Inside the Human Genome: 
The Case for Non-Intelligent Design

by John C Avise

reviewed by Arcady Mushegian and Eric Kessler

Evolution takes place at the natural history scale: life originated on the earth as long ago as 3.5 billion years, and perhaps as long ago as 3.8 billion years (Knoll 2003), and the first Homo sapiens populations may have lived at least 200,000 years ago (McDougall and others 2005). Evolutionary biology as a science is much younger: direct scientific-style observations of nature by human beings did not start until several millennia ago at the earliest, and the methods of modern science have been in existence for only two centuries or so, while some, such as statistical inference, are even younger, and yet others, undoubtedly, still have to be developed. Such is the intrinsic difficulty of the scientific study of evolution: scientists were not around to observe most of the events that happened in the past. Those disinclined to accept evolution tend to seize upon this, to put forward two related arguments. First, they may say, because it is impossible to have direct evidence about the past, in the absence of any reliable eyewitness testimony, any claims about the past are simply speculation. Second, they may add, there is reliable eyewitness testimony about the origin of life and of the origins of its major groups, to be found in the book of Genesis (or perhaps a revelatory text outside of the Abrahamic tradition). It is this second argument that most often underpins creationism.

Fortunately, direct observation of natural phenomena is not the only way to learn about and understand them: the natural sciences teem with methods, from the mundane to the sophisticated, for investigating the world that go beyond direct observation. Moreover, it is not only in the natural sciences that we justifiably make statements about past events without direct eyewitness accounts. (In fact, modern psychology teaches that eyewitness testimony is not the golden standard of truth, since witnesses tend to interpret what they observe, and unknowingly may impute their own motivations and prejudices even into an account of a random event [Wells and Loftus 2003]. And even if the omniscience of the narrator of Genesis is conceded, there remain serious questions about the accuracy of the transmission of the testimony [Ehrman 2005] and the way in which it is to be interpreted [Scott 2004].) In the human sciences, instead of relying on oral or written records only, we also learn about the societies of the past by the artifacts they left behind, by the changes of the environment that their lifestyle appears to have caused, and, most recently, by the historic record that is accumulated in their genes in the form of hereditary difference between human populations.

Not all creationists are skeptical about the possibility of scientific knowledge of the past. Those who are not do not deny the old age of the earth and the life on it, and they accept
the reality of the fossil record that helps to form the framework of the scientific understanding of evolution. Moreover, they accept the mechanisms of natural selection. They agree, for example, that abrupt spontaneous changes of hereditary traits sometimes happen—how this can be doubted when such “sports of nature” are the basis of many plant and animal domestications?—and they agree that different manifestations of a hereditary trait have different chances of survival in their natural habitat—and this also should not be in doubt, as the silkworm will not survive on its own even among the mulberry trees, on whose leaves it forages in a magnanery. (Note that very similar arguments about domestication were discussed repeatedly by Charles Darwin in the *Origin of Species*—not as the ultimate proof of evolution, but as examples of how we can understand the past through rigorous analysis of the relevant events observed today.) Such creationists will concede all these facts, but will attempt to identify obstacles to evolution in the complexity of biochemistry. It is this kind of assault on the evolutionary arguments that John Avise is examining in his book.

Avise is Distinguished Professor of Ecology and Evolutionary Biology at the School of Biological Sciences at the University of California, Irvine. He is a National Academy of Sciences member and a long-time advocate for better understanding of modern science by the general public. He has authored almost 150 research articles on ecological genetics and mitochondrial inheritance in various animals, as well as twelve books, many of them dealing with the public understanding of science and in particular with evolutionary approaches in biology. In his most recent book *Inside the Human Genome: A Case for Non-Intelligent Design*, Avise has three goals:

- to help to educate a broad audience about the inner workings of the human genome;
- to challenge proponents of Intelligent Design to address, more critically, the ancient theodicy challenge as it applies at the biomolecular level; and in general to promote the evolutionary sciences as a preferred means to comprehend biological phenomena. (p 40)

In his first chapter, “The eternal paradox,” Avise relates a brief history of human thought and study of organismal design, from its roots in natural theology through the Darwinian revolution and the subsequent creationist and “intelligent design” challenges to this movement. (Along the way, a convincing argument is presented that “intelligent design” is a secret child of creationism—not a scientific discipline, as the public is sometimes led to believe.) This sets the stage for his premise that a deeper, evolutionary, understanding of the genome could provide a meaningful, though complex, perspective on the age-old theological question, “Why does suffering exist in a world governed by a loving and all-powerful deity?” (Interestingly, though this problem has occupied theologians for a long time, it took a polymath scientist and philosopher, Gottfried Leibniz, to coin the specific term theodicy for the project of trying to solve it [Leibniz 1710]).

In the three chapters that follow, Avise delves into the structural details of the genome, building the case that it was non-intelligent processes that gave rise to the unnecessarily baroque, redundant, and inefficient features of the human genome, such as introns and repetitive genetic elements (duplicate genes, pseudogenes, and microsatellites), as well as intrinsic errors in genome copying, which manifest in human genetic diseases, often so severe, even in clearly innocent small children. None of this is easily explained by actions...
of either a loving and merciful God or of an unnamed but highly competent Designer. In contrast, these features are well-explained by the stochastic nature of DNA mutation and the lack of foresight in the evolutionary processes of variation and selection. In fact, it has been noted (Kondrashov 1999) that it was Charles Darwin himself who pointed out, in the *Origin of Species*, that the evidence of evolution is brought into light not by perfection in the adaptations of the living species that we observe, but precisely by their non-optimality. The reasons for non-optimality are in part purely mechanistic (DNA copying, recombination, and repair mechanisms are error-prone, and they anyway can operate only on those genes that already exist in the species or can be produced by gene duplication) and in part involve population-genetic factors, such as finite population sizes and interplay of selection and stochastic changes in gene frequencies.

The suboptimality of genetic traits is in fact a crux of the debate between evolutionary biology and “intelligent design”. As explained in the last chapter of Avise’s book, it is there that the design proponents, such as Michael Behe, tend to lose their pretense of scientific discussion. Faced with challenges to explain suboptimality, they resort to appealing to our inability to “psychoanalyze” the purported designer. But, Avise argues, “if we cannot draw objective inferences about the designer from the many well-documented flaws of biological craftsmanship, then neither can we make logical inferences about the creator from any suspected artistry of design” (p 155).

Avise’s account is concise but rich in historic and medical detail, and the prose is elegant and lucid. The book is a joy to read, and is suitable for anyone who is interested in science and medicine enough to be a casual reader of *Scientific American* or *Discover* magazines. The main text is followed by twenty-six pages of extensive notes and references, allowing any reader to follow up with the science that informed the text. There is also a detailed glossary defining approximately 150 terms important in evolutionary biology and genomics, and a seventeen-page index.

So what about the three stated goals of the book? We suspect that the second goal, to appeal to the moral seriousness of the “intelligent design” proponents to assume their fitting burden of scientific proof, will not be fruitful: judging by the arguments of Michael Behe examined in the book, the ID champions continue to shift the arguments and change their venues, while laughing the more serious concerns away. This leaves two other goals, and the intended beneficiaries of those are no longer the creationists or ID proponents, but rather the scholars and educators seriously interested with what genome biology has to say about evolution. Avise’s book fulfills this twofold educational objective in a number of ways. Besides being accessible to high school students directly, this book aids in bridging the gap that exists between the content covered in school textbooks, which are generally outdated, and the world of genomic science as viewed from an evolutionary perspective. The high school educator will find the book rewarding. The evolved genomic design features, explored in chapters 2–4, and the subcategorization of each of these topics with numerous examples, including the names of more than 100 distinct genomic disorders, provides a great framework and a clearinghouse of interesting topics for educators who would have their students explore the evolutionary view of the human genome.

**References**


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