SPRING BOOKS

BIOTECHNOLOGY

Recombinant gold

Nathaniel Comfort applauds a nuanced history of genetic engineering's early years.

In 1969, the molecular biologist Gunther Stent published one of the most spectacularly inaccurate predictions in the history of modern science. In *The Coming of the Golden Age: A View of the End of Progress* (Natural History Press), he stated his belief that molecular genetics — which had only really been a science for 15 years — had peaked. The "golden age," he wrote, would be one of modest discovery and waning public interest in science. That year, Jonathan Beckwith isolated the first gene. In 1970, Hamilton Smith found the first site-specific restriction enzyme, which his colleague Daniel Nathans developed into a tool for cutting and pasting DNA. Then, in 1972, Paul Berg spliced a bacterial gene into a virus. With the ability to engineer genes, molecular genetics began in earnest. Never mind the Age of Aquarius; this was the age of recombinant DNA.

In *Gene Jockeys*, the biologist and science historian Nicolas Rasmussen delicately unravels the tangled fibres of discovery, entrepreneurship and lab life in the first decades of genetic engineering. Moving drug by drug through a series of case studies, he depicts a world of scientists in transition from curiosity-driven research to commercial biotechnology. He then shades in the outlines with the internal contradictions, the rationalizations, and the mixed feelings with which biotech pioneers moved towards a profit model of science. Rasmussen's research is dogged and creative, his analysis perceptive and nuanced. Although his inner gene jockey shows through in a wealth of technical detail, any scientifically literate reader will find an engaging, ultimately

ILLUSTRATION BY MARTIN O'NEILL

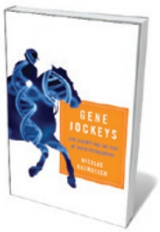
elegiac tale of lost innocence, as researchers struggle with the angel of the search for truth on one shoulder, and the devil of wealth and fame on the other.

Imagine a gold rush sparked not by the discovery of gold, but by brainy miners lured by the problems of extraction, speculating that their methods could be applied to mining precious metals; initially, the gold itself is a proof of concept. In Rasmussen's view, the first recombinant drugs were no mother lode. They met no demand in the medical marketplace. Rather, development was driven mainly by scientific curiosity. But the culture of academic science created an environment favourable to commercial development of genetically engineered drugs.

For example, in 1973, Stanley Cohen and Herbert Boyer developed an elegant variation on the recombinant-DNA technique. Cohen's institution, Stanford University, quickly filed for a patent on it. The following year, anxious about having regulations imposed from without, Berg and other recombinistas self-imposed a moratorium on genetic-engineering experiments. Boyer, however, neatly sidestepped it, performing experiments including the insertion of a frog gene into a bacterium. At Asilomar, California, in 1975, molecular biologists agreed to lift the moratorium. The following year, Boyer's fledgling company, Genentech, drafted its first business plan and quickly settled on cloning human insulin as its first commercial project. Thus, Rasmussen argues, biologists set the intellectual values, technical proficiency, ethical standards and regulatory policy during the early development of biotech. An overheated investment climate and frenzied marketing took it from there.

Curiosity-driven science continued to shape both the marketplace and the legal environment in which biotech could thrive into the 1980s. This led to some strange dance partners. Tracing the development of the cancer drug α-interferon, Rasmussen examines the "pas de trois" of the commercially sponsored clinical trial: government regulators requiring private companies to pay university researchers to test their own drugs for efficacy. Erythropoeitin (Epo) — a hormone that stimulates red blood cell production — was the first true blockbuster drug to come out of the new genetics. But Epo was a mixed blessing, Rasmussen writes. By moulding the biotech reward system to favour expensive, high-tech drugs, it primarily benefited wealthy patients, further stratifying US medical care. Rasmussen acknowledges that recombinant interferon and Epo were significant medical contributions, but insists that they were also grossly oversold.

With such triumphs, the scales tipped: commercial interests began to drive the science. As Rasmussen shows, recombinant tissue-type plasminogen activator, or tPA, a clot-dissolver that could be used to mitigate a heart attack in progress, was hailed as the "billion-dollar protein". The stakes were now too high to sustain the lofty, lefty ideals of 'pure' communal science. Researchers became entrepreneurs. Discoveries became intellectual property. Patenting preceded publishing. The science never disappeared, but business values increasingly trumped it. Rasmussen is wistful for the early days of biotech's golden age, when science drove business rather than the other way around.



Gene Jockeys: Life Science and the Rise of Biotech Enterprise
NICOLAS RASMUSSEN
Johns Hopkins University Press: 2014.

The parallels between biotech and the contemporaneous (and neighbouring) rise of computing are relevant, given the degree to which genomics and information science have merged. Rasmussen does not provide this context, which would have situated the history better and helped to connect it to the present day. The contrasts between computing and biotech are as interesting as the continuities. Unlike the nerds of Silicon Valley, who started up their companies in garages, the bio-geeks started theirs in well-stocked, mainly government-funded university labs. But, as in IT, the dream became having your little company bought by one of the big corporations. By the 1990s, both industries had become less freewheeling and curiosity-driven, and more privatized and gold-directed.

GRADUATE STUDENTS WANT TRAINING IN ECONOMICS, MARKETING AND MANAGEMENT. YOU CAN NOW GO INTO BIOLOGY FOR THE MONEY.

This trajectory, of course, tracks society's. The Human Genome Project began around the time that the Berlin Wall came down and the Soviet Union collapsed. Soon, a collective mythology emerged — particularly in the United States — that capitalist individualism had 'won'. The resulting shift towards privatization is hitting every sector, but biomedicine is a sharp lens through which to view it. Molecular biology still has its idealists, but their ponytails are greying. Today's graduate students want training in economics, marketing and management, even MBAs. You can now go into biology for the money.

Perhaps Stent wasn't as far off as we thought. Certainly, he missed big by presciently foreshadowed, if not the coming of the golden age, the coming of the age of gold. ■

➲ NATURE.COM
For Comfort on Craig Venter's vision for DNA, see:
go.nature.com/bkcykn

Nathaniel Comfort *is professor of the history of medicine at Johns Hopkins University in Baltimore, Maryland. His most recent book is* The Science of Human Perfection: How Genes Became the Heart of American Medicine.
e-mail: comfort@jhmi.edu