Undeterred, Bob Gore redesigned his membrane. He shifted the molecules around, making them impervious to body oils. He perfected a method of laminating the membrane onto soft fabrics to give it body and strength. Then he watched sales of Gore-Tex skyrocket.

TEFLON BODY PARTS

If the Gore-Tex story had ended there, it would have been a fairy tale of the fashion industry. But lost in the glare of success in sporting goods is one of Gore-Tex's greatest but quietest achievements. It started back in 1971, ten years before Gore-Tex was just coming into its own in the sportswear industry.

The Gores had been taking one of their regular ski trips to Vail, Colo. A member of this vacation trip was a physician from Denver General Hospital, Dr. Ben Eiseman.

During a break, Bob yanked a piece of Teflon tubing out of his pocket and showed it to the doctor. When told of the inert properties of Teflon, Eiseman offered to implant the tube in a pig and see what happened. Doctors were always looking for new materials that would not be rejected by the body.

A few weeks later, an excited Eiseman phoned Gore to tell him that his experiment had been a success—the pig did not reject his Teflon tube. That was the beginning of the Teflon age of medicine. Since then, millions of people have had artificial body parts made out of Gore-Tex—arteries and ligaments—successfully implanted into their bodies. The pores make an ideal place for the natural tissues to grow into, and the inert properties of Teflon fool the body into thinking Gore-Tex is not a foreign object.*

People can wear Gore-Tex on both the inside and the outside of their bodies at the same time.

* Roy Plunkett, discoverer of Teflon, tells about the time "I was at a dance and a doctor friend asked me if I wanted to meet somebody. He said 'This guy is here only because he has a Teflon aorta which I installed.' "

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Nylon: The Hit of the '39 World's Fair

We Enter the World of Tomorrow
—New York World's Fair, Forum on Current Problems, 1939

THE 1939 NEW York World's Fair will be remembered for many things: for Americans' first glimpse of television, for their first "rides" in space.

But to three thousand excited members of a women's club, the World's Fair site was their first keyhole to the future of hosiery. For at Flushing Meadow that October day in 1938, where the TV sets of tomorrow, the rides into the future, and the outdoor theater would sit a year later, E.I. du Pont de Nemours, Inc., chose to show these women a material never seen before on earth. Unlike wool, cotton, or silk, which were made out of naturally occurring fibers, this one, in the words of Du Pont vice president Charles Stine, was "the first man-made organic textile fiber wholly from new materials from the mineral kingdom."

Du Pont called it nylon.

THE AGE OF THE MAN-MADE FIBER

As a product of science, nylon carried almost mythical properties. "Though wholly fabricated from such common raw materials as coal, water, and air," Stine told the silenced audience, "nylon can

be fashioned into filaments as strong as steel, as fine as a spider's web, yet more elastic than any of the common natural fibers."

What more could any clothes-conscious woman ask for? They erupted into applause. They were sure they had just witnessed the dawn of a new age: the indestructible stocking. No longer would unsightly rips and tears embarrass these ladies. No longer would the edge of a file cabinet drawer be a lethal weapon. The run was dead. Before long women would wait hours in line to purchase their "nylons."

Nylon would change the course of fibers and fabrics around the world. It heralded the era of "man-made" fibers with trade names like Dacron and Orlon. But none of the smiling women in the audience knew that the product that would become the biggest cash cow in the history of Du Pont was the result of a lucky accident back in the labs.

Wallace Hume Carothers had come to the Du Pont labs in Delaware in 1928 to conduct basic research—that is, he really didn't know what direction his work would take, where it would end up, or if it would produce anything at all. The idea behind basic research is to find out as much about something as you can, and if that path leads to something useful, all the better. Some of the world's greatest discoveries and advances had started this way. Carothers had been spirited away from Harvard University and been guaranteed by Du Pont that he would be allowed to continue doing his pure science. Being a brilliant researcher, Carothers was given enough line by the company and allowed to run.

SPAGHETTI MOLECULES

Du Pont's Stine told the young idealist Carothers that the direction the company wanted him to take was in opening up the emerging world of polymers: long, stringy, spaghetti-like molecules that gave rubber and silk their special properties. By learning how they were constructed, it might be possible to create man-made fibers out of raw materials found cheaply in the mineral kingdom. After all, if a silk worm could do it, why not a human?

What scientists around the world didn't know at the time was what held those spaghetti molecules together. What were the forces involved? Were they the same as those that held smaller molecules together, or were they unique?

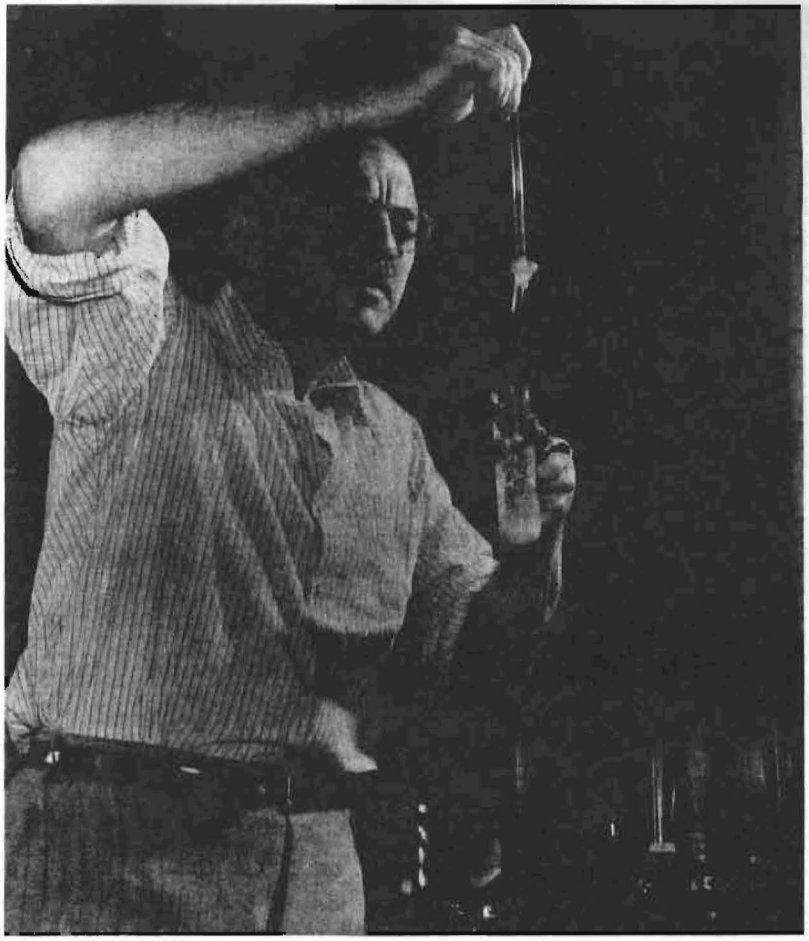
One way to find out, thought Carothers, was to build those molecules from scratch—synthetically—and to find out in the process what binds them. By 1930 Carothers and his colleagues had reached the conclusion that polymers were molecules just like all others—only longer—and held together the same way. By April of that year, using this knowledge, they had accidentally made the first synthetic rubber, neoprene. But then their work hit a dead end.

THE ACCIDENT THAT CHANGED HISTORY

By the middle of 1933 the fiber research had come to a halt. The research team had learned a lot about polymers, but they had not hit the jackpot. Carothers decided in early 1934 that he was a failure; there would be no synthetic version of silk. Then came the kind of accident that makes inventions famous.

Carothers had created a new substance—a polyamide—with a structure similar to silk but without silk's properties. Its melting point was too high to be spun into fibers, so what good was it? Carothers stuck his product—nylon—on the shelf without even bothering to patent it. His colleagues at Du Pont turned their attention to a more useful class of plastics, polyesters, which were easier to work with in the laboratory. One of those intrigued by the properties of polyesters was Julian Hill. While fooling around in the lab with a beaker full of the stuff, Hill noticed that when he stuck a glass stirring rod into the polyester, fixed a glob of it onto the rod, and drew the rod out, the polymer would stretch into silky strands as thin as a spider's webbing.

This curious property of "cold-drawing" intrigued the entire lab. And as the story goes, they all waited until the boss (Carothers) was off the premises and conducted an unorthodox experiment of



Like Pulling Taffy. Dr. Julian Hill reenacting the discovery of nylon.

their own. Affixing another ball of the gooey plastic to the end of a rod, Hill and his lab buddies decided to see how far they could stretch it. Much to their surprise—and delight—they could stretch the polyester string the entire length of the hallway.

The act of cold-drawing and stretching actually increased the strength of the material by aligning the molecules. And if it worked for these polyesters that had melting points too low to be made into fabric, what about that old, useless polyamide stuff that Carothers had shelved?

Sure enough, it worked. Cold-drawing was the secret to creating nylon. It gave nylon excellent qualities; nylon was stronger and stood up to abuse better than silk.

Within five years Du Pont brought nylon onto the market. Nylon was aimed squarely at the hosiery-buying public. Du Pont resisted efforts at making nylon a substitute for such commodities as leather, wool, and cellophane, and in this way could concentrate on keeping the price below the cost of silk. Of course, it also helps to have a monopoly on a product.

EPILOGUE

Wallace Hume Carothers never lived to reap the fame and fortune of his discoveries. Prone to depression, Carothers suffered various bouts over a period of two years. In the summer of 1936 he succumbed to a nervous breakdown. The sudden death of his sister did not help matters. On April 29, 1937, Carothers took a fatal dose of cyanide and committed suicide in a Philadelphia hotel room. His death came just three weeks after the patent for nylon had been filed and two days after his forty-first birthday.[1]