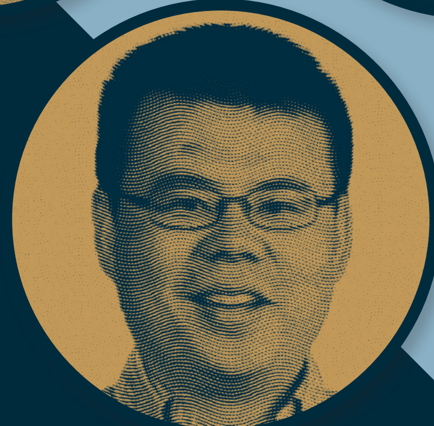






Faces Of American Innovation

The Inspiring Triumphs of the Bayh-Dole Act

"Possibly the most inspired piece of legislation to be enacted in America over the past half-century was the Bayh-Dole Act of 1980… More than anything, this single policy measure helped to reverse America's precipitous slide into industrial irrelevance."

– *The Economist Technology Quarterly*, 2002

Bayh-Dole
COALITION

Faces Of American Innovation

Table of Contents

A bipartisan miracle that changed the world

Against all odds, the Bayh-Dole Act was passed into law in 1980 — a momentous event that unleashed a wave of innovation.

Indiana Senator Birch Bayh was facing tough times.

He'd been elected to office in 1962, two years into the Kennedy Administration, in one of those rare moments when the party in the White House picks up midterm seats. At just 34, the Democrat became part of a new generation of leaders breathing excitement into national politics.

But by the late 1970s, things were different. Indiana had soured on President Jimmy Carter, dimming Bayh's own hopes of reelection. And vastly worse was the fact that his wife, Marvella, faced a recurrence of cancer. She'd been a dynamic spokeswoman for the American Cancer Society, and she tried to stay optimistic. But doctors told her the disease was inoperable.

Preoccupied as he was, Bayh took a call from Ralph Davis, who was in charge of the technology transfer office at Purdue University. Davis had a problem: Scientists at Purdue were making discoveries with the help of grants from the Department of Energy. With more investments of time and money, these inventions had the potential to become useful products.

But there was a hitch. As a condition of those federal grants, the government took the patent rights on the university's inventions and made them available to anyone who was interested. While well-intended, that destroyed any incentive to invest the time and resources necessary to turn early-stage discoveries into useful products, as rival companies could also get a license from the government and copy their work. As a result, potentially important discoveries just gathered dust on shelves in Washington.

> ***Nevertheless, Bayh and Dole found a common purpose. Together, they crafted a bill that allowed academic institutions, nonprofit laboratories, and small businesses to retain intellectual property rights on discoveries made with government support.***

This dilemma resonated with the Bayhs personally. They'd learned that restrictions on patent rights for government-funded research had delayed a tool that could predict how patients would react to chemotherapy. And Marvella was undergoing experimental treatment at the National Institutes of Health. Bayh recognized that while she might benefit from the most cutting-edge research, it would take more time and money to develop that research and share it with the wider public as an approved treatment. He wanted to make sure that happened.

As Bayh soon learned, of some 28,000 patents the government held in the late 1970s, just 5% had ever been licensed for further development. When the government took patent rights away from inventing organizations, not a single drug came to market out of research funded by the National Institutes of Health. Taxpayers were

seeing little benefit from the breakthroughs they'd helped fund.

The backdrop to all this was that the United States, the engine of the global economy after World War II, was losing ground to competitors like Japan and Germany. The industrial heartland became known as the Rust Belt as factories closed. Under the circumstances, it made no sense to let billions of dollars' worth of publicly funded research go to waste.

Bayh was determined to do something — and he learned that Senator Bob Dole, the Kansas Republican, was also interested in the issue. Bayh and Dole were on opposite sides of the political aisle; Dole was working tirelessly to defeat the Democrats in the 1980 election. The country was divided, with Carter facing an uphill battle to stay in office.

Nevertheless, Bayh and Dole found a common purpose. Together, they crafted a bill that allowed academic institutions, nonprofit laboratories, and small businesses to retain intellectual property rights on discoveries made with government support. Royalties universities made from commercialization would be invested back into funding new research and rewarding their inventors. And federal laboratories would be able to effectively license inventions made by their scientists.

Passing the legislation wasn't easy.

The bill faced seemingly insurmountable resistance. The Carter administration opposed the legislation and developed an alternative approach, focused on large government contractors rather than small firms and universities. Russell Long, the powerful Senator from Louisiana, opposed the legislation from the get-go — and threatened to kill it by offering multiple amendments to the bill when it first came to the Senate floor.

Sens. Bayh and Dole worked for months to beat back that opposition and drum up enough support to get the legislation over the finish line. And finally, after countless debates and conversations behind the scenes, the Bayh-Dole Act passed the Senate in April of 1980.

But in the House, lawmakers were throwing their support behind the Carter administration's approach. Before the chambers could align the two bills, the November elections rolled around.

Americans voted both Bayh and Carter out of office, so it looked like Bayh-Dole was doomed. Yet Congress had to reconvene in a lame-duck session to pass a budget, so there was still an outside chance the legislation would survive.

Bayh struck a deal with House leadership as time was running out. The House would include Bayh-Dole in its year-end legislation so long as the Senate passed the bill without any changes. The last hurdle was a unanimous vote in the Senate — a requirement for non-budgetary bills during lame-duck sessions of Congress. And Long was standing in the way.

Long liked the status quo of government patent policies. But apparently, he liked Bayh more. Hours before Congress recessed, Bayh's phone rang. "Birch," Long said, "you can pass your damn patent bill — and I'm sure going to miss working with you!"

In December 1980, the bill became law.

Bayh-Dole doesn't guarantee success. It simply provides the incentives and authorities needed to transform early-stage inventions into useful products. These are the stories of some of the men and women who seized that opportunity — and changed the world.

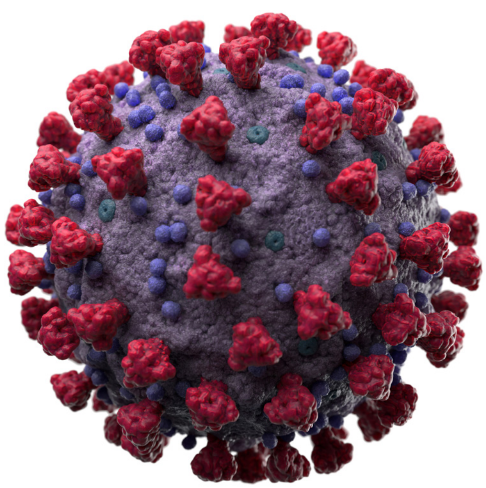
Carol Mimura: How a dose of persistence revolutionized cancer treatment

Few people know what tech transfer officials do. But one of them played a key role in giving cancer patients around the world new hope.

Finding companies to license early-stage university inventions is a hard job under the best of circumstances. It's even more challenging when you've been trying for years, a potentially revolutionary approach to cancer treatment is on the line, and you keep getting "no" for an answer.

Carol Mimura, who worked in the technology transfer office at the University of California, Berkeley, found herself in this situation in 1998.

It had all started three years earlier, when Berkeley immunologist James Allison faxed her about an apparent breakthrough in his lab. He believed he'd found a way to engage the body's own immune system to fight cancer. At the time, the only available treatments were surgery, radiation, and chemotherapy, which killed cancer cells but also ravaged the patient's body. Many people dreaded the treatment more than the disease.



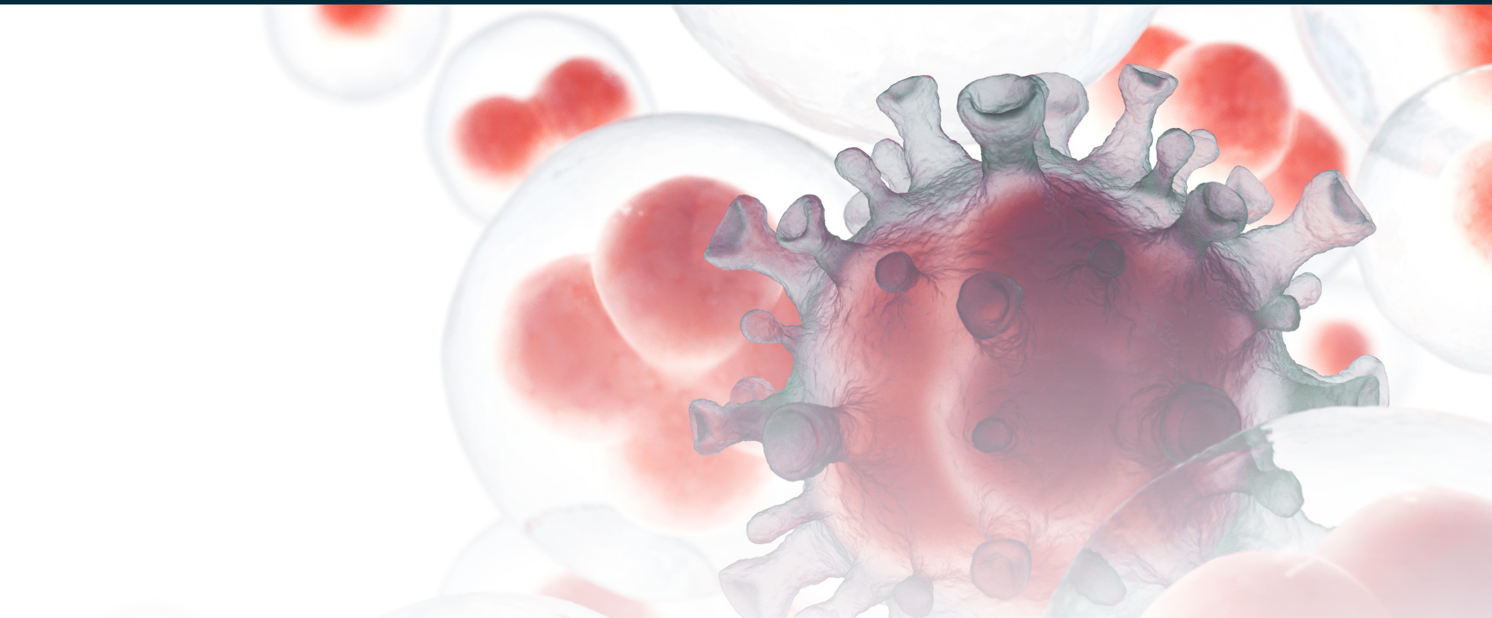
Mimura, who had trained as a biochemist, believed in Allison and his idea and applied for patents to protect his discovery. It wasn't a step she took lightly. Although the Bayh-Dole Act allows universities to own and license federally funded inventions, they still have to bear the cost of applying for broad patent coverage, which can easily exceed $150,000.

But she knew taking that risky step would enable the tech transfer office to license the discovery to a private company that could develop it into a useful product and earn the university royalties it could funnel back into research, just as Bayh-Dole intended. So she set out to find a commercial partner — and show her colleagues and bosses that the big expenditure was worth it.

Instead, the CEOs of companies she approached told her that Allison's idea would "never work." Some said Allison's method would kill patients before it cured them. The field of immunotherapy was simply too new.

The cancer-research community was similarly skeptical of Allison's idea to "release the brakes" on a patient's immune system to target tumors. Even after he published his seminal research, Allison recalled that "everyone thought [he] was crazy."

Mimura and Allison needed a win. But drug development is a high-risk endeavor. It typically costs a company more than $2 billion to transform a discovery into a fully tested and approved medicine. The failure rate for potential new drugs that start out along this path is about 95%. As the months ticked by, no one stepped forward to take a shot.



Ironically, given the expense and risk, small companies are more likely than large ones to license a new patent, because success can rocket them to the big time. Of course, failure can destroy them — and their investors — overnight.

Mimura had great confidence in Allison and his research, and she kept trying. California's Bay Area, where Berkeley is located, is a life-sciences hotbed, and she worked all her connections. Yet even the company executives and venture capitalists who saw potential in the breakthrough were hesitant. If all went well, the new drug would need approval from the Food and Drug Administration — and the FDA was known to move very slowly when confronted with novel approaches to treating diseases.

There are no prizes for patent licensing... Her reward is knowing that because she, Allison, and her team refused to quit, cancer patients the world over have new hope.

As companies kept saying "no," pressure grew on Mimura to let the patents lapse, which would save the university money. But she retained her faith in Allison. If he was right, better treatments for cancer patients were within reach.

Finally, she and Allison found a small biotech company, NeXstar Pharmaceuticals, to license the patents. A larger company soon acquired NeXstar and sublicensed the technology to another company called Medarex, which spent six years in research and development. In 2005, it joined forces with a pharmaceutical giant, Bristol Myers Squibb, to put the therapy through clinical trials.

The results were astounding. Patients with the most severe skin cancers added 11 months to their lives. Many with advanced melanoma lived years longer than they would have otherwise. The company submitted the impressive data to the FDA, which, as expected, took a long time to consider the revolutionary treatment.

In March 2011 — nearly 16 years after Allison first contacted Mimura — the FDA approved the new drug, which would be sold under the brand name Yervoy. It was a great success in treating cancer. The millions who have benefited include Allison himself. Today, immunotherapies treat 18 different types of cancer. In 2018, Allison was one of two scientists to win the Nobel Prize for Medicine.

There are no prizes for patent licensing. So, Mimura and her team went back to work launching new discoveries into the world. Her reward is knowing that because she, Allison, and her team refused to quit, cancer patients the world over have new hope.

Yan Wang: The materials engineer who dreamed of a greener future

Thanks to one young professor's big idea, more electric cars will be equipped with recycled batteries in years to come.

As a newly minted engineering professor in 2010, Yan Wang was convinced of two things.

The first was that there would be an electric vehicle revolution in the United States. The second was that it was only a matter of time before the lithium batteries in those cars died.

Wang knew that replacing the batteries would be a problem. After all, they were made of scarce metals that were only found in a few countries, like his native China. With virtually no domestic supply chain in place, the United States would be forced to rely on environmentally destructive mines in those few nations to fulfill its battery needs.

Not many of Wang's colleagues shared his concerns. Back then, the focus was on how to make batteries more powerful, not how to limit their ecological impact. Undeterred, and with just two years in the United States under his belt, he began dreaming of a way to recycle lithium batteries — and bring about a greener future.

Undeterred, and with just two years in the United States under his belt, he began dreaming of a way to recycle lithium batteries — and bring about a greener future.

At the time, rechargeable lithium batteries were already powering countless devices, from the new iPhone 4 to power tools. But some of the first electric vehicles to run on lithium batteries — Chevy Volts and Tesla Roadsters — were just hitting American roads.

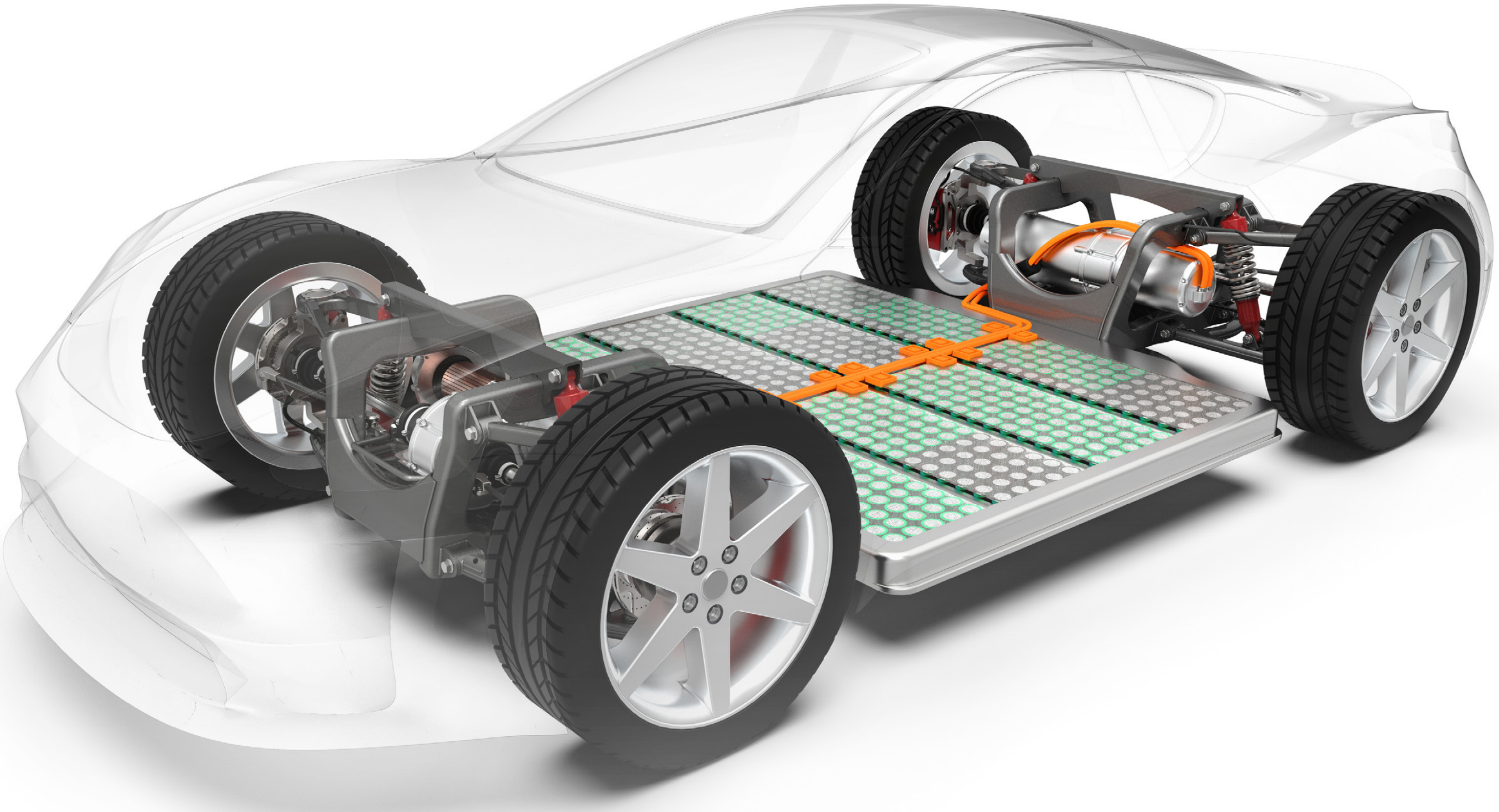
Wang understood that new EV batteries would likely stop working within a decade. If he couldn't figure out a way to harvest their critical metals before they all piled up in landfills, the industry would have to mine, process, and ship more ore — at an extreme fiscal, environmental, and human cost.

Extracting one ton of lithium — enough to make just 15 to 30 electric car batteries[1] — requires more than 580,000 gallons of water, and contaminates the surrounding soil, water, and air.[2] Another key battery ingredient, cobalt, is mostly found in the Democratic Republic of the Congo, where low-paid miners work in dangerous conditions and often endure abuse.

Wang also worried about the supply chain. Roughly 80% of U.S. lithium battery imports come from just one country, China.[3] And even metal battery components mined elsewhere are shipped to China for refinement. From there they're sent to a battery maker, with batteries finally shipped to factories that install them in consumer products. Wang realized that the EV market would be doomed if any part of this supply chain went offline.

When his peers caught wind of his plan to create an efficient and cost-effective means of recycling, they joked that Wang would never have enough lithium batteries to put through the process. There was simply no guarantee that EVs would catch on as Wang expected.

But he continued working in his lab at the Worcester Polytechnic Institute in Massachusetts



anyway. With the help of grants from the United States Advanced Battery Consortium — a partnership between automakers and the Department of Energy — and the National Science Foundation, he soon devised a technique to recycle lithium batteries.

After shredding a battery into small parts, Wang removed the cheaper components and dissolved the rest in acid. From the solution, he synthesized new battery materials. He stuck those materials onto a metal strip and inserted it into a new battery.

Because of the Bayh-Dole Act, Worcester Polytechnic could file for patents based on the young professor's big idea and begin the search for a private partner who could commercialize Wang's technique. And they found just the person for the job.

In 2015, Wang joined forces with one of his postdoctoral researchers and another professor to co-found a spin-off company, license the patents, and bring his process to market. That company, Ascend Elements, has achieved what was once unimaginable.

Using a scaled-up and perfected version of Wang's original process, Ascend can capture 98% of the critical metals in an old lithium battery. The process releases up to 90% fewer carbon emissions than the traditional manufacturing process — and it costs half as much.[4]

Better yet, the recycled batteries charge two to three times faster and last longer than new batteries, according to a peer-reviewed study.[5] Even Wang couldn't have predicted that the recycled batteries would actually work better than new ones.

Meanwhile, the booming EV market has proved his naysayers wrong. There could be 230 million on the road by 2030, according to the International Energy Agency.[6] Thanks to Wang, more of those vehicles will be equipped with recycled batteries.

Wang's vision and determination have catalyzed the development of additional battery innovations, including a dry coating technology that lowers costs, energy consumption, and emissions for the battery industry. He co-founded another spin-off company, AM Batteries, to commercialize the technology. And he's continuing to look for other ways to make the future a little greener for us all.

Katalin Karikó: How decades of "failure" transformed the course of a pandemic

Without one woman's dogged perseverance — and a chance encounter at an office photocopier — the Covid-19 mRNA vaccines might have never been developed.

It was a bad week for Katalin Karikó. And that was an understatement.

The year was 1995. She had just been demoted by her bosses at the University of Pennsylvania, who were frustrated by the lack of funding she was pulling in for her research. Just days prior, she had been diagnosed with cancer. And she would largely have to endure multiple surgeries and her demotion alone, since her husband was at home in Hungary fighting authorities over a visa issue.

It might have been a career-ending few days for many scientists in Karikó's shoes. But she was no stranger to adversity. In fact, she had battled it all her life. And though she didn't know it then, her dogged perseverance would one day help save the lives of millions of people.

> **Suddenly, decades of work by Karikó and countless other researchers combined to offer the world its best hope for developing a vaccine against what became known as Covid-19.**

Growing up in a two-room house in a tiny village in communist Hungary, Karikó often watched her father, a butcher, at work. She became determined to understand the science of life.

She was part of a generation of young girls pushed into the sciences by Party leaders. But that didn't mean doing science was easy. In those years under communist rule, lab materials were hard to come by. As an undergraduate, Karikó's lab had to create the ingredients they needed to conduct their experiments.

It was in one of her college classes that she first learned about messenger RNA — genetic material that instructs the body to create the proteins it needs to live. Throughout graduate school, her PhD studies, and her postdoctorate career, Karikó became increasingly convinced mRNA could unlock the body's disease-fighting potential.

She had a hard time proving it. Messenger RNA can be finicky, and many of the techniques used to study it today simply hadn't been discovered yet. Karikó's experiments failed more than they succeeded, and her lab eventually lost its financial backing.

That was the first time she found herself searching for another lab where she could continue studying mRNA. But it wouldn't be the last.

Karikó began looking for jobs in the United States and soon found one at Temple University. So she sold the family car on the black market. She stuffed the proceeds — about $1,200 — into her two-year-old daughter's teddy bear because Hungary wouldn't let citizens leave the country with more than $100. She then bought one-way tickets to Philadelphia for herself, her husband, and their daughter.

After three years at Temple and a brief stint in a lab in Bethesda, Maryland, Karikó accepted a low-level job as a research assistant professor at the University of Pennsylvania. But her employment came with none of the flashy perks

an Ivy League researcher would normally receive. To continue with her mRNA research, Karikó had to rely on grants and better-resourced professors willing to take her under their wings.

That was easier said than done.

At the time, the thought of using mRNA to instruct the body to make disease-fighting proteins — from antibodies against a virus to tissue-repairing enzymes — was more science fiction than respectable theory. Though previous scientists had some success in mice, Karikó couldn't get her idea to work without the immune system killing off her synthetic mRNA. So it was all but impossible to convince the scientific community that her research was worth funding.

Karikó could easily have focused on more assured endeavors. Instead, she doubled down.

She worked mornings, nights, weekends, holidays, and every time in between. She received grant rejection after grant rejection. She moved between labs when the more senior researchers leading them left Penn.

All the while, her salary never exceeded $60,000. At one point, her husband estimated that she earned roughly a dollar an hour, considering all the extra time she was devoting to her research.

Still, she was demoted on that fateful day in 1995. It would be two years until she crossed paths with Drew Weissman in a chance meeting at an office photocopier.

He told her he was working to develop a vaccine against HIV. Karikó, as determined as ever to see her years of research vindicated, told Weissman she thought mRNA could be the key.

With federal dollars supporting their work, the two scientists figured out a way to prevent the immune system from attacking Karikó's synthetic mRNA. They worked with the University of Pennsylvania to patent the innovation — a move only made possible by the Bayh-Dole Act — and published their results in 2005. Weissman and Karikó braced themselves for the excitement their research would generate in the scientific community.

Instead, their discovery was met with deafening silence. Another five years would pass before two virtually unknown biotech companies called BioNTech and Moderna licensed the patents and began working on mRNA vaccines and therapies.

The firms' work didn't receive much attention as they worked to perfect their mRNA vaccine platforms. That is, until severe illness from a novel coronavirus began spreading around the globe in early 2020.

Suddenly, decades of work by Karikó and countless other researchers combined to offer the world its best hope for developing a vaccine against what became known as Covid-19. The work Moderna and BioNTech had put in enabled them to plug in the genetic information for the new coronavirus and produce safe and effective shots in record time.

As of March 2023, more than 5.5 billion Covid-19 vaccine doses had been administered around the globe. Many of them were mRNA vaccines made by Moderna and BioNTech in partnership with Pfizer.[7]

And the full impact of Karikó's persistence isn't yet known. Researchers are now investigating mRNA vaccines for diseases ranging from HIV to cancer. Clinical trial results already look promising.[8]

Karikó faced countless closed doors throughout her career. But in the process of blowing right through them — and uncovering life's secrets — she opened innumerable others.

Peter Stern: Looking for a Christmas miracle

Sometimes, even experienced startup CEOs need a Christmas miracle to keep a company afloat.

Peter Stern likes to grow new companies. Having done it many times before, he's good at it. And thanks to a long record in venture capital, he also knows the long odds against turning a university invention into a useful product.

Now, days before Christmas in 2021, he was scrambling to keep his company alive. He'd gone most of the year without a salary. His staff had taken voluntary pay cuts to keep the business afloat, because they believed in their groundbreaking technology.

Despite these sacrifices, the end was near. If Stern didn't quickly find new funds, they would have to shut down. And while raising money for a startup is always hard, the odds of finding venture capital over the holiday break seemed hopeless.

It had all started with Dr. Michal Lipson, a physicist at Columbia University who investigates the microscopic properties of light. With some help from federal funding, she had discovered ways of using light detection — also known as lidar — that could revolutionize transportation, giving cars and drones new powers to "see" their surroundings and steer themselves.

Two of her former graduate students, Christopher Phare and Steven Miller, decided to forgo secure jobs in academia to form a company around Lipson's inventions. They could do so only because the Bayh-Dole Act enabled Columbia to retain the patents on the discoveries and license them to a private firm.

Pare and Miller negotiated the patent licenses with the university and called the new company Voyant Photonics. They soon faced every start-up's primary challenge. They needed money.

Recognizing that required business experience to complement their technical knowledge, Peter Stern was hired as CEO for his impressive track record of launching high-tech businesses.

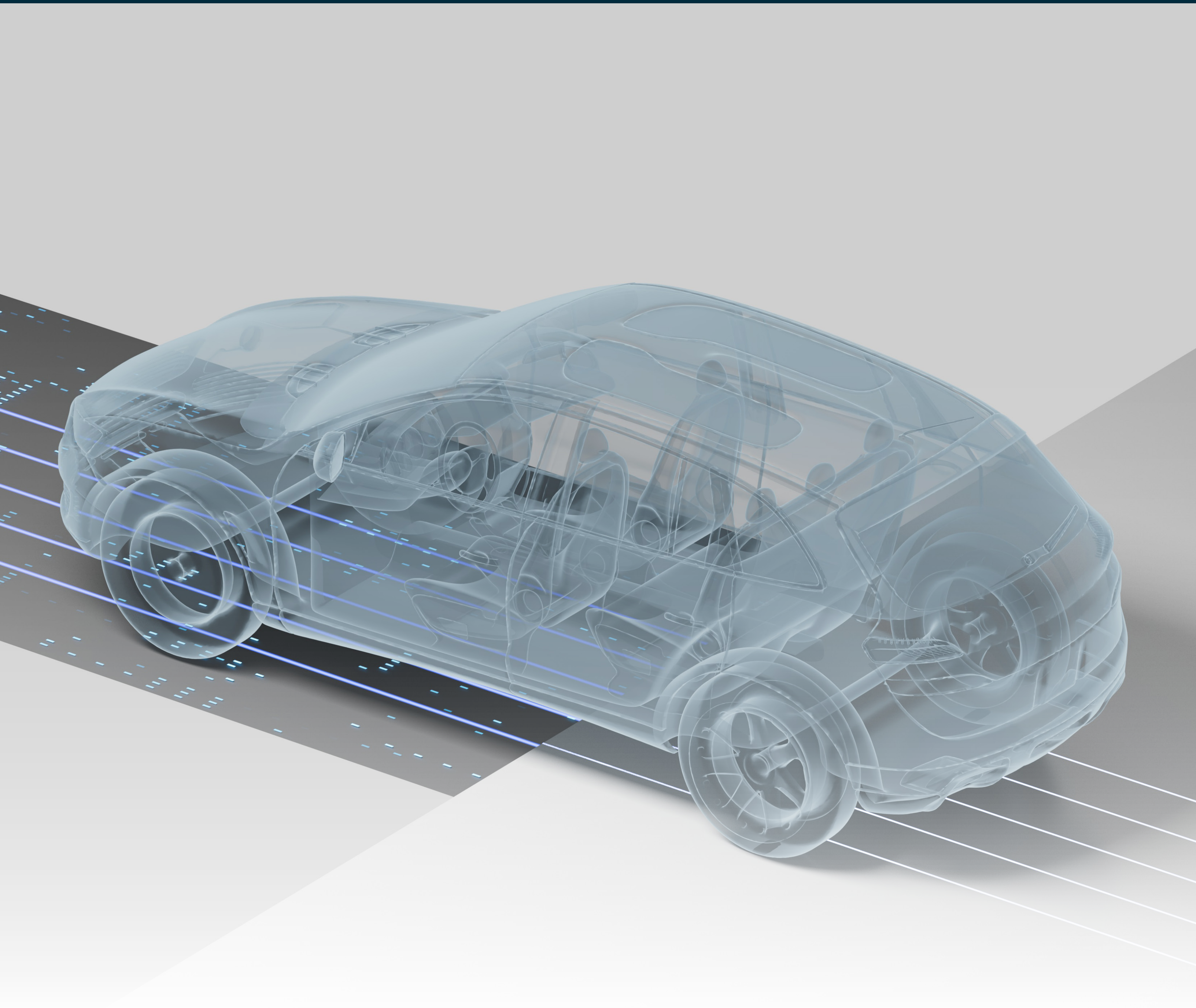
Things got off to a fast start. Voyant won a government contract, which gave it enough credibility to raise a first round of venture funding. That was used to build a prototype.

He had just hours left before he needed to inform Voyant's loyal staff that their dream was dead and they'd soon be out on the street.

But Voyant faced a crucial hurdle. Lidar products had all been bulky and expensive. The goal was to make one that fit on a fingertip, yet still had all the capabilities of a larger device. And that required even greater amounts of venture funding.

Product development was going well and the technology continued to look promising, but Voyant was almost out of cash. Throughout 2021, Stern met with venture capitalists who were impressed with Voyant's technology. But those would-be investors were also influenced by bigger forces — not least a pandemic and its economic impact — that were outside of any company's control. Stern's leads kept falling through.

He had just hours left before he needed to



inform Voyant's loyal staff that their dream was dead and they'd soon be out on the street. His calls and emails went unanswered as potential funders left for the holidays. But Peter Stern doesn't give up easily. He kept working his contact list but he needed a miracle.

Finally, he realized it was time to face reality. The jig was up. Just then the phone rang. One of those contacts was on the line. Three venture capital firms would pool their resources to invest $15.4 million dollars in Voyant.

That allowed Stern to fully pay the staff who'd loyally stuck by him. Voyant could scale up production. And Peter Stern could finally get paid as well.

Voyant has developed a tiny lidar chip that it's testing in robots and self-driving cars. The device could also be applicable to archeology, agriculture, renewable energy, and many other fields.

Like all startups, Voyant has challenging days ahead. But thanks to Stern's tireless work — and a timely Christmas reprieve — the company could have a profound impact on how we move through the world. That's how entrepreneurial companies drive American innovation. But it's never easy.

Dennis Liotta: Commuting a death sentence

One scientist helped change the course of not one, but two pandemics.

In the summer of 1981, a trickle of people started showing up in doctors' offices with a mysterious ailment. Their immune systems were shutting down, turning everyday infections into deadly threats.

The trickle turned into a flood. Something was drastically wrong. And all doctors could do was try to make patients comfortable as their bodies fell apart. Soon they were dead.

By 1983, the new disease had killed thousands in the United States, and it had a name: acquired immune deficiency syndrome, or AIDS. Another horror emerged. It was in the blood supply, infecting anyone who received a tainted transfusion. In the United Kingdom, an estimated one-third of those who contracted AIDS through their blood bank were children.

Dr. Robert Gallo, a biomedical researcher at the National Institutes of Health, co-discovered the human immunodeficiency virus — HIV — as the cause of the disease. He and colleagues invented the first HIV test kit that was patented and licensed by NIH. It helped diagnose patients and protect the blood supply, which was a huge advance. But there was still no treatment. Between 1981 and 1990, more than 100,000 Americans died of the disease.[9]

In sub-Saharan Africa, it was much worse. By 1998, life expectancy had dropped by a quarter, from 64 to 47 years. More than 2 million people were infected each year.[10]

Scientists all over the world felt called to act. One of them was Dennis Liotta at Emory University. But fighting AIDS fell outside his field of expertise. He wasn't a virologist or an immunologist but specialized in inventing ways to make new chemicals.

His colleague, Raymond Schinazi, learned at an AIDS conference about a molecule that inhibited HIV. Inspired, Liotta developed a more efficient way to create similar molecules and soon designed two compounds that safely inhibited the replication of HIV.

But Liotta could only do so much. For his discoveries to make an impact, they had to be transformed into medicines. That required private-sector partners.

But Liotta could only do so much. For his discoveries to make an impact, they had to be transformed into medicines. That required private-sector partners.

Drug development is among the riskiest commercial endeavors. Inventing a new treatment often takes more than a decade of work and costs hundreds of millions — or even billions — of dollars. Projects fail at a rate of 95%, and when they do, companies take the hit. That makes life-science firms very choosy about what to back.

Liotta persuaded Emory's tech-transfer officials to exercise their authority under the Bayh-Dole Act and patent his discoveries. Like Bayh and Dole, he recognized that companies wouldn't consider the project without intellectual property protections.

Yet even the promise of patent protections

didn't guarantee Liotta's discoveries would reach patients. Just one week after Emory filed for patents on the molecules Liotta discovered, a Canadian company included one of the discoveries in a patent filing of its own. This set the stage for a patent dispute. Although potential development partners thought Liotta's discoveries were promising, many shied away from the project because they weren't interested in getting into a costly legal fight.

Despite these challenges — and the sudden need to learn about patent law — Liotta never lost sight of his primary goal: getting his discoveries to those living with HIV.

Emory and Liotta finally scored a success when they licensed the patents to the non-profit drug company Burroughs Wellcome. Now the real work began.

Liotta's friend — and former student — George Painter was a virologist at Burroughs Wellcome, and now they shared a mission to halt the terrifying disease. But in the lab, HIV was becoming resistant to Liotta's molecule. The project seemed doomed.

Fortunately, there were multiple experiments going on. Researchers discovered that if they used one of Liotta's molecules with AZT, another drug that inhibited HIV, the combination could overwhelm the virus. It was a novel approach for a novel disease. Soon, the idea of creating a "cocktail" of multiple medications provided the first real hope.

That hope was almost dashed, though. In a trial of a new HIV combination therapy in South Africa, several patients developed complications. Then two died. The trial was immediately halted. The problem, it turned out, was caused by another drug in the mix. The data showed that Liotta's molecules were safe and highly effective, so testing resumed.[11]

On the business side, Emory spent over $20 million to defend its patents and resolve the intellectual property disputes that eventually materialized. With those fights settled, the road to FDA approval seemed clear.

In 1995 — roughly 15 years after the virus began its deadly trajectory — the FDA approved one of Liotta's compounds to treat HIV. In 2003, it approved the other. Today, the majority of HIV treatments on the market contain one of the two compounds originally synthesized in Liotta's lab. HIV has been transformed from a death sentence into a manageable chronic disease.

The U.S. Department of State estimates that 25 million lives were saved in Africa alone once we made modern antiretroviral drugs available.

Liotta went on to establish the Emory Institute for Drug Development, which sprang into action when the Covid-19 pandemic hit. He and Painter created the first antiviral for treating patients at risk of severe complications.

So, Dennis Liotta helped change the course of not one, but two deadly pandemics. Not bad for a chemist who had to learn virology on the fly.

Not all roads lead straight to success

Some innovations fail despite the best efforts of everyone involved. But "failure" can easily become a stepping stone to a future success.

But not every Bayh-Dole story is a success. After all, getting an invention from the lab to the marketplace is a long, risky, and expensive endeavor. Often, there's a snag in the process. It's entirely possible for researchers, universities, and private partners to do everything right — and still fail.

Cody Friesen: The inventor whose batteries ran out of juice

Cody Friesen had no intention of joining the faculty at his alma mater in 2004. But when he learned that Arizona State University was exploring ways to harness ideas on campus to solve real-world problems, he knew he had to take part.

And he had just the real-world problem to solve.

At the time, there were few cost-effective, reliable, and sustainable ways to store renewable energy, such as solar and wind power. That changed when Friesen discovered a way to make zinc-air batteries rechargeable. He founded Fluidic Energy in 2007 to commercialize the research.

The technology was a raging success. It helped bring electricity to millions of people in the developing world. And it attracted millions of dollars in venture capital.

Despite years of triumph, Friesen's technology failed to catch on in the broader energy storage market. Fluidic tried to keep going by laying off half its workforce. But even that couldn't save the company from shutting down.

Yet Friesen's ingenuity wasn't for naught. In 2020, a new company called Form Energy acquired all of Fluidic's assets and patents. Technology that Fluidic perfected over a decade now underpins an essential component of Form Energy's iron-air battery.

Form Energy's CEO credits Fluidic with saving his own company years of research and unnecessary risk. In other words, one innovation's "failure" can provide just the right amount of juice for another's success.

James Crowe: The antibody hunter missing from history books

As mysterious cases of a novel coronavirus started popping up in early 2020, the Defense Advanced Research Projects Agency — DARPA, a federal department — came knocking at James Crowe's door. The world needed a treatment to neutralize Covid-19 — and fast.

The Vanderbilt University vaccine researcher knew time wasn't on his side. He had previously discovered antibodies that could fight viruses like Ebola and bird flu, but the process usually took him months. With Covid-19 spreading rapidly, Crowe had just days to find a solution.

So he hunkered down in his lab, working around the clock to sift through survivors' blood and find a needle in a haystack: antibodies that could fight Covid-19.

After just 25 days, Crowe succeeded. He delivered a batch of antibodies to AstraZeneca for further development. In December 2021, some of them were granted Emergency Use Authorization by the U.S. Food and Drug Administration under the name Evusheld.

But as the government worked to get a grip on the pandemic, there was no coordinated effort to educate providers or the public about the new

tool against Covid-19. Many Evusheld doses went unused.

Meanwhile, the virus evolved rapidly, eventually rendering the medication ineffective. In January 2023, the FDA revoked its authorization for Evusheld after data showed the treatment was not effective against more than 90% of the new Covid-19 variants circulating in the United States.[12]

Despite Evusheld's eventual demise, roughly 720,000 courses were administered to U.S. patients. The medication likely saved thousands of lives.[13]

When the story of Covid-19 is written, few will remember the antibodies on the market for little more than a year — let alone the university researcher who holed himself up in a lab and delivered them to patients in record time.

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James Dumesic: The professor with a recipe for success

Former University of Wisconsin-Madison chemist James Dumesic knows what it takes to turn early-stage, federally funded research into a real-world product.

In 2002, he did just that.

Dumesic and a colleague discovered a revolutionary process that could convert plant sugars into the compounds that make up energy sources like gasoline, diesel, coal, and jet fuel. The pair launched a spin-off company called Virent to license and commercialize the research.

With millions of dollars in federal grants, numerous awards, and multiple partnerships with companies ranging from Coca-Cola to Shell, Virent is a huge success. So when Dumesic developed a separate process to turn organic matter into industrial chemicals and founded Glucan Biorenewables in 2012 to license the research, many likely thought it'd be another home run.

But investors weren't biting. In a world running on cheaper, fossil-fuel-based chemicals, attracting interest in the biochemical space was incredibly difficult. Despite raising over a million dollars in funding, the company couldn't stay afloat.

Dumesic had all the right ingredients: a good idea, the right patents, and experience commercializing breakthrough research. But sometimes, even with all those elements, success is still elusive.

Epilogue

We must protect the Bayh-Dole system — for all the inventors to come and for all the Americans who deserve to reap the benefits of future breakthroughs.

As Senators Bayh and Dole learned that President Carter had signed their legislation into law, they couldn't have known of its revolutionary impact, nor imagined the inspiring triumphs that would follow.

Bayh and Dole dreamed of a world where brilliant ideas would no longer be confined to labs and scientific journals. They created a strong incentive structure for private companies to license and develop federally-funded research because they knew it would break those chains and unleash a wave of innovation.

The Bayh-Dole system works because it incentivizes private companies to partner with public sector researchers and bring government-funded discoveries to fruition. We must protect and uphold that system — not just for the sake of carrying on Bayh and Dole's legacy, but for all the Katalin Karikós, Dennis Liottas, Carol Mimuras, Peter Sterns, and Yan Wangs to come, for the researchers and entrepreneurs who turn breakthroughs into products, and most of all, for the Americans who deserve to reap the rewards of the scientific breakthroughs of our time.

Endnotes

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Bayh-Dole COALITION

Celebrating the past. Protecting the future.

Bayh-Dole Coalition Executive Director Joseph Allen sitting alongside Senator Birch Bayh as his aide in the Bayh-Dole hearings

About the Bayh-Dole Coalition

The Bayh-Dole Coalition is a diverse group of innovation-oriented organizations and individuals committed to celebrating and protecting the Bayh-Dole Act, as well as informing policymakers and the public of its many benefits.

About Joseph P. Allen

Joe is the executive director of the Bayh-Dole Coalition. As a professional staffer on the Senate Judiciary Committee to Sen. Birch Bayh (D-IN), he played a key role in the successful passage of the Bayh-Dole Act of 1980 and its subsequent amendments.

He later served as the director of the Office of Technology Commercialization at the U.S. Department of Commerce, which oversees the implementation of Bayh-Dole across all federal agencies. Joe chaired the Interagency Committee on Technology Transfer, where he helped agencies implement the Federal Technology Transfer Act and worked to insure that international science and technology agreements conformed to Bayh-Dole. He also served as president of the National Technology Transfer Center.