

A Valhalla of science

Ed Regis

Millikan's School: A History of the California Institute of Technology. By Judith R. Goodstein. Norton: 1991. Pp. 317. \$25, £17.95.

As befits a book about an institute of technology located in southern California, *Millikan's School* first comes to life — one might say erupts — in a chapter about earthquakes. The initial chapters brim over with dull administrative detail, paragraph after paragraph of who contributed how much money to the growing school, of how many acres of orange groves were sacrificed to classroom buildings, and so on, to the comparative neglect of the grand purpose of it all, which was the further advancement of science. But suddenly, a hundred pages into the story (and not a moment too soon), earthquakes burst upon the scene with all the impact of a magnitude 6 event on the Richter scale.

Charles Richter was, in fact, one of the leading lights of Caltech. He first visited the campus in the early 1920s and heard Robert A. Millikan lecture on physics. So impressed was he with Millikan's talk that Richter, who had an undergraduate degree from Stanford, left his job as a warehouseman and enrolled as a graduate student in physics. Not long afterwards, he was seeing Albert Einstein bicycling around the campus, listening to guest lectures by Erwin Schrödinger and Max Born, and

attending parties with the likes of Fritz Zwicky and J. Robert Oppenheimer. "These were almost too interesting times", Richter recalled much later.

His comment might well serve as the motto for the place ever since, for Caltech attracted famous scientists the way its orange groves attracted fruitflies. Indeed, fruitflies landed on campus *en masse* when Thomas Hunt Morgan, the *Drosophila* king, arrived from Columbia University in 1928 bringing his 'fly room' with him. Five years later, in 1933, Morgan won a Nobel prize for his work in genetics.

Caltech has had no shortage of Nobel prizewinners on the staff; the school's greatest strengths, though, have not been in the life sciences, but in such hard sciences as rocketry, aerospace technology and physics. In the 1930s, Theodore von Kármán, the Hungarian physicist, arrived from Germany to direct GALCIT, the Guggenheim Graduate School of Aeronautics. Later, during the Second World War, the school's rocket programme developed a succession of inventions: the proximity fuse, JATO (jet-assisted take-off) and missiles of various types. Later still, JPL, Caltech's Jet Propulsion Laboratory, played a starring role in the US space programme.

The school itself was started by Amos Gager Throop, a man who had made, lost and then remade several fortunes in lumber and real estate by the time he became mayor of Pasadena. In 1891, Throop founded a little college there with a faculty of six, modestly naming the whole after himself: Throop University. Then, through a succession of metamorphoses duly recounted in the book, Throop University over the next three decades became Caltech.

Millikan was head of the place for 24 years. Ironically, the story of Millikan's life as a scientist is not one of the better told in the book. Early on, he had determined the value of Planck's constant and had verified Einstein's photoelectric equations, but just how he accomplished these things, and what they meant to physics, are not explained by the author. And although Millikan's best-known contribution to science, the oil-drop experiment — from which he deduced the charge on individual electrons by watching oil droplets float around in a chamber of air —

is arguably one of the more spectacular feats of experimental science, Goodstein reduces her account of this work to a single and rather elliptical sentence.

Some other Caltech luminaries receive



Relatively easy — Einstein visited Caltech in the 1930s and attracted much public attention.

similar short shrift. Murray Gell-Mann is mentioned only once, and Richard Feynman twice, but perhaps Goodstein felt that their careers are already too well known to warrant another telling.

If anyone is the star of *Millikan's School*, it is George Ellery Hale, a name familiar to all who have beheld astronomical photographs tagged with the credit line "Hale Observatories". Whereas Millikan was ever the stingy one, always trying to save a nickel or two (he "liked to boast that southern California's sunshine equalled several thousand dollars in salary"), it was Hale who went out and got millions of dollars for the construction of the observatory at Mount Wilson and later of that at Mount Palomar. Always a frail specimen physically, Hale suffered from a variety of health problems, and in 1923, after a succession of nervous breakdowns, he gave up the directorship of Mount Wilson Observatory. He decided at the time that he had "not the remotest intention of undertaking the organization of another institution of this kind", but he was soon plotting an even grander venture.

Hale's 200-inch telescope was a heroic project that took 20 years to complete. Sites were examined all over southern California, and more than a thousand sketches were made. Roads were put in, and a dome constructed. And then there was the making of the 200-inch disk



Turning the wheels — Millikan and his wife, Greta, setting out for the Harz Mountains in Germany in 1912.

itself: "Pouring the molten glass into the mold took seven hours; the disk was then sealed in the annealer, where it remained, cooling slowly, for many months." Grinding the mirror, which removed more than five tons of glass while exposing many slight flaws, took several more years.

The story of Mount Palomar Observatory makes fascinating reading, livened up as it is by one of those monumental battles of egos that often accompanies the doing of great deeds. Here, the conflict was between Hale and the president of the Carnegie Institution, John Merriam, who was vying for ownership of the telescope.

Goodstein, Caltech's archivist for 20 years, has produced a cleanly written, scientifically well informed account of

one of the world's foremost institutions for science and technology. Whether reading about Linus Pauling and the nature of the chemical bond, Charles Lauritsen's work with high-energy X rays, or relishing the unintentionally amusing boasts of the institute's former presidents ("There are no good appointments at Caltech — only superb ones. Of course, occasional mistakes occur . . ."), one will come away convinced that, with its 21 Nobel prizewinners and its 1,800 students bearing near-perfect entrance-test scores, this was and is one of the chosen Valhallas of latter-day science. □

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Missing the biotech boat

Alfred E. Middleton

The Biotechnologists. By Stephanie Jones. Macmillan: 1992. Pp. 252. £25.

How to describe *The Biotechnologists*? An impressionistic oral history of the biotechnology business? A primer for those considering starting up and running a biotech company? A comparison of the similarities and differences between biotechnology in the United States, Europe and Japan?

Any one of these is a more apt depiction of the essence of this book than the author's full-blown aim: "the analysis of the progress of biotechnology start-up companies in the USA and Europe through the perspective of the biotechnologists who founded them and/or now run them." To capture this perspective, Jones interviewed ten biotechnology chief executives and five venture capitalists in the United Kingdom and Europe, and nine biotechnology chief executives and one venture capitalist in the United States. All the US chief executives she interviewed were from so-called 'first generation' companies founded between 1978 and 1982, that is, from companies far removed from their start-up stages.

Jones has divided her book into three disparate sections: a preface in which she attempts to outline rules and models for the stages of a biotechnology company's growth; an introduction in which she competently relates the history of commercial biotechnology, particularly in the United Kingdom, and compares biotechnology in various countries; and the core, the interviews.

One large and several smaller mistakes compromise the effectiveness of

the book. Jones conducted her interviews in the United Kingdom and Europe during the winter of 1989-90, and in the United States during the summer of 1990. From then to the book's publication in January 1992, she committed a blunder of grievous proportions by impersonating Rip Van Winkle, slumbering through 1991 and completely ignoring what was happening last year in US biotechnology.

Last year was a watershed period in US biotechnology. Amgen became the industry's leader, doubling its revenues to \$699 million and dramatically increasing its profits — by 2,400 per cent — on the strength of sales of its two drugs, Epogen (EPO) and Neupogen (G-CSF). Starting in March 1991, 39 biotechnology companies floated initial public offerings, raising a total of \$1,200 million or an average of more than \$30 million apiece. Of these companies, about 21 were less than 3 years old, nullifying Jones's statement that "after 5 to 7 years, or perhaps much longer, a biotech enterprise may be ready to go public". In some cases, the initial public offerings were so well received and share prices maintained so well that these newly public companies were able to return to the public markets in a few months with second issues. A total of 88 separate US biotechnology stock issues were consummated in 1991, garnering more than \$4,000 million. Several of the US biotechnology companies whose chief executives Jones interviewed, raised additional capital through public offerings (Genzyme, \$142.9 million; Repligen, \$25 million).

Genetics Institute, whose chief executive, Gabriel Schmergel, was interviewed by Jones, lost a patent dispute to Amgen in March 1991 and was the target of a two-tier takeover offer by American Home Products for 60 per cent of its stock in November. Chiron acquired Cetus during the summer, creating a

combined company of 1,400 people and a launching pad for further growth. All these events strengthened US biotechnology, created formidable competition for biotechnology companies in other countries and put pressure on companies such as British Biotechnology to increase their capital base; yet Jones does not acknowledge them even in an epilogue.

While duplicating a section of Robert Teitleman's *Gene Dreams* (Basic Books, 1989; see *Nature* 342, 25; 1989) and being influenced by his pessimistic tone, Jones fails to pick up on the strongest feature of that book — the incisive personality and character descriptions. In her hands, the executives and venture capitalists are ciphers. We know them only by their words, not hers.

Consider the description in *Gene Dreams* of Robert Nowinski, one of the founders of Genetic Systems: "a strong, aggressive personality; a quick wit, boundless confidence — capable of thinking in large conceptual terms, an able fund raiser, quick to organize a team to follow his lead". You get a sense of a formidable presence. Nowinski was one of the three co-founders of Icos, along with George Rathmann, former chairman of Amgen, whom Jones interviewed. Rathmann comes across in *The Biotechnologists* as a practical, common-sense individual. His advice on funding: "get as much money as you can — go public when the time is right". Last September, Rathmann ousted Nowinski, the company's largest shareholder, from Icos. As well as his practical mind, Rathmann must have very sharp elbows indeed, but you would not know it from Jones.

Jones turns on her tape recorder and the interviewees ruminate. She makes no attempt to steer the monologues to critical issues — pricing, patents, government regulation. Those making the most outrageous statements stand out. Jim Vincent of Biogen wins for his comments on the superiority of US business, science and management. Herbert Schoe-maker of Centocor is a close runner-up with his statement, "in a recent wave of forming start-ups, 1,200 new biotech companies have been formed". Thoughtful, perceptive statements such as those of Keith McCullach of British Biotechnology get lost in the shuffle.

As an oral impressionistic history of biotechnology, *The Biotechnologists* passes muster. To paraphrase John Dalton a century earlier, this book will no doubt be found interesting by those who take an interest in it. □

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