INNOVATIONS IN FORMING EARN BRIAN ATTWOOD TAPPI'S 2000 GUNNAR NICHOLSON GOLD MEDAL

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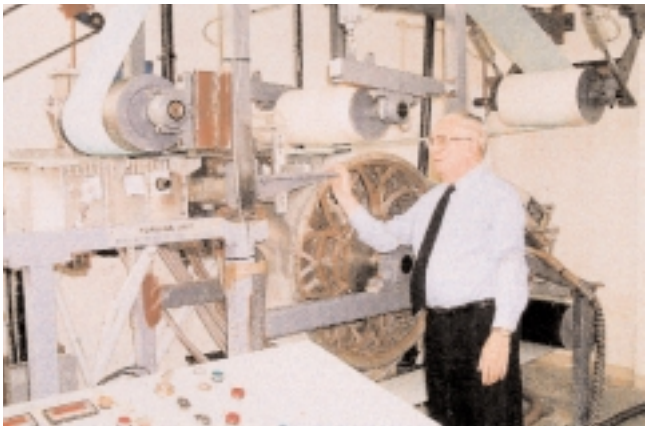
MILL-BASED RESEARCH LED TO NEW FORMER DESIGNS

EXCEPT FOR A FEW STREET NAMES AND WHAT USED TO be headquarters, little remains of the St. Anne's Board Mill on the site it used to occupy in Bristol, England. Brian W. Attwood, TAPPI's 2000 Gunnar Nicholson Gold Medalist, can still point to the corner of the building where his office used to be. Much of the early work for which Attwood is best known—the development of twin-wire forming—took place here, but the mill itself has since been torn down, the woodyard cleared, and new businesses took over along the River Avon.



Brian Attwood with the pilot machine at Pira

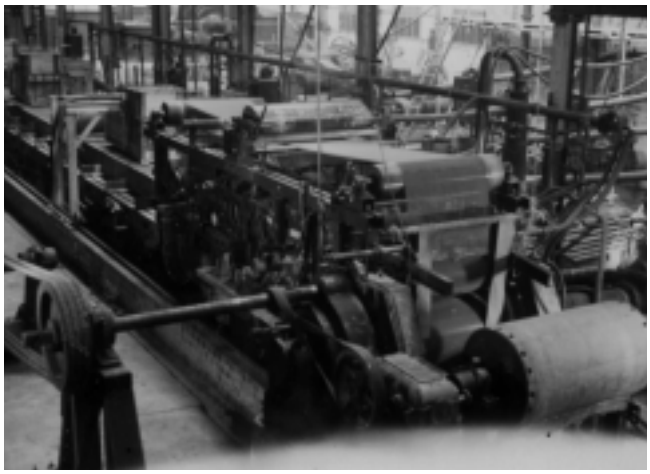
Born in Bristol, England, in 1927, Attwood is the only child of a working class family. His father worked for Marden, part of the Imperial Tobacco Group, in the printing industry. His mother came from a family of 10 children. She thought a job in a bank would be a good career for her son—a step up from manual labor—so Attwood took courses in short-hand, typing and bookkeeping at school.

Then World War II began. Attwood left school at 14 and went to work in the office at St. Anne's Board Mill. It was a fateful decision, and a stroke of luck for Attwood. Throughout his life, Attwood has admittedly had a welcome share of good fortune, and made some good decisions when opportunities came along. But a positive outlook, a sense of humor, and enthusiasm for the work he's done are all important factors in Attwood's success. His motto: "Given time and consideration, there is no situation that can not be turned to your advantage."

Because of his father's position, there were some concerns about Attwood working in the main office, so they asked if he would work in the technical records office where they kept records of mill operations. There Attwood went to work for George Curry, later a consultant for Jasper Mardon. Curry told Attwood to forget about shorthand and typing, "you're going to become technical." So Attwood was signed up for "night school," which, because of the air raids, meant attending classes Saturday afternoons and all day Sundays.

When hardly 17 years of age, Attwood was identified as having the potential to be a mill superintendent. While he was working toward becoming qualified for that job, however, he was called into military service.

In 1946, Attwood joined the Royal Air Force and was put into a radar fitters course, an intense 21 months of intense training that included studies in the new science of microwaves. He already had some chemistry training.



The pilot machine at St. Anne's

The Inverform team in 1952, from left, Reg Fothergill, Herbert Taylor, R.J. Thomas, Stanley S. Smith, and Brian W. Attwood

He eventually became an instructor in microwave radar techniques.

Then came a bit of what first seemed to be bad luck. Attwood was due to come out of the service and St. Anne's had a vacancy for him in the mill superintendent training program. Because of the Berlin Airlift, however, Attwood was kept in the RAF a while longer and missed the training slot. When he finally got out, he went back to work in the technical records office.

Then, because of his experience with radar and knowledge of chemistry, he was assigned to the company's newly formed R&D department. And Attwood thought, "This is the end of my career."

Stanley Smith was Attwood's boss in the R&D department, "a person who has been very key in my career." Together, Attwood and Smith worked on a number of projects. The major project was a fundamental study of drying on steam-heated cylinders. For the study, the pair built a simulator of the process. "I'm a great one for hands-on work," Attwood noted.

At the time, little was known about the fundamentals of drying and what factors were important. In their studies, Attwood and Smith determined that temperature and the tension of the felts were the key elements. While temperature was somewhat fixed by steam pressure, tension was a variable that might be manipulated to improve drying efficiency, they reasoned. They recommended that the mill put new felt carrier rolls on one of its board machines and worked with the felt suppliers to increase the tension, with the result that output on the machine increased 10%. And it was done at relatively little cost, so output on the mill's other machines was similarly improved.

"At this point the R&D section became the glory boys of St. Anne's," Attwood said.

Another area of the board making process that had potential for improvement was formation, Attwood and Smith believed. They got permission to research the latest developments in forming around the world. A few multifourdrinier machines did exist, mainly in Finland. But they were big and complicated, with four or five stacked fourdriniers. There were also linerboard machines in the United States that used secondary headboxes.

Attwood and Smith decided to build a pilot wet-end, perhaps the first in the paper industry and at a mill. It was a small machine, with a fourdrinier wet end. Their target was to make a better product at 500 ft/min. "In those days, formations went off very badly at 300 ft/min, with normal cylinder machines," Attwood explained.

"Our first approach was to use a multiplicity of headboxes...and build one ply on the other," he continued. "Well, the thing that hits you straight away is the drainage problem, of draining down. It's not so bad with the first layer and second layer; it's very bad with the third and extremely bad with the fourth. So we were stumped."

A lot of simulation work was devoted to suction box design. Attwood discovered that the bars and the spacing of the bars on a suction box are key.

In the meantime, Attwood published his first *Tappi* magazine paper with Smith—"Paperboard drying investigation by means of an experimental drying machine"—in the November 1953 issue.

The team continued work on the problem of multiply forming. Although they were able to get a reasonably formed sheet, the energy demand would have been high and the wire life would have been extremely short. And in those days, wires were made from bronze and stainless steel.

Two of the board machines at St. Anne's used a "baby press" ("You take the sheet on the making felt, it runs down at an angle, and you have presses."). What was unusual about the configuration was that the machines had a wire on top at the presses, purely to get water up, and then there was a slice after each roll. At the time the team was concerned only with water removal. They installed a top wire on a machine with a number of internal rolls, basically dandy rolls.

Attwood believes that one of the reasons St. Anne's did so well in developing a number of innovative machine designs was that its research was conducted at the mill. And there was a policy of bringing mill managers in on development projects. So when the research did move to the mill, the team had an ally.

Smith himself had been a mill superintendent. "The great thing about Stanley was that he used his hands and he knew the mill," Attwood remembered.

But Smith was interested in further advancement, also. He was assistant technical manager and wanted to be technical director. In spite of his efforts, he didn't get any indication from the company that he would be made technical director, so he left St. Anne's. With the project at a critical point, and a substantial amount of money already invested in it, they had no alternative but to put Attwood in charge of the pilot machine. He was fortunate to have a very good machine man (Bert Taylor), a superb fitter (Reg Fothergill), and a good technical staff. But there was an additional bit of luck that came into play.

"We knew we could get water up, by rolls, very gently," Attwood explained. The question was how to get it up more quickly. So one Saturday morning, Taylor and Attwood took a plank of wood, held it across the machine, and pressed it down into the wires. "And of course, more water came up."

"Being clever developers, we took samples each time," Attwood said, "and this is the luck, we found that as we changed the pressure, we changed the formation, so bingo, we had a former."

An immediate advantage of being able to doctor water up off the sheet was that fewer vacuum boxes were needed on the machine Attwood was using. They went from one on the first ply, three on the next, nine on the third and 27 on the fourth, to just one vacuum box. In doing so, they were able to increase machine speed from 400 ft/min to 600 ft/min. After a good deal of further development in the early 1950s, they ended up using a fourdrinier for the first ply and top wires for the rest. Using that configuration, they were able to increase production to 1200 ft/min.

Full-scale development followed. The research team petitoned the parent company, Imperial Tobacco Group, to rebuild one of the six board machines at St. Anne's—the one with the "rotten" wet end—with "Inverform" units. (The name was suggested by a secretary, Attwood said. It derives from upside-down or "inverse" formation.)

R. J. Thomas, the managing director, was a key proponent of the project. Though autocratic and conceited, according to Attwood, Thomas had been a production manager and he saw the potention for the design. He helped get funding for the rebuild and was ultimately included in the patent.

Thomas had a friend, George Sheldon, who ran Walker Brothers, a company that built winding gears for coal mines, as well as bits and pieces for the paper industry. Sheldon offered to build the wet end if St. Anne's would design it. By the time the design was completed, Walker Brothers had been bought by Walmsley, and Sheldon was made a senior manager, eventually to become chairman and managing director.

Walmsley was offered exclusive manufacturing rights. It was only interested in the U.K. and Europe, however, and suggested contacting Beloit to see if that company might be interested in North American rights. One of the people brought over to view the pilot machine was Edgar J. Justus, an engineer who was in charge of setting up an R&D department at Beloit.

Brian and Janet Attwood on the occasion of his being made a Fellow of the City and Guilds of London Institute in 1999

Attwood looks back through notes he kept during development of the Inverform

"We met on a Sunday morning," Attwood recalled. The group was given a demonstration and they discussed some of the possibilities. Justus "grasped it straight-away," and on the walk back offered Attwood a job at Beloit, which he politely declined.

Beloit assigned Joe Parker and Dave Gustafson, along with Jerry Brezinski, to conduct forming studies based on the design. They suggested "Twinverform" as the name, from which "twin-wire" forming, as used today, derived, Attwood said. It became the first commercial twin-wire forming machine.

The Reed Paper Group became interested in the design and in collaborating with Attwood's group in further developing it for higher speed formation. Using a second pilot machine, they were running at 3300 ft/min by 1956. At the same time, felt manufacturers were developing plastic fabrics to overcome the limitations of metal wires.

The second major Inverform machine was sold to APM in Australia. The company had previously installed a duplicate of St. Anne's No. 5 cylinder/Yankee machine at its Petrie mill. They also built a pilot machine to do further studies with the new design and suggested the use of a curved bottom on an inverted vacuum box to build tension. That led to the development of the BelBond. "It's a wonderful example of a paper mill becoming involved with development, spin-offs, international relationships, and how it all worked."

Attwood's attention was next focused on the headbox, which was somewhat crude in the early stages. The development team at St. Anne's knew they could make the middle layers at about 1.8% consistency, but headboxes weren't available to do that. They designed a compact box with an explosion chamber which worked well and they were able to install it on the pilot machine. It gave them better speed, better basis weight, and a better product. The basic concept for the BRDA (Boxboard Research and Development Association) pressure former grew from that.

Attwood's boss, George Curry, was dead set against trying to develop a pressure former, however. So during a visit by A. Thomas Luey of BRDA, Attwood took him to the pilot plant during a break and demonstrated the model. They then schemed to get approval to collaborate on developing it. Attwood gave Luey the drawings. Luey went back to Western Michigan University and, with a great deal of help from Ward Verseput, developed the design. (Verseput was also responsible for converting the Converflow to multiply, Attwood noted.)

Various other spin-offs resulted, sometimes by accident, and various other ideas were tried. "These things all come about by doing things," Attwood said. "If you sit on your backside and don't do anything but talk, and then you think you can put it on a computer and get the answers, forget it."

Attwood's teams were also involved in studies of dry forming and in developing from it various aspects of pressing and drying. Some of that work formed the basis for the Hydronip process, he noted.

As a wholly-owned subsidiary of Imperial Tobacco, St. Anne's was dependent on the parent company for project funding. As Imperial began to diversify, first into foods, then breweries, it became harder and harder to devote money for paper machine development.

In 1977, Attwood was promoted to process and technical director at St. Anne's, with a staff of about 900 people. In 1980, after analyzing its real needs and interests, Imperial decided to sell St. Anne's. The industry was beginning a slump, however, and there were no buyers. So the mill closed.

"I didn't know what I was going to do, to be quite honest," Attwood confided. "I was 52 at the time. I now know that is a very good age for this to happen."

Attwood had worked for St. Anne's for most of 40 years and was eligible for a full pension, index-linked. He was also offered back the many inventions he had worked on that had been assigned to the company, subject to collection of outstanding debts. He collected royalties on those patents he chose to keep. "I didn't make much money out of this, but the great thing about it was it kept me involved in the industry."

For his new career, Attwood decided to become a consultant, specializing in forming, water removal, press-

ing and drying. He established himself as director of St. Annes Paper and Paperboard Developments Ltd. in 1981. In that capacity he's worked with Black Clawson, Pira International, Arthur B. Little, and others.

Although many consultants work from home, Attwood felt he needed a separate office when he started out. It turned out that a machinist had a work shop in the same building. He was able to make working models of various former designs Attwood would come up with.

As time has passed and technology has advanced, Attwood decided the separate office was no longer needed. His home is now his base of operations, though he maintains space at the machinist's shop for his files and for hands-on work. Typically, Attwood works two or three days a week now, and he is still active in many pulp and paper associations, such as TAPPI, and especially Pira. That involvement has helped Attwood maintain contacts within the industry, stay current with technological developments, and attract clients.

A particular interest for some time now is small machines. "There is a case, now, where a lot of this new technology can be put together for a completely radical small machine," Attwood said. Such a machine would use pressure forming, run no faster than 300 m/min, and would produce up to 5 tons/hour.

Working with Pira, Attwood had hoped to obtain government funding to keep it a "British" machine, but most likely the money will come from outside the United Kingdom.

Another of Attwood's strong points has been international relations. He served a three-year term on TAPPI's Board of Directors and served two years as chairman of TAPPI's International Committee. He participated in study tours of Eastern Europe in 1991 and Asia in 1994. In December, he represented TAPPI at the PaperEx conference and exhibition in India.

Attwood used to enjoy building model airplanes; not the plastic kind, but the kind with wooden frames and doped wings, the kind that actually flew. A current interest is aircraft of World War I, as well as the history of warfare. Another interest is industrial archaeology, as well as local history. He is a member of the Bristol Industrial Archaeological Society and of the British Paper Historians Association. Other interests include art and painting in water colors, music, reading, and walking.

Attwood's wife, Janet, was trained in chemistry. She worked in the lab at St. Anne's when they first met. When they became engaged, she left to work as a government paper examiner, then attended classes to become a teacher. She then taught science and general courses to primary age children, and was "a great field hockey player," Attwood said. She regularly travels to conferences with Attwood, now, and assists with his office work.

Attwood continued his education at Bristol College of Technology (now the University of the West of England) where he obtained a Fellowship of the Royal Society of Chemistry. He also received an Insignia Award from The City and Guilds of London Institute. The "insignia" is the top exam. It requires a first class pass of the top level course, a thesis (Attwood's was on twin wire forming), and written and oral examinations. He was recently elected a Fellow of City and Guilds and has served as an examiner/moderator for the institute's vocational courses.

Attwood received the TAPPI Paper and Board Manufacture Division Award in 1977 and became a TAPPI Fellow in 1987. Among other awards bestowed upon him have been the EuCePa Gold Medallion, the Gold Medal of the British Paper Industry, the Silver Jubilee Medal of the U.K. Paper Industry Technical Assocaition (PITA), and the PITA Gold Medal. TJ

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