THE FATEFUL CODE

The remarkable advances in genetics during the last 50 years have prompted an outpouring of books and articles about the science. Along with journalists, many of the more prominent researchers have weighed in with books for the general reader. This has proved to be a mixed blessing. While throwing considerable light on a complicated science, the array of books can be bewildering. While a number of these may *seem* to be about genetics—including François Jacob's **The Logic of Life** (Pantheon, 1973)—they in fact focus on such matters as human behavior and man's ultimate place in the universe. Many writers skirt the fringes of genetics, discussing the ethics, or implications, or mechanics of their science. Yet few provide a simple history of who, what, when, and how.

Two exceptions are Gunther Stent's **Coming of the Golden Age** (Natural History, 1969) and Horace Freeland Judson's **Eighth Day of Creation** (Simon & Schuster, 1979). Though somewhat dated, both contain a wealth of history. Stent, a molecular biologist at the University of California, Berkeley, offers an excellent thumbnail retrospective, sketching the now-familiar tale of the rise of modern molecular biology from its roots in Gregor Mendel's 19th century pea-plant experiments to Francis Crick and James Watson's 1953 discovery of DNA's structure. (Readers are forewarned that Stent indulges in a rather New Age meditation on the connection between genetic research and the evolution of human intellect.)

Judson, a professor of humanities and science at Stanford University, explains the late 20th-century breakthrough in biology and genetics as a "synthesis of particular lines from five distinct disciplines": x-ray crystallography, physical chemistry, genetics, microbiology, and biochemistry. What sets genetics apart from sciences such as physics or astronomy—each of which had its Newton or Copernicus—is that it evolved not through "great set-piece battles but by multiple small-scale encounters—guerrilla actions—across the landscape." Genetics had no "ruling set of ideas" such as the Ptolomeic system of the universe to overcome.

One event that was truly revolutionary—Crick and Watson's discovery of DNA's structure—is treated in Watson's highly personal account, **The Double Helix** (Norton, 1980). Reading this book, one is struck not so much by the magnitude of Watson and Crick's discovery as by the obsessive and, at times, graceless way they went about achieving it. Locked in a furious race with Nobel Prize–winning chemist Linus Pauling, Watson and Crick repaired to a local pub to drink a "toast to the Pauling failure" when the American published an early but incorrect description of DNA's structure. Recent editions of Watson's book, edited by Gunther Stent, provide further tantalizing glimpses of politics and etiquette inside the laboratory. Stent appends disapproving reviews of the original book, rebuttals, and recriminations, one coming from Crick himself, who calls it "a rather vivid fragment of [Watson's] autobiography, written for a lay audience."

The impression that the expanded book leaves of Watson—now the most visible leader of the U.S. Human Genome Project—is less than flattering. Robert L. Sinsheimer, one of the project's early promoters, talks about Watson and Crick's reliance upon "cadged data... overheard in seminars, pried out in conversations, even provided by Max Perutz from a privileged report." Sinsheimer suggests that others were close to reaching the same conclusions and that the scientists' "ingenuity and clutching ambition bought a year or two in time—and fame."

A common thread running through many recent books is the realization that modern geneticists—like the scientists who unlocked the secret of the atom—are delving into a realm of knowledge that man may lack the ethics to control. This concern echoes through several books that take the Human Genome Project as a point of departure. Among these are **Genome** (Simon & Schuster, 1990) by journalists Jerry E. Bishop and Michael Waldholz, **The Human Blueprint** (St. Martin's, 1991) by chemist Robert Shapiro, and science writer Lois Wingerson's **Mapping Our Genes** (Dut-

ton, 1990). Devoting less attention to past discoveries than to what *might* be discovered, all of these authors frame the various sides of the ethical debate. Shapiro takes the most hopeful view, trusting in our wisdom to reap what is best in genetic research while limiting abuses. By contrast, Jeremy Rifkin, author of **Algeny** (Viking, 1983) and **Declaration of a Heretic** (Routledge, 1985), warns that "with the emergence of genetic engineering, society entertains the prospect of a new and more deadly form of segregation . . . based on genotype."

The dismaying history of eugenics receives full treatment in historian Paul Weindling's **Health, Race and German Politics Between National Unification and Nazism, 1879–1945** (Cambridge, 1989) and in Robert Proctor's **Racial Hygiene** (Harvard, 1988). As Proctor points out, the legacy of the abuses of science under the Nazis is not just that Nazi racial policy was allowed to triumph but that "this struggle was played out, at least in part, in the spheres of science and medicine," forever tainting genetic research, at least in the public mind, with a sinister aspect.

One potentially sinister outgrowth of genetic research is the ability to screen individuals for genetic defects. **Ethics and Human Genetics** (Springer-Verlag, 1989), edited by D. C. Wertz and J. C. Fletcher, provides an international survey of such practices as the screening of unborn fetuses for fragile X syndrome and the testing of adults for susceptibility to depression. The authors' findings suggest that the geneticists seem more concerned about the burden of increased demand for such tests than about the possible moral dilemmas they may present individuals. Those wishing to ponder such choices may consult **Dangerous Diagnostics** (Basic, 1989), by Dorothy Nelkin and Laurence Tancredi; **Backdoor to Eugenics** (Routledge, 1990), by Troy Duster; **Proceed with Caution: Predicting Genetic Risks in the Recombinant DNA Era** (Johns Hopkins, 1989), by Neil A. Holtzman, M.D.; the Office of Technology Assessment's **Genetic Monitoring and Screening in the Workplace** (U.S. Government Printing, 1990); or, in a more visionary vein, Aldous Huxley's dystopian **Brave New World** (1932).

But as Daniel J. Kevles and Leroy Hood remind us in the introduction to their forthcoming collection of essays, **The Code of Codes: Scientific and Social Issues in the Human Genome Project** (Harvard, 1992), "science-fiction fantasies about the genetic future distract attention from the genuine problems posed by advances in the study of heredity"—particularly those that relate to insurers, employers, and the government. Assembling an impressive cast of commentators, including Nobel Prize winners Walter Gilbert and James Watson, the book explores the history, methods, and implications of the Human Genome Project. Readers may sample such exotica as Horace Judson's poetic musings on gel electrophoresis—"molecules of DNA behave in the electrical field like strands of aquatic weed strung out and floating down a flowing stream." Or they may learn how researchers compare the DNA of bacteria and fruit flies to human DNA to find the key to what makes us human, a quest that Gilbert likens to the "grail of human genetics." Part of that knowledge, says Gilbert, is "to realize that genetic information does *not* dictate everything about us." Science can only go so far. Society will still have to decide "how much of our makeup is dictated by the environment, how much . . . by our genetics, and how much . . . by our own will and determination."