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## Origin of Species



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### Synonyms

*On the Origin of Species; The Origin of Species*

### Definition

*On the Origin of Species, The Origin of Species, or On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* is a book published in 1859 by English naturalist, biologist, and geologist Charles Darwin.

### Introduction

*On the Origin of Species* is a scientific book considered to be the first structured introduction to modern evolutionary biology. It popularized the process of evolution by natural selection. Much of the data inspiring and supporting Darwin's theory was collected during his voyages to the coast of South America (including Galápagos), Australia, and South Africa (Desmond and Moore 1991). At the point of

publishing the book, support for evolutionary ideas was already growing in the field of biology both in academic and public settings, and an evolutionary framework was used to explain novel biological findings. However, due to the close relationship the English academia had with the conservative Church of England, nontheological explanations were perceived as controversial because they claimed that humans are not unique or superior to other living organisms, and, therefore, it took several dozen years for the ideas described by Darwin to be widely accepted in academia.

One of the reasons for the popularity of *On the Origin of Species* was the fact that, despite describing complicated biological processes, it targeted readers who were not professional biologists. The book was written in a way that was both scientifically insightful and also relatively easy to read. Darwin was familiar with the scientific literature of the time, and he was able to compose the book in an engaging style. Darwin was a known scientist, and his ideas were used as strong supportive evidence of scientific naturalism by biologist and anatomist Thomas Henry Huxley, who promoted secularization of science. Approval of Darwin's and Huxley's ideas was not immediate; it took some decades before the theory of evolution by natural selection was accepted and approved by the majority of academia. The acceptance of evolution by natural selection as a unifying concept for all the life sciences was sealed around the middle of the twentieth century by

the emergence of the extended evolutionary synthesis, which highlights the importance of two unifying concepts of an evolutionary approach to biology – reciprocal causation and constructive development.

## History of Evolutionary Thought

Before the presentation of Darwin's ideas, the main framework for understanding life was natural theology, which was based on a literal interpretation of the Bible according to which all species were perceived as God-made in their final form. Even Carl Linnaeus's taxonomy considered species to be in their ultimate form. That understanding of life stood in opposition to a view favoring progressive, gradual development of species from their ancestral forms. The idea of transformism (transmutation of species) was popularized at the end of the eighteenth century by Erasmus Darwin, a grandfather of Charles Darwin, and then, at the beginning of the nineteenth century, further developed by Jean-Baptiste Lamarck. Lamarck introduced the process later called Lamarckism and explained that organisms are progressively transforming towards greater complexity. However, at that point, English scientists were still often Church of England clergymen, and, therefore, the abovementioned processes were construed as designed and executed by God (Bowler 2003).

Charles Darwin was exposed to Lamarckism from the early years of his childhood. He attended a school run by a preacher and then, in 1818, joined the Anglican Shrewsbury School (Desmond and Moore 1991). In 1825 he went to the Edinburgh University and studied medicine. In 1826, he abandoned his medical studies and, for 4 months, assisted Robert Grant's empirical research on marine invertebrates (Browne 1995). Then, he went to Cambridge University. Under the supervision of the botanist John Henslow, Darwin started studying science in a natural theology framework, and with the geologist Adam Sedgwick, he pursued the ideas of catastrophist geology, which understood transformation as a process of adapting to repeated worldwide

catastrophes, such as the biblical flood (Bowler 2003; Browne 1995). An important event in Darwin's life was the expedition aboard the *Beagle* that he joined as a geologist and naturalist at the end of 1831. Reading the *Principles of Geology* by Charles Lyell and discovering fossils of *Glyptodon* (then considered extinct gigantic armadillos), Darwin understood that there is no gap between animals and humans and started to suspect that species might not be "fixed" and "final" (Bowler 2003; Keynes 2000; Larson 2004).

After returning to England, Darwin further analyzed empirical data from both living animals and fossils of extinct species and, by drawing conceptual evolutionary trees, started to drop Lamarck's ideas about independent species transforming into their advanced forms and formed an idea about species evolving from a common ancestor. After seeing an orangutan, he acknowledged its similarity to humans (Desmond and Moore 1991). After comparing methods of professional breeders with the natural processes of specialization he observed, he became aware of the similarities between these phenomena. Then, while continuing his work, exchanging letters, and corresponding with scientists such as Joseph Hooker and Herbert Spencer, he began to write down and soon published his findings. By 1856, his theory of evolution by natural selection was almost fully formed.

Another English biologist, naturalist, anthropologist, geographer, and explorer, Alfred Russel Wallace, came to similar conclusions as Darwin and in 1855, published a paper with a theory that all species developed from closely related species (Wallace 1855). However, Darwin decided not to discuss his findings with Wallace and instead decided to work on his own project instead and in 1856 began formulating the first draft of a book (Quammen 2006). During the process of writing a book, Wallace sent Darwin a draft of his description of a process similar to the one described by Darwin; the difference was mainly due to Darwin perceiving the newly discovered process as similar to the one used by breeders and focused on competition, whereas Wallace placed emphasis on ecological pressures and described processes similar to the process nowadays called group

selection. By arrangement of Darwin's friends and colleagues, and in order to preserve Darwin's precedent, a paper co-authored by Darwin and Wallace was read at a London scientific meeting, titled *On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection* (Bowler 2003; Darwin & Wallace 1858; Larson 2004; Quammen 2006). Neither Darwin nor Wallace was present, and this first public presentation of evolution by natural selection did not generate much interest or discussion.

In 1859, Darwin reached out to ask John Murray whether he would be interested in publishing his book, which he planned to title *An Abstract of an Essay on the Origin of Species and Varieties Through Natural Selection*. Murray agreed, but after some discussions, they decided to modify the title; Darwin hoped the new title would include *Through Natural Selection or the preservation of Favoured Races* (Desmond and Moore 1991). An early draft of the book was entitled *On the Mutability of Species*. The title kept changing; the next version was *An Essay on the Origin of Species and Varieties*, then *An Essay on the Origin of Species*, and finally, with Murray's encouragement, the title became *On the Origin of Species, with the subtitle by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. The book with the final title was published on the 24th of November 1859. The book sold out quickly, so a second edition with corrections was soon published. Twelve years after the *On the Origin of Species* was published, George Mivart published a book called *On the Genesis of Species* in which he contested Darwin's ideas. The sixth edition of *Origin* – and the last one published during Darwin's lifetime – included an additional chapter addressing Mivart's opinions. In addition, in the sixth edition, the term "evolution" was used for the first time, and the title was changed to the simpler *The Origin of Species* (Darwin 1859). The book was published in several other countries, but some translations were inaccurate, often because the translators subverted the content of the book to support their own beliefs. That happened, for example, with the first German translation.

While Darwin was still alive, his book was translated to German, Swedish, Danish, Polish, Hungarian, Spanish, and Serbian (Freeman 1977).

## Content of the Book

The main revolutionary message described in *On the Origin of Species* was that, in contrast to what was previously believed and accepted by learned peoples and the public, species did not appear as separate from each other and in their final, God-given form. Instead, they were changing from previous forms because of the process of *natural selection*. Darwin first explained evolution by comparing it to artificial selection in animals and plants and then provided evidence from various disciplines that evolution is indeed happening (Darwin 1859).

The content of *On the Origin of Species* differs slightly depending on the edition of the book. The title page and introduction consist of quotes by several prominent thinkers. Darwin also mentions Wallace and highlights that he came to the same conclusions as the one presented in the book. In the third edition and beyond, Darwin provided a brief history of the development of the idea of evolution. In the book, Darwin explains the idea of variation under nature and domestication. He describes the process of breeding plants and animals, both in modern times and in the past, and introduces the idea of selective breeding, using the example of pigeons. Then he further clarifies how vague the distinction between varieties and species is and highlights how much variability there is in nature. He explains his concept of *natural selection*, or *the survival of the fittest*, and how a feature that is profitable will tend to be preserved and passed to offspring and therefore will become more frequent in the population. He draws the analogy with selective breeding that it sharpens the feature that is preferred by a breeder. He proposes the idea of competition-driven sexual selection to explain features that are sexually dimorphic. He highlights the complexity of adaptations and provides the first draft of an evolution-based taxonomy in a form of a "tree." He provides details about his ideas of heredity and variation,

but at the point of writing the book, the field of genetics was not yet developed, and, therefore, Darwin did not understand how heritability works. Darwin also explained the idea of common descent and how, in sexually reproducing species, offspring express features of both their father and mother (Darwin 1859).

Darwin addresses possible problems with the theory, including that there often is no evidence for the existence of forms between two species. He did, however, present examples with intermediate structures, e.g., flying lemurs or flying squirrels, explaining that they may share features of transitional forms of other flying mammals, such as bats. He also observed the unique behavior of honeybees constructing hexagonal cells, implying they must have evolved from bees making round cells, but the behavior of building hexagonal cells evolved to conserve space for honey. He also observed that hybrids of two different species occasionally are fertile, challenging the natural theological claim that hybrids are infertile by God's design (Darwin 1859).

In later editions of the book, Darwin added another section in which he addresses criticisms. Critics argued that some adaptations could not have appeared because of natural selection because they do not seem to have any adaptive purpose. Darwin replied that some features might either be by-products of the evolution of other features or adaptations we do not yet understand.

Darwin includes chapters addressing the geological record. He points out that many forms of fossils seem to appear suddenly. However, he argues fossils are relatively rare, and therefore the available fossils do not accurately reflect the past variability of species. Darwin was sure that, as geology progressed, more data would be collected and analyses that are more detailed would become possible. He also anticipated that changes happen at different paces, depending on how quickly the environment changes. Some species evolve more quickly, and some remain the same for a longer time. In the final sections of the book, he writes about geographic distribution of plants and animals. He points out that, despite environmental similarities between various geographical locations, fauna and flora differ between

locations, e.g., in warm regions of Australia, Africa, and South America. He realized that migration barriers were important to explain the distribution of species on different sides of these barriers (e.g., mountains). He explains his thoughts about taxonomy and the way species are classified. Finally, in the last section, he reviews previous assumptions and highlights that he anticipates that evolution by natural selection will revolutionize biology (Darwin 1859).

### **Reception of *On the Origin of Species***

Due to the fact that the book did not only have revolutionary biological, anatomical, and morphological assumptions, but also indirect implications standing in opposition to religion, it caused vigorous debates. There was massive resistance against the idea of evolution by natural selection. Some scientists, such as Joseph Hooker, Asa Gray, Thomas Huxley, Ernst Haeckel, and Henry Bates, supported the idea, but the resistance of some biologists was caused by the fact that they did not understand the idea, e.g., despite Darwin's arguments, they still believed that evolution is progressive and purposeful. Resistance among other readers was associated with the fact that accepting Darwin's idea might lead to social reform; also, it was often the case that understanding of Darwinian ideas was superficial. There were many scientists in the field of biology that did not agree with Darwin's ideas, e.g., Richard Owen, British anatomist, perceived the gradual changes as a process that was caused by God or George Campbell, the Duke of Argyll, who argued that specific features of animals were designed by a Creator. Despite the fact that Darwin did not explicitly mention that humans also shared ancestry with all other species (and he did not do so until 1871 when he published his book, *The Descent of Man, and Selection in Relation to Sex*), heavy hints were dropped, and the idea could have been indirectly concluded from the rest of the text. The first widely popularized attempt to place humans on the phylogenetic tree belonged to Huxley, who, in 1858, noted similarities between the anatomy of apes and humans.

Outside of England, evolutionary ideas faced similar challenges. As time progressed, more and more scientists were convinced and accepted evolution by natural selection as the explanation for all life (Bowler 2003).

Even the scientists that agreed with Darwin's ideas were sometimes skeptical or dubious about some of the processes he described. Carl Nägeli raised a concern that features that do not provide any adaptive benefit could not be retained by natural selection. Mivart agreed with Darwin that such features could have been linked with features that were adaptive but then later criticized natural selection and supported the idea of "directed" evolution; his arguments were addressed by Darwin in later editions of *On the Origin of Species* (Bowler 2003; Mivart 1871).

Another wave of criticism came from readers alerted that the idea of evolution by natural selection supported secularism. Although Darwin did not explicitly discuss the origin of humans, the content of the book indirectly placed humans among animals, which was not in line with accepted dogma of religion. Evolution and recent findings in geology regarding the age of the Earth posed a direct threat to the standard biblical creationist view. Even those agreeing with Darwin often assumed natural selection is a mechanism directed by the Creator. To placate these critics, in the second edition of the book, Darwin added the phrase "by the Creator" to the sentence "Life, with its several powers, having been originally breathed [by the Creator] into a few forms or into one..." Despite taking that step, the book's content deviated from established thinking of the time, and its implications irrevocably shifted the bounds of popular conversations, causing debates about issues regarding the origin of humans, the human soul, and spirituality, in general, that in some forms continue to this day (Bowler 2003; Larson 2004).

## Conclusion

*On the Origin of Species* authored by Charles Darwin argues that all species evolve by the natural selection of inherited, small variations

increasing the individual's ability to survive, compete, and reproduce. The data from Darwin's notebooks, including the very early ones, suggests he perceived evolution as a process that links biological findings together, making it possible to understand life, and included humans in biological model of flora and fauna. In the conclusion of his book, he highlighted that evolution will be a foundation for other sciences, such as psychology and natural history. He was right; *On the Origin of Species* is widely considered the most innovative contribution to modern science, and Darwin himself is considered one of the most influential individuals in the history of science. The book is centrally important in pursuing both scientific and humanist ideas.

## Cross-References

- ▶ [Adaptation](#)
- ▶ [Alfred Russel Wallace](#)
- ▶ [Charles Robert Darwin](#)
- ▶ [Domestication](#)
- ▶ [Erasmus Darwin](#)
- ▶ [Evolution](#)
- ▶ [Evolutionary Byproduct](#)
- ▶ [Fossil Record](#)
- ▶ [Group Selection](#)
- ▶ [Herbert Spencer](#)
- ▶ [Heredity](#)
- ▶ [Hybrid](#)
- ▶ [Jean Baptiste Lamarck](#)
- ▶ [Natural Selection](#)
- ▶ [Sexual Dimorphism](#)
- ▶ [Sexual Selection](#)
- ▶ [Specialization](#)

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