

## SCIENCE & TECHNOLOGY

**COPIES IN SECONDS:**  
*How a Lone Inventor and an Unknown Company Created the Biggest Communication Breakthrough since Gutenberg—Chester Carlson and the Birth of the Xerox Machine.*

By David Owen. Simon & Schuster.

320 pp. \$24

The first copying machine, David Owen tells us, was language, and the second was writing. Papyrus followed clay tablets, parchment followed papyrus. Later technology included movable type, lithography, and James Watt's copying press, patented in 1780. It's a story full of twists and turns and sudden illuminations, culminating in one of the most significant technological developments of the 20th century—Chester Carlson's invention of xerography.

Carlson (1906–68) spent much of his childhood in miserable poverty. By the age of 16, he was his family's principal breadwinner. He managed to put himself through the California Institute of Technology, and in 1930, degree in hand, he was hired as a research engineer by Bell Laboratories in New York. He spent his days in a dingy basement lab, performing simple quality tests, and his evenings in a rented room, imagining his future as a famous inventor.

Over the next couple of years, he outlined hundreds of ideas in pocket notebooks, including a raincoat with gutters, a see-through toothpaste tube, an improved cap for ginger ale bottles, and a machine that could make multiple copies without harming the original document. The progress of copying in the 20th century would have taken quite a different turn if Carlson had devoted himself to one of his other ideas (apparently, the raincoat with gutters was already patented). But his ambition increasingly focused on the copy machine. He began spending his free hours at the New York Public Library, reading science journals and pondering the challenges.

In 1933, Bell Labs fired Carlson for “scheming” to start his own company. It was a fortunate dismissal, for he landed a

job in the patent office of the electronics firm P. R. Mallory & Company, where, besides learning about patent law, he saw firsthand the difficulty of copying drawings in patent applications with photostat machines and other slow, cumbersome technologies available at the time. More convinced than ever that he was on the right track, he set up a makeshift lab in his kitchen, purchased rudimentary equipment, and started to experiment. With the help of an assistant, he produced the first xerographic copy, using a microscope slide and India ink, in 1938.

What would we do, Owen asks, without xerography? “We would have fewer lawyers, larger forests, smaller landfills, no Pentagon Papers, no laser printers, more (fewer?) bureaucrats” —the list goes on. Yet xerography “was so unusual and nonintuitive that it could conceivably have been overlooked entirely.” Carlson met with skepticism when he tried to pitch his idea. Only a small company named Haloid, located in Rochester, New York, was willing to invest in his process. Even after the first copy machine—the 914 Office Copier—



A 1960 ad promoted Xerox's new line of photocopiers, which promised to save time and money, if not space.

went into production in 1960, some scientists considered the process unfeasible.

*Copies in Seconds* is an elegant, fascinating study of a dogged inventor and his doubtful idea. Ultimately, it's a story of vindication: By 1966, Haloid had changed its name to Xerox (adapted from the 1940s coinage *xerography*) and was the 15th-largest publicly owned corporation in the United States, Chester Carlson was one of the country's wealthiest men, and information was circulating more widely than ever before.

—JOANNA SCOTT

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**LOOKING FOR LONGLEAF:**  
*The Fall and Rise of an  
American Forest.*

By Lawrence S. Earley. Univ. of North Carolina Press. 322 pp. \$27.50

Longleaf pines once covered 92 million acres of sand dunes, savannas, and foothills from southeastern Virginia to eastern Texas: "a continuous, measureless forest, an ocean of trees," German traveler Johann David Schoepf wrote in the 1780s. Today, less than three million acres of longleaf forest remain, mostly fragmented into isolated stands near the Gulf and Atlantic coasts. The former range of this long-needled, giant-coned species is now dominated by loblolly and slash pines—and, of course, by civilization.

The decline of the longleaf pine is a complex story, well and thoroughly told by journalist Lawrence Earley. Human exploitation of the longleaf forest began in the 18th century, when settlers loosed millions of grazing cattle and foraging hogs beneath the canopy. Later in the century, the tar industry rose in the Southeast to satisfy worldwide demand for naval stores; it was followed in the early 19th century by the rapid expansion of the turpentine industry. Turpentine "chippers," Earley writes in one of his charming detours, hacked into the trees to draw out the resin, while crews of "dippers" collected the gum for the distillers—"outlaw work carried on by outlaws," in the words of one worker. Though these practices didn't always kill the trees, "cutting into a living tree with an ax . . . was not conducive to its health," Earley writes. Slapdash chipping and dipping exhausted hundreds of thousands of acres of longleaf forest each year.

With a half-century of enthusiastic "cut-and-run" logging that began around 1875, the timber industry liquidated most of the remaining longleaf stands. What the 18th-century explorer William Bartram described as "the solemn symphony of the steady western breezes . . . rising and falling through the thick and wavy foliage" was largely silenced. Though some observers mourned the loss of the graceful trees, there was little hope for the species. Longleaf was difficult to cultivate and grew slowly, so the pulp mills that followed the loggers planted the now-ubiquitous loblolly and slash pine.

The U.S. Forest Service, wedded to its long campaign against wildfire, also helped keep longleaf off the landscape during much of the 20th century. Beginning in the 1930s, several researchers found that regular fires encouraged the recovery of longleaf stands, but the federal agency discouraged the release of their work. "Smokey Bear could not distinguish between a fire that warmed a house and one that burned it down," a retired Forest Service researcher said. Not until the mid-1980s, when environmentalists sued, did the Forest Service commit to reversing the decline of the longleaf forest.

By the time the tale reaches the present day, one wonders how even a single longleaf pine could have survived. Yet Earley finds some hardy remnants. At Eglin Air Force Base in the Florida Panhandle, tall turkey oaks camouflage a large swath of old-growth longleaf; at a Girl Scout camp in southern Louisiana, a Louisiana State University researcher is attempting to piece together a longleaf ecosystem. Longleaf restoration is usually considered a money-losing proposition, but a few small landowners, timber companies, and managers of hunting plantations have turned restoration projects to their financial advantage by selling longleaf needles, so-called brown gold, for garden and landscaping mulch, or by patiently raising large, high-value trees.

Could the once-grand longleaf forest, whose remains still shelter some of the most diverse plant communities in the world, be restored to its past glory? Not in our lifetimes. But the corps of longleaf defenders, Earley suggests, may yet midwife a humbler recovery.

—MICHELLE NIJHUIS