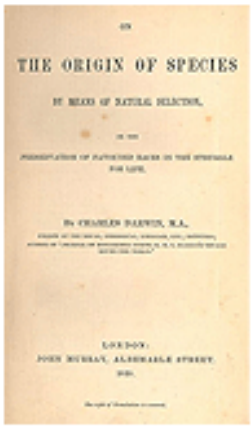
By Michael J. Dougherty

On February 12th, 2009, we celebrated the bicentennial of the births of two men, born on different sides of the Atlantic, whose ideas profoundly shaped the 19th century and continue to guide our thinking today. Abraham Lincoln and Charles Darwin shared a quiet humility and burning intellect. They also shared a courageous willingness to express truths that threatened the dominant establishments, one moral and political, the other religious and scientific.

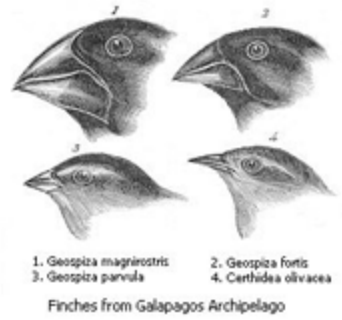

ON THE
ORIGIN OF SPECIES
BY MEANS OF NATURAL SELECTION,
OR THE
PRESERVATION OF FAVOURED RACES IN THE STRUGGLE
FOR LIFE.
By CHARLES DARWIN, M.A.,
LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.

Most of us know the story of Lincoln, and the media will rightly celebrate his struggle to hold the country together and bring closer to reality the "all men are created equal" clause of the Declaration of Independence. Unfortunately, there will be little fanfare for Darwin, whose *On the Origin of Species by Means of Natural Selection* was published 150 years ago. This is sad because never in the history of science has one idea been so successful.

Indeed, Darwin's idea is the unifying concept underlying all of genetics, organismal biology, developmental biology, biochemistry, physical anthropology, archaeology, paleontology, and many other disciplines related to how species came to be as they are today. That idea, so elegant in its simplicity and yet so profound in its implications, threatened not only the natural history of Darwin's colleagues but also the religious belief systems of those who put their faith in biblical inerrancy and special creation.

In spite of the challenge it posed to existing biology, natural selection was so compelling that many scientists rapidly adopted Darwin's theory as the most productive way to advance their own research. And nothing has changed in the century and a half that has elapsed since. In fact, every new discovery related to evolution has strengthened Darwin's insight that all species have descended with modification from common ancestors. Thus, existing species and extinct species are related through time the way distant cousins are related in extended families.

Darwin's idea is elegant and intuitive—the kind of idea that led some of his contemporaries to remark that they should have thought of it themselves. (Indeed one did, Alfred Russell Wallace, natural selection's co-discoverer.) In a nutshell, Darwin realized that for most traits populations of organisms display tremendous variation. For example, within a finch population, some birds have longer, thinner beaks, others have shorter, thicker beaks, and most fall somewhere in between. Given scarcity of resources and the pressures of population growth, not all finches are likely to survive. Those that have some physical or behavioral advantage will be more likely to survive and reproduce. If the trait that aided survival is heritable (i.e., can be inherited, at least in part), then finches will pass their version of the beneficial trait to their offspring.



Finches from Galapagos Archipelago

In this process, the natural environment defines what traits are beneficial and serves as the filter of selection. And the process always works to yield traits in the present generation that were beneficial in the environment of an organism's parents' generation. Evolution does not anticipate the future except in so far as present conditions are not likely to be dramatically different from conditions in the recent past. For example, if small, soft seeds begin to disappear, finches with thicker, more powerful beaks will have a survival and reproductive advantage (i.e., a selective advantage) because they can eat large, hard seeds. Assuming small, soft seeds remain scarce, over several generations thick-beaked finches will become more numerous in the population because they are better adapted to eating large, hard seeds (because that was the trait of their most successful ancestors). This is evolution. Of course, if finches with thicker, more powerful beaks do not exist in the initial population, then the population will become extinct rather than evolve. Evolution depends on trait variation, which ultimately arises from genetic variation. Eventually, if finches with different adaptations begin reproducing only with "like" finches, different species will arise. (Recall that the biological definition of a species is a reproductively isolated population of organisms.)

The ultimate source of all this heritable, genetic variation is DNA, and the connection between DNA and traits is why researchers are so interested in the genetics underlying health and disease traits. The evolutionary link between humans and non-human animals such as mice is why researchers can study disease processes in them (i.e., mice are our genetic cousins). The genes we share in common tend to behave the same way in closely related species, so understanding a gene's function in mice is likely to shed light on a similar process in humans. Even distant relatives (evolutionarily speaking), such as fruit flies and yeast, have genes that allow us to better understand human embryonic development and cancer.

In 2009, the Year of Science, we linked February, Darwin's month, with April, the month we celebrated DNA Day. Darwin didn't live to see how genetics would validate his theory, but we smile for him as we imagine how pleased this humble man would have been to witness the genomic revolution.