f21 Iterative evolution < sickelbacks, globigerines >

> They learned every trick in the book billions of years ago, so we cannot be surprised if their repertory has been endless variations on well-worn themes. —Simon Conway Morris.[1]

Iterative evolution refers to repetitions of descendant types in taxonomic groups. An example is provided by the Cenozoic history of morphologic types of planktonic foraminifera described by Richard L. Cifelli in 1969.[2] From a persisting conservative type, the globigerines, six other types evolved twice. Repeated evolution of similar forms in the development of the same main line indicates conserved regulatory genes. Turned on, these exerted an overriding morphogenetic control. Iterative evolution in the fossil record is known for a wide range of groups.

In western Canada, a genus of lake fish is of three-spired sticklebacks. One species of these, short, slim and small-mouthed, is judged to be little specialized from those that first invaded lakes that filled 13,000 years ago when covering continental glaciers vanished. One highly specialized species, evolved into a big bulky and wide mouth form, is a mud sucker. For these, Dolph Schluter measured a number of traits important to their way of life. He then bred them. Repeated measurements on offspring, when mature, established the range of variability of this stickleback species' genes. Noticeably, the form variations between the generations were not random: unusually long sticklebacks were also unusually fat and had wide mouths; and, short sticklebacks were slender and had narrow mouths. The traits varied together because genes that orchestrate one trait play a part in creating other traits as well. In these fish, the traits of shortness, slimness, and narrow mouths, have remained linked for at least 13,000 years. Evolution is biased toward the kinds of body shapes produced most easily by the variability of the genes. Schluter maintains that this genetic rein on natural selection can be found in almost any species. For some (sparrows, finches, and mice) he finds genetic constraints have variously persisted for millions of years.[3]

Lizards that are snakelike (having lost their legs but without the flexible skull of true snakes) have evolved, John J. Wiens in 2001 describes, over and over again to become either "burrowers," which tend to be small and to have relatively short tails and long trunks, or "grass swimmers," which live above ground, often in dense grass, and have longer tails and shorter trunks than do burrowers.[4]

Songbirds with comparatively large and strong beaks, such as those adapted for crushing hard seeds, are less able to twitter than songbirds that have evolved smaller beaks, such as those adapted to probe for insects. In the Galápagos islands, Stephen R. Palumbi in *How Humans Cause Rapid Evolutionary Change*, 2001, notes that in real time the beaks of finches expand and shrink as droughts and rains change the supply of seeds that the birds eat. Jeffrey Podos in 2001 has found that the female finches could be using physically imposed song signatures in their mate choice to coordinate their evolution as food resources come and go. Natural selection favors female's recognition of males with the same beak type—intermediate beaks that result from hybrid matings might be less efficient for dealing with either food type for which the parents are specialized.[5]

Bioluminescence (light emitted by organisms can be by means of several distinct chemical mechanisms) evolved separately, and so likely (invoking Darwin's South American discovered principle for speciation by evolution: that what occurs laterally also occurs vertically) iteratively, in diverse taxonomic groups (excluding flowering plants, birds, reptiles, amphibians or mammals for lack of extant examples) as include: glowing fungus on dead wood, insects (the firefly), sea luminescent dinoflagellates and bacteria, squid, and in out-of-the-light dwelling deepwater marine fish (*Aristostomias*) and deep-freshwater fish (Lake Baikal).[6]

Drought-resistant C4 photosynthesis (as in now fully sequenced sorghum)[7] has evolved on separate occasions (Rowan F. Sage in 2001 counted 30)[8] in different plant lineages. More efficient than the C3 photosynthesis found in most plants (as in rice, wheat and most other cereals) is a separation in C4 plants of photosynthesis into two pathways operating in different types of cells (strikingly visible in maize in what is dubbed a 'Kranz' (German, *wreath*) anatomy of alternating bundles of mesophyll and darker green sheath cells that form stripes running the length of the leaf).[9] ❑