

[Ernst Heinrich Philipp August Haeckel \(1834-1919\)](#) ^[1]

By: Wellner, Karen Keywords: [Biography](#) ^[2] [Evolution](#) ^[3]

Ernst Heinrich Philipp August Haeckel was a prominent comparative anatomist and active lecturer in the late nineteenth and early twentieth centuries. He is most well known for his descriptions of phylogenetic trees, studies of radiolarians, and illustrations of vertebrate embryos to support his [biogenetic law](#) ^[4] and Darwin's work with [evolution](#) ^[5]. Haeckel aggressively argued that the development of an embryo repeats or recapitulates the progressive stages of lower life forms and that by studying embryonic development one could thus study the evolutionary history of life on earth.

Haeckel was born on 16 February 1834 in Potsdam, Germany (then Prussia) to Charlotte Sethe and Karl Haeckel. His father and maternal grandfather were lawyers but they had little luck in convincing Haeckel to follow them in their professions. Rather, he became interested in the natural sciences and plant collecting and prepared himself to study medicine. His first medical studies were at the [University of Würzburg](#) ^[6] where one of his teachers was the renowned comparative pathologist Rudolph Virchow. Haeckel continued his studies at the [University of Berlin](#) ^[7] and studied with [Johannes Müller](#) ^[8], who was instrumental in fostering Haeckel's interest in marine biology. In 1857 Haeckel graduated with MD and MCh degrees. He immediately began practicing medicine but in 1859 decided to stop working with patients and turned instead to the study of marine organisms at Messina, in southern Italy. In 1862 Haeckel married his cousin Anne Sethe. She died in 1864 and in 1867 Haeckel married Agnes Huschke, with whom he had three children.

An accomplished artist and illustrator, Haeckel made many zoological expeditions that directly contributed to his illustrated descriptions of over four thousand new species of marine invertebrates. He published several monographs including [Radiolaria](#) ^[9] (1862), [Siphonophora](#) ^[10] (1869), [Monera](#) ^[11] (1870), [Calcareous Sponges](#) ^[12] (1872), [Deep Sea Medusae](#) ^[13] (1881), and [Deep Sea Keratosa](#) ^[14] (1889).

In 1861 Haeckel became a *Privatdozent* (lecturer) at the [University of Jena](#) ^[15] and one year later was chosen extraordinary professor of comparative anatomy and director of the Zoological Institute. He was appointed chair of zoology in 1865 and became colleagues with [Wilhelm Roux](#) ^[16] and [Hans Driesch](#) ^[17]. Haeckel remained at Jena until his retirement in 1909. Comparative anatomy and [embryology](#) ^[18] flourished at Jena with the work of Haeckel and [Carl Gegenbaur](#) ^[19]. Two of Haeckel's students, Oscar and Richard Hertwig continued innovative [embryology](#) ^[18] work at Jena, studying the coelom and reinterpreting Haeckel's embryological findings.

After reading the German translation of [Charles Darwin](#) ^[20]'s *Origin of Species* (1859), Haeckel became an aggressive advocate of organic [evolution](#) ^[5]. He was at the forefront of raising questions about evolutionary development and subsequently became a champion of [evolution](#) ^[5], not only for Darwin, but for many German scientists and citizens alike. Darwinian [evolution](#) ^[5] provided Haeckel with the foundation for his [biogenetic law](#) ^[4], or as he termed it, "the fundamental law of organic [evolution](#) ^[5]." According to Haeckel, the embryological development of an embryo ([ontogeny](#) ^[21]) recapitulates or repeats the adult stages of the organisms from which it has evolved ([phylogeny](#) ^[22]).

Phylogeny is a term coined by Haeckel in his first book, [Generelle Morphologie der Organismen](#) ^[23] (1866), a book he dedicated to the three authors that had most influenced his scientific life: Johann Goethe, Jean-Baptiste Lamarck, and Darwin. Lamarck in particular was singled out as having a strong influence on Haeckel's idea of [phylogeny](#) ^[22].

Other terms introduced by Haeckel in *Generelle Morphologie* that are still in use today (although their meaning has perhaps changed) include monophyletic, polyphyletic, ecology, and Metazoa. In addition to these concepts, Haeckel wrote about the inner heredity force (*inner Bildungstrieb*) and outer formative forces (*äusserer Bildungstrieb*) that he believed acted on embryos. The notion of inner and outer formative driving forces eventually served as the basis for Roux's and Hans Spemann's embryological experiments. As with many of Haeckel's books and papers, readers found his writing so full of new words that it often contributed to negative reviews of his work.

The [biogenetic law](#) ^[4] had a substantial following in the 1870s, a time when mechanistic mechanisms were used to explain the entire history of life. At the heart of Haeckel's law was the identification of embryonic [germ layers](#) ^[24]. Embryologists had shown that most metazoans pass through an early developmental stage called a [gastrula](#) ^[25], a hollow ball of cells that infold via cell migrations to form the gut of the organism. Haeckel surmised that at one time, an organism that he called a [gastraea](#) ^[26] existed, and that it looked like the [gastrula](#) ^[25] stage of advanced organisms. According to Haeckel's [gastraea](#) ^[26] theory, the [gastraea](#) ^[26] was a hypothetical form from which metazoans had evolved. Because the [gastraea](#) ^[26] had left no paleontological trace, the only evidence for it was the [gastrula](#) ^[25] stage in [ontogeny](#) ^[21].

In using [embryology](#) ^[18] as a model for the history of life on earth, Haeckel's [biogenetic law](#) ^[4] allowed for [Lamarckism](#) ^[27] to play

a major role. Both Haeckel and Jean- Baptiste Lamarck highlighted a progressionist [evolution](#)^[5] in which lower animals were merely stages in nature's ascent toward the fully mature form of the human species. In illustrating taxonomic patterns and patterns of descent, Haeckel was the first to publish phylogenetic trees showing the [evolution](#)^[5] of man from lower organisms.

Haeckel's famous comparative embryo drawings served as his evidence for the [biogenetic law](#)^[4]. His lithographic plates comparing embryos of different phyla were first published in *Natürliche Schöpfungsgeschichte* (*The Natural History of Creation*^[28]) in 1868 and later in *Anthropogenie oder Entwicklungsgeschichte des Menschen* (*The Evolution of Man*^[29]) in 1874. Later accused of doctoring his images to exaggerate the similarity of vertebrate embryos, Haeckel responded that because there were so few human embryos at his disposal, he had drawn his ideas and idealized them to prove his point. He admitted combining figures of species types to create thought-provoking images. Many distinguished scientists, including Richard Hertwig and [August Weismann](#)^[30], while not approving of Haeckel's tendency to exaggerate and perhaps overspeculate, refused to attack him in public, believing that his embryological drawings still held significant validity in the field of evolutionary development.

Even today, arguments about whether Haeckel intentionally falsified his embryo drawings continue to fuel debates between evolutionists and creationists. Misconceptions about evolutionary [embryology](#)^[18] have been reinforced by the manner in which Haeckel's drawings are presented in modern [secondary biology textbooks](#)^[31], with no accompanying historical reflection about problems with Haeckel's [biogenetic law](#)^[4].

Haeckel was a firm believer in German nationalism and the greatness that Germany would play in history's future. Over time he eventually developed a philosophy of monism based on Darwin's work, a philosophy that presented a world view based on scientific knowledge. In monism, all organic and inorganic things, whether mind or matter, are ruled by materialistic scientific laws. A supernatural or spiritual world cannot coexist with a monistic world.

Haeckel's Monist League was a strong supporter of German superiority prior to WWI. In 1918 Haeckel became a member of the *Thule Gesellschaft*, some of whose members later became members of the early German Workers party, the forerunner of the Nazi Party. After publishing his last scientific work in 1917 (*Kristallseelen*) and with his health failing, Haeckel sold his house in Jena to the Carl [Zeiss](#)^[32] Foundation, which transformed it into a museum dedicated to evolutionary theory. Haeckel died 9 August 1919.

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