BOOKS: COMPUTER SCIENCE

Visionary Architect of the Net

John Naughton

To most people outside the field of computer science (and, indeed, to many of its younger practitioners), the name J. C. R. Licklider means little, if anything. Yet Licklider was a seminal figure in the evolution of computer science as a discipline, and he directly or indirectly inspired much of the networking and computer technology we take for granted today. M. Mitchell Waldrop's *The Dream Machine* is a valiant attempt to rescue "Lick," as he was universally known, from the condescension of posterity and to explain his significance to a contemporary audience.

The Dream Machine
J.C.R. Licklider and the Revolution That Made Computing Personal
by M. Mitchell Waldrop
Viking, New York, 2001. $29.95, C$43.99. 512 pp. ISBN 0-670-89976-3.

Joseph Carl Robnett Licklider, born in Missouri in 1915, was the kind of boy for whom the term prodigy might have been coined. He began his professional career as a psychologist specializing in acoustics, but wound up as an eloquent visionary who saw a symbiotic relationship between humans and computing machines at a time when computers were massive, expensive, and unapproachable. Unlike most visionaries, however, Licklider had an opportunity to translate his dreams into reality, for he occupied a key post in the U.S. Department of Defense's Advanced Research Projects Agency (ARPA) at a crucial moment in the agency's development. Although he spent a relatively short time in the Pentagon, his tenure there was critical in establishing ARPA's operating style and in providing relatively secure and lavish funding for favored researchers in computer labs all over the United States. It is no exaggeration to say that Lick's patronage shaped the evolution of computer science as an academic discipline, and thereby influenced the development of an entire industry.

Licklider's greatness stems from three major insights. The first was what he called "man-computer symbiosis," that is, the notion that the digital computer could become a powerful tool for augmenting human capabilities. This notion implied a partnership in which the machine did what it was good at (filing, calculating, etc.), thereby freeing the human partner to do what humans excel at (intuition, reasoning, creating). But for such a partnership to become possible, computers had to be devices with which users could interact in real time, in contrast to the batch-processing mainframes of the day. The only technology available in the early 1960s for enabling this kind of interactivity was time-sharing, so Lick used his personal authority and buckets of Pentagon money to ensure that time-sharing became a dominant technology long before the computer industry perceived its significance.

Also, he recognized sooner than most that when people used a time-shared computing resource, they merged into a community. He saw that such "virtual communities" of minds had great creative possibilities. Thus, he understood the importance of networking long before the technology for implementing it existed. The social impact of the ARPAnet and, later, the Internet provided vivid confirmation of his intuition.

Licklider's third great insight concerned how to inspire young people and foster truly innovative research. His basic philosophy was to hire the brightest young people he could, give them all the resources they needed, and then stand back. He was a living contradiction of the contemporary obsession with bottom lines and "deliverables." He believed that, given enough space, smart people would produce magic. While at the Pentagon, he relentlessly implemented this philosophy in ways that would nowadays land him in jail for contravening Federal procurement laws. He was saved from such a fate because his judgment of people was so good and because, overall, the recipients of his support repaid the investment a thousandfold.

The story of how Licklider inspired the evolution of a discipline and an industry is a complex one with many strands. In general, Waldrop, formerly a senior news writer at *Science*, tells it well. He weaves together a biography of Licklider; a history of computing; and developments in cybernetics, cognitive science, artificial intelligence, communications, and networking. The book is good on grand themes (such as the importance of trusting researchers and the significance of cybernetics and analog computing) and on detail (the little-known contributions of Xerox's Palo Alto Research Center to the development of the Internet protocols, for example). But in the end, *The Dream Machine* is also a slightly depressing read, for it reminds us that Licklider's buccaneering style would be impossible to replicate today. The spaces he created for geniuses to work undisturbed are now partitioned into cubicles for accountants. Nonetheless, his enormously productive approach was great while it lasted.

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BROWSINGS

The Anatomy of Nature. Geology & American Landscape Painting, 1825–1875. *Rebecca Bedell.* Princeton University Press, Princeton, NJ, 2001. 199 pp. $45. ISBN 0-691-07463-1.

Through much of the 19th century, American landscape painters and geologists shared methods and ends. Both groups built on accurate observations of the natural world and sought to illuminate the bounty and order of God's creation. Bedell examines the ways in which geology affected the artists' perceptions and depictions of nature. She draws on the writings of contemporary scientists, artists, and critics and on the record from newspapers and periodicals of the time. But her emphasis is on 26 paintings by six artists (Thomas Cole, Asher Durand, Frederic Church, John Kensett, William Stanley Haseltine, and Thomas Moran) who represent different aspects of the relations between science and art. The author sees Haseltine's *The Rocks at Nahant* (below), one of a very popular series from 1864, as reflecting both the social distinction attached to this summer resort favored by Boston's elite and Louis Agassiz's accounts of the volcanism and glacial action that formed and shaped the rocks.

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