THE RESEARCH REVOLUTION

SCIENCE AND THE SHAPING OF MODERN LIFE

A VIEWING AND DISCUSSION PROGRAM IN AMERICA'S LIBRARIES

Written by: Robert Rosenberg
Historian of Science and Technology

Session 6 Focus on Science
Biodiversity

In the middle of the nineteenth century, Charles Darwin and Alfred Russel Wallace arrived independently at the same remarkable conclusion: Given enough time, the natural variation in life from generation to generation would lead to certain individuals being better able to survive and reproduce, and this variation in itself-this "natural selection"-would be enough to account for speciation. They were led to this conclusion by their observations as naturalists, by the discovery of increasing numbers of unaccountably strange fossils, and by the vista on the past opened by the new uniformitarian geology, which required huge stretches of time.

There is a common analogue to natural selection. Selective breeding, by which farmers, pigeon fanciers, and dog breeders draw out certain characteristics in plants or animals, is a forced selection that accelerates evolution. It results in silver queen and feedlot corn, winesap and pippin apples, and Yorkshire terriers and Great Danes. The difference is human foresight operating in the place of blind chance.

In a natural setting, the DNA responsible for passing characteristics from one generation to the next does not always replicate perfectly. These random imperfections-mutations-are most often small. They may nevertheless confer upon the offspring some small advantage. It might be slightly better eyesight or a keener sense of smell; it might be a behavior that is more helpful to members of a social group or attractive to potential sexual partners. If it is indeed advantageous, the individual possessed of the new atttribute will have a better chance of living to adulthood and passing on the trait to another generation.

This is not a simple, one-way progression, though. A beneficial mutation might find itself in the company of other, harmful mutations, or an individual with a beneficial mutation might get eaten early anyway. Most important, the environment in which organisms live might change, as environments always do. In the face of such change, what had been advantageous might become a liability; for example, less body fat, allowing greater speed and mobility, would not help in an ice age. Over a long enough time, some mutations favorable to an organism's particular situation will be passed on and spread through a population. Without that time-in the event of a catastrophic, sudden darkening of the planet caused by a huge meteoric impact, for example-adaptation is impossible, and extinction occurs.

The effects of natural selection are not limited to individuals or even to single species. There are, for example, many species of plants that rely on a particular insect or bird for pollination, and hence for survival. The remarkable webs woven by the interdependence of the plants and animals that make up the Earth's biota seem at once resilient and fragile. Stephen Jay Gould coined the phrase "the great asymmetry" to describe the simple truth that destruction is easier than construction, and that what has been built over hundreds of millions of years can be eliminated in decades.

Darwin, Charles. *On the Origin of Species by Means of Natural Selection.* (Many editions). Darwin wrote a surprisingly readable book: He lays out his argument in plain language with easily understood examples

Stein, Bruce A., Lynn S. Kutner, and Johnathan S. Adams (eds.). *Precious Heritage: The Status of Biodiversity in the United States.* Oxford, 2000

BBC's "Evolution Website"
http://www.bbc.co.uk/education/darwin/atoz.htm