Anagenesis Versus Cladogenesis Encyclopedia Article

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Most **evolution** consists of two processes: anagenesis and cladogenesis. Anagenesis describes the transformations occurring within a single lineage, as a population develops new characteristics. Cladogenesis, by contrast, describes the splitting of a **species** into two or more groups that subsequently diverge in their traits through anagenesis. The evolution of the horse, from Hyracotherium to Equus, has traditionally served to illustrate anagenesis, a single lineage being traced from ancestor to descendant, but as this interpretation has recently been questioned, a better example is *Biston betularia,* the peppered moth. In Britain before the industrial revolution, the white form of the moth predominated; pollution from smokestacks darkened the environment, however, and the exposed the white moths to predators. Black forms came to dominate instead of white. Since the change occurred within the species, this is anagenesis. Cladogenesis is represented by Darwin's finches, a single South American species having multiplied into several species after reaching the Galapagos Islands.

Biologists had an understanding of these two concepts for decades before they became formalized during the middle of the twentieth century. The German biologist Bernhard Rensch (1900-1990) introduced the terms in 1954; the English biologist Julian Huxley (1887-1975) popularized them three years later, and the American paleontologist George Gaylord Simpson (1902-1984) finalized the definitions in 1961. Rensch and Huxley restricted the term anagenesis to progressive change, but Simpson broadened the term to include any type of change. In addition to anagenesis and cladogenesis, Huxley and Simpson introduced terms describing other evolutionary processes that never caught on.

These different modes of evolution have given rise to different styles of taxonomy. Evolutionary taxonomists such as Simpson use both cladogenesis and anagenesis in their classifications, arguing that taxonomic groups should be based on the branching points in evolution and the degree of difference between groups. A competing group of taxonomists, cladists, by contrast, focus only on cladogenesis in their classification. Following the German entomologist Willi Hennig (1913-1976) cladists trace the history of branching events back to the beginning of life and diagram this pattern as a cladogram. Arguing that groups resulting from the same branching event --called sister groups--belong to the same classificatory rank, the cladists convert their cladograms into classification systems. These different taxonomic philosophies illustrate the difficulty of transforming evolutionary processes into classifications.