Cotton Processing Machinery

An American textile mill at the end of World War II was anything but a model of assemblyline production. With most of its machinery unchanged for decades, cotton processing consisted of many interrelated steps, each of which required the assistance of human hands. A bale of cotton had to travel a long and inefficient route from the concrete floor of the opening room to the spinning frame or weaving loom.

A cotton technologist at the New Orleans lab some 40 years ago describes the sorry state of a cotton bale when it arrived at the textile mill. Before it got there, he says, saws at the gin had separated the lint from the seed and removed some sand and plant trash. The cotton had been compressed repeatedly to bale it, wrapped in burlap, and girded with steel bands.

"At each exchange of ownership in its trade route, the bale is knifed to give up a sample," the technologist recalls, adding that contents of the ragtag bale looked even less promising when it was opened. "Cotton at this stage is a mass of tangled fibers of varied lengths. It contains [dirt], sand, particles of leaf and stalk of the cotton plant, and some seed fragments."

After opening, cotton from many bales was blended, then vigorously cleaned in several operations, damaging the fibers as little as possible. The matter clumps of cotton, "sometimes hard as wood," were then reduced to small tufts and eventually to separate fibers on their way to spinning into yarn.

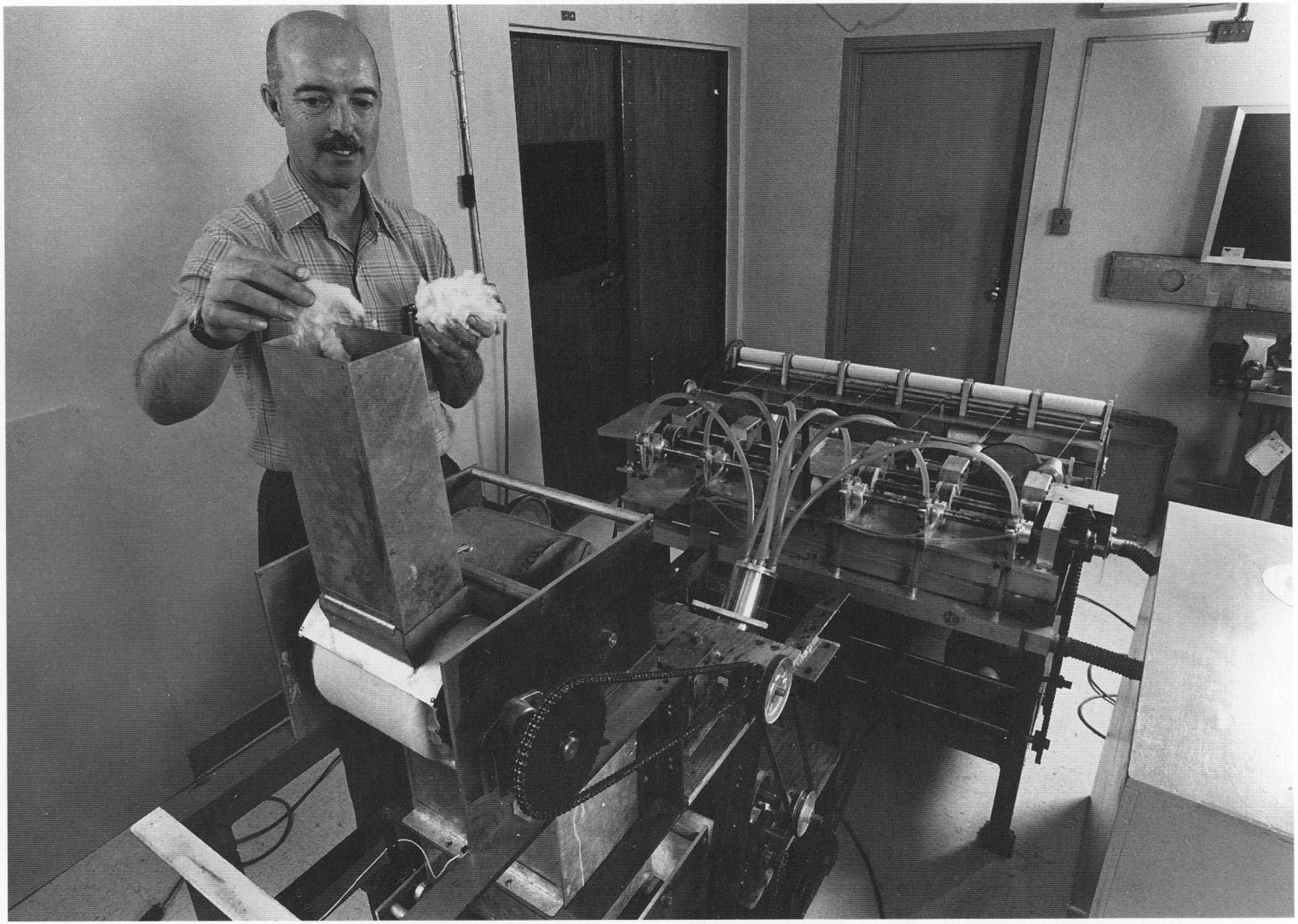
Over the years, the Southern laboratory has made uncounted improvements in every step of cotton processing. These include better machinery, smoother, more efficient processes, and innovative testing equipment. These developments helped save the U.S. cotton industry.

One of the most important early inventions to emerge from SRRC was the cotton opener-cleaner, patented in 1957. With the growth of mechanical harvesting, cotton contained more trash than ever, and cleaning it became progressively more difficult. The opener-cleaner combined the steps of opening bales and blending cotton with more efficient cleaning, producing a smoother-spinning lint. It could process 1,600 pounds of cotton per hour. The first machines were installed in mills within a year, and manufacturers reported savings of up to $100 a day per machine. Farmers benefitted because the opener-cleaner broadened the use of lower grades of cotton.

SRRC engineers soon improved their invention by adding two inexpensive attachments—the aerodynamic cleaner and air-brush doffer. The aerodynamic cleaner increased by one-third the capacity of the opener-cleaner. Together, they removed up to 45 percent of the trash from lint cotton, compared to 30 percent for conventional cleaners. Just as important to mill owners, the SRRC inventions cleaned out much of the so-called pepper trash—tiny bits of leaves and bark that had previously resisted removal.

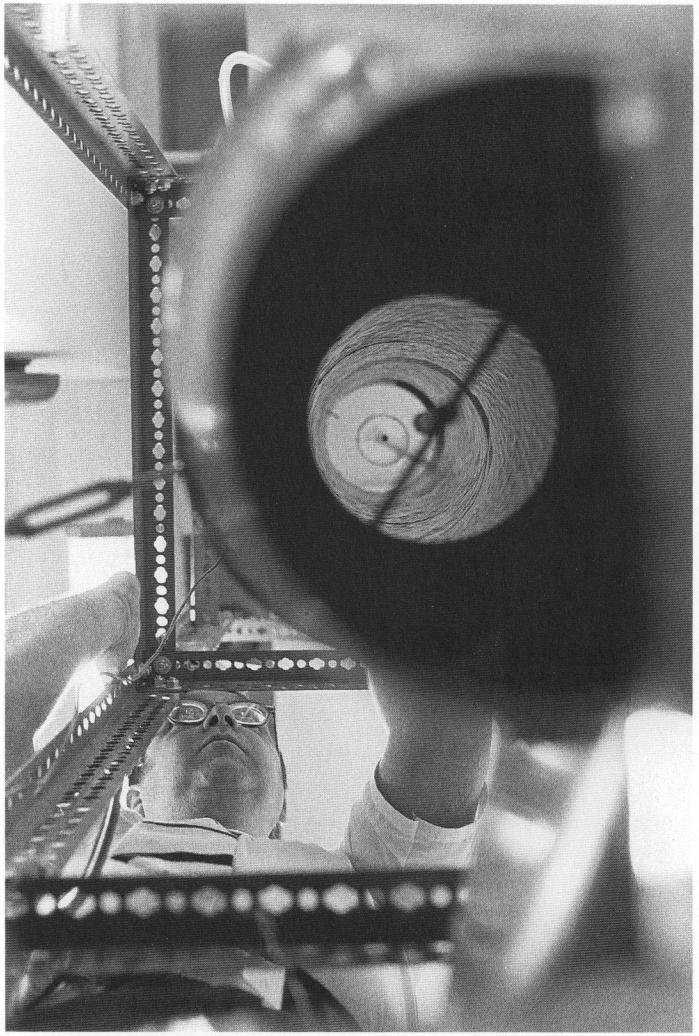
Over the years, the Southern laboratory has made uncounted improvements in every step of cotton processing . . . These developments helped save the U.S. cotton industry.

The next big SRRC invention in aid of cotton processing was the granular card, patented in 1959. Simple and relatively inexpensive, it was the first major change in the cotton carding machine since its invention 200 years earlier. Like the machine it was designed to replace, its purpose was to brush, clean, disentangle, and straighten the cotton fibers before spinning them into yarn. The granular card replaced a carding machine that had an elaborate assembly of brushes and other moving parts. The new carding machine has a rough, granular surface on the underside of a fixed cover. As the cotton passes over this rough surface, pushed along by air currents, its matted fibers are disentangled and smoothed for subsequent spinning into yarn.



Craig L. Folk, an engineering technician in the New Orleans laboratory, feeds tufts of raw cotton into the hopper of a prototype yarn processing system. An electro-optical sensor maintains a constant level of fibers in the hopper, assuring production of continuous, uniform cotton lap.

Modern cotton gin, producing 35 bales an hour, bears little resemblance to outmoded gins of World War II vintage and contains many innovations resulting from SRRC research.



Water swirls down the inner surface of an experimental wet-wall air cleaner, washing away electrically charged particles of cotton dust. The cleaner, tested here by SRRC physicist Devron P. Thibodeaux, uses both electrostatic and inertial forces to control and remove dust in cotton gins and textile mills.

Use of SRRC's granular card cut cotton waste in half. Since it was a sealed unit, it also eliminated a major source of cotton dust in textile mills. The machine was an instant success. One technologist remembers his first look at the new card: "The cotton came out as light as a cloud and just as white. It seemed to float." Within 6 years after its invention, 24 firms had been licensed to manufacture it and 2,500 cards had been installed.

The industry was also quick to adopt a small inexpensive SRRC invention called the pre-opener roll. Its function was to remove the large unopened lumps of cotton from the card and return them to an earlier stage of processing so that they could be reprocessed. Developed at a low cost, some 4,000 pre-opener rolls were installed within 6 years.

The year 1963 saw the invention of the fiber retriever, another inexpensive device that increased the efficiency of the cleaning section of the card by as much as 40 percent. It also removed a high percentage of short cotton fibers and decreased the loss of spinnable fibers, thus improving yarn strength and uniformity. It was also welcomed by industry; more than 20,000 retrievers were in use within 3 years.

Many of the most useful inventions developed in New Orleans were instruments and procedures for testing cotton fibers. New varieties of cotton and new methods of harvesting and ginning caused wider variations in cotton quality than ever before. Also, faster spinning speeds in textile mills and other changes made it more important than ever for mills to know the significant properties of cotton in each bale before blending it with others.

One new testing instrument SRRC scientists named the nepotometer; it predicts the neppiness of cottons. Neps are the small knots of tangled fibers that form during processing. They are tough to remove and one of the many causes of poor fabric quality.

Another tester developed in the 1950's under SRRC contract was the stelometer, which measures the strength and stretchability of bundles of cotton fibers. Yet another was the digital fibrograph to measure fiber length and length distribution with speed and economy. And there have been many other processing innovations from the New Orleans lab.

Some of the more significant cotton processing inventions made by the regional labs . . .

1962—A radically new ringless spinning machine eliminated the time and labor required to change bobbins and rewind yarn. It accomplished this feat by eliminating the bobbin.

1963—Researchers showed that cotton blends containing as much as 5 percent of fungus-damaged fiber could be spun into yarn of satisfactory quality, although spinning performance was lowered.

1966—An experimental machine proved able to blend cotton from as many as 20 different bales at one time.

1970—High-speed motion picture photography enabled scientists to examine the action of textile machinery in extreme slow motion, a big help in designing improvements.

1972—A study showed that raising the temperature and relative humidity in a textile mill could reduce the forces needed to separate cotton fibers by from 35 to 45 percent.

1974—Spiral carding, a new cotton processing system, cut steps in individualizing fibers to allow them to be drawn into a strand and twisted into yarn.

1976—ARS scientists designed, built, and operated a prototype system to process raw cotton stock continuously into yarn.

1979—A no-twist cotton yarn used a liquid binder instead of a twist to hold yarn together. The binder was washed out of the finished fabric when no longer needed.

1985—A new apparatus reduced the amount of hazardous cotton dust in the air in textile mills by removing fine trash and dust from the surface of cotton tufts before the tufts become matted. Foreign matter was trapped inside the machinery. This was a major advance in dealing with byssinosis. Also, Southern lab researchers evaluated yarn samples and conducted production runs to test a high-speed electrostatic spinner, developed under a Federal research contract by the Battelle Memorial Institute, Columbus, Ohio.