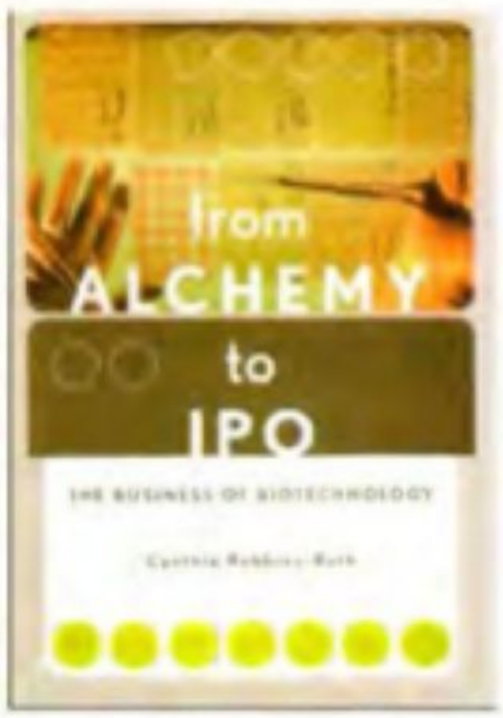
Exploring the nature within us in the century of biology.

From Alchemy to IPO: The Business of Biotechnology
By Cynthia Robbins-Roth
253 pages, Perseus Publishing, $26

Time, Love, Memory: A Great Biologist and His Quest for the Origins of Behavior
By Jonathan Weiner
300 pages, Vintage Books, $14

WHAT IS A HUMAN BEING? Even regarded only as a quantity of DNA, it turns out, quite an extensive thing. If the spiral chains of nucleotides comprising the DNA in a single human cell were uncoiled, that DNA might stretch two meters. If the DNA from all the cells in an individual's body could somehow be unwound, it might literally extend from the earth to the sun and back.

More conventionally, DNA resembles a spiral ladder, with each rung consisting of two out of four chemical possibilities—adenine, cytosine, thymine, and guanine—which are the nucleotides. The rungs function like different letters in an alphabet. Over 3 billion letters of genetic code exist in every human cell's nucleus. That's a lot of data. By the mid-21st century, the Internet may seem a sideshow to the main event in IT—the explosion of bioinformatics. The Human Genome Project's working draft of the genome's sequence gives us a first hint of this New World's scale. This century will be the Biotech Century, with as many headlines about discovery, cures, and healing as the 20th century had about war and destruction.

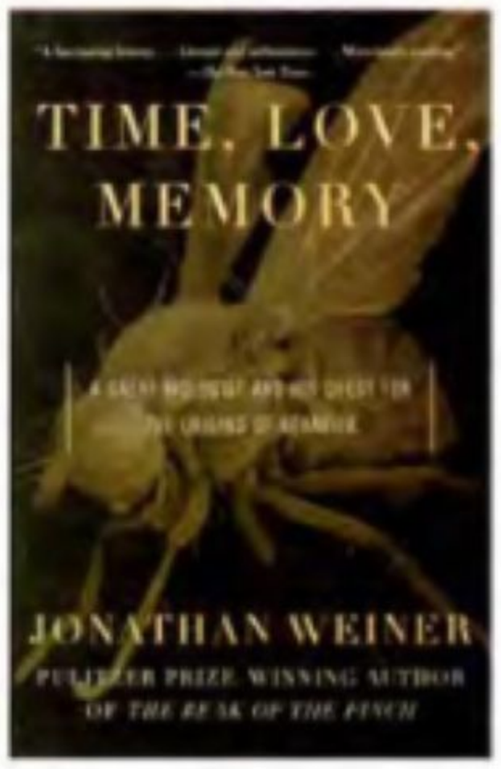


Unfortunately, it was easier for most of us to understand how, say, SQL Server and BackOffice compared to high-end Oracle and IBM DB2, than how a codon specifies a ribosome so the gene can express an amino acid. Also, the mechanics of how biotech companies get funded and move toward an IPO are unlike those of the traditional IT industry.

Don't worry. Cynthia Robbins-Roth has written *From Alchemy to IPO: The Business of Biotechnology*, a concise guide and reference to everything you're going to need to know. In 1980 Ms. Robbins-Roth was lured from postdoctoral research into cancer and the immune system when she gave a seminar at Genentech, in South San Francisco. Under visionary CEO-founder Robert Swanson, Genentech was the first company to use recombinant genetic engineering to manufacture human insulin, growth hormone, and the blood clotting factor that hemophiliacs lack; it was also the first biotech company to undertake a (wildly successful) IPO. In joining Genentech, Ms. Robbins-Roth became part of the team heading that first generation of biotech companies. Since then she's founded and managed a biotech consultancy firm while running a daily news service, publishing a quarterly industry magazine, and writing for the general press.

So she knows the science, the business, and how to explain both to neophyte investors. Old biotech hands will likewise find *From Alchemy to IPO* valuable, since it provides a more succinct account of the industry's past, present, and foreseeable future than other sources.

In fact, the book demonstrates how dense text can be replaced by good charts that lay out for readers the details of who did what when. The author clarifies biotech's relationship to Big Pharma, showing how in the '70s and '80s big pharmaceutical companies—knowing their main money-makers would lose patent protection in the '90s, yet disdaining the small companies and the new technology—were caught asleep at the wheel. Still, she shows, biotech and Big Pharma companies needed each other to survive. Big Pharma wants biotech's products. Biotech companies require Big Pharma's resources: the average cost of generating a new drug is $500 million; the average time to move a drug from discovery, through animal testing, into clinical trials, then past the Food and Drug Administration and into the marketplace has been 15 years. Typically, Ms. Robbins-Roth informs us, a biotech company starts as a research and development house, uses corporate partners for late-stage development and marketing, then tries to retain more manufacturing and marketing rights for itself.

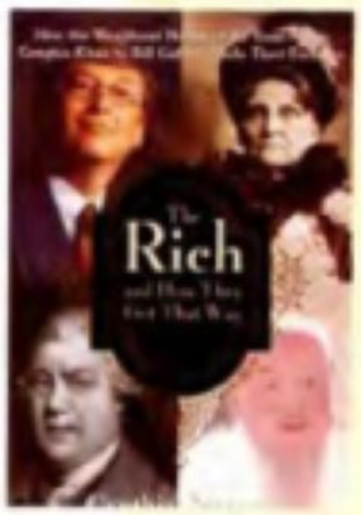


Not that drugs and recombinant protein therapeutics are the whole story, of course. With monoclonal antibody technology, for example, vats of antibodies are grown that are targeted at specific diseases and cancers. *From Alchemy to IPO* surveys emergent aspects of genomics such as proteomics (studying

SHELF LIFE

The Rich and How They Got That Way: How the Wealthiest People of All Time—From Genghis Khan to Bill Gates—Made Their Fortunes, by Cynthia Crossen
(Crown Business, $25)

Getting rich sure isn't what it used to be. Today making millions of dollars can be as easy as having a good idea and finding some funding. A thousand years ago, becoming one of the world's wealthiest individuals required far more than that. Back then the world was akin to the "all against all" situation that Thomas Hobbes describes in *Leviathan*. Wealth consisted mainly of land and gold, and acquiring them usually meant taking them from someone else by force. Not surprisingly, the world's richest men (and they were nearly always men) were men of violence: feudal lords, bandits, or marauding barbarians.



By now this has all changed. The strong can still get rich, but it's by building huge businesses, not by pillaging neighboring villages. How intelligence has overtaken physical strength as the most important factor in becoming wealthy is what Cynthia Crossen traces in her latest book, *The Rich and How They Got That Way*. Ms. Crossen, a senior editor at the *Wall Street Journal*, looks at the life of one fabulously wealthy person from each of the past ten centuries. Her choices range from 11th-century tyrant Machmud of Ghazni to 15th-century banker Jacob Fugger to 20th-century software magnate Bill Gates.

Ms. Crossen's picks do not necessarily represent the richest individuals from each era, but they all are people who became rich in a way that was emblematic of how routes to wealth had changed. Several of her choices are refreshing surprises: African king Mansu Musa enriched himself as a middleman in the rise of global trade, and Pope Alexander VI abused his office in order to line his pockets. Ms. Crossen uses each person as a starting point through which to examine how new financial concepts such as paper money and new technologies like the steam engine irrevocably altered the economic landscape.

The Rich and How They Got That Way is at its most engaging when we get juicy details about the megarich who are profiled, such as multimillionaire stock speculator Hetty Green, who was so cheap that she lived in flophouses and wore tattered clothing. Enjoyable though it may be, Ms. Crossen's work comes up short when it comes to providing a deeper understanding of what wealth is, rather than just how it has changed, leaving the reader with little more than a cursory survey of an economic history that begs a more thorough treatment.

—Peter Rojas

variations in gene expression between healthy and sick cells) and pharmacogenomics (identifying individuals' differences in gene sequences to understand varying susceptibilities to disease and drug treatments). Ms. Robbins-Roth also reviews the current state of microarrays (known as DNA chips or biochips, these profile what genes are turned on and off), antisense drugs (synthesized genetic segments which mirror genetic sequences in diseased cells or viruses so that, when delivered, they stick to and block the targeted genes), tissue engineering, cell replacement, gene therapy, and agricultural biotech.

Ms. Robbins-Roth reports on the National Aeronautics and Space Administration's bleeding-edge research. NASA administrator Dan Goldin has proposed a "Coke-can-sized craft that will land on a passing asteroid...and use its DNA-based biomimetic system to evolve, adapt, and grow...using the asteroid's iron, carbon, and other materials to build a nervous system" for an interstellar probe.

Back on Earth, *From Alchemy to IPO*'s second half explores biotech finance and why—given the cost and duration of getting a drug to market—anyone would want to invest. Among other reasons, says Ms. Robbins-Roth, because 140 new drugs are now nearly through the FDA's regulatory process and many of these will be $1 billion blockbusters. I think, as you've gathered, that the medical-industrial complex will likely become our economy's dominant sector in the coming century, and *From Alchemy to IPO* is the best primer I've seen.

You may also want to check out Jonathan Weiner's *Time, Love, Memory: A Great Biologist and His Quest for the Origins of Behavior*. Now out as a trade paperback, *Time, Love, Memory* centers on Seymour Benzer, who, in the '40s, was among those scientists from different disciplines who gathered in Cold Spring Harbor, New York, to speculate on the molecular basis of life. The field of molecular biology was ushered into existence by people who, in many cases, are still working today. In 1954 Mr. Benzer proved, by painstakingly crossing mutant strains of bacteriophage, that the double-helix model of DNA was as crucial as James Watson and Francis Crick had claimed at Cold Spring the previous year, and that genes were indeed long molecules that could be divided—and recombined.

But you've probably never heard of Mr. Benzer. He's been a scientist's scientist—an astute profile to assume, given that his work's implications in the '60s and '70s would have been anathema to many. By breeding mutant fruit flies whose biological clocks, mating activity, and memory functions were demonstrably altered, he established that the flies' genes determined their behavior. And if that was so, what's a human being?

Time, Love, Memory reports that Mr. Benzer, who's in his 80s, is now investigating genes and aging. In short, it appears that much as we became able to bulldoze, pave over, and reconstruct nature around us to suit ourselves, we're acquiring that capability in regard to nature within us. Which is what has been known as the human condition. So what is a human being?

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