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Darwin's Revolution: From Natural Theology to Natural Selection

The argument from design has two parts. It asserts, first, that organisms evince to have been designed; second, that only God could account for the design. The argument from design was advanced, in a variety of forms, in Classical Greece and early Christianity. Its most extensive formulation is due to William Paley in his *Natural Theology* (1802). The eye – as well as all sorts of organs, organisms, and their interactions – manifest to be outcomes of design and not of chance, thus showing to have been created by God. In the 1990s, the design argument was revived in the United States by several authors.

Darwin's theory of evolution by natural selection disposed of Paley's arguments: the adaptations of organisms are not outcomes of chance, but of a process that, over time, causes the gradual accumulation of features beneficial to organisms. There is "design" in the living world: eyes are designed for seeing, wings for flying, and kidneys for regulating the composition of the blood. But the design of organisms is not intelligent, as it would be expected from an engineer, but imperfect and worse: defects, dysfunctions, oddities, waste, and cruelty pervade the living world.

Evolution can be seen as a two-step process. First, hereditary variation arises by mutation; second, selection occurs by which useful variations increase in frequency and those that are less useful or injurious are eliminated over the generations. Natural selection is much more than a "purifying" process, for it is able to generate novelty by increasing the probability of otherwise extremely improbable genetic combinations. Natural selection in combination with mutation becomes, in this respect, a creative process. Moreover, it is a process that has been occurring for many millions of years, in many different evolutionary lineages and in a multitude of species, each consisting of a large number of individuals. Evolution by mutation and natural selection has produced the enormous diversity of the living world with its wondrous adaptations.

Darwin and other 19th-Century biologists found compelling evidence for biological evolution in the comparative study of living organisms, in their geographic distribution, and in the fossil remains of extinct organisms. Since Darwin's time, the evidence from these sources has become stronger, more detailed, and more comprehensive. Moreover, biological disciplines that have emerged recently—genetics, biochemistry, ecology, ethology, neurobiology, and especially molecular biology—have supplied powerful additional evidence and detailed confirmation.

Molecular biology, a discipline that emerged in the second half of the 20th Century, provides the strongest evidence of the evolution of organisms. Molecular biology proves evolution by showing the unity of life in the nature of DNA and the workings of organisms at the level of enzymes and other protein molecules. Moreover, molecular biology makes it possible to reconstruct evolutionary relationships that were previously unknown, and to confirm, refine, and time all evolutionary relationships from the universal common ancestor up to all living organisms. Three attributes characterize and enhance the value of molecular evolution: precision, universality, and multiplicity.