

Passion + Ingenuity = Breakthroughs

SETON HALL INVENTORS USE CREATIVITY TO SOLVE THORNY PROBLEMS.

Less than five miles from the University's Farinella Gate on South Orange Avenue, one of the country's most influential inventors, Thomas Edison, made his home. At Edison's West Orange lab — one of the first dedicated to research and development — the father of the light bulb, the phonograph and the motion picture conducted experiments resulting in more than 1,000 patents. Many years later, Seton Hall graduates have channeled that same creative, solution-driven energy into life-changing inventions of their own. We share a few of their stories here.

The Clean Air Catalyst

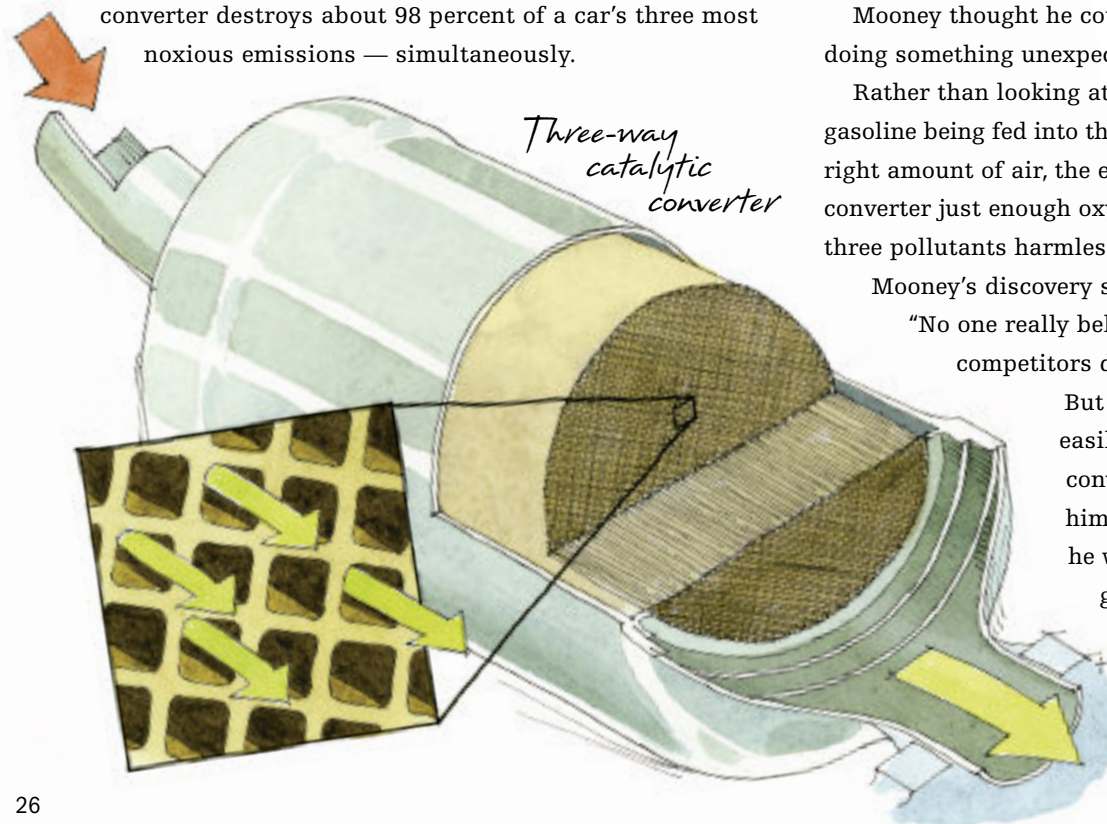
The FedEx package from John Mooney '55 arrives less than a week after our first meeting. Mooney — an 83-year-old man with a nimble step — has sent two reports.

He wrote the first paper for the United Nations in 2004 to convince a few holdout countries to eliminate lead from their gasoline. The other is a new paper out of the University of Michigan asking if the 230 million or so automobiles in the United States represent a peak. (Unlikely.)

Mooney, a chemical engineer, chose the reports to illustrate how dangerous internal combustion engines can be. But something else is present in the reports: Mooney's passion for tough problems — and innovative solutions.

"If you don't think there's a solution, then you just haven't asked the right question," says daughter Elizabeth Convery, quoting a mantra her father often tells his five children and 14 grandchildren to live by.

That fits. Mooney is the co-inventor of the three-way catalytic converter, a small exhaust-cleaning device that hangs beneath about 80 percent of automobiles. Each converter destroys about 98 percent of a car's three most noxious emissions — simultaneously.



"That was a phenomenon that no one else thought was possible," says Mooney.

Not for lack of interest. By the late '60s, thick smog around Los Angeles sparked public demand for cleaner air, says Joseph Kubsh, executive director of the Manufacturers of Emission Controls Association (MECA). An extension of the 1963 Clean Air Act was on its way in 1970, with the Environmental Protection Agency and emissions standards in tow.

The standards would force most automakers to add a catalytic converter to their cars. A lot of companies wanted to sell it to them. That included Engelhard, Mooney's then employer, a chemical company based in Iselin, N.J., now part of BASF.

But a good device wasn't so easy to build.

The chemical reactions that clean up a car's most noxious pollutants are very different. Oxygen has to be stripped away from nitrous oxide, but must also be added to carbon monoxide and unburnt hydrocarbons. Most thought this would require a bulky, two-stage system.

Mooney thought he could do it in one. He proved it by doing something unexpected.

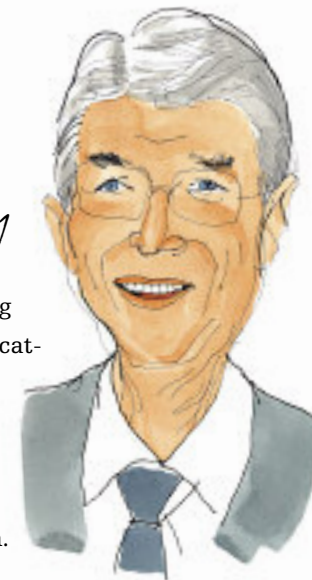
Rather than looking at the exhaust, he focused on the gasoline being fed into the engine. If it was mixed with the right amount of air, the exhaust would offer a one-stage converter just enough oxygen to simultaneously render all three pollutants harmless.

Mooney's discovery seemed like magic.

"No one really believed me," he says. "Probably our competitors didn't either."

But Mooney was never one to give up easily. Take his first car, a 1941 Ford convertible he bought in 1949 to carry him to Seton Hall University, where he was starting work on an undergraduate degree in chemistry. The car worked — but not well enough. So Mooney, 19, took

John Mooney



its engine apart, leaving more than 100 pieces scattered across a friend's garage. Problem was, he didn't know what they did.

That was no problem. Mooney talked to some mechanics, and soon knew what he had to do. The big V8 was rebuilt in time to roar north for a summer road trip to points unknown. A faint smile spreads across Mooney's face as he remembers the old car. "It had a nice noise to it," he says. "It purred."

That can-do spirit carried the day with the three-way catalytic converter too.

It inspired his boss and co-inventor at Engelhard, a scientist named Carl Keith, to send him around the world in the early '70s to convince automakers to add an oxygen sensor to their engines. The sensor would monitor the fuel-to-air ratio so each engine could be tuned to the sweet spot where Mooney's one-stage converter would work.

Volvo listened first, and by 1976, the device was rolling off some of its assembly lines. Just about every automaker would soon follow suit.

The results are legendary. BASF says the three-way catalytic converter has destroyed more than a billion tons of nitrous oxide, carbon monoxide, and hydrocarbons since it was released. More impressive: To protect the device from damage, highly poisonous lead has been removed from gasoline in nearly every country.

"It's really an amazing thing that's been created," says MECA's Kubsh.

Mooney breathes, sucking in fresh, clean air. He couldn't agree more.

Illustrations by Tom Dunne

The Bone Doctor's Knees

It all started in the mid-'70s on scrap paper: cocktail napkins, lined yellow paper, whatever was near.

Frederick Buechel '67, M.D., and Michael Pappas, Ph.D., were designing artificial joints. They worked on schematics wherever they were, sometimes even at a bar near their homes in northern New Jersey. For Buechel, the work has never been far from his mind.

"To this day, you'll see a piece of paper on his desk with a drawing on it," says his son, Frederick Buechel Jr., M.D.

That's no surprise. His father is the co-inventor of one of the world's best-known artificial knees. It was one of the first to truly simulate the real thing — bending up and down while also twisting a little left and right as people walk. A version of it has been sold by DePuy Orthopaedics for more than 30 years. First known as the New Jersey Knee, it's now called the N.J. LCS® Mobile Bearing Total Knee System.

"You should allow the ligaments and muscles to act in their own normal way," says Buechel Sr., 67.

While DePuy, now part of Johnson & Johnson, doesn't discuss market share, it has been reported that the LCS Knee has been chosen by a million people worldwide. That's a number that could grow rapidly. Knee replacements are increasingly common. Between 2000 and 2011, the number of operations grew almost 130 percent, the American Academy of Orthopaedic Surgeons says, with more than 600,000 done each year in the U.S. alone.

"It's a hot topic," says Daniel Brown, an orthopedic devices analyst at Millennium Research Group.

There are at least two reasons. People younger than 65 increasingly want to temper sport and other high-impact injuries, and those who are older are staying active longer.



Frederick Buechel

But, in 1974, none of that was true yet. Buechel, then a 28-year-old orthopedic resident at New Jersey Medical School (now a part of Rutgers University) was overseeing a research project on an ankle-replacement device.

“Many of these were developed in personal labs, almost in garages,” says Stuart Hirsch, M.D., a clinical professor of orthopedics at Seton Hall’s School of Health and Medical Sciences.

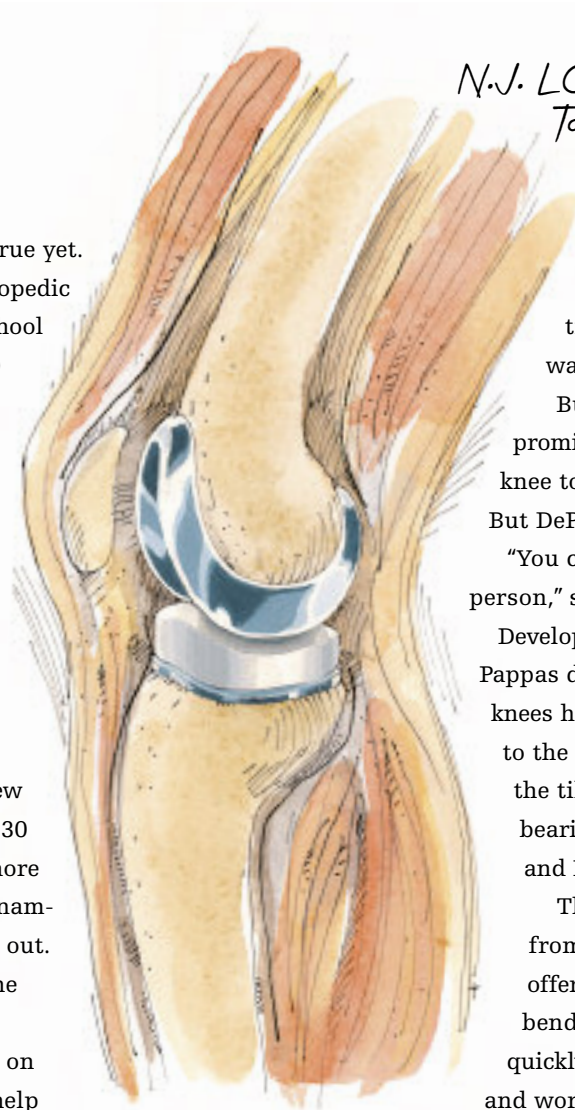
The orthopedic surgeon has known Buechel since organizing a panel of knee designers for the New Jersey Orthopaedic Society about 30 years ago. Other presenters had more elite credentials, but Buechel’s dynamic, data-driven presentation stood out. “I immediately switched over to the New Jersey Knee,” says Hirsch.

When Buechel first began work on his ankle replacement he sought help from Pappas, at the time a 41-year-old mechanical engineer teaching at New Jersey Medical School. “Any problem that I’m capable of solving is of interest,” says Pappas, now 80.

Buechel’s decision to ask for help wasn’t entirely surprising. The young doctor, who won four New Jersey Amateur Athletic Union and three Metropolitan Intercollegiate Wrestling Championships while at Seton Hall, liked a challenge — if evenly matched. Once he started working on the replacement ankle, he realized he wasn’t well matched; he hadn’t thought about the technical aspects of building the device.

Pappas’s engineering know-how evened the odds.

By 1976, the two men were building joints on their own time. Their focus shifted to shoulders, and they were also considering the knee. Then, good luck struck. Buechel



*N.J. LCS® Mobile Bearing
Total Knee System*

presented a paper about their shoulder at a conference, and caught the attention of an executive from DePuy, who wanted to license it.

Buechel saw his shot, and made DePuy promise to sign a contract to sell his artificial knee too. Bold move, as there was no knee yet. But DePuy agreed.

“You can’t live without being a business person,” says Buechel.

Development began. Buechel defined problems, Pappas designed solutions. At the time, artificial knees had two major components. One attached to the femur, a hip-to-knee bone; the other to the tibia, a knee-to-ankle bone. These “fixed-bearing knees” bent like a hinge, but Buechel and Pappas weren’t satisfied by the results.

Then a new idea arrived from a group from Oxford in the United Kingdom. It offered a way to make a knee that could both bend and turn a bit. Buechel and Pappas quickly adopted this “mobile-bearing” design, and worked to improve it.

By 1977, their mobile-bearing knees were a lot like the real thing, and in theory, would last longer than the fixed-bearing kind. DePuy, which sells both types, says one independent study found that, after 15 years of use, Buechel’s LCS Knee still was in good shape 97 percent of the time.

(The Buechel-Pappas partnership with DePuy ended some time ago, but the men still work together on their own.)

Still, knees are big business, and the technology keeps improving. Debates about which type is best remain some of the hottest at orthopedic conferences today, says Millennium’s Brown, the device analyst.

Buechel, always ready for a good challenge, is prepared to defend the merits of his knee.

The doctor clearly likes his odds.

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Cracking the College Code

Last winter, 15 students from Newark’s Technology High School took part in a six-month pilot program from Seton Hall’s Center for Mobile Research and Innovation. The “Young Developers Program” had a simple, yet important goal: prepare the students — who hail from a traditionally underprivileged community — to design and build mobile apps for smartphones and tablet computers on their own.

“That’s of value no matter what you decide to do,” says associate professor of political science Michael Taylor, the CMRI’s academic director.

That’s probably true. Mobile devices are booming. In 2007, smartphones were relatively rare and tablet computers were

non-existent. Today, just six years later, the United States has amassed 140 million smartphone and 123 million tablet users, reports eMarketer, a tech consultant. As a result, these devices have penetrated nearly every walk of life.

But not all teens are being given the skills and confidence needed to harness these forces.

The Young Developers program was designed to help by teaching students from disadvantaged areas to build mobile apps — a form of software — for smartphones and tablets. Each of its 12 lessons, which range from computer logic to user interfaces, includes a video lecture, in-class coding problem and take-home lab. A \$250,000 corporate gift from AT&T paid for the curriculum, as well as smartphones and laptop-tablet hybrids running Microsoft Windows.

The Newark Tech teens were also responsible for building their own mobile apps. All told, it was a lot of work.

To keep them on track, the students were paired with mentors from Seton Hall who had a similar socio-economic background. “I’ve lived in poverty, and I’ve seen poverty,” says Franck Nelson ’13, one of the six undergraduate mentors.

A biology major, Nelson immigrated from Haiti to Trenton, N.J., when he was 14. He joined the Young Developers pilot to offer tangible proof that nothing is out of reach. While the program’s focus is on coding, Nelson, who just started a graduate program at Seton Hall’s College of Nursing, says mentors spent as much time talking about college.

“We had people believe in us to get here,” he says. “We believe we can return the favor.”

Taylor, who is now running a second pilot project in Newark and trying to raise more money from AT&T to expand to two more cities in the next year, says the program’s first run ended with an unexpected surprise. He wasn’t sure if all the teens would finish their software. But they did, on their own or in a small group, building 12 apps.

“A lot of them weren’t satisfied by what they created,” he adds.

That’s just fine. Now they know how to do better. ■

| JAMES ERIK ABELS

