

The Big Problem of Brittle Books

Preservationists use high-tech, low-tech methods to fight the culprit—acid paper

ALONG the corridor of chemical plants east of Houston, where the production of petrochemicals and plastics is the norm, the Library of Congress is running an unusual set of experiments in a pioneering attempt to rescue millions of books from oblivion.

The challenge at the Texas Alkyls, Inc., plant in Deer Park is to develop a reliable method for removing acid chemicals that are slowly eating away the printed knowledge of the world. Some experts believe the Library's experimental process offers substantial hope, but the technology is still unproven on a commercial scale. The process has been suspect because a previous experiment with the process ended in spectacular failure when a major explosion damaged a pilot plant in Maryland.

Next month, the Office of Technology Assessment (OTA) is expected to release a report evaluating various methods to combat the acid in paper. Although the findings will not be officially disclosed until then, Peter Johnson, project director of the OTA report, said in an interview that the Library's process "is the most reasonable choice" among the current alternatives to neutralize acid paper. But he notes that the current plant is only a pilot and that a full-scale facility will require additional design, construction, and a "shakedown" period.

The task of preservation is urgent because tens of millions of books, manuscripts, and documents are literally crumbling to dust in libraries and archives around the world. Since the mid-1800s, virtually all publications worldwide have been printed on highly acidic paper, which begins to disintegrate rapidly 50 years after publication.

The decay of books and documents due to acid paper "has been a hidden problem," says Patricia Battin, executive director of the Commission on Preservation and Access, a nonprofit group devoted to saving the information in brittle books.

But now preservationists are pressing state and federal authorities, publishers, and industry to help put out what they call the "slow fires" that are destroying books. Librarians, conservators, and archivists are promoting the transfer of information from

brittle books onto microfilm and optical disks, and they are urging the use of acid-free paper by book publishers. Last month, for example, the National Library of Medicine began a campaign to encourage medical publishers to print on alkaline paper.

Until recently, "preservationists weren't as organized as they are now. They really have been beating the drums," says Faye Pladgett, assistant staff director of Congress's Joint Committee on Printing, which has a strong influence on the types of paper purchased by the government.

But they face a long, uphill battle. Lack of funds and inadequate technology hamper their efforts. The sheer quantity of works embrittled or endangered is staggering.

Progress is "incremental," Pladgett says. As a result of preservationists' efforts, she says, in the next 2 months the Joint Committee on Printing will issue a purchasing standard for "permanent" acid-free paper for important federal documents.

The major problem at present, however, is the huge volume of books and documents already in print. In the United States, 25% of the collections at old, large research libraries—or 76 million books—will crumble into confetti if handled, according to estimates by the preservation commission, which was created by the Council of Library Resources, major American universities, and others. At the National Archives and Records Administration, more than a half-billion sheets of paper are at "a high risk of loss," according to Archive estimates, and the number is rising at a rate of 3% annually.

Rare items already get kid glove treatment by the small cadre of conservators at the Library of Congress, the Archives, and elsewhere. But this labor-intensive treatment is reserved for the most valuable works (see box).

Peter Sparks, a senior preservationist at the Library of Congress, says that conservators at the turn of the century predicted the enormous problem. But "it's taken more than a half century to get...big enough to get the attention of people."

The root of the problem is that paper just is not made the way it used to be. Since its invention in China almost 2000 years ago

until the mid-1800s, paper was made mainly from linen and cotton, which forms a long-lasting web of cellulose fibers. (Among paper purists, Egyptian papyrus sheets do not count as the first paper because the fibers were not separated and reformed.)

But in the 1850s, as the demand for mass information mushroomed internationally, papermakers turned to wood as a cheaper source of fiber. Unfortunately, manufacturers must add alum and rosin, which are aluminum sulfates, during processing to prevent ink from bleeding or feathering on the paper. The sulfates eventually turn acidic. The switch to wood as a fiber source "was the start of the demise," Battin says.

Once a book is embrittled, the paper is probably beyond redemption, to the chagrin of the many scholars who prefer to use books rather than microfilm, preservationists say. ("People go bananas when they have to discard a book," Sparks says.) A few new promising methods exist to strengthen the old paper, but none is widely used. Microfilming or using optical disks is expensive. The Council on Library Resources says that if duplication among the 76 million fragile books is eliminated, and the list winnowed to the most valuable titles (a tough task in and of itself), about 3.3 million books would be left. The costs to process and record the information of these selected books alone is roughly \$380 million, says Robert Hayes, dean of the Graduate School of Library and Information Science at the University of California at Los Angeles.

This month, the preservation commission asked Congress to appropriate an additional \$200 million over the next 20 years to broaden preservation activities by the National Endowment for the Humanities, but the commission's clout is untested.

So far, however, "we're only chipping away at the brittle book problem," says Tamara Swora, who helps direct microfilming at the Library of Congress, one of the leaders in the effort. Swora notes, for example, that 11,000 volumes at the Library are photographed annually although an additional 77,000 start to disintegrate during the same period.

The Library of Congress, the world's largest library, has worked hard to perfect a deacidification cure for its own unique holdings. Already, 3.5 million are too fragile for handling. The Library receives 6000 new books daily, virtually all printed on acid paper.

The ideal method for the Library, Sparks says, is one that treats lots of books at a time and "requires no previous thought" in selecting what items can be treated. "You want to be able to take books, maps, documents, and posters in a wholesale way, move

them into a black box, so to speak, and remove the acid," he explains. The treatment should also leave an alkaline residue on the paper to act as a buffer against any remaining acid and environmental pollutants such as sulfur dioxide. Treatment could extend the life of a book three to five times, he says.

From the outset of its search, which began 25 years ago, the Library of Congress has focused almost exclusively on one chemical method to neutralize the acids. Early on, researchers at the Library discovered that they could deacidify a handful of books by subjecting them to vapors of diethyl zinc or DEZ in a pressure cooker. But the system is still not refined, and the Library has been criticized for pursuing the DEZ method exclusively at the expense of other techniques.

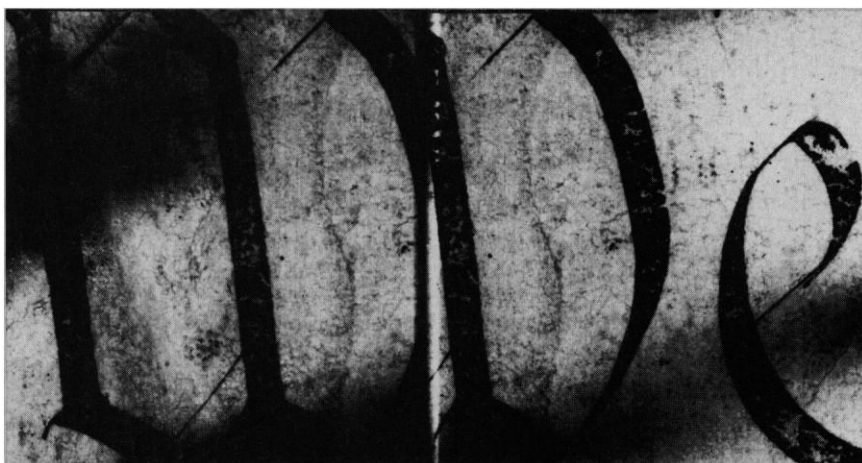
The Canadian Library and Archives routinely uses a method known as the Wei T'o process to deacidify books, which relies on different chemistry from the DEZ process. It treats 150 books at a time. The Library of Congress aims to deacidify 3500 at once. The Canadian process also requires that books be carefully sorted, adding substantial time and expense to the process.

The Library of Congress, meanwhile, has suffered some embarrassing setbacks. In 1982, it enlisted the help of the National Aeronautics and Space Administration (NASA) and Northrop Services, Inc., to set up a pilot DEZ plant at the Goddard Space Flight Center in Maryland because Goddard had big vacuum chambers to conduct the tests.

The recipe for DEZ treatment is as follows: books are put in a vacuum chamber, dehydrated, permeated with gaseous DEZ, and then rehydrated to restore flexibility to the paper sheets. DEZ and its by-products are not considered toxic, chemical experts say. But as Sparks, who has headed the Library's mass deacidification project for 10 years, notes in an interview, "DEZ needs special handling" because, in liquid form, it ignites spontaneously with air. It also reacts vigorously with water, quickly forming ethane gas.

In early December 1985, the vacuum chamber at the pilot plant caught fire during a test run because water was accidentally mixed with liquid DEZ. The blaze caused significant but not major damage.

Two months later, on the afternoon of Valentine's Day, a researcher opened a valve in the system and, within seconds, an explosion occurred, blowing apart the walls and two doors to the equipment room, according to a 1986 report by a NASA investigation board. Brine had been mixed inadvertently with liquid DEZ, leading to a tremendous buildup of pressure of ethane in the



Rare Treatment for Rare Items

Of the millions of items ever printed or drawn, few are chosen for individual conservation. But when they are, preservationists will go to great lengths to save a paper treasure. With painstaking care, the conservators, who combine the skills of a chemist and the creativity of an artist, restore books, maps, manuscripts, music scores, documents, and photographs.

At the Library of Congress, for example, an old book may get a new binding done by hand and a custom made box with a small bone hook for a closure. The title may be done in calligraphy. On a recent afternoon, single sheets of a book had been dipped into an alkaline solution to neutralize the acid in the paper and dried individually on racks. Small, new boxes constructed by hand from acid-free paper board encase a series of children's books, called "Big Little Books" from the 1930s.

Other jobs are impressive because they simply represent a big effort. Last year, the Library encapsulated in clear polyester sheets all of the 1917 editions of *Izvestia*, the first year of publication by the Soviet newspaper.

At the National Archives, a team of conservators in the basement tend to the nation's most valuable historical documents. To restore small holes in an old Civil War document, they make a patch that blends invisibly with the original by actually making the paper to match its weight and tinting the new paper with water colors to correspond with the original. A black-and-white photograph by Margaret Bourke-White is torn, missing a half-inch square spot on the side. A conservator recreates the missing chunk with just the right amount of gloss and grays.

The federal government's most elaborate and costly conservation effort is centered on the Charters of the nation—the Bill of Rights, the Declaration of Independence, and the Constitution. The Charters were written on parchment, which is made of animal skin and has been quite durable over the centuries. They are stored in a helium-filled cabinet sealed in 1952.

But the Archives uses a new \$3.5-million space-age tool to help monitor their condition. A high-resolution camera coupled with a computer, developed in collaboration with the Jet Propulsion Laboratory, measures minute changes in the documents. The camera can move as little as 1 millimeter at a time and converts the image into a million bytes of data, which are then fed into the custom-built computer. Alan Calmes, the preservationist in charge of the Charters, says, "We're looking for changes in the image." On the first page of the Bill of Rights, for example, Calmes is tracking the first "e" of "We the people. . . ." The ink of the letter has flaked off ever so slightly over time.

The dream of preservationists at the Archives, like those at the Library of Congress, is the broader use of acid-free paper. Kenneth Harris, director of the Archives' preservation policy and services, notes that today's pens don't help preservationists either because virtually all of them use acidic inks. "Most pens today are junk," he says. ■ M.S.



Crumbling to dust

Millions of books are at risk because acid is eating away the paper.

pipeline. (No books were in the chamber and no one was injured in either accident.)

After the explosion, NASA authorities deemed the pilot plant so unstable—because it could not account for all the DEZ still believed to be in the system—that they ordered the \$574,000 unit demolished. Library of Congress officials argued against such a drastic action, contending that the pipes could be tapped to locate the DEZ. But a week after the accident, the Army Corps of Engineers was called in by NASA authorities to “disassemble” the plant with explosives, the NASA report said.

The February accident “was a comedy of errors,” said George Cunha, who wrote a lengthy technical report last year on mass deacidification techniques for the American Library Association.

The accidents rocked the library community and confirmed their worst fears—that the DEZ process was dangerously unstable. The Library did not help itself by withholding details about the explosion soon after it occurred, Cunha notes. The project was denounced in an editorial in the *Library Journal*, a major trade publication. Senior editor Karl Nyren, in a 1986 piece entitled “It’s time to dump DEZ,” compared the accidents to the failures of the Sergeant York gun and the Challenger disaster.

Sparks asserted in an interview that the explosion “wasn’t such a big deal as it was blown up to be. That’s not a pun.” Daniel Boorstin last year noted in testimony before a House education subcommittee, prior to his retirement as the Librarian of Congress, that the deacidification program was “a pioneer project, and like all pioneer projects, is subject to risks.”

But the NASA accident report revealed serious flaws in the management of the experiments. For example, project researchers initially said that 30 pounds of DEZ were shunted into the system before the accidents occurred, but investigators later discovered that more than 700 pounds of

DEZ were actually fed into the pipelines. The crew failed “to follow good practice in the development and implementation of operating procedures,” the report said. “The Board observed that a certain amount of improvisation occurred during the operations which preceded these mishaps.”

William Welsh, deputy Librarian of Congress, acknowledged last year at a House appropriations hearing that “collectively, NASA and Northrop Services . . . did not have . . . expertise in chemical processing.” Sparks says that “it was a mistake on our part to stay with NASA. We should have gone to the chemical industry for help [from the start].”

Now all eyes in the library community are on the progress of the \$1.2-million pilot plant run by the Texas Alkyls, which has produced DEZ for 20 years for chemical polymerization. Two chemical engineering firms have collaborated on its design and construction and an industrial chemical engineer serves as Library staff adviser.

Johnson of OTA says that the plant is “well designed and well operated on a pilot scale. I don’t know of any major problems.”

Eight of 18 experiments have been completed to date, says plant manager Joe Ligi in an interview. Ligi says, “There is nothing that we’ve been confronted with so far that we had not anticipated,” but he would not elaborate. Sparks has barred reporters from the plant since it went on-line earlier this year “in order not to disturb the experiments,” he says. “What would you want to see? It’s like watching grass grow.”

Sparks estimated that a commercial-size plant could be designed within a year. The big plant would process up to a million books a year for \$4 to \$5 per volume, he predicts.

Until now, the Library had planned to build its own facility at Fort Dietrick, Maryland, near Washington, says Sparks, who has a large banner hanging on the wall outside his office, “Fort Dietrick by 1990 or

Bust.” But in a major shift, this month Sparks has begun advocating that the Library sign a long-term contract with a company that would build its own DEZ deacidification plant on the East Coast. “Fort Dietrick is not the heart of the chemical industry,” Sparks says. The company would license the patented DEZ technology from the Library and sublicense it to others.

“That’s a wonderful change of events,” says Carolyn Harris, head of preservation at Columbia University’s Butler Library. “The Library of Congress doesn’t need to be in the chemical business.” Johnson comments that the new plan “is a good approach.”

The Library has already received an unsolicited proposal from the parent company of Texas Alkyls, Akzo Chemicals, Inc., to build such a commercial plant.

The ultimate solution to prevent the acid paper problem in the future is to convince book publishers to use alkaline paper. Many university presses publish on acid-free paper, but this accounts for only a modest portion of total book publishing.

Several factors in the paper market discourage wider use or availability of acid-free paper. Alkaline stock is generally regarded as more expensive than acid paper, at least according to conventional wisdom, says Batten of the preservation commission. “Alkalinity is just one factor that goes into the pricing of paper,” she explains. In addition, mills have little incentive to change because book paper accounts for only about 5% of the total 11-million-ton market for printing and writing paper, according to James Hutchison, a vice president at the American Paper Institute. Converting a paper mill to produce alkaline stock is expensive.

On the other hand, plants making alkaline paper produce less pollution than acid paper manufacturers. And in some cases, alkaline paper is competitive in price with acid stock. Ironically, successful operation of a large deacidification plant could leave publishers merely with what Sparks terms “a moral incentive” to shift to acid-free paper.

Other companies besides Akzo are already beginning to see book deterioration as a commercial opportunity. One of the nation’s biggest book binding companies, Information Conservation, Inc., in Greensboro, North Carolina, established a conservation division last fall to restore books and other materials, for example. It hired Donald Etherington, who was a conservator at the Library of Congress for the past 10 years. Etherington says he prefers to restore rare books, “but we need to tackle conservation on a larger scale.”

Cunha says, “I think the ice has been broken. People are starting to pay attention.” ■ **MARJORIE SUN**