

EXPRESSING THE NATURE AND MEANING OF DNA:
SIX BOOKS FOR TEACHERS AND STUDENTS

by Charles F. Smith

The Thread of Life: The Story of Genes and Genetic Engineering. By SUSAN ALDRIDGE. New York: Cambridge Univ. Press, 1996. 272 pages. \$12.95 (paper).

The Genetic Gods. By JOHN C. AVISE. Cambridge, Mass.: Harvard Univ. Press, 1998. 288 pages. \$29.95.

Unraveling DNA. By MAXIM D. FRANK-KAMENETSKII. New York: VCH Publishers, 1993. 2d ed. rev. 1997. 214 pages. \$15.00 (paper).

Genetic Ethics: Do the Ends Justify the Genes? Edited by JOHN F. KILNER, REBECCA D. PENTZ, and FRANK E. YOUNG. Grand Rapids, Mich.: Eerdmans, 1997. 288 pages. \$22.00 (paper).

The DNA Mystique: The Gene as a Cultural Icon. By DOROTHY NELKIN and M. SUSAN LINDEE. New York: W. H. Freeman, 1995. 276 pages. \$12.95 (paper).

The Future of DNA. Edited by JOHANNES WIRZ and EDITH LAMMERTS VAN BUREN. Dordrecht, Netherlands: Kluwer Academic, 1997. 289 pages. \$148.00.

Abstract. DNA is an important agent not only in chemistry and biology but also in technology and modern culture. A number of books approach the double helix from different angles. These perspectives include (1) the science of DNA and genetics; (2) genetic engineering; (3) the ethics of manipulating genetic material; and (4)

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DNA in culture and religion. Various views of DNA provide insights into human nature beyond its molecular composition.

Keywords: B-form DNA; cultural icon; Richard Dawkins; DNA; eugenics; gel electrophoresis; genetic engineering; genetic sovereignty; *ifgene*; protein; selfish gene; Z-form DNA.

Deoxyribonucleic acid (DNA) is a chemical substance that not only fashions our cells and ourselves but also fires our imaginations. In our age of science and technology, this master molecule has been identified as the pattern for protein production. Proteins make up much of the physical structure of living things, and they are the emissaries—catalysts, enzymes, and hormones—that keep plants and animals alive from one moment to the next. DNA, in concert with enzymatic proteins of stunning complexity, directs the dynamic processes of reproduction and the development of embryos that permit new individuals to come into the world.

Recent books deal with DNA and its role in genetics. Some focus on the DNA double helix itself, how it operates and carries out control, maintenance, and procreation. Others target how science can manipulate DNA in testing, medicine, and genetic engineering. Some focus on the ethics of these manipulations. Still others examine how DNA has entered popular culture and even approaches religious dimensions.

DNA could mean “Do Not Ask.” The sheer amount of scientific information in the field of molecular biology is overwhelming, even intimidating. Genetic science is in a perpetual state of flux, shifting and expanding as new discoveries come to light and seemingly outrageous procedures are carried out. Some seem worthy of Dr. Seuss: the egg of an elephant was recently implanted in a mouse, for example.

DNA might stand for “Doing Nature’s Agenda.” When we work with hereditary material, some say we are helping nature help itself. Others say “Do Nothing Artificial.” They warn that we are charting a course into the “un-natural” and that we may face serious consequences if we reprogram the software of our own and other species.

Perhaps DNA should be placed alongside the letters BNA: “Be Not Afraid.” The wellsprings of life should be approached with caution and respect, not with recklessness and abandon, and yet not with fear and dread.

In the discussions of these six books, many voices speak concerning the nature of DNA, what DNA means in terms of processes and perceptions, and what difference it will make as genetic wiring is teased, tempered, and reconnected now and in the uncertain circuits of the future.

The Future of DNA is a record of the proceedings of the International Forum for Genetic Engineering (*ifgene*) conference, held in Dornach, Switzerland, in 1996. *The Future of DNA* is a wide-ranging volume that contains sections on “DNA-Thinking in Science and Society,” “DNA in Living

Organisms,” “DNA and Human Biography,” and also material from plenary sessions and workshops. A wealth of information is contained in many discrete essays from a number of nations and points of view. Most *ifgene* essays fit in neatly with the topics on which the other books focus.

Genetic Ethics: Do the Ends Justify the Genes? is a compendium that approaches the subject matter from another perspective. For the most part, molecules, manipulations, and morals are viewed through the lens of the Christian faith. Biologists, pastors, policy makers, physicians, and scholars are represented in this volume through essays on topics from “Genetic Testing and Confidentiality” to a “Theological Basis for Genetic Intervention.” Francis S. Collins, director of the Human Genome Project, is a contributor, as is Charles Colson, who writes on “Contemporary Christian Responsibility.”

THE SCIENCE OF DNA

In terms of nuts, bolts, and molecular bonds, *Unraveling DNA* is an excellent guide to how the double helix was discovered and how it operates in the depths of the cell. Maxim Frank-Kamenetskii presents the history of molecular biology. The first hints of DNA surfaced in the physics of the 1930s. *Unraveling DNA* picks up the trail in those early days and continues to the near-present.

Unraveling DNA is full of scientific information; however, it is not dry, nor does it overwhelm the reader. It gets the science exactly right. It describes not only molecules and biochemical mechanisms but also lab procedures such as gel electrophoresis (used to separate pieces of DNA so the code can be deciphered). The process is graphically depicted: “Like a snake caught in a fisherman’s net, wormlike DNA molecules crawl very slowly to the anode” (p. 65).

Frank-Kamenetskii points out that DNA is not really an acid. It is a salt. We do not call table salt “hydrochloric acid.” “However, the name DNA is here to stay” (p. 64). Misconceptions such as this are pointed out in *Unraveling DNA*. Moreover, while the basics are thoroughly covered, the reader is transported several levels upward into the world of rings, loops, and knots of DNA as well as alternate Z-form and B-form DNA. Frank-Kamenetskii also dares to present “The Controversy Around the Double Helix.” He reports that recent findings suggest that Watson and Crick may not have been right!

The depth of information in *Unraveling DNA* may seem excessive and intimidating to some readers. Nevertheless, even the most current developments are clearly explained. Science books for general readers can be shallow and can leave readers at the starting gate. The explanations in *Unraveling DNA* fill in often-omitted details and at the same time proceed to a popular understanding at the cutting edge of the field at the present time.

DNA cannot be reduced to a child's alphabet blocks with *A*, *T*, *C*, and *G* on them. It is an oversimplification to say that DNA "makes a copy of itself." The molecule exists in a complex environment that involves configurations, twists, and especially relationships with other chemical species. Reactions are rapid, and the twin strands twirl as they open and close, vibrate and react. *Unraveling DNA* unravels the entire field of DNA, to the extent that this can be accomplished in a nontechnical book. It provides a sufficiently wide glimpse of the science involved in turn-of-the-century genetics.

The Thread of Life also does well with the science of the gene. A method for obtaining one's own sample of DNA is provided. Dishwashing liquid, salt, water, vodka, an oven, and a blender are required. However, this research protocol does not involve human cells. Follow the instructions and the DNA of an onion will be isolated. Nevertheless, the very stuff of life can be obtained in almost any kitchen. Susan Aldridge presents a concise account of DNA basics, unfolding the history of the double helix in a manner that covers all the bases. The writing is clear and the facts are accurate. The sections on the genetic code, protein synthesis, and gene expression are especially well done. The role of the "Thread of Life" is unrolled into the topics of the genome and evolution. Aldridge tries to fathom "Where did DNA come from?"—a topic that leads into genetic engineering. It is here that *The Thread of Life* excels.

The Future of DNA contains several essays that focus on the chemistry and biology of DNA. These include "DNA and the New Organism" and "DNA at the Edge of Contextual Biology." Although these articles are technical and are much more than primers on DNA, they provide a taste of what is going on at the frontier of DNA research and genetics.

The DNA Mystique and *The Genetic Gods* provide some preliminary information on DNA. However, the scientific background material is cursory. The task of these two volumes is to examine DNA as a new cultural icon.

GENETIC ENGINEERING

Beyond studying the history, nature, and activity of DNA in living things, human beings now have the potential to modify gene action. They do this not only in laboratory experiments but also in higher organisms, including human beings themselves.

Genetic Ethics includes several essays on genetic intervention, including some on eugenics. Contributors urge caution in regard to using new genetic procedures, and it can be argued that due caution is merited. The power of these techniques is such that they impinge on the very matrix of our biological existence. Religious deliberation about genetic engineering should not be ignored. Belief systems may also have been selected for their role in the development of our species.

Genetic Ethics presents a number of viewpoints on our growing ability to alter our genes. Topics include “Behavioral and Germ-Line Genetic Research,” “Genetic Counseling,” “Genetic Therapy,” and “The Case of Human Growth Hormone.”

The Future of DNA approaches genetic engineering from a different direction. After all, it reflects the proceedings of *ifgene*, the International Forum for Genetic Engineering. Technical papers can be heavy going, such as “DNA at the Edge of Contextual Biology” and “The Role of Genetic Disposition in Human Health and Disease—Bioethical Aspects of DNA Testing.”

The Future of DNA shares some common ground with *Genetic Ethics* in that religion is also factored in with science. The abstract of an article entitled “Back to the Future—Towards a Spiritual Attitude for Managing DNA” states that “This contribution is a philosophical effort in order to save the reality of life and nature from the consequences of ‘DNA thinking’ and sketches an ‘ethical biology.’ It is stated that gen-ethics is more important in shaping our future than genetics” (p. 43).

There is also a contribution on “Heredity, Gene Therapy and Religion.” DNA science is making rapid advances, as evidenced in *The Future of DNA*, but not without some input from spirituality and religious ethics.

The science and techniques of genetic engineering are set forth and explained in *Unraveling DNA* and *The Thread of Life*. While Frank-Kamenetskii titles a chapter “Genetic Engineering: Hazards and Hopes,” he envisions a “Golden Age of Biotechnology.”

Susan Aldridge weaves *The Thread of Life* into the areas of creating new life-forms, gene therapy, plant biotechnology, and “environmental solutions” from genetic engineering. This treatment paints a detailed picture of the benefits that may accrue from manipulating DNA. While the possible dangers may not have been adequately depicted, this is understandable, because the potential for genetic engineering is so great that any downside tends to be eclipsed. However, potential dangers and benefits, gains and losses, must be kept in mind as we embark on uncharted waters within the membranes of our own cells.

DNA AND CULTURE

The Genetic Gods and *The DNA Mystique* go beyond presenting DNA as an entity in the field of biology. Their premise is that the stuff of genetics has been adopted as a cultural icon or even an object of religious veneration.

Dorothy Nelkin and M. Susan Lindee describe a number of examples of this DNA mystique. From new phrases such as “it’s as if it had a DNA of its own” to the near-universal recognition of the double helix, “gene talk” permeates culture. DNA fingerprinting solves crimes and establishes paternity. Teens trade cards containing copies of rock star DNA. Genetic material has become material for myth and folklore.

Taken a step further, genetic pop can pop up as a cult of the gene. Cards containing a snippet of the DNA of the famous resemble the relics of the saints. The genetic fingerprint is transfigured from the ultimate hallmark of personal identity to something more ultimate still: the modern equivalent of the human soul. DNA can be considered the essence of an individual. It also survives beyond death (although in altered versions) in one's children.

In *The Genetic Gods*, the stress is on "Genetic Sovereignty." The critical chemicals of life not only assemble us and maintain our life functions but also are the powerful "new lords of our genes" (p. 171) active in recombinant DNA techniques, gene therapy, and genetic engineering.

John Avise identifies genes as "gods" that "have special powers over human lives and affairs, . . . exert influence over the course of nature" (evolution). "Genes are potentially immortal," and we "are merely ephemeral vessels that evolved as a means of perpetuating DNA" (p. 3).

The fascinating view that organisms are vehicles that genes use to make more genes was borrowed from Richard Dawkins's book, *The Selfish Gene* (1976). Nelkin and Lindee note, in *The Gene Mystique*, that "in soap operas and talk shows" there are "selfish genes, pleasure-seeking genes, violence genes, celebrity genes, gay genes, couch-potato genes, depression genes, genes for genius, genes for saving, and even genes for sinning" (p. 2).

This may be the case, but it seems more likely that this is a frame-of-reference phenomenon. Human failings are transferred to the powerful new entities that have emerged from lab pipettes. It is easier to come up with new genetic gods than to take a hard look at ourselves.

Is the appearance of genetic icons in popular culture and even religion a real phenomenon that impacts on our lives? In many cases the gene scene is trivial and superficial. Genetic engineering jokes crop up in comic strips and late night humor. But in a larger sense, gene jargon and genetic thinking permeate our culture.

The soul of DNA so far is an academic concept. However, as the pace of gene therapy quickens and embryo cloning and even more radical procedures become commonplace, attitudes and belief systems may shift with the tide of new information and new innovations. The challenge will come down to whether these shifts can somehow be directed in ways that will build up our ethics and to how we see ourselves in the light of new understandings based on our deep biology.

The Future of DNA also addresses the cultural aspects of the double helix. Ernst Peter Fischer writes of "The Archetypal Gene—The Open History of a Successful Concept." He observes that *gene* is a fuzzy entity with no clear-cut definition in sight.

Susan Lindee, the historian who coauthored *The DNA Mystique*, contributed an article to *The Future of DNA* with the title "The Cultural Power

of the Gene—Identity, Destiny, and the Social Meaning of Heredity.” Some of the same mystique is set forth, but Lindee includes additional examples.

“Is DNA God?” asks a skeptical medical student in an essay in a medical journal. “Given [its] essential roles in the origin, evolution and maintenance of life, it is tempting to wonder if this twisted sugar string . . . is in fact God” (Henderson 1988, quoted in *The Future of DNA*, p. 28).

Deoxyribonucleic acid is nothing but two strings of molecules linked together. It directs chemical reactions and “Does Nature’s Agenda.” DNA is a master molecule that is immortal. It makes people what they are and has programmed evolution on earth. “Do Not Ask!” How can we begin to understand such an omnipotent agent? But—“Be Not Afraid”—we can make the stuff in the kitchen sink with some vodka in the blender!

These books reveal DNA as a molecular mirror. We peer at our genetic material and see ourselves looking back. It is not enough to know the intricate details of the genes, even though it is important to understand the physics, chemistry, and biology. It is not sufficient to ponder the philosophy and ethics and cultural dynamics, though these are essential tasks that must be carried out and taken very seriously.

The most important thing to keep in mind is that DNA is us! It is not all of us or even the most important part of the human being, but it is a big part. We are not sure how big it is or even what it is in terms of our entire humanity. It is less than a god and more than a residue in the sink.

Books like these challenge us to increase our understanding of our genetic source code. They may help us know better who we are and how we are to act in a world that is being changed by our knowledge of DNA.

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