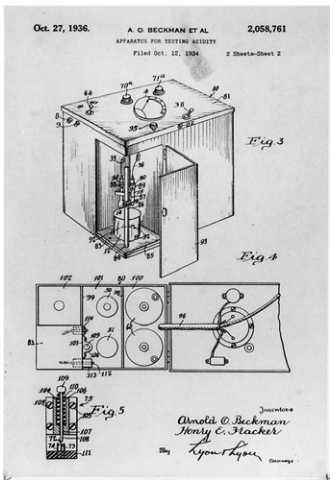
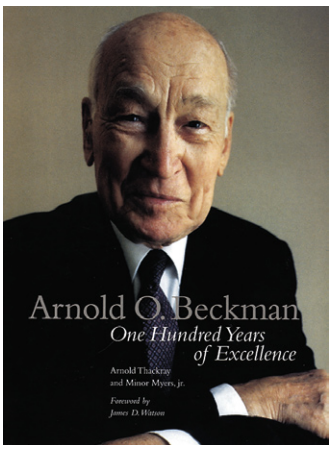


The pH meter, which was born in 1934, was, in fact, a marriage of electronics and chemistry in a single, simple, portable instrument.

Arnold O. Beckman
One Hundred Years of Excellence



by Arnold Thackray and Minor Myers, jr.
Forward by James D. Watson
Chemical Heritage Foundation
379 pages
$65.00

The legend of Arnold Beckman has been oft retold (twice in *E&S* alone). Histories of Beckman Instuments have chronicled the huge success of the firm, sprung from modest beginnings—perhaps the first start-up company in a garage. Was there anything left to say?

Yes, it turns out—as *Arnold O. Beckman: One Hundred Years of Excellence,* by Arnold Thackray and Minor Myers, jr., makes clear. Published by the Chemical Heritage Foundation in a series that "records, analyzes, and makes known the human story of chemical achievement," the book offers a picture of Beckman's inventive genius and the significant role he played in bringing about a revolution in instrumentation.

The Horatio Alger story is here, of course, retold with much new detail—growing up a blacksmith's son in Cullom, Illinois, where his interest and ability in chemistry was apparent by the age of nine; working his way through the University of Illinois playing the piano; meeting and marrying Mabel Meinzer, his wife and partner in all things for 64 years, and then traveling across the country to Pasadena in a Model T that suffered 19 flat tires in one day in the Badlands; joining the Caltech faculty after receiving his PhD in 1928; and inventing (for a friend in the citrus business) the pH meter, out of which grew Beckman Instruments and a personal fortune for its founder.

Everyone at Caltech knows the latter chapters. You only have to look around at Beckman Auditorium, Beckman Institute, the Mabel and Arnold Beckman Laboratories of Behavioral Biology, and the Arnold and Mabel Beckman Laboratory of Chemical Synthesis to see how generous the Beckmans have been with their fortune. (And Caltech has not been the only recipient.)

But what this book does particularly well is detail the middle of the story: Beckman's instruments themselves, especially the ones he invented and built with his own hands. It might not make as good a movie as the rest of the legend, but it's fascinating all the same. Not only was Arnold Beckman an enormously talented, hands-on scientist, he also had the vision to sense "the sweet spot of opportunity" in all the right places.

For example, when Beckman temporarily abandoned his Caltech chemistry studies in 1924 to return to the East Coast for a couple of years to court and marry Mabel, he happened to walk in the door of what was to become Bell Labs and joined the founding research group. There, at the forefront of electronics, he learned lessons that would serve him well later on.

The pH meter, which was born in 1934, was, in fact, a marriage of electronics and chemistry in a single, simple, portable instrument. With its vacuum-tube amplifier, it was, say the authors, the "first chemical instrument with electronic technology at its heart."

Beckman soon realized that the amplifier in his pH meter could strengthen all sorts of weak electrical signals, a recognition that turned him toward optics and a new class of analytical instruments. The most famous of these was the DU spectrophotometer, still hallowed in chemical labs countrywide (they were produced until 1964). It enabled chemists to determine composition by analyzing a substance's absorption spectrum. "A key ingredient in what historians have called the 'second chemical revolution' (the first was that of Antoine Lavoisier in the late eighteenth century), through its speed, precision, accuracy, and affordability, the DU

Arnold and Mabel Beckman were deeply involved with all their philanthropic ventures. Here, in what would become the sub-basement of Caltech's Beckman Institute, they toast the laying of the cornerstone in September 1988.

increased the pace of chemical research," say the authors.

In 1942, when the DU came into being, the United States was going to war; the DU played a significant role in the production of penicillin and synthetic rubber. Beckman dove deeper into the war effort and the electronics business with a potentiometer (he called it the helipot, also derived from the pH meter) that he developed for radar research at MIT's Radiation Lab, as well as the micro-microammeter for measuring radiation. Several decades later he noted that, although electronics manufacturing might seem "a far cry from a pH meter, yet along the way each step was a logical extension of something we were already doing. As someone said about sin, 'One thing leads to another!'"

The Pauling oxygen analyzer, designed by Linus Pauling and built by Arnold Beckman, was a war project to measure the oxygen in a mixture of gases in submarines and high-flying aircraft. Because of the instrument's secrecy, Beckman couldn't tell the board of directors of his company, National Technical Laboratories, about it, and so formed another—Arnold O. Beckman, Inc., the first bearing his name. (Beckman Instruments, Inc. was founded in 1950.) The oxygen analyzer was also the first of the medical and biological instruments for which the Beckman name became known: after the war it was used to protect premature babies from too much oxygen, which caused blindness. Caltech, because of Pauling, held the patent, and for many years the royalties on it were Caltech's largest single source of patent income.

Besides being in the vanguard of biotechnology, Beckman was present at the creation of the silicon chip industry—Silicon Valley came within a hair of locating in Orange County. But this time his sense of the sweet spot deserted him; he backed the wrong horse: William Shockley. Beckman had indeed sensed the significance of the silicon chip, but failed to see in time that Shockley had dropped the ball and that others were about to score the goal.

The Shockley/Fairchild/Intel story is recounted with a level of candor and a richness of anecdote that you don't often come across in business histories. But it's characteristic of the detailed chronicle of Beckman's own companies as well as the book as a whole, which is chock full of all sorts of things you may never have known about Arnold Beckman and his influence.

Like smog. When Arie Haagen-Smit began to lose interest in studying Los Angeles pollution, it was Beckman who spurred him on—and then Beckman, of course, who built the instruments to detect the smog components that Haagen-Smit discovered.

Beckman had a lifelong passion for photography, which has contributed a wealth of previously unpublished family pictures to this handsome, large-format volume. There are detailed diagrams of Beckman's instruments and sidebars on all sorts of extraneous information—on such things as smog, radar, Bell Labs, and Steele's *Fourteen Weeks in Chemistry*, which inspired a nine-year-old boy in Illinois. The book also comes with a CD-ROM video portrait of Beckman, narrated by his son.

James Watson says in his introduction: "Arnold Beckman's contribution to science and to society came, in part, from his rare talent for creating these new instruments and his decision to make them available to industry and science alike. It has been amplified by his unique philanthropic support of the same forward-looking research that his innovations furthered."

Beckman himself, in characteristic modesty, claimed in his 90s that he had been given far more credit as a scientist than he deserved. "As an instrument maker, a toolmaker, fine. I get credit as a businessman, and I don't consider myself a businessman. . . . I still think I was a damn good teacher." □ —*JD*

This book may be ordered from the Caltech Bookstore, Mail Code 1-51, Pasadena, CA 91125;
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