “geological cycle.”

**Erasmus Darwin** (English, 1731-1802) was Charles Darwin's grandfather and is regarded by some as the first modern evolutionist. In his work, *Zoonomia* (1794), he formulated one of the first formal theories of evolution.





**Jean-Baptiste de Lamarck** (French, 1744-1829) in his *Philosophie Zoologique* (1809), famously proposed the theory of **transformation** (also known as Lamarckism) in which traits acquired during an individual's lifetime could be inherited by its offspring.



According to Lamarck's theory, a giraffe could, over a lifetime of straining to reach high branches, develop an elongated neck that could then be passed on to its offspring. This type of inheritance, sometimes called Lamarckian inheritance, has since been disproved by genetics.



**Thomas Malthus** (English, 1766-1834) was a political economist. In his *Essay on the Principle of Population* (1798), he observed that plants, animals, and humans are capable of producing more offspring than can survive. He suggested that human overproduction results in limited resources, famine, and poverty.

**Georges Cuvier** (French, 1769-1832) was a paleontologist. He developed the method of reconstructing an animal from fossilized bone fragments. He was one of the first to claim that fossils are real (not tricks put there by God to test man's faith) and thus to acknowledge that extinction had occurred.



**Charles Lyell** (Scottish, 1797-1875) was a geologist and friend of Charles Darwin. In his *Principles of Geology* (1830-1833), he concluded that the world is old and that rain, sea, volcanoes, and earthquakes can be used to explain the geological history of Earth.

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Post-Darwinian

**transformation** • The theory suggesting that traits of an organism are produced and inherited by direct influence of the physical environment, by effort, or by use or disuse of body parts.

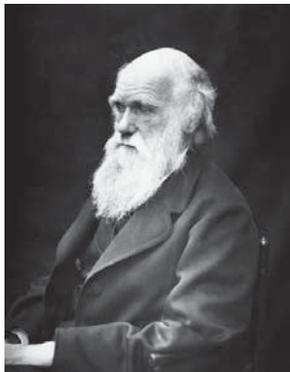
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***Post-Darwinian***

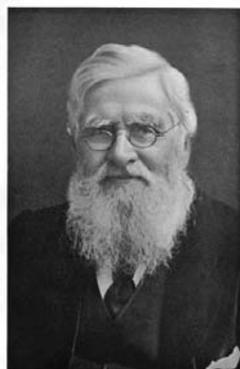
## Post-Darwinian



**Charles Darwin** (English, 1809-1882) is best described as a gentleman scholar. He ultimately received a degree in theology from Cambridge University, but never had any formal training in natural history, zoology, or geology. In 1832, he joined the round-the-world voyage of the *HMS Beagle* during which he collected and studied a large number of specimens. His influential book *On the Origin of Species* was published in 1859, 21 years after returning from the voyage.

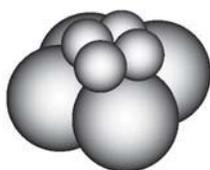
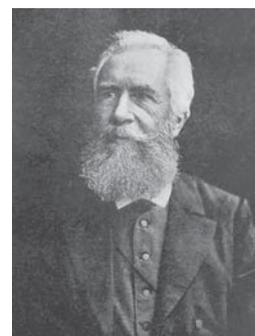


**Gregor Mendel** (Austrian, 1822-1884) was a monk. He conducted experiments in plant hybridization using yellow and green peas, and formulated many principles of governing the inheritance of traits (1866). His theories of heredity have been generally accepted since the 1920s and now form the basis of modern genetics.



**Alfred Russel Wallace** (English, 1823-1913), an entomologist, can rightfully be called the “co-discoverer” of the theory of natural selection. A letter from Wallace to Darwin in 1858, asking Darwin’s opinion on Wallace’s ideas about natural selection, prompted Darwin to announce the theory that he had been working on for 21 years. On the evening of July 1, 1858, a joint paper by Wallace and Darwin was presented (although neither author attended) at a meeting of the Linnean Society of London, entitled “On the tendency of species to form varieties; and on the perpetuation of varieties and species by natural means of selection.”

**Ernst Haeckel** (German, 1834-1919) coined the terms ontogeny, phylogeny, and ecology, and was the first to represent evolutionary relationships on a tree.



**Karl Grobber** (Austrian, 1854-1945) named the two main groups of coelomate animals, Protostomia (mollusks, annelids, arthropods) and Deuterostomia (echinoderms, chordates), on the basis of (among many characters) whether cleavage of the egg is spiral (illustrated at left, in bivalves) or radial.



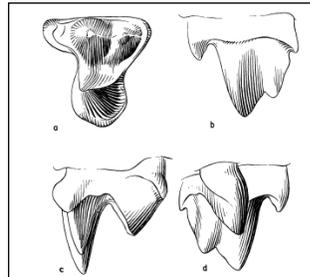
**Alfred Wegener** (German, 1880-1930) proposed the theory of continental drift (1920), now known more properly as plate tectonics, based in part on the distribution of fossils.

**Julian Huxley** (English, 1887-1975) described **neo-Darwinism** in his classic book *Evolution: The Modern Synthesis* (1942). During the 1930s and 1940s, neo-Darwinism gradually spread through all areas of biology and became widely accepted, unifying genetics, systematics, paleontology, comparative morphology, and embryology.



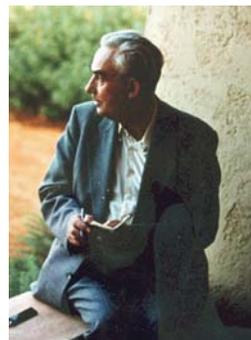
**Theodosius Dobzhansky** (Russian/ American, 1900-1975) conducted classic experiments on evolution using *Drosophila* (fruit fly) populations, highlighting breeding experiments or “artificial selection” as an effective method of studying natural selection.

**George Gaylord Simpson** (American, 1902-1984) was the first paleontologist to apply the fossil record to the **Modern Synthesis**. His 1951 illustrations of a tooth of *Gypsonictops*, a Cretaceous insectivore, are shown at right.



**Ernst Mayr** (German/American, 1904-2005) studied species, speciation, and punctuated equilibrium. In his book *Systematics and the Origin of Species* (1942), he wrote that a species is not just a group of morphologically similar individuals, but a group that can breed only among themselves, excluding all others.

**Willi Hennig** (German, 1913-1976), an entomologist, was the principle architect of the method of phylogenetic systematics or cladistics.



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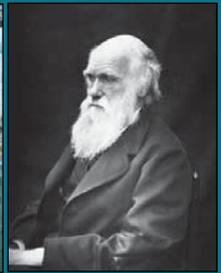
**Modern Synthesis** • The union of ideas from several biological specialties that formed a sound account of evolutionary theory. This synthesis has been generally accepted by most working biologists. The Synthesis was produced over approximately one decade (1936–1947), stimulated by the development of population genetics (1918–1932). This showed that Mendelian genetics was consistent with natural selection and gradual evolution. The Synthesis is still, to a large extent, the current paradigm in evolutionary biology.

**neo-Darwinism** • The merger of classical Darwinian evolution with population genetics.

# The Teacher-Friendly Guide to Evolution

Using Bivalves as a Model Organism

By Paula M. Mikkelsen & Robin Henne



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1259 Trumansburg Road  
Ithaca, New York 14850 U.S.A.  
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