

## Will the Future Be Written in E-Ink?

### A New Printing Technology Sets Off a High-Stakes Race With Some Big Backers

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**I**N THE ATHLETIC-WEAR DEPARTMENT at J.C. Penney in Marlboro, Mass., a 4-by-4-foot sign hangs from the ceiling above an aisle of \$70 white sneakers. "Hello down there!" it greets shoppers. "So glad you stopped by! You've gotta try the Nike Air Quest. It's super comfortable and lightweight too!"

The sign looks like a piece of foam board, but it's actually a high-tech gadget that uses electronic "ink" to display text. Penney is trying out the technology to see if electronic signs—which can be changed with a few keystrokes—could someday replace thousands of its old-fashioned signs.



J. D. Albert

Penney's experiment marks the first consumer trials for E Ink Corp., a start-up that is trying to stake out a lead in a high-tech race to create futuristic electronic paper. E Ink, founded on technology developed at the Massachusetts Institute of Technology, has already snagged funding and other support from Motorola Inc., International Business Machines Corp., Lucent Technologies Inc., and Hearst Corp. The Cambridge, Mass., company is the first of the electronic-paper makers to introduce a prototype product.

But E Ink faces competition from much bigger rivals: Copier giant Xerox Corp. has teamed up with Minnesota Mining & Manufacturing Co. to develop their own version of electronic ink and paper. NOK Corp., a Japanese electronics and rubber-products maker, has also begun research in the field.

All are vying to develop a product that may fundamentally change the way the printed word is delivered. While the idea isn't brand new, big companies have only recently thrown their weight behind the technology. Electronic paper aims to display electronic text on thin, flexible sheets that look and feel like paper. The sheets are

filled with millions of microscopic capsules that show either dark or light images in response to electrical charges.

Electronic paper could be bound together into book or newspaper form. Using wireless technology, content could be downloaded instantly onto the electronic pages. Imagine, for example, a daily e-newspaper beamed in each morning.

Electronic paper is different from electronic books, which are already commercially available and generally work like laptop computer screens, relying on liquid crystal displays. Electronic books haven't made a big splash, because so far many people don't see much advantage to using a cumbersome computer screen to read a book. "They feel like you're reading from a laptop," says J.D. Albert, one of E Ink's founders.

Electronic paper may run into the same hurdle. "Can you envision yourself sitting down with a nice cup of coffee with a little electronic newspaper? No," says Michael Wider, technical director for new technology at Flint Ink Corp., a major maker of printing ink for newspapers.

Pierre Wiltzius, a Lucent research director, says the telecommunications giant looked at products from both Xerox and E Ink but chose the startup because it has an "edge in technology." Mr. Wiltzius says electronic paper could have a "huge" impact on the dissemination of information. "It could really define industries," he says.

Electronic ink was first envisioned in the early 1970s, when Xerox researcher Nick Sheridan began poking around for alternatives to the computer screen, then often plagued by darkness and flickering. Working out of the company's fabled Palo Alto Research Center, known as PARC, he created microscopic balls that were half black, half white. When an electrical charge was applied, the balls rotated, casting light or dark images. Around 1973, Mr. Sheridan

created the first electronic letter in history: an X, for Xerox.

Reaction at Xerox was lukewarm, and Mr. Sheridan was asked to direct his attention to developing printer technology. The company didn't pay much attention to electronic ink until the 1990s, when PCs began to proliferate. By the fall of 1995 about six PARC scientists, including Mr. Sheridan, were working on electronic paper. Today Xerox declines to discuss the specifics of its electronic-paper research.

Meanwhile, at about the same time in 1995, Joseph Jacobson, a young physicist, joined the MIT Media Lab. Dr. Jacobson, a voracious reader who had long wanted to develop an electronic book, hired some students to work on his project, including Mr. Albert and Barrett Comiskey.

Mr. Comiskey is an impassioned mathematician with an unruly tuft of brown hair perched on his forehead. Mr. Albert is a laid-back mechanical engineer with bleached blonde hair and long sideburns. Their idea of research was to read patents and scientific papers. But the duo stumbled onto a discovery.

In 1996, Mr. Albert, then 20, had trouble making a perfect black-and-white ball like the one that Mr. Sheridan of Xerox had invented. The MIT undergraduate would drop liquid onto a spinning disk, black ink on one side, white on the other, but it always came out uneven. By accident, he made some all-white balls.

In 1997, Mr. Comiskey tried encapsulating those white balls in a liquid mixture of oil and a dark dye. Electrical charges made the white particles move and create images. When the white particles were drawn to the capsules' surface, the images created were white. When those particles were submerged, the images were dark.

The two were successful in establishing the idea of electronic paper. School was another matter. In Mr. Comiskey's senior year at MIT, he almost flunked a course in advanced theoretical math because he was working 20-hour days in Switzerland, helping Swatch Group AG develop watches using his e-ink technology. From his lakeside hotel room, he checked a Web site to discover he had received a D in the course.

The Swatch experiment didn't go any-



Barrett Comiskey

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