in order to be granted a patent he needed a working model, which he did not possess.

The stage was set for a battle. In June of 1959, Townes and Arthur Schawlow took their laser idea and filed for a patent. Nine months later, Gould filed to patent his similar ideas. And a patent fight between the parties has been in the courts ever since, centered on who owns the rights to laser concepts. Gould achieved a limited victory in 1977 by winning two patents—one for laser pumping and the other for a method of processing materials with lasers. But the "laser wars" are continuing to this day with a tenacity that would make even Darth Vader blanch.

13

Velcro: Improving on Nature

Beauty in nature is a quality
which gives the human sense a chance
to be skillful.

—BERTOLT BRECHT, *The Messingkauf Dialogues*, 1965

WHEN ASTRONAUTS AND cosmonauts first began circling the globe, they faced a unique problem: how to keep track of all their stuff. On the ground, if you wanted to stow your car keys, for example, you simply left them on the night table. They could be found in the morning right where you left them—perhaps after a bit of last-minute searching on the way out the door—but at least they stayed put.

Space travelers faced a different problem. Objects had a habit of just floating off. A pencil, a wrench, would just hang around drifting weightlessly wherever a tiny shove or air current would take it.

Keeping tabs on a capsule full of flotsam was a job in itself, a full-time job because if a tiny piece lodged itself into the hardware, it could short-circuit who-knows-what. The fact that orbital living quarters would make a phone booth look spacious only compounded the problem of keeping things neat and orderly.

How could one make sure things stayed put?

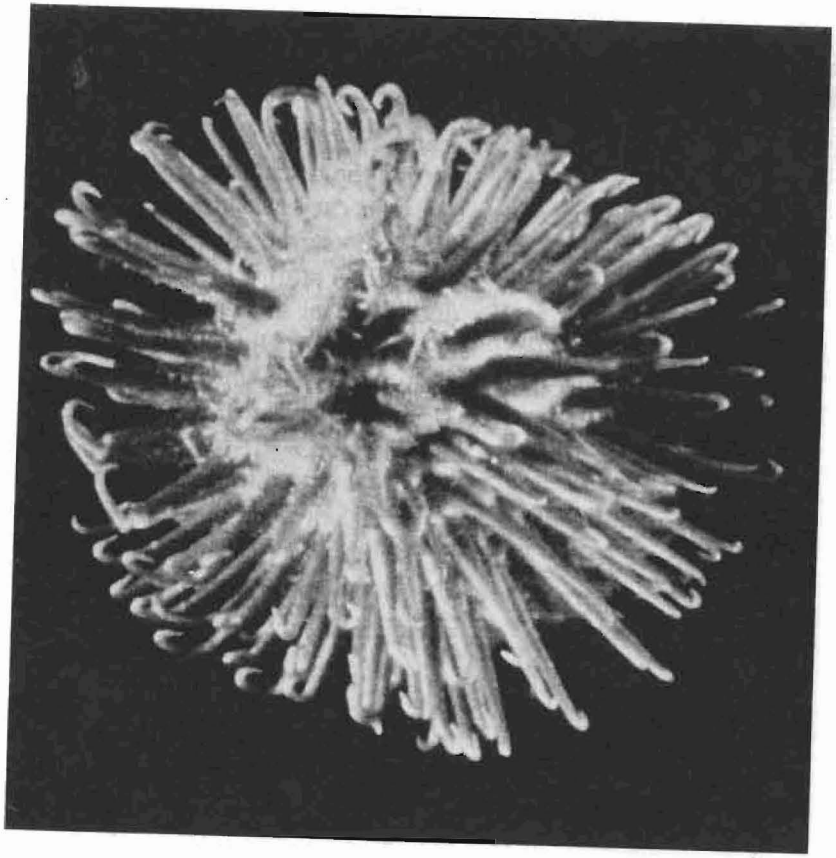
COCKLEBURS TO THE RESCUE

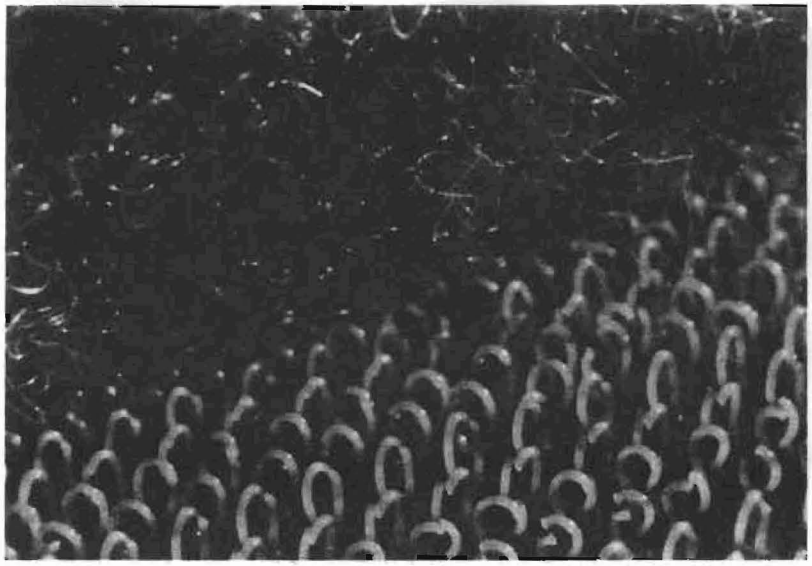
The answer came from another lucky walk in the country (see Chapter 23, "The Wasp That Changed the World") taken just a few

years before the space race began in the early 1950s. This time our hero was one George de Mestral, who happened to be taking a stroll one day in his native Switzerland.

Upon arriving home, he found his jacket covered with cockleburs. Picking the sticky seed pods off his clothing, de Mestral wondered what act of natural engineering could account for their tenacious sticking ability. Whereas you or I might just curse the darned cockleburs for being such a nuisance, de Mestral pulled out

Cocklebur. George de Mestral's examination of a cocklebur, Mother Nature's original "push fastener," following a nature walk in Switzerland led to the development of Velcro.





Velcro Under the Microscope. Thousands of tiny hooks engage countless loops. Velcro now comes in every shape and size—it's even made out of steel.

his microscope and took a careful look. Focusing in on the cockleburs' structure, he noticed they were covered with little hooks that entangled themselves in the loops of fabric of the jacket. Mother Nature had invented an ingenious method for catching a free ride to the next seeding spot by lodging her seed carriers in the fur of passing birds and animals.

If nature could be so resourceful, why not take advantage of her design and turn nuisance into necessity? Artificially create a system of hooks and loops that when pressed together tightly stick to one another but when pried apart easily separate. Velcro*—derived from *vel*vet and *cro*chet—was first made in France. Each Velcro tape was made by hand and took almost forever to produce. The loops could be easily made by machine but the hooks did not lend themselves easily to mechanization. What to do? Make the loops

* Velcro is a registered trademark for fasteners made by Velcro Companies.

mechanically and then cut them in such a way that the clipped ends formed hooks! This way hooks could be fashioned from loops from the simple act of cutting.

With the mechanical problems solved, Velcro's holding power was improved. The original nylon material used to make the hooks and loops was strengthened by thickening. Blends of polyester and nylon made them even stronger. NASA found ribbons of unique fastening material it needed to hold the countless odds and ends of space travel.*

Even today, no better substitute has been found. When getting ready to leave orbit, space shuttle astronauts literally spend a full day in space collecting all of the material Velcroed to the walls.†

Of course Velcro has been improved over the years. It has become impervious to water, chemicals, and corrosive ultraviolet light. Extra-strong Velcro can be made out of stainless steel and synthetic fibers that withstand temperatures upwards of 800°F. and do not catch fire.

* About ten to fifteen pounds per square inch of force is required to pull apart standard Velcro. A ton of force is needed to pull apart two hundred square inches.

† President Bush's White House staff has coined the word velcrosis to mean a situation in which people uncontrollably tend to swarm around and "stick" to the President when he makes a public appearance. You can watch velcrosis in action the next time any famous person is greeted by a crowd of celebrity-seekers.

14

Teflon: The Top-Secret Discovery

The lowest coefficient of static and dynamic friction of any solid.

—*Guinness Book of World Records*, describing Teflon

ROY J. PLUNKETT didn't know he had invented Teflon. Teflon appeared totally by surprise to the young chemist. Just two years earlier he had graduated with his Ph.D. from Ohio State University. And now, on April 6, 1938, as a chemist for Du Pont, Plunkett had unknowingly invented a compound that would change the world.

Plunkett had been assigned a project: Come up with a nontoxic refrigerant. Jack Rebok, Plunkett's lab assistant at Du Pont's Jackson Laboratory in New Jersey, had just cracked the valve on a bottle of special Freon gas that Plunkett had concocted. But no gas came whistling out. Scratching his head, Rebok turned to Plunkett.

"Hey doc, did you use all this stuff up last night?"

"No. I don't think so," replied a perplexed Plunkett.

"Well, there's nothing coming out," said Rebok as he examined the opened valve.

"Well that's odd. Let's check it out."

Trying to understand where the gas had gone, Plunkett suggested they weigh the cylinder. "It weighed what we expected it to, so we knew something was in there."

Perhaps the valve was stuck? Running a wire through the valve showed it to be open. The only thing left to do was open her up. Sawing open the cylinder, Plunkett dumped out its contents. "I was flabbergasted," he said. "Gee whiz, it's gone wrong."

And sure enough, out of the innards of the cylinder came not a gas but instead a greasy white powder. What was this stuff?