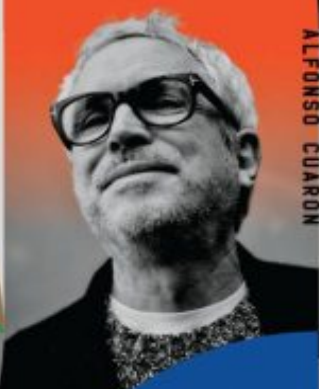# WIRED

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ISSUE

Wired Magazine, Monthly Edit

Magazine Articles

Magazine Articles

[The New Gods of Weather Can Make Rain on Demand—or So They Want You to Believe](#) [Priscila, Queen of the Rideshare Mafia](#) [The Mayor of London Enters the Bullshit Cinematic Universe](#) ['Over Time the Trust Will Come': An Exclusive Interview With TikTok's CEO](#) [The Spy Who Dumped the CIA, Went to Therapy, and Now Makes Incredible Television](#) [The Hottest Startups in Dublin in 2024](#) [The Hottest Startups in Helsinki in 2024](#) [The Hottest Startups in Madrid in 2024](#) [Europe's Innovation Ecosystem Can Make It the New Palo Alto](#) [The Hottest Startups in Amsterdam in 2024](#) [The Hottest Startups in Lisbon in 2024](#) [The Hottest Startups in Zurich in 2024](#) [The Hottest Startups in Paris in 2024](#) [The Hottest Startups in Berlin in 2024](#) [The Hottest Startups in London in 2024](#) [The Hottest Startups in Stockholm in 2024](#) [Six-Word Sci-Fi: Stories Written by You](#) [This Homemade Drone Software Finds People When Search and Rescue Teams Can't](#) [The Secret Alchemy of Making Ice Cream](#) [These New Biomaterials Can Help Decarbonize Fashion and Construction](#) [Eight Scientists, a Billion Dollars, and the Moonshot Agency Trying to Make Britain Great Again](#) [How a 15-Year-Old Gamer Became the Patron Saint of the Internet](#) [When War Came to Their Country, They Built a Map](#) [This Is the Most Detailed Map of Human Brain Connections Ever Made](#) [This Code Breaker Is Using AI to Decode the Heart's Secret Rhythms](#) [This Gargantuan Lab Simulates Blasting Satellites Into Space](#) [Jane Goodall Thinks It's Not Too Late to Save the World](#) [Health Care Should Be Designed for the](#)

[Tests If Heat-Proof Clothing Actually Works? These Poor Sweating Mannequins](#) [Nick Hornby's Brain-Bending Sculptures Twist History Into New Shapes](#) [This Small Wearable Device Reduces Parkinson's Symptoms](#)

[Amit Katwala](#)
[The Big Story](#)
Jul 30, 2024 6:00 AM

The New Gods of Weather Can Make Rain on Demand—or So They Want You to Believe

In a gold-trimmed command center on the outskirts of Abu Dhabi, scientists are seeking to wring moisture from desert skies. But will all their extravagant cloud-seeding tech—planes that sprinkle nanomaterials, lasers that scramble the atmosphere—really work at scale?

Play/Pause Button
⏸

ILLUSTRATIONS: ANA MIMINOSHVILI

In the skies over Al Ain, in the United Arab Emirates, pilot Mark Newman waits for the signal. When it comes, he flicks a few silver switches on a panel by his leg, twists two black dials, then punches a red button labeled FIRE.

A slender canister mounted on the wing of his small propeller plane pops open, releasing a plume of fine white dust. That dust—actually ordinary table salt coated in a nanoscale layer of titanium oxide—will be carried aloft on updrafts of warm air, bearing it into the heart of the fluffy convective [clouds](#) that form in this part of the UAE, where the many-shaded sands of Abu Dhabi meet the mountains on the border with Oman. It will, in theory at least, attract [water](#) molecules, forming small droplets that will collide and coalesce with other droplets until they grow big enough for gravity to pull them out of the sky as rain.

This is cloud seeding. It's one of hundreds of missions that Newman and his fellow pilots will fly this year as part of the UAE's ambitious, decade-long attempt to increase rainfall in its desert lands. Sitting next to him in the copilot's seat, I can see red earth stretching to the horizon. The only water in sight is the swimming pool of a luxury hotel, perched on the side of a mountain below a sheikh's palace, shimmering like a jewel.

More than 50 countries have dabbled in cloud seeding since the 1940s—to slake droughts, refill hydroelectric reservoirs, keep ski slopes snowy, or even use as a weapon of war. In recent years there's been a new surge of interest, partly due to scientific breakthroughs, but also because arid countries are facing down the early impacts of climate change. Like other technologies designed to treat the symptoms of a warming planet (say, pumping sulfur dioxide into the atmosphere to reflect sunlight into space), seeding was once controversial but now looks attractive, perhaps even imperative. Dry spells are getting longer and more severe: In Spain and southern Africa, crops are withering in the fields, and cities from Bogotá to Cape Town have been forced to ration water. In the past nine months alone, seeding has been touted as a solution to air pollution in Pakistan, as a way to prevent forest fires in Indonesia, and as part of an effort to refill the Panama Canal, which is drying up.

Apart from China, which keeps its extensive seeding operations a closely guarded secret, the UAE has been more ambitious than any other country about advancing the science of making rain. The nation gets around 5 to 7 inches of rain a year—roughly half the amount that falls on Nevada, America's driest state. The UAE started its cloud-seeding program in the early 2000s, and since 2015 it has invested millions of dollars in the Rain Enhancement Program, which is funding global research into new technologies.

This past April, when a storm dumped a year's worth of rain on the UAE in 24 hours, the widespread flooding in Dubai was quickly blamed on cloud seeding. But the truth is more nebulous. There's a long history of people— tribal chiefs, traveling con artists, military scientists, and most recently VC-backed techies—claiming to be able to make it rain on demand. But cloud seeding can't make clouds appear out of thin air; it can only squeeze more

rain out of what's already in the sky. Scientists still aren't sure they can make it work reliably on a mass scale. The Dubai flood was more likely the result of a region-wide storm system, exacerbated by climate change and the lack of suitable drainage systems in the city.

The Rain Enhancement Program's stated goal is to ensure that future generations, not only in the UAE but in arid regions around the globe, have the water they need to survive. The architects of the program argue that "water security is an essential element of national security" and that their country is "leading the way" in "new technologies" and "resource conservation." But the UAE—synonymous with luxury living and conspicuous consumption—has one of the highest per capita rates of water use on earth. So is it really on a mission to make the hotter, drier future that's coming more livable for everyone? Or is this tiny petro-state, whose outsize wealth and political power came from helping to feed the industrialized world's fossil-fuel addiction, looking to accrue yet more wealth and power by selling the dream of a cure?

I've come here on a mission of my own: to find out whether this new wave of cloud seeding is the first step toward a world where we really can control the weather, or another round of literal vaporware.

The first systematic attempts at rainmaking date back to August 5, 1891, when a train pulled into Midland, Texas, carrying 8 tons of sulfuric acid, 7 tons of cast iron, half a ton of manganese oxide, half a dozen scientists, and several veterans of the US Civil War, including General Edward Powers, a civil engineer from Chicago, and Major Robert George Dyrenforth, a former patent lawyer. Powers had noticed that it seemed to rain more in the days after battles, and had come to believe that the "concussions" of artillery fire during combat caused air currents in the upper atmosphere to mix together and release moisture. Powers figured he could make his own rain on demand with loud noises, either by arranging hundreds of cannons in a circle and pointing them at the sky or by sending up balloons loaded with explosives. His ideas, which he laid out in a book called *War and the Weather* and lobbied for for years, eventually prompted the US federal government to bankroll the experiment in Midland.

Powers and Dyrenforth's team assembled at a local cattle ranch and prepared for an all-out assault on the sky. They made mortars from lengths of pipe, stuffed dynamite into prairie dog holes, and draped bushes in rackarock, an explosive used in the coal-mining industry. They built kites charged with electricity and filled balloons with a combination of hydrogen and oxygen, which Dyrenforth thought would fuse into water when it exploded. (Skeptics pointed out that it would have been easier and cheaper to just tie a jug of water to the balloon.) The group was beset by technical difficulties; at one point, a furnace caught fire and had to be lassoed by a cowboy and dragged to a water tank to be extinguished. By the time they finished setting up their experiment, it had already started raining naturally. Still, they pressed on, unleashing a barrage of explosions on the night of August 17 and claiming victory when rain again fell 12 hours later.

It was questionable how much credit they could take. They had arrived in Texas right at the start of the rainy season, and the precipitation that fell before the experiment had been forecast by the US Weather Bureau. As for Powers' notion that rain came after battles—well, battles tended to start in dry weather, so it was only the natural cycle of things that wet weather often followed.

Despite skepticism from serious scientists and ridicule in parts of the press, the Midland experiments lit the fuse on half a century of rainmaking pseudoscience. The Weather Bureau soon found itself in a running media battle to debunk the efforts of the self-styled rainmakers who started operating across the country.

The most famous of these was Charles Hatfield, nicknamed either the Moisture Accelerator or the Ponzi of the Skies, depending on whom you asked. Originally a sewing machine salesman from California, he reinvented himself as a weather guru and struck dozens of deals with desperate towns. When he arrived in a new place, he'd build a series of wooden towers, mix up a secret blend of 23 cask-aged chemicals, and pour it into vats on top of the towers to evaporate into the sky. Hatfield's methods had the air of witchcraft, but he had a knack for playing the odds. In Los Angeles, he promised 18 inches of rain between mid-December and

late April, when historical rainfall records suggested a 50 percent chance of that happening anyway.

While these showmen and charlatans were filling their pocketbooks, scientists were slowly figuring out what *actually* made it rain—something called cloud condensation nuclei. Even on a clear day, the skies are packed with particles, some no bigger than a grain of pollen or a viral strand. "Every cloud droplet in Earth's atmosphere formed on a preexisting aerosol particle," one cloud physicist told me. The types of particles vary by place. In the UAE, they include a complex mix of sulfate-rich sands from the desert of the Empty Quarter, salt spray from the Persian Gulf, chemicals from the oil refineries that dot the region, and organic materials from as far afield as India. Without them there would be no clouds at all—no rain, no snow, no hail.

I'm suddenly very aware that I'm on a military base. Couldn't this giant movable laser be used as a weapon?

A lot of raindrops start as airborne ice crystals, which melt as they fall to earth. But without cloud condensation nuclei, even ice crystals won't form until the temperature dips below –40 degrees Fahrenheit. As a result, the atmosphere is full of pockets of supercooled liquid water that's below freezing but hasn't actually turned into ice.

In 1938, a meteorologist in Germany suggested that seeding these areas of frigid water with artificial cloud condensation nuclei might encourage the formation of ice crystals, which would quickly grow large enough to fall, first as snowflakes, then as rain. After the Second World War, American scientists at General Electric seized on the idea. One group, led by chemists Vincent Schaefer and Irving Langmuir, found that solid carbon dioxide, also known as dry ice, would do the trick. When Schaefer dropped grains of dry ice into the home freezer he'd been using as a makeshift cloud chamber, he discovered that water readily freezes around the particles' crystalline structure. When he witnessed the effect a week later, Langmuir jotted down three words in his notebook: "Control of Weather." Within a few months, they were dropping dry-ice pellets from planes over Mount Greylock in Western Massachusetts, creating a 3-mile-long streak of ice and snow.

Another GE scientist, Bernard Vonnegut, had settled on a different seeding material: silver iodide. It has a structure remarkably similar to an ice crystal and can be used for seeding at a wider range of temperatures. (Vonnegut's brother, Kurt, who was working as a publicist at GE at the time, would go on to write *Cat's Cradle*, a book about a seeding material called ice-nine that causes all the water on earth to freeze at once.)

In the wake of these successes, GE was bombarded with requests: Winter carnivals and movie studios wanted artificial snow; others wanted clear skies for search and rescue. Then, in February 1947, everything went quiet. The company's scientists were ordered to stop talking about cloud seeding publicly and direct their efforts toward a classified US military program called Project Cirrus.

Over the next five years, Project Cirrus conducted more than 250 cloud-seeding experiments as the United States and other countries explored ways to weaponize the weather. Schaefer was part of a team that dropped 80 pounds of dry ice into the heart of Hurricane King, which had torn through Miami in the fall of 1947 and was heading out to sea. Following the operation, the storm made a sharp turn back toward land and smashed into the coast of Georgia, where it caused one death and millions of dollars in damages. In 1963, Fidel Castro reportedly accused the Americans of seeding Hurricane Flora, which hung over Cuba for four days, resulting in thousands of deaths. During the Vietnam War, the US Army used cloud seeding to try to soften the ground and make it impassable for enemy soldiers.

A couple of years after that war ended, more than 30 countries, including the US and the USSR, signed the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques. By then, interest in cloud seeding had started to melt away anyway, first among militaries, then in the civilian sector. "We didn't really have the tools—the numerical models and also the observations—to really prove it," says Katja Friedrich, who researches cloud physics at the University of Colorado. (This didn't stop the USSR from seeding clouds near the site of the nuclear meltdown at Chernobyl in hopes that they would dump their radioactive contents over Belarus rather than Moscow.)

More than 50 countries have dabbled in cloud seeding since the 1940s—to combat droughts, refill hydroelectric reservoirs, keep ski slopes snowy, or even use them as a weapon of war.

To really put seeding on a sound scientific footing, they needed to get a better understanding of rain at all scales, from the microphysical science of nucleation right up to the global movement of air currents. At the time, scientists couldn't do the three things that were required to make the technology viable: identify target areas of supercooled liquid in clouds, deliver the seeding material into those clouds, and verify that it was actually doing what they thought. How could you tell whether a cloud dropped snow because of seeding, or if it would have snowed anyway?

By 2017, armed with new, more powerful computers running the latest generation of simulation software, researchers in the US were finally ready to answer that question, via the Snowie project. Like the GE chemists years earlier, these experimenters dropped silver iodide from planes. The experiments took place in the Rocky Mountains, where prevailing winter winds blow moisture up the slopes, leading to clouds reliably forming at the same time each day. The results were impressive: The researchers could draw an extra 100 to 300 acre-feet of snow from each storm they seeded. But the most compelling evidence was anecdotal. As the plane flew back and forth at an angle to the prevailing wind, it sprayed a zigzag pattern of seeding material across the sky. That was echoed by a zigzag pattern of snow on the weather radar. "Mother Nature does not produce zigzag patterns," says one scientist who worked on Snowie.

In almost a century of cloud seeding, it was the first time anyone had actually shown the full chain of events from seeding through to precipitation reaching the ground.

The UAE's national Center of Meteorology is a glass cube rising out of featureless scrubland, ringed by a tangle of dusty highways on the edge of Abu Dhabi. Inside, I meet Ahmad Al Kamali, the facility's rain operations executor—a trim young man with a neat beard and dark-framed glasses. He studied at the University of Reading in the UK and worked as a forecaster before specializing in cloud-seeding operations. Like all the Emirati men I

meet on this trip, he's wearing a *kandura*—a loose white robe with a headpiece secured by a loop of thick black cord.

We take the elevator to the third floor, where I find cloud-seeding mission control. With gold detailing and a marble floor, it feels like a luxury hotel lobby, except for the giant radar map of the Gulf that fills one wall. Forecasters—men in white, women in black—sit at banks of desks and scour satellite images and radar data looking for clouds to seed. Near the entrance there's a small glass pyramid on a pedestal, about a foot wide at its base. It's a holographic projector. When Al Kamali switches it on, a tiny animated cloud appears inside. A plane circles it, and rain begins to fall. I start to wonder: How much of this is theater?

The impetus for cloud seeding in the UAE came in the early 2000s, when the country was in the middle of a construction boom. Dubai and Abu Dhabi were a sea of cranes; the population had more than doubled in the previous decade as expats flocked there to take advantage of the good weather and low income taxes. Sheikh Mansour bin Zayed Al Nahyan, a member of Abu Dhabi's royal family—currently both vice president and deputy prime minister of the UAE—thought cloud seeding, along with desalination of seawater, could help replenish the country's groundwater and refill its reservoirs. (Globally, Mansour is perhaps best known as the owner of the soccer club Manchester City.) As the Emiratis were setting up their program, they called in some experts from another arid country for help.

Back in 1989, a team of researchers in South Africa were studying how to enhance the formation of raindrops. They were taking cloud measurements in the east of the country when they spotted a cumulus cloud that was raining when all the other clouds in the area were dry. When they sent a plane into the cloud to get samples, they found a much wider range of droplet sizes than in the other clouds—some as big as half a centimeter in diameter.

The finding underscored that it's not only the number of droplets in a cloud that matters but also the size. A cloud of droplets that are all the same size won't mix together because they're all falling at the same speed. But if you can introduce larger drops, they'll plummet to earth faster, colliding and

coalescing with other droplets, forming even bigger drops that have enough mass to leave the cloud and become rain. The South African researchers discovered that although clouds in semiarid areas of the country contain hundreds of water droplets in every cubic centimeter of air, they're less efficient at creating rain than maritime clouds, which have about a sixth as many droplets but more variation in droplet size.

So why did this one cloud have bigger droplets? It turned out that the chimney of a nearby paper mill was pumping out particles of debris that attracted water. Over the next few years, the South African researchers ran long-term studies looking for the best way to re-create the effect of the paper mill on demand. They settled on ordinary salt—the most hygroscopic substance they could find. Then they developed flares that would release a steady stream of salt crystals when ignited.

Those flares were the progenitors of what the Emiratis use today, made locally at the Weather Modification Technology Factory. Al Kamali shows me a couple: They're foot-long tubes a couple of inches in diameter, each holding a kilogram of seeding material. One type of flare holds a mixture of salts. The other type holds salts coated in a nano layer of titanium dioxide, which attracts more water in drier climates. The Emiratis call them Ghaith 1 and Ghaith 2, *ghaith* being one of the Arabic words for "rain." Although the language has another near synonym, *matar*, it has negative connotations— rain as punishment, torment, the rain that breaks the banks and floods the fields. *Ghaith*, on the other hand, is rain as mercy and prosperity, the deluge that ends the drought.

The morning after my visit to the National Center of Meteorology, I take a taxi to Al Ain to go on that cloud-seeding flight. But there's a problem. When I leave Abu Dhabi that morning there's a low fog settled across the country, but by the time I arrive at Al Ain's small airport—about 100 miles inland from the cities on the coast—it has burned away, leaving clear blue skies. There are no clouds to seed.

Once I've cleared the tight security cordon and reached the gold-painted hangar (the airport is also used for military training flights), I meet Newman, who agrees to take me up anyway so he can demonstrate what *would* happen on a real mission. He's wearing a blue cap with the UAE

Rain Enhancement Program logo on it. Before moving to the UAE with his family 11 years ago, Newman worked as a commercial airline pilot on passenger jets and split his time between the UK and his native South Africa. He has exactly the kind of firmly reassuring presence you want from someone you're about to climb into a small plane with.

Every cloud-seeding mission starts with a weather forecast. A team of six operators at the meteorology center scour satellite images and data from the UAE's network of radars and weather stations and identify areas where clouds are likely to form. Often, that's in the area around Al Ain, where the mountains on the border with Oman act as a natural barrier to moisture coming in from the sea.

If it's looking like rain, the cloud-seeding operators radio the hangar and put some of the nine pilots on standby mode—either at home, on what Newman calls "villa standby," or at the airport or in a holding pattern in the air. As clouds start to form, they begin to appear on the weather radar, changing color from green through blue to yellow and then red as the droplets get bigger and the reflectivity of the clouds increases.

Once a mission is approved, the pilot scribbles out a flight plan while the ground crew preps one of the four modified Beechcraft King Air C90 planes. There are 24 flares attached to each wing—half Ghaith 1, half Ghaith 2—for a total of 48 kilograms of seeding material on each flight. Timing is important, Newman tells me as we taxi toward the runway. The pilots need to reach the cloud at the optimal moment.

Once we're airborne, Newman climbs to 6,000 feet. Then, like a falcon riding the thermals, he goes hunting for updrafts. Cloud seeding is a mentally challenging and sometimes dangerous job, he says through the headset, over the roar of the engines. Real missions last up to three hours and can get pretty bumpy as the plane moves between clouds. Pilots generally try to avoid turbulence. Seeding missions seek it out.

When we get to the right altitude, Newman radios the ground for permission to set off the flares. There are no hard rules for how many flares to put into each cloud, one seeding operator told me. It depends on the

strength of the updraft reported by the pilots, how things look on the radar. It sounds more like art than science.

Newman triggers one of the salt flares, and I twist in my seat to watch: It burns with a white-gray smoke. He lets me set off one of the nano-flares. It's slightly anticlimactic: The green lid of the tube pops open and the material spills out. I'm reminded of someone sprinkling grated cheese on spaghetti.

There's an evangelical zeal to the way some of the pilots and seeding operators talk about this stuff—the rush of hitting a button on an instrument panel and seeing the clouds burst before their eyes. Like gods. Newman shows me a video on his phone of a cloud that he'd just seeded hurling fat drops of rain onto the plane's front windows. Operators swear they can see clouds changing on the radar.

But the jury is out on how effective hygroscopic seeding actually is. The UAE has invested millions in developing new technologies for enhancing rainfall—and surprisingly little in actually verifying the impact of the seeding it's doing right now. After initial feasibility work in the early 2000s, the next long-term analysis of the program's effectiveness didn't come until 2021. It found a 23 percent increase in annual rainfall in seeded areas, as compared with historical averages, but cautioned that "anomalies associated with climate variability" might affect this figure in unforeseen ways. As Friedrich notes, you can't necessarily assume that rainfall measurements from, say, 1989 are directly comparable with those from 2019, given that climatic conditions can vary widely from year to year or decade to decade.

The best evidence for hygroscopic seeding, experts say, comes from India, where for the past 15 years the Indian Institute of Tropical Meteorology has been conducting a slow, patient study. Unlike the UAE, India uses one plane to seed and another to take measurements of the effect that has on the cloud. In hundreds of seeding missions, researchers found an 18 percent uptick in raindrop formation inside the cloud. But the thing is, every time you want to try to make it rain in a new place, you need to prove that it works in that area, in those particular conditions, with whatever unique mix of aerosol particles might be present. What succeeds in, say, the Western

Ghats mountain range is not even applicable to other areas of India, the lead researcher tells me, let alone other parts of the world.

If the UAE wanted to reliably increase the amount of fresh water in the country, committing to more desalination would be the safer bet. In theory, cloud seeding is cheaper: According to a 2023 paper by researchers at the National Center of Meteorology, the average cost of harvestable rainfall generated by cloud seeding is between 1 and 4 cents per cubic meter, compared with around 31 cents per cubic meter of water from desalination at the Hassyan Seawater Reverse Osmosis plant. But each mission costs as much as $8,000, and there's no guarantee that the water that falls as rain will actually end up where it's needed.

One researcher I spoke to, who has worked on cloud-seeding research in the UAE and asked to speak on background because they still work in the industry, was critical of the quality of the UAE's science. There was, they said, a tendency for "white lies" to proliferate; officials tell their superiors what they want to hear despite the lack of evidence. The country's rulers already think that cloud seeding is working, this person argued, so for an official to admit otherwise now would be problematic. (The National Center of Meteorology did not comment on these claims.)

By the time I leave Al Ain, I'm starting to suspect that what goes on there is as much about optics as it is about actually enhancing rainfall. The UAE has a history of making flashy announcements about cutting-edge technology—from flying cars to 3D-printed buildings to robotic police officers—with little end product.

For the UAE, it's almost irrelevant whether cloud seeding works. There's soft power in being seen to be able to bend the weather to your will.

Now, as the world transitions away from the fossil fuels that have been the country's lifeblood for the past 50 years, the UAE is trying to position itself as a leader on climate. Last year it hosted the annual United Nations Climate Change Conference, and the head of its National Center of Meteorology was chosen to lead the World Meteorological Organization, where he'll help shape the global consensus that forms around cloud

seeding and other forms of mass-scale climate modification. (He could not be reached for an interview.)

The UAE has even started exporting its cloud-seeding expertise. One of the pilots I spoke to had just returned from a trip to Lahore, where the Pakistani government had asked the UAE's cloud seeders to bring rain to clear the polluted skies. It rained—but they couldn't really take credit. "We knew it was going to rain, and we just went and seeded the rain that was going to come anyway," he said.

From the steps of the Emirates Palace Mandarin Oriental in Abu Dhabi, the UAE certainly doesn't seem like a country that's running out of water. As I roll up the hotel's long driveway on my second day in town, I can see water features and lush green grass. The sprinklers are running. I'm here for a ceremony for the fifth round of research grants being awarded by the UAE Research Program for Rain Enhancement Science. Since 2015, the program has awarded $21 million to 14 projects developing and testing ways of enhancing rainfall, and it's about to announce the next set of recipients.

In the ornate ballroom, local officials have loosely segregated themselves by gender. I sip watermelon juice and work the room, speaking to previous award winners. There's Linda Zou, a Chinese researcher based at Khalifa University in Abu Dhabi who developed the nano-coated seeding particles in the Ghaith 2 flares. There's Ali Abshaev, who comes from a cloud-seeding dynasty (his father directs Russia's Hail Suppression Research Center) and who has built a machine to spray hygroscopic material into the sky from the ground. It's like "an upside-down jet engine," one researcher explains.

Other projects have been looking at "terrain modification"—whether planting trees or building earthen barriers in certain locations could encourage clouds to form. Giles Harrison, from the University of Reading, is exploring whether electrical currents released into clouds can encourage raindrops to stick together. There's also a lot of work on computer simulation. Youssef Wehbe, a UAE program officer, gives me a cagey interview about the future vision: pairs of drones, powered by artificial intelligence, one taking cloud measurements and the other printing seeding material specifically tailored for that particular cloud—on the fly, as it were.

I'm particularly taken by one of this year's grant winners. Guillaume Matras, who worked at the French defense contractor Thales before moving to the UAE, is hoping to make it rain by shooting a giant laser into the sky. Wehbe describes this approach as "high risk." I think he means "it may not work," not "it could set the whole atmosphere on fire." Either way, I'm sold.

So after my cloud-seeding flight, I get a lift to Zayed Military City, an army base between Al Ain and Abu Dhabi, to visit the secretive government-funded research lab where Matras works. They take my passport at the gate to the compound, and before I can go into the lab itself I'm asked to secure my phone in a locker that's also a Faraday cage—completely sealed to signals going in and out.

After I put on a hairnet, a lab coat, and tinted safety goggles, Matras shows me into a lab, where I watch a remarkable thing. Inside a broad, black box the size of a small television sits an immensely powerful laser. A tech switches it on. Nothing happens. Then Matras leans forward and opens a lens, focusing the laser beam.

There's a high-pitched but very loud buzz, like the whine of an electric motor. It is the sound of the air being ripped apart. A very fine filament, maybe half a centimeter across, appears in midair. It looks like a strand of spider's silk, but it's bright blue. It's plasma—the fourth state of matter. Scale up the size of the laser and the power, and you can actually set a small part of the atmosphere on fire. Man-made lightning. Obviously my first question is to ask what would happen if I put my hand in it. "Your hand would turn into plasma," another researcher says, entirely deadpan. I put my hand back in my pocket.

Matras says these laser beams will be able to enhance rainfall in three ways. First, acoustically—like the concussion theory of old, it's thought that the sound of atoms in the air being ripped apart might shake adjacent raindrops so that they coalesce, get bigger, and fall to earth. Second: convection—the beam will create heat, generating updrafts that will force droplets to mix. (I'm reminded of a never-realized 1840s plan to create rain by setting fire to large chunks of the Appalachian Mountains.) Finally: ionization. When the beam is switched off, the plasma will reform—the nitrogen, hydrogen, and

oxygen molecules inside will clump back together into random configurations, creating new particles for water to settle around.

The plan is to scale this technology up to something the size of a shipping container that can be put on the back of a truck and driven to where it's needed. It seems insane—I'm suddenly very aware that I'm on a military base. Couldn't this giant movable laser be used as a weapon? "Yes," Matras says. He picks up a pencil, the nib honed to a sharp point. "But anything could be a weapon."

These words hang over me as I ride back into the city, past lush golf courses and hotel fountains and workmen swigging from plastic bottles. Once again, there's not a cloud in the sky. But maybe that doesn't matter. For the UAE, so keen to project its technological prowess around the region and the world, it's almost irrelevant whether cloud seeding works. There's soft power in being seen to be able to bend the weather to your will—in 2018, an Iranian general accused the UAE and Israel of stealing his country's rain.

Anything could be a weapon, Matras had said. But there are military weapons, and economic weapons, and cultural and political weapons too. Anything could be a weapon—even the idea of one.

This article appears in the September/October 2024 issue. [Subscribe now](#).

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By Lauren Smiley
The Big Story
Jul 10, 2024 6:00 AM

Priscila, Queen of the Rideshare Mafia

She came to the US with a dream. Using platforms like Uber, Instacart, and DoorDash, she built a business empire up from nothing. There was just one problem.
Photograph: Tony Luong

To understand Priscila Barbosa—the pluck, the ambition, the sheer balls—we should start at the airport. We should start at the precise moment on April 24, 2018, when she concluded, *I'm fucked*.

Barbosa was just outside customs at New York's JFK International Airport, 5-foot-1, archetypally pretty even without her favorite Instagram filter. She was flanked by two rolling suitcases stuffed with clothes and Brazilian bikinis and not much else. The acquaintance who had invited her to come from Brazil on a tourist visa, who was going to drive her to Boston? The one who promised to help her get settled, saying that she could make good money like he did, driving for Uber and Lyft?

He's not answering her texts.

Barbosa was stranded. She cried. She took stock of her belongings: the suitcases, her iPhone, 117 bucks not just in her wallet, but total. She called her mom back in Brazil, but she already knew that her family couldn't pay for a ticket home. No way was she asking her friends, who had doubted this plan all along; one said she was too old to start over in a new country and, with a whiff of class judgment, insinuated that immigrating was not something their social circle really *did*.

What now?

Well, Barbosa has a phoenix tattooed on her back. She radiates a game sense of *What can I say yes to today?* The type of person who, when she and a pal don't want to splurge on a fancy hotel during a girls trip, swipes right on every guy on Tinder until one joins their bar-crawl and invites them to sleep on his boat. (Says a friend: "Priscila is craaaazy.") The US government would one day put it more grandly, speaking of Barbosa's "unique social talents," calling her "hard-working," "productive," and "very organized."

She knew there was no going back to Brazil but also, deep down, that she didn't want to, that opportunity was *here*. "I loved this place"—the US—from nearly the moment she stepped off the plane, she declares. She was 32 years old, college educated, and spoke decent English. She had no choice but to work her way out of this mess.

Barbosa couldn't have predicted where her striving would end: that she'd become the heavy in a web of fraud. That she'd expose the [gig economy's](#) embarrassing blind spot. That, one day, multibillion-dollar companies like [Uber](#) and [DoorDash](#) would cry victim. *Her* victim. Or that she'd fall so far, or that her relationship with Uncle Sam would grow so deeply twisted and codependent.

She did know, that day at JFK Airport, that her doubters back in Brazil would only see one plotline on Instagram: Priscila's march to victory. Taking a $10 Lyft to a bus station, eyes still puffy from her airport cry, Barbosa aimed her iPhone at the traffic speeding across the Throgs Neck Bridge on a clear spring day. She labeled the video "New York, New York," and uploaded it onto her Story, ripe with the promise that she was heading somewhere big.

In real life, Barbosa is candid ("I'm a bad liar"). She drops self-deprecating jokes and lets loose big, jagged laughs that sound like a car trying to start. She grew up in Sorocaba, an industrial city of 723,000 people about two hours west of São Paolo. Her dad was an electrician, mom a postal worker. They set their eldest daughter on a path "to be a very educated and polite person"—English lessons and ballet classes. Barbosa loved to mess around

on computers. As a teen, she kitted out her home PC with a terabyte of storage and an Nvidia processor so she could play *Counter-Strike* and *World of Warcraft*. She also hung out at a local cyber café, where she and a few other gamers formed a tournament team called the BR Girls ("BR" for Brazil). Offscreen, high school was miserable. She was bullied for being a teacher's pet, for being "chunky," for being terrible at sports. When a few boys showed romantic interest in her, she turned them down for fear it was a prank.

Barbosa studied IT at a local college, taught computer skills at elementary schools, and digitized records at the city health department. She also became a gym rat ("I've had to fight for the perfect body my whole life") and started cooking healthy recipes. In 2013, she spun this hobby into a part-time hustle, a delivery service for her ready-made meals. When orders exploded, Barbosa ramped up to full-time in 2015, calling her business Fit Express. She hired nine employees and was featured in the local press. She was making enough to travel to Walt Disney World, party at music festivals, and buy and trade bitcoin. She happily imagined opening franchises and gaining a solid footing in the upper-middle class.

But Brazil was in the middle of a recession, and after a few years, her customers started disappearing. Trying to stay afloat, Barbosa cashed out her bitcoin and, when that wasn't enough, took out high-interest loans ("What a stupid idea, by the way"). She closed Fit Express. Her younger sister had just graduated from college, and her parents had lost their bakery, their retirement gig. Barbosa felt it was up to her to pull everyone out.

She texted that Boston-area acquaintance about her desperation, and he answered: *Why didn't she move to the US and drive for Uber and Lyft?* He sent her screenshots of what he was making—$250 a day, better than attorney-level money in Brazil. He said undocumented people could live like normal citizens. She already had a tourist visa. With her family broke and her job search going nowhere, "I couldn't see any other option," she says.

The first night at the flophouse, Barbosa slept on the floor. The second, a Walmart air mattress.

A one-way ticket to JFK cost nearly $900. She sold a ring from her grandpa for $1,000. At the airport, her father tried to cut through the family's gloom, saying, "Rock out, and get a Mustang for Dad!"

A flight across the equator later, and the momentary meltdown at JFK shaken off, Barbosa hurtled north from New York City to Boston on a Peter Pan bus, fervidly scrolling through Facebook groups dedicated to Massachusetts' large Brazilian community, tapping out DMs and dialing numbers. A Brazilian pizzeria owner told her to come in for a try-out the next day. A Brazilian landlord, who had a tiny room in a flophouse in the western burb of Framingham, said he would take the $400 rent once Barbosa got paid. A shot-in-the-dark call: a Brazilian guy from Boston whom she'd met years before on vacation in Miami. Miraculously, he not only answered but met her at South Station, let her stay the night, and ferried her the next morning to the pizzeria, where she aced the cooking test.

The first night at the flophouse, Barbosa slept on the floor. The second, a Walmart air mattress. She shoved magazines below the door to keep out the rats ("Disgusting!"). Without a car, she walked an hour to the pizza joint, past strip malls and Brazilian bakeries. On the way, she'd stop at Planet Fitness to lift weights and use the shower. (She welcomed the side effect of all the survival schlepping: "The most skinny I ever got!")

Barbosa was earning about $800 in cash a week at the pizzeria. Aiming to pay down her debts and build her new life quickly, she looked for a second part-time job. One restaurant manager said he needed her to have a Social Security number, and handed her the number of a guy who could make her fake work documents, but Barbosa didn't dare call. "When you first get here," she explains, "you think ICE is going to be waiting for you on every single corner." She tried cleaning houses but lasted exactly two days, loathing every second. Then the pizzeria got slow for the summer and laid her off. Scrolling Facebook in bed one morning, she saw a post in a Brazilian group asking: *Do you want to work for Uber/ Lyft and be your own boss?*

Barbosa quite enjoyed being her own boss. Working for other people since arriving in the States had felt like a necessary but major downgrade. She

also finally had a car, having financed a used Jeep Liberty after a couple months of work. When she called the listed number in the ad, the guy who answered told her that, for $250 a week, she could rent an Uber driver account. It would have Barbosa's photo, her car, and her bank account, but would use another name. Barbosa didn't ask any questions. She says she didn't know exactly how she was skipping right over the app's onboarding requirements: a US driver's license, a year of driving experience in the US, a Social Security number, and a background check. She did know that she cleared $2,000 in her first week, enough to stop worrying about another job.

Illustration: Michelle Mildenberg

Not long after she started, Uber deactivated Barbosa's account out of the blue. So she switched to renting one on Lyft from the same guy. Now she drove as "Shakira." When the Lyft app prompted Barbosa to confirm her identity by scanning her license, she texted the guy she was renting from: *What now?* He sent back a photo of Shakira's ID. *Oh. She was real.* He paid Shakira a fee each week.

Driving without a license, under the table on a tourist visa, loaded Barbosa with stress. One night, Barbosa picked up a passenger at 2 am and he tried to kiss her. She had to fight him off and left him one star on the app; she didn't want to risk calling the cops. Another time, she was pulled over for having her lights off. Barbosa froze as the officer strode up to her window, worried she might get her car towed and end up in jail, or even—who knows?—deported. She showed the cop her Brazilian driver's license, and said she'd left her American one at home. He let her go.

In WhatsApp groups, and while waiting for riders at Logan Airport, Barbosa chatted up other Brazilian drivers also renting accounts. They traded tips about driving without papers, the nuances of the fuzzy don't-ask-don't-tell status quo in a country that hasn't passed comprehensive immigration reforms in more than three decades. Far from an ICE officer on every corner, she heard, if you kept your head down, didn't drink and drive or pick fights, you could manage.

In October, Barbosa posted a humblebrag on Instagram to mark six months in the US: "Thankful every day that I had such courage and audacity." She

had reasons to be proud: From being stranded with $117 at JFK, she'd moved into a better apartment and had already sent enough money back to Brazil to pay her parents' bills and nearly clear her own debts. She was buying clothes at TJ Maxx, perfume at Macy's, restarting her regimen of technicolor manicures and wrinkle-busting Botox ("a priority"). In another Instagram photo, she was holding her cocktail aloft and dancing with a giant furry bear at a club, kissing toward the camera. The post quoted the iconic Apple ad: "Here's to the crazy ones, the misfits, the rebels …"

The six-month anniversary also meant Barbosa was officially overstaying her tourist visa. The grind continued. She was clocking 14-hour days on Uber. She was also still paying a middleman just to use an account. Then, that fall, Barbosa stumbled on a way out.

One of her customers left their wallet in her car. She followed the woman's convoluted instructions to return it, driving to two far-flung locations over two hours. Miffed, at one point Barbosa opened the wallet. She looked at the woman's license, blonde with blue eyes. Barbosa snapped a picture. She thought the woman might tip her or at least say "thank you" for having wasted two hours, unpaid, to do her a favor. Instead, the woman was rude and short, giving Barbosa the push she'd been looking for. "I said, yeah, now I'm going to use this."

Over the next few weeks, she would click through the driver onboarding process on both Uber and Lyft, reading over the steps to create her own account, mulling the risk. Finally, lying in bed on Christmas night, the first one she'd spent without her family, it was time: She opened her phone and scrolled to the blonde woman's license. Barbosa uploaded the license to the Uber app. She used the woman's name but her own insurance and registration. She entered her own iCloud email and phone number and set her own picture—brown hair, brown eyes—on the driver profile. She made up a Social Security number, submitted the application, and went to sleep.

The next day, Uber approved the account. Like that, Barbosa was in business for herself.

"I looove to party," Barbosa once wrote me during the year and a half that we talked and emailed. For her, going out is less a dalliance than a

birthright, Barbosa's wildly extroverted brand of self-care. "I'm a human being, too," she says, "I deserve to have fun."

On Fridays, as other drivers shared their earnings in the WhatsApp group, she'd post a pic of her fresh pineapple vodka cocktail and invite them to join her at happy hour. Barbosa headed to bars and clubs several nights a week—the Grand, Scorpion Bar, the Harp, Ned Devine's, Royale—and threw parties at her apartment. She thrived on meeting other Brazilians ("I hate to be alone"), plugging their numbers into her phone, asking what they did for work.

A few incident-free weeks after Barbosa started driving with the Uber account she'd made, a new business opportunity arose. An acquaintance asked Barbosa to find a renter for his Uber and Lyft accounts, which he wasn't using. (Some undocumented drivers traveled to states like Maryland and California, which would issue licenses to residents regardless of immigration status. Barbosa would soon get her own license, using a friend's address in California.) She scouted a candidate, and the acquaintance gave her a cut of the rent, $50 a week. She soon did the same for a few other people she knew who also wanted to rent out their accounts —a popular side hustle among expats, she quickly realized. Voilà, $300 in passive income a week.

Barbosa readily admits she enjoyed the ego boost of beating powerful Silicon Valley companies on their own platforms. "I feel pride in breaking their stupid systems," she wrote me.

One day, while chatting over barbecue and Mike's Hard Lemonade at one of her house parties, a friend mentioned that for whatever reason, the onboarding process for ride-sharing accounts seemingly couldn't verify Social Security numbers issued after June 2011, when the Social Security Administration changed the way it assigned the numbers.

After the party, Barbosa couldn't resist; she plugged a few random sequences into ssn-verify.com, a website that shows when a number was issued. She tried one that started 776-94. *Bingo.* Maybe assigned after 2011. She entered the combination while making a new driver account. When Checkr, a company that does background checks for Uber, emailed asking

for her to verify the number, Barbosa says she simply plugged it in again. Then Checkr sent whatever information it gathered to Uber, and Uber approved the account. (A source close to Checkr insists that the company could, in fact, do background checks using numbers assigned after 2011, and Social Security numbers are just one data point they use to find information. All Barbosa knows is, in that era, her trick worked.)

Barbosa also met people with pictures of real licenses to sell, and she spotted another opportunity: By buying a license and adding in her simple Social Security trick, Barbosa could create new driver accounts on Uber and Lyft en masse. She set rent at the price she'd previously paid, $250 a week. Business took off. Word got around; more people pinged her WhatsApp, wanting their own profiles. By late summer, with some eight renters bringing her $2,000 a week, Barbosa stopped driving. Now she spent her days at her dining table on her laptop, concocting accounts.

"It never, never crossed my mind that I was, like, being a criminal," Barbosa says.

Photograph: Tony Luong

Barbosa figured she had gotten lucky on her own slapdash Uber account that she'd hatched on Christmas. Now, when she found a client, she registered a burner phone number on TextNow and an encrypted email with Proton Mail. Uber seemed to have gotten more discerning, so if her customer looked nothing like the person on the driver's license, she photoshopped the customer's face in place of the original. That way, when the app prompted them to take a selfie as a security spot check, they would pass. She also photoshopped the name from the license onto the customer's insurance documents. Ever organized, Barbosa kept an Excel spreadsheet with each account's details. In her Apple Notes, she checked off clients once they Venmoed or Zelled her the weekly rent.

"It never, never crossed my mind that I was, like, being a criminal," Barbosa says. Sure, she would learn that her suppliers were getting the driver's license photos on the dodgy down-low. One guy was sneaking pictures of customer's IDs from his job at a car dealership. Other pictures were bought off the dark web. Some people in the underground driver's

license economy in Maryland or California would snap a photo of the licenses before mailing them to their out-of-state immigrant clients, and then rent or sell those photos to people like Barbosa. Somehow ("my naive concept," she says), uploading doctored documents onto an online platform seemed a lesser transgression than buying fake work documents IRL.

Barbosa rationalized that she wasn't stealing money, and she had certain standards. She didn't buy licenses off a guy who reportedly dinged his car into people's bumpers and photographed the victim's ID in the post-crash exchange. To Barbosa, that seemed truly beyond the pale.

Mostly, she felt like an entrepreneur, supplying the demand. Undocumented immigrants wanted to drive in the gig economy, and with the system that existed, they legally could not. People like Barbosa—with no family in the States to sponsor them for green cards and their undocumented status precluding them from applying for many other types of visas—were short on options. "If the US gave more opportunities for immigrants to be able to work legally and honestly here," she says, "nobody would look for something like this."

It wasn't just about business, though. Barbosa readily admits she enjoyed not just the challenge but the ego boost of beating powerful Silicon Valley companies on their own platforms. "I feel pride in breaking their stupid systems," she wrote me. "These companies are all about money. They don't care for the drivers (we are just numbers for them)." So she held open yawning security loopholes and waved undocumented drivers in. "I never had evil intentions," she explains. "I always thought I was helping my people."

The good faith Barbosa showed to her customers paid off. Soon she was raking in about $10,000 a month

Of course, Barbosa was poking the rideshare industry's weak spot: The companies sometimes had no idea who was driving. Uber and Lyft, vying for supremacy and scale, competed to add drivers as fast as possible. Onboarding was optimized for ease and speed, done remotely, via the app. Both companies outsourced criminal background checks, but they didn't catch everything. (That led to a torrent of lawsuits, regulator spats, and bad

press about Uber– and Lyft–approved drivers who'd committed robbery, sex offenses, and assault.) A year before Barbosa arrived in Massachusetts, the state had tried to wrangle the chaos with its own background check for drivers, the toughest oversight in the country at the time. An audit later found that program severely lacking, too.

Background checks, of course, are useless if the person being vetted is not actually the driver. As Barbosa was finding, in that era, *verifying* the driver's identity was a Swiss cheese of flaws to exploit. In 2019, London regulators reported 43 unauthorized drivers who had simply uploaded their photo to another Uber worker's account to give some 14,000 rides. Officers at San Francisco International Airport were ticketing Lyft and Uber drivers after discovering people who didn't match their app profiles. Industry observers called the issue of drivers sharing or renting accounts an open secret. (The companies claim to have ramped up security since, but the American Immigration Council says that, in its analysis of 2022 census data, undocumented workers are very much still a part of this sector.)

Barbosa tried to do her own vetting of drivers, for safety and business. She texted the potential customers: *Did they have a driver's license in Brazil? Did they have a car? How often do they plan to work?* Dilettantes, she learned, tended to stop paying rent, wasting an account.

She started to become well known in Boston's Brazilian community ("famous," she calls it) as, paradoxically, an honest broker. All over social media were warnings about scammers preying on undocumented drivers, taking advantage of the fact they wouldn't go to police or the courts. Some vendors charged exorbitant rent or would take money upfront and never give someone an account. Others siphoned the drivers' earnings to their own wallets.

The good faith Barbosa showed to her customers paid off. Soon she was raking in about $10,000 a month and was pairing up with business partners to help make and manage some accounts. In the summer of 2019, she bought a used black Mustang. (She posted on Instagram, "Dad, this is for you.") She shared her #route66roadtrip, the Grand Canyon, a crowded Vegas pool party. From Epcot, she and a friend posted cocktail toasts from a whirlwind of Disneyfied countries. She posed in front of a Beverly Hills

sign and on Rodeo Drive. Her followers were paying attention. On a picture of Barbosa wearing a faux fur coat in New York City, one person commented, "She's Hollywood now!" In phone calls, her mom asked, "What do you do for work, Priscila?" She answered vaguely, "Making accounts."

Then, the fall brought a nearly existential blow: Uber asked drivers on profiles with fake Social Security numbers—about 35 of Barbosa's clients at that point, she estimates—to present their documents in person. ("We're committed to constantly improving our detection capabilities to protect against fraudsters' ever-evolving schemes," said Heather Childs, chief trust and security officer at Uber.) Barbosa and her drivers had no choice but to walk away: a loss, she says, of around $30,000 a month in rent. Until this point, she recalls, account deactivation had been rare.

DoorDash incentivized drivers to invite new workers to the app by dangling a referral bonus. The setup was ripe for exploitation.

Now Barbosa knew that if she wanted to keep making lucrative Uber accounts, she'd need real Social Security numbers. She searched the dark web for the numbers belonging to the people on the licenses she bought, but struck out. So Barbosa started purchasing stolen numbers from a contact, $100 a pop. She nervously created a few new accounts with the real numbers, but didn't feel comfortable repeating that at scale; it felt, she says, like she'd "crossed the line."

Barbosa was wondering whether she'd need to leave her Uber business altogether, when one of her customers gave her an idea. Alessandro Da Fonseca was an amiable guy in his twenties who'd recently emigrated from a shantytown district of Rio de Janeiro. He rented one of Barbosa's cars for a pizza delivery job and a Lyft gig, where he could get along with just a few words of English and an animated "Yeah!" as customers chatted him up. He'd also started driving for DoorDash. ("I prefer food, because food doesn't talk," he told me.) DoorDash incentivized drivers to invite new workers to the app by dangling a referral bonus, which would be paid out after the first-time driver made a set number of deliveries. The setup was ripe for exploitation.

At the time, DoorDash required a driver's license number but no picture of the actual card. Barbosa tried making an account, reusing a number from a license she had on hand. Success. Fonseca started driving—as her "new" referral—on this account. She offered him a 50-50 split of the bonus. Barbosa and Fonseca got into a routine: She created new accounts to refer, and he typically cleared enough deliveries to earn the bonus on two accounts he worked under simultaneously (also against the rules) every two weeks.

While waiting for orders at McDonalds, Chipotle, or Burger King, Fonseca would chat up other Brazilian delivery workers. Some were getting kicked only 20 percent of the referral bonus from their account maker. Fonseca pitched his contact and her 50-50 split.

Thanks to her previous business, Barbosa was sitting on a stack of IDs, and her old Uber customers who'd lost their accounts now wanted in. She could push out a DoorDash account in five minutes. Pretty soon, she says, she had 10 customers. Fonseca found Barbosa to be a showboat on Instagram, sure, but also unfailingly polite and generous. She invited him to her house parties and dispensed recommendations on anything from a good car dealer to a Japanese restaurant. In business, she was demanding, prodding him when his referrals were dallying in reaching the bonus. Sometimes she'd give Fonseca a laggard's login, and he would ask the driver whether he could finish the jobs himself. (A spokesperson for DoorDash said, "We've made huge strides on tackling fraud, and the fact is, what we did five years ago is not what we do today.")

Barbosa started making Instacart accounts, too, and soon she was again minting money, to the tune of some $12,000 a month. The week before Christmas 2019, Barbosa posted on Instagram a picture of her in New York City, grabbing the charging Wall Street bull by its enormous bronze balls.

Illustration: Michelle Mildenberg; Getty Images

Distracted by her burgeoning delivery app business, Barbosa mostly stopped thinking about Uber and Social Security numbers. Then Covid struck and cratered ride-sharing overnight.

A mother lode of food delivery surged in its place. DoorDash and Instacart cranked up their referral bonuses to lure more drivers to the road. At one point, she recalls, it was $2,000 on DoorDash, $2,500 on Instacart. Immigrants ineligible for unemployment or Covid relief texted Barbosa with a new level of desperation. They needed to make rent, to feed their kids. Now she was hearing from Brazilians all over the United States. Spanish-speaking immigrants too. Even some US citizens who couldn't drive because of DUIs or reckless driving tickets.

Barbosa went into overdrive, churning out accounts "as fast as I could." For friends, or people whose situations sounded especially grim, she'd sometimes make them for free.

On Instacart, she'd scan the front of her own California license, so she could then take a selfie to pass the platform's face-recognition test. She says she did this on hundreds of accounts. For the license's backside, she photoshopped on a barcode that she generated with software, using the identity information from her existing stockpile of drivers' IDs. When she needed more licenses, she bought fresh ones off Instacart workers who were using a new harvesting technique: While scanning the back of a customer's ID into the app during alcohol deliveries, the worker would sneak a photo of the front.

On DoorDash, a few zealous drivers were nabbing the referral bonus in a single day and coming back the next day for another account. Sometimes, Barbosa had up to 20 new accounts on various platforms going through background checks; at her Covid apex, she says, she raked in about $15,000 in one week.

Barbosa—always a "materialist," she concedes—catapulted to a new realm of buying power. She flaunted her acquisitions on Instagram: a Sea-Doo ($7,000, used), Louboutin heels, Gucci sunglasses, a Louis Vuitton purse. She upgraded her cross necklace to a 24k gold one with 18 inset diamonds (not religious, just superstitious), and her bed to a California king. With most clubs shuttered, Barbosa outfitted her latest rental upgrade, a three-story townhome in Saugus, with a karaoke machine and a keg tap, plus a hot tub and a firepit in the backyard. She adopted a Yorkie named Bailey, for whom she bought so many toys that house visitors asked whether she

had kids (no, and no thanks). She posted an Instagram Story that someone had filmed of her standing out of the sunroof of her gleaming white Porsche Macan, hair whipping. (For extra money, she rented out the Porsche and her Mustang on Turo.) She dropped $13,000 to rent an event hall in the Boston burbs for her 35th birthday bash, with a band and 50 guests. The next day, she was awed but not stressed by an additional $12,000 charge on her credit card for the open bar. She bought a plot of land outside of Fort Myers, Florida, that she saw advertised on Facebook for $5,000. ("I'm like, that's so cheap!") She planned to someday build a house there and move in with her boyfriend, a Brazilian house painter whom she hoped to marry.

Uber seemed to be wising up. Then Barbosa would noodle a workaround, and the cat-and-mouse game would continue.

Barbosa also had enough money to solve what she thought was her biggest problem: She couldn't go home to see her family, because she needed a green card to leave and reenter the US. So a couple of months into Covid, she flew to LA and flipped through a binder full of pictures of potential husbands in an office on Wilshire Boulevard. A sham marriage would cost some $28,000—$18,000 to the agency and $10,000 to the husband, paid out in $350 monthly chunks to keep him cooperative throughout the process. She felt zero guilt: At least she wasn't feigning romance with a citizen. Cleaner for it to be a business transaction.

Barbosa bought a white sundress at a boutique and a crown of white flowers and drove to a park, where a Covid-masked officiant married her and a man named Mario by a flowering jacaranda tree. An agency staffer snapped pics for evidence, and Mario's real girlfriend looked on. Barbosa's family, who knew the drill, FaceTimed in on her phone. Her Instagram post from the day doesn't mention what was really happening; it shows her alone in her sundress on the beach. Caption: "The sky is the limit!"

Throughout the pandemic, Barbosa was a digital nomad tending her accounts mill. From a water park, she'd call DoorDash customer service to clear up a flubbed delivery from one of her workers who didn't speak English. Poolside in Vegas, she'd log in to a client's Instacart to snap a selfie for a face recognition spot-check. (Some customers kept a printout of Barbosa's photo on hand for the checks. Instacart says those tricks would

not work today.) When Instacart deactivated some 85 percent of her accounts—a particularly dire crisis—she ignored her boyfriend's protests and hunkered down in a Florida hotel room for days to remake each one.

Over time, Barbosa invited a small group of compatriots in the business into a WhatsApp group that she cheekily named Mafia. (An unfortunate choice, in hindsight: "I should have put 'People From Church.'") The Mafia shared tips and problems and agreed on account prices, with plenty of banter to enliven the drudgery of the digital assembly line.

By the fall of 2020, drivers were asking for Uber Eats accounts. If Barbosa wanted their business, she would again have to face the Social Security number dilemma. She mulled it over. It had been months since she'd queasily made her first accounts using the real numbers, which she'd bought off a contact. Nothing bad had happened. She'd since found the right dark-web site to purchase them directly. Why ease off now? "I was already so involved in this," she wrote me.

So Barbosa decided to wade back into the Uber biz. She bought a batch of Social Security numbers off the dark web with bitcoin.

By then, Uber seemed to be wising up. Accounts would be deactivated after a week, a month at most. Then Barbosa would noodle a workaround, and the cat-and-mouse game would continue. But in late 2020, after a wallop of new deactivations, the Mafia seemed to finally hit a wall. For days, then weeks, they tried to figure out a new method that would get an account approved. No luck. Barbosa recalls someone texting, chagrined, "The Titanic is sinking."

Then, one Mafia member mentioned that Uber kept metadata on the accounts. Barbosa noticed that all of her axed accounts had, in fact, been created on her phone—*iPhone de Priscila Barbosa*. What if she made her computer look like a different device each time? She restarted her laptop, accessed the web through a VPN, changed her computer's address, and set up a virtual machine, inside which she accessed another VPN. She opened a web browser to create an Uber account with a real Social Security number bought from the dark web. It worked. Barbosa delivered a few orders herself. The account held.

She texted the Mafia, "Guys, this is working."

They exploded in texts of relief and joy: "If Priscila can't figure it out, no one can!" Barbosa felt a pride she had only known back in Brazil when her meal business was booming. She felt smart, and needed: She'd kept scores of immigrants working during the pandemic; she'd helped get people food as a deadly virus menaced. If she blurred the details, she could feel good about all of it.

The glow was short-lived. As the year wound down, a vague rumor hit one of her WhatsApp groups: Police might be investigating the fake accounts biz. Already uneasy about buying Social Security numbers, Barbosa says she didn't want to be caught flat-footed if the rumor turned out to be true. She hustled around her apartment, grabbing Instacart, DoorDash, and Grubhub bags, logo stickers, and app-issued debit cards. Outside, she placed several phones under her Porsche's wheels and drove over them. She threw all the evidence into garbage bags and, that night, chucked them into several dumpsters in various parking lots.

She'd long taken comfort that WhatsApp and Proton Mail, the email service she'd used for the apps, were encrypted. She used an alias, Carol, on her work phone so clients couldn't easily snitch on her. Now the physical evidence was gone too. ("Sweet illusion," she wrote me.) For a couple of weeks after the purge, Barbosa forced herself to stop making accounts.

She spent New Year's in Miami Beach, where she posted a photo of herself wearing Gucci sunglasses and holding a frozen mai tai the size of her head. She shared the pic with the Mafia.

Someone quipped back, "Find me, FBI."

"I had so many chances to stop, but I didn't," she wrote me. "It looked like an addiction you know."

As 2020 turned to 2021 and Barbosa continued making accounts, a low hum of dread invaded her idle moments. She started to ponder an exit.

She confided to a Mafia pal that she was scared of losing everything. News in February didn't help: A 30-year-old Brazilian named Douglas Goncalves had been arrested for working under a stolen identity on Instacart. It was the first time Barbosa had heard of criminal consequences for a fake profile, and she recognized the suspect's name: Goncalves, she says, had texted her a couple of weeks earlier about getting an account. His long-winded answers to her usual vetting questions annoyed her, and she ghosted him, she recalls. But the texts might still be sitting on his phone.

Fonseca, Barbosa's DoorDash partner, also started to worry. Too many people were hawking accounts, licenses, and Social Security numbers in his WhatsApp groups. "Everybody knew this bomb would explode someday," he said. "People are stupid and don't take care."

Barbosa thought about going legit, getting back into the food business, opening a Brazilian steakhouse. She figured startup costs at about $50,000; she had that amount many times over. She googled around to see what kind of permits she'd need.

Still, her frauds kept compounding. Uber was now rejecting the doctored ID photos; she bought a printer to create physical fake licenses. She had more than 50 customer accounts active on various platforms, and new people kept texting her, often with a woeful tale. To calm her fraying nerves, she told herself that with so many people in the accounts trade, some doing more audacious things than she was, why would *she* get in trouble? One Mafia member, she says, was running a team that spoofed DoorDash deliveries for food that, in reality, was never picked up or delivered.

"I had so many chances to stop, but I didn't," she wrote me. "It looked like an addiction you know."

In April 2021, while Barbosa was cooking dinner, a text pinged her phone. Her green card had been approved. Barbosa screamed; she called her parents in tears. Then she threw together a party for the next night to celebrate. When Fonseca arrived, he squeezed through the loud, packed house and grabbed some Brazilian barbecue. Outside on the back porch, he found Barbosa, in cut-off shorts and a halter top, swigging overflowing champagne from the bottle.

If you ask Barbosa when she was happiest, she'll say it was that moment: "Everything was perfect." She had a green card. She had the house and the (real) boyfriend and the Porsche that she wanted. She booked a round-trip ticket—first class—to visit her family in Brazil for two weeks in late May. She bought Versace sneakers, because why not. She was going to open her steakhouse, marry her boyfriend, and, down the line, move into the house she'd build in Florida. Just three years after landing at JFK, she had risen to the top of a shadow Silicon Valley gig economy. She'd hacked her way to the American Dream.

On May 6, 2021, a new Instagram Story. Among the vacation bacchanalia and designer haul videos, this one stood out. Barbosa filmed ahead, over handlebars as she pedaled a bike through her sunny townhouse complex. No humblebrag, or even brag-brag. Carefree.

The next morning, she woke up at dawn to her Yorkie barking. A banging on the front door. A booming voice, ordering her to come downstairs.

Find me, FBI. They did.

Illustration: Michelle Mildenberg; Getty Images

Later that day, crying in the back seat of an unmarked car en route to a Rhode Island prison, Barbosa recalls an FBI agent trying to calm her down. He complimented her apartment, which she admits, even given the circumstances, pleased her just a little.

As it turns out, in late 2019, right about the time Barbosa was grabbing the Wall Street bull by the balls, Uber did know something was off. The company detected a ring of people bypassing its background checks in Massachusetts and California, and tipped off the FBI in Boston. Investigators served a warrant to Apple; they wanted to see the iCloud account of a Brazilian guy named Wemerson Dutra Aguiar who, after getting hurt at his job in construction, started driving for apps and later dealing fake accounts. Barbosa didn't know Aguiar, but a Mafia member had once asked her to email him a Connecticut driver's license template. She did. By February 2021, law enforcement had circled in on her, and served Apple a search warrant for her iCloud too. In early April, the FBI

had tracked Barbosa's location via her T-Mobile cell number. Investigators staked out her apartment and watched her come and go.

All this time, Barbosa had worried that getting caught could mean the government would seize her money and property—to her, disaster enough. She was shocked that the FBI raided her house, "like arresting a murderer." *All this for me?* Then she was locked in a prison cell and charged, along with 18 other Brazilian nationals, with conspiracy to commit wire fraud and aggravated identity theft, for making and renting fake accounts over the prior two-plus years.

Barbosa was accused of being a heavy in the case: The government said she pushed out some 2,000 accounts, using hundreds of driver's licenses, and profited more than $780,000. Barbosa says about half of that was her actual take. The rest she either split with her business partners or sent along to the immigrants who didn't have their own bank accounts and used hers. (The government conceded in court filings that Barbosa did let other people use her bank account.)

For the next two weeks, Barbosa says, she sat alone in her jail cell for 23 hours a day—for a mandated Covid-era quarantine—suffering from panic attacks and spiraling self-loathing. "I was feeling that my life was over," she wrote me. "I fucked up everything." Her attorney mailed her a flash drive of the government's evidence: her bank statements, the contents of her iCloud account, her Excel spreadsheet, some Mafia WhatsApp chats. Barbosa cringed upon reading "Find me, FBI." ("I bet the FBI agent's face, when they read that, they said hahaha, like, stupid woman!")

While Barbosa was in jail, her sister traveled to Boston and packed four suitcases full of Versace and Louboutin shoes and LV purses, then took them back to Brazil. Barbosa had a contact transfer $30,000 back to Brazil before it could be seized. (The feds did later grab approximately $55,000 in bitcoin.) On a video call, her sister showed her stories in the Brazilian press. "My name was in everyone's mouth in my city," she says. The former teacher's pet from Sorocaba who taught computers to kids, now an alleged felon with some Mafia texting group in the US. Her mom was devastated. For months and months, the legal process dragged on.

Barbosa holds onto the shoes and gray sweats she wore in prison.

She took up crochet, among other hobbies, while incarcerated.

So, question: Did you think Priscila Barbosa, queen of accounts, was going to sit idle in jail? At the Gloria McDonald Women's Facility in Rhode Island, she morphed into Barbosa, Star Inmate. She cooked for more than 100 prisoners in the cafeteria and shared Brazilian recipes with fellow kitchen staff. That earned her $3 a day. ("Ridiculous," she says, but she enjoyed the work.) She joined inmates in planting an organic vegetable garden in the yard. She aced law clerk and English composition classes. She picked up crochet, writing down pages of instructions that her sister had emailed: a headband, glittery unicorn slippers, a Christmas tree, stockings, and snowmen to deck out the unit for the holidays. She conquered a 2,000-piece puzzle of jellyfish and whales, then a 5,000-piece world map. She did daily squats and jumping jacks. She watched *Orange Is the New Black* and declared it somewhat accurate. She watched a TV commercial for WhatsApp's "private" texting and declared it a lie. When she entered a room, she says that some inmates, resentful, would snipe, "Here comes the princess." Upon hearing about her crime, one woman called her "Brazilian Robin Hood."

The name was snappy, but an awkward fit. Barbosa hadn't stolen money from the rich as much as identities from ordinary people. Now sitting in jail, she says, she finally thought about them. "This is going to sound awful," she warns, but here goes: "I feel bad that I caused some emotional distress to people. But at the same time, I did it in peace, because I never took money from any of those people. It wasn't victimless, because I used people's identity. But nobody really got damaged."

None of the three identity-theft victims who spoke to me—a Harvard professor and two tech workers—knew how or when their identity had been stolen. None had experienced financial harm. They felt unnerved because their information was exposed, but they were also curious about, and even

showed a degree of empathy for, the thieves. One victim mused to me, "It's kind of a sad crime in a way, isn't it? Obviously, it's a crime and they shouldn't have done it, but sad that people have to do stuff like this to get by."

In prison, the crime was regarded as rather pathetic. Alessandro Da Fonseca, Barbosa's DoorDash ally (arrested on the same day), was waiting out the legal process with many other defendants in a Rhode Island detention center, and found that more serious fraudsters were baffled. With all the personal information the ring had access to—enough to open bank accounts, credit cards—their only con was to … create Uber profiles? Fonseca shrugged it off. "We are not criminals, with a criminal mind," he told me in a jail call. "We just want to work."

Uber disagreed. During the legal wranglings, the company accused the ring of stealing money and tallied its losses: some $250,000 spent investigating the ring, around $93,000 to onboard the fraudulent drivers, plus safety risks and damage to its reputation. Defense attorneys shot back that no one lost money at all: The jobs were done. The food was delivered. People got their rides. The gig companies, in fact, profited off the undocumented drivers, taking their typical hefty cut—money that, once the fraud was discovered, there was no evidence they'd refunded to customers.

As the rush of freedom subsided, Barbosa faced the sobering task of another new start. At least she had more than $117, and her family had shipped back her designer clothes.

In February 2022, Barbosa sat in her Rhode Island prison cell, reading two packets of papers: one agreement to plead guilty to felony identity theft and conspiracy to commit wire fraud, another to cooperate with the US government. She had already done the latter in two hours-long interviews, in hopes of a lighter recommended sentence. She signed both agreements with a star in the P of Priscila (a sort of watermark, she says, in case the government tried to use her signature elsewhere).

A year later, in June 2023, Barbosa walked into her sentencing inside the red-brick federal courthouse along Boston's waterfront. It felt nice to be back in civilian clothes—a white flouncy blouse and black pants—but she

was still afraid. The government was recommending three years for her, given her cooperation. Other defendants, whose alleged profits were lower, had been sentenced to that or more.

In court, assistant US attorney David Holcomb told the judge that Barbosa was the "most prolific creator" of the accounts, a "central figure" in the network, "highly effective" at this kind of fraud, with "unique social talents" bringing together ex-boyfriends, social contacts, and competitors. Barbosa's attorney argued that her intentions were mostly good. "She is a very intelligent woman," he said, who "put her intelligence to use in an extraordinary way," helping immigrants work. (Barbosa enjoyed that part.) The judge wasn't convinced. Her intelligence was all aimed at defrauding people, he said, and he had to set an example: "I hope those chat rooms are now filled with chats about 'Did you hear about what happened to Priscila Barbosa?'" Her use of technology—the dark web, bitcoin, Photoshop— constituted "sophisticated means," a sentencing enhancement, he added.

When Barbosa spoke, she cried. She said she was ashamed. She apologized "from the bottom of my heart" to the people whose identities she used. Then the judge read out her sentence: three years, just what the assistant US attorney recommended. Barbosa exhaled. With the two years she'd already served in prison, and with time shaved off for good behavior, she'd be released within a few months. For that last stretch, she was shipped off to Aliceville federal prison in Alabama.

Then, late in the hot summer, she got a visit from federal immigration officers. After she finished her sentence, they told her, she'd be taken to deportation proceedings. ("It looks like this nightmare never ends," she wrote me.) As the months ticked by, Barbosa's hopes of being able to stay in the US had grown. Now, crestfallen, she slipped into depression. She also decided that she would not fight it. She'd pay for her own ticket to Brazil so she'd be free as soon as possible. With the weeks dwindling, she typed me a very un-Barbosa message:

"Too bad they got me too, it is what it is."

Sitting in her quiet living room in January, she said, "Maybe this is me adjusting to the world again."

That, you might have guessed, was never how the story of Priscila Inc. was going to end.

Remember Barbosa's sham marriage in LA? The government found out about it too, while raiding her apartment. Along with her laptops and phones and driver's license printer, investigators took an album of wedding photos and a receipt for the $28,000 "Package Plan." They asked her about it during those interviews while she was in jail.

In October, as Barbosa's deportation drew nearer, she heard from her attorney. Thanks in part to the intel from the apartment raid and her interviews, the government had busted the 11-person ring. Now she was being subpoenaed to testify at one person's trial.

Barbosa didn't want to take the stand, but given her cooperation agreement, she had little choice. So on November 15, 2023, the day before she had been scheduled to be taken into ICE custody, Barbosa was on a commercial plane, flying back to Boston with two US Marshals, hiding her handcuffs from other passengers inside her hoodie's kangaroo pocket. At the federal courthouse, she was (technically) rearrested, this time as a material witness. A magistrate judge released her with an ankle monitor to await the trial.

To understand Priscila Barbosa—the pluck, the sheer balls—consider that as other fraudsters were counting the days until their deportations or still living on the lam, she was walking out of a Boston courthouse's front door.

Barbosa was 37 years old. Fluent in English. Still wearing her gray Alabama prison sweatsuit. A bulky GPS cinched on her ankle. She breathed in the autumn air, along with a surreal feeling of once again being in charge of her own day. "I don't have even a toothbrush!" she told me over the phone the next day, giddy. "It is incredible to feel free again."

Two weeks later, she'd stride into the trial and recount the meeting at the marriage agency's office on Wilshire, the binder of potential spouses, the wedding by the jacaranda tree. The defendant's attorney, while cross-examining Barbosa, would rub in just how much she was benefiting from testifying: that she'd helped herself by telling the government about others

("I was just being truthful," she retorted), that her prison sentence had been shorter ("Who wants to be in jail?" she replied).

Her deportation had been temporarily halted for her testimony, but she would still need a permanent immigration remedy to stay long-term. Barbosa says she applied for asylum late last year, claiming that she fears retribution from the associates of the wedding agency and some people in the Uber case.

Illustration: Michelle Mildenberg

As the rush of freedom subsided, Barbosa faced the sobering task of another new start. At least she had more than $117 this time, and her family had shipped back her designer clothes. Solving one immediate problem, she could get a legitimate driver's license now; Massachusetts had started issuing them regardless of immigration status. She could also work while her asylum application was pending, and her English skills, burnished by constant use in prison, got her part-time gigs translating medical appointments and home-renovation sales pitches. But frankly, neither felt like Barbosa-sized jobs. Her boyfriend had moved on while she was in prison, so she moved into a studio apartment alone. She hit the old clubs and parties with a smaller circle of friends—her closest one had been deported, others distanced themselves. At times, depression sank in.

Sitting in her quiet living room in January, she said, "Maybe this is me adjusting to the world again." As she spoke, she wobbled between the versions of herself. The Barbosa who meant well but, yes, did bad … but had been quite good at it, hadn't she? The Barbosa vowing to never go anywhere near a gig app ever again, then the one who could still, when asked, recount every fraudulent keystroke. The repentant Barbosa who was glad getting caught forced her to quit. The pragmatic Barbosa who knew she would never have made a single fake profile had she just been legally allowed to work. With her future suspended between two countries, she wondered what was next.

So that's it. Barbosa wanted you to know the full story, "the real Priscila," the complex one. For the easy plot with a clean ending, there's Instagram.

In December, Barbosa put up her first after-prison post, picking up her victory march where she'd left off. She stood in front of a suburban Boston ballroom's Christmas tree in pleather bell bottoms, forehead newly Botox-smoothed, Louis Vuitton purse dangling from her wrist. She typed out a fresh bio: "Brazilian Living in USA … Grateful for Life. Paralegal. MasterChef. IT Professional."

All of it more or less true.

Updated: 7/22/2024, 11 am EDT: Wired clarified aspects of Priscila Barbosa's home computing set-up.

Let us know what you think about this article. Submit a letter to the editor at mail@wired.com.

Hair and makeup by Rose Fortuna

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Mar 26, 2024 3:00 AM

The Mayor of London Enters the Bullshit Cinematic Universe

It all started with an asthma attack. Now Sadiq Khan finds himself at the center of a global conspiracy.
Photograph: Tom Cockram

It's a slate-gray Tuesday morning in January, and Sadiq Khan is marching through Camden Market trailed by a caravan of officials, press officers, and the hulking presence of his Metropolitan Police protection unit.

The mayor of London bustles with a sleeves-rolled-up, CEOish energy. The 53-year-old is short—famously so—but bantamweight trim, sharp-suited but approachably tieless. When he pauses in front of a row of arcade claw machines to take questions from local media, he answers fast, in full sentences—lawyerly and reasonable—dropping his "t"s and "g"s in a way that was once a popular affectation of British politicians but which in Khan's case is authentically South London.

In contrast to the shambolic upper-classness of his predecessor in City Hall, Boris Johnson, Khan is something of a throwback: a politico of the Tony Blair era. But the questions show how much has changed. The subjects are a jarring mix of the hyperlocal and the geopolitical: Can he comment on a fatal bus crash in Victoria? How will he help small businesses through the cost-of-living crisis? Should a "Chinese" transport company be allowed to run the Elizabeth Line? What is his view on Israel's bombardment of Gaza?

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Photograph: Tom Cockram

Khan hangs around for an hour, swapping affable banalities with traders and colleagues—on vegan food, vinyl records, dogs—and recording a video to announce a new policy on small business funding. It's a routine stop; mundane, even. Khan's banter with jewelry designers and record stall owners has a scripted feel, the gentle fictions of small politics. It's a sharp contrast to the Sadiq Khan discussed on social media and on the conspiracy-inflected right-wing channels that dominate political coverage in the UK.

Since the UK's highly divisive 2016 vote to leave the European Union, the country's political discourse has spun wildly off center. The economy is in deep decline, the cost of living has spiraled, and public services are collapsing—water deregulation has left Britain swimming in a moat of its own excrement. The national conversation has been dominated by the Conservative government's cartoonish policies and culture wars over gender, "wokery," and climate change. The ruling party has abandoned the political center ground to govern from the fringes. In doing so, it has thinned the membrane that separates the mainstream from the dark currents of far-right extremism and misinformation that flow online.

In that bullshit cinematic universe, Khan is a recurring character, a unifying figure for a dissonant global coalition of racists, conspiracists, anti-vaxxers, and climate change deniers. There's a fictional Sadiq Khan who lives on the internet and in the heads of the far right, and a fictional London that he runs —a "Londonistan" given over to migrants, extremism, and knife crime; a dire warning of the cost of liberal leftist rule. This is partly why Khan needs that police protection. Threats to his life are routine now, part of the violence that has returned to British politics for the first time in decades.

Photograph: Tom Cockram

Last summer, one of Khan's flagship policies—a benign pollution reduction measure—was fused with the global conspiracy, sucked into a nightmarish mass delusion about climate authoritarianism, and co-opted by populist culture warriors to justify a rollback of carbon emissions targets. The chaos that ensued shows how the drip of online conspiracy and radicalization,

driven by algorithms and exploited by opportunists, has warped political discourse in democratic societies. It is now much harder for elected leaders to manage the compromises needed to keep cities—and countries—together and functioning. That battle is becoming ever more one-sided, fueled by conspiracy theorists and cheap and convincing deepfakes. Khan's bid for reelection in May will be the UK's first major vote in this strange new world, a precursor to a national election happening some time this year—and, quite possibly, a warning sign of how dangerous the merging of populism, extremism, and technology has become.

It started innocuously enough. In 2014, Khan ran the London Marathon. While in training, he found himself breathless and wheezing—more than a man in his forties should have been. His doctor diagnosed him with adult-onset asthma. Khan admits that he'd previously had little passion for environmental causes. The diagnosis started him on a journey of revelation.

At the time, he was in his second term as the Labour member of parliament for Tooting, the area of South London where he'd grown up—the son of a bus driver and a seamstress who had emigrated to the UK from Pakistan in the 1960s. He'd already spent more than a decade combining his career as a human rights lawyer with an unglamorous, poorly paid role as a local councillor—the lowest rung of elected office.

In 2016, he ran for mayor. He leaned into his origins in his campaign—a local boy who reflected the diverse reality of London in the 21st century. While his Conservative opponent was accused of using racist dog whistles to try to turn Hindu and Jewish communities against the Muslim candidate, Khan's message of consensus won him the mayorship. Six weeks later, the UK veered the other way, voting to leave the European Union. After Khan took office, he spoke out against then-presidential-candidate Donald Trump's proposed ban on Muslims entering the US, sparking a rolling spat with Trump that continued for years. Soon, Trump-supporting US media was amplifying stories about knife crime in London and mocking the mayor. Khan was more focused on something that was *actually* harming thousands of his constituents.

Air pollution contributes to the early deaths of an estimated 4,000 Londoners a year. According to City Hall, 99 percent of the capital's

residents live in areas that fail to meet the World Health Organization's guidelines for pollution from small, dangerous particles known as PM2.5. Public health experts warn about a buildup of invisible conditions, limiting children's development and causing early deaths. Kids exposed to high air pollution have smaller lungs and higher blood pressure. King's College researchers estimate the economic cost to London in treatment and lost working hours to be as much as £3.7 billion ($4.7 billion) a year.

Most of the pollution comes from cars. The roots of the problem are in London's geography and the compromises made by previous generations of politicians and urban planners. Since the 1920s, plans have been made and scrapped for an expressway around the city center. Instead of a single road, the capital's main arteries—the North and South Circular—are a patchwork of urban streets where 21st century traffic is jammed onto aging infrastructure. Going clockwise, the southern half starts in the old docklands in the east of the city, running through warehouse districts now given over to the hipster overspill of Shoreditch and Deptford, to banker pads and "golden brick" investment properties. It loops southwest, heading through suburbs that have been slowly agglomerated into the urb, clusters of sewage works and bus depots and the low-rise residential hinterlands of South London: Lewisham, Dulwich, Streatham. At Brixton, in the south, an air monitor set up over the high street often hits the annual legal limits of nitrogen dioxide before the end of January.

"Everyone knows a kid with asthma. Everyone does," says Jemima Hartshorn, founder and director of Mums for Lungs, which launched in Brixton in 2017 and campaigns to reduce the amount of traffic on inner-city roads. It was partly the group's lobbying that inspired Khan's administration to focus on schools in its attempts to understand and tackle air pollution. "A lot of our schools were built in Victorian times," Khan says. "And subsequently, for the last 100 years roads have been built outside the schools. So when kids go and play in the playground they breathe in poison."

So, starting in 2019, City Hall invested in new monitoring tools, including backpacks with air quality monitors and GPS tags that were handed out to

primary school children. Pollution data was made publicly available so that citizens could see for themselves how bad things were.

The data revealed not just the scale of the problem but also how unevenly distributed it is, in a city where about half of households don't own a car. "It's those least responsible who are dying, those least likely to own a car: Black, Asian, minority ethnic, because they live on main roads rather than side roads," Khan says. "These environmental issues are also health justice issues, social justice issues, and racial justice issues."

Addressing the problem would mean asking or compelling generally wealthier, whiter people to change their behavior to benefit everyone. And it threatened the sanctity of car ownership, which has been associated with British reactionary conservatism since before the terms "culture war" and "woke" entered the country's political lexicon. But Khan was hopeful that most people would be happy to compromise for the greater good. "It's difficult because there's a lot of noise being made from the extremes," he says. "But people in the middle just want to know what's going on, what the evidence is, and so forth."

"It's those least responsible who are dying. These environmental issues are health issues, social justice issues, racial justice issues."

Khan dusted off an old proposal from his predecessor, Johnson, to charge the most polluting diesel and petrol vehicles a fee to enter the very center of the city—a small area that had already been covered by a congestion charge since 2003. When it was launched in 2019, the scheme was given the blandly descriptive title of the "Ultra Low Emissions Zone," or ULEZ. Two years later, it was expanded to fill the area bounded by the North and South circulars. According to Transport for London, 1 million vehicles enter that zone daily, but TfL estimated that only 14 percent were old or polluting enough to actually be subject to the charge. Khan introduced a "scrappage" scheme to help drivers replace their old bangers with newer, cleaner vehicles. Mostly, he says, people were concerned until they realized they wouldn't actually have to pay.

Photograph: Tom Cockram

By February 2023, nitrogen dioxide emissions had fallen by 46 percent in Central London and by [21 percent in the expanded ULEZ area](). That, Khan says, means 4 million residents breathing cleaner air. There were protests—including one, in April 2023, attended by [notable conspiracy theorists]()—but they were largely small, local affairs. Air pollution campaigners were almost unanimous in their support. The scheme was due to expand further to cover London's outer limits in August 2023, encompassing [another 5 million people](). It felt like the battle had been won. But something weird and violent was simmering out of sight.

The reality of the mayorship is that crises are often thrust upon the city. Britain's biggest political rupture of the century so far, Brexit, was imposed on London (largely against its will—[a majority of Londoners voted Remain]()), disrupting communities, wrecking businesses, and cutting off a flow of young migrants from Europe. Khan calls Brexit "an aberration." The reason the mayor needs a view on the war in Gaza is that its aftershocks play out on London's streets—in [protests and counterprotests](), in rising antisemitism and Islamophobia.

At the same time, the UK's decline is magnified on London's streets. A cost-of-living crisis has sent households and companies to the wall. [Homelessness is rising precipitously](). Public services are crumbling. Holding the city together is hard enough without people trying to make the cracks bigger. But the nature of conspiracy and misinformation, and the binaries of modern politics, means things that should be unifying—like a quest for cleaner air—suddenly aren't.

In June 2023, Boris Johnson, who had resigned as prime minister the previous September, also [quit his seat in Parliament](), jumping before he was pushed amid an investigation into his conduct in office. That triggered an election in his former seat, Uxbridge and South Ruislip, on the outer edge of London, and inside the soon to be expanded ULEZ area.

Polling suggested that Labour had a good chance of winning the seat from the ruling party. But the Conservative candidate, Steve Tuckwell, ran on a platform opposing the expansion of the ULEZ zone. He held on to the seat by just [500 votes](), but in the circumstances it felt like a much bigger victory. The government's media machine seized on the ULEZ narrative, taking the

opportunity to divert attention from its rolling omnishambles. Right-wing commentators pushed the idea that emissions restriction was "wokeness"; the imposition of elite concerns on the embattled working class.

ULEZ found its way to conspiracy groups on Telegram, where it merged with well-established fantasies about elites using environmental concerns as cover to impose their will on the masses. The pandemic unleashed a cloud of virulent conspiracy theories centring on vaccines, 5G, mind control, and Bill Gates. These overlapped with older "elite control" and antisemitic tropes about shadow governments, with a racist conspiracy theory that alleges white Europeans are being deliberately displaced by immigrants, and with newer, internet-native conspiracy communities, like QAnon, whose central belief is that an elite cabal of Satan-worshipping pedophiles runs the US via a "deep state." By the middle of the pandemic, this new meta-conspiracy had a name: The Great Reset.

Online conspiracy groups habitually cross-pollinate in this way. Just as commercial brands try to jump on trends, conspiracy influencers work to attach their big idea to new conspiracy fads or to some news event that can be shoehorned into their narratives. Often, they'll look for international examples that can provide what researchers call "social proof" for their ideas. American commentators looking for "proof" of social collapse will point to knife crime in the UK (despite the fact that London's homicide rate is less than half that of New York's); those looking to demonstrate the socially corrosive impact of emissions targets will highlight farmer protests in the Netherlands.

This can lead to some bizarre moments, where global figures suddenly direct their enormous audience to somewhere ill-prepared for the attention. In early 2023, influential alt-media commentators, including the Canadian psychologist Jordan Peterson, boosted a [conspiracy about "15-minute cities](#)"—an innocuous urban planning concept based on providing services to residents close to where they live. In the bizarro world of the conspiracy theorist, the 15-minute city was reimagined as a plan by shadowy elites to force us all to stay in our neighborhoods, depriving us of our freedom of movement. Soon, protesters including members of the [1990s pop band](#)

[Right Said Fred](#) descended on Oxford to oppose the city's traffic control measures on the basis that they were a gateway to tyranny.

Social media algorithms drive the madness. When mainstream media and politicians start using the same terminology as the conspiracy groups, it can drive a flywheel of attention. It also helps to have a unifying figure who brings together multiple conspiracy constituencies. Which is how Sadiq Khan—liberal, left-wing, Muslim—got sucked into the vortex.

"He is a tool that's used as a way of eliding two battles that otherwise have very few things in common: The hatred of Muslims and the desire not to take action on climate change," says Imran Ahmed, CEO of the Center for Countering Digital Hate, an advocacy group. "He's an enemy, a figure they can use to bring them together. It allows them mutual amplification, succor, support … It's a way of cross-fertilizing extremism."

When mainstream media and politicians start using the same terminology as the conspiracy groups, it can drive a flywheel of attention.

ULEZ is now an established franchise of the conspiracy. A [cursory search for the term on X](#) brings up a parade of far-right and conspiracist accounts, pushing climate lockdown conspiracies related to the "Great Reset," including restrictions on movement and bans on meat and car ownership. "If you saw some of the banners, there were some really disparate issues," Khan says.

The fury wasn't just online. Groups of vigilantes who call themselves "Blade Runners" now roam the outskirts of London, destroying the license-plate-recognition cameras that have been set up to monitor vehicles entering the ULEZ. By November 2023, the Metropolitan Police had investigated [nearly 1,000 incidents of vandalism](#). In December, two men in their sixties were arrested for allegedly [using an improvised explosive device](#) to blow up a camera in the [London suburb of Sidcup](#).

Campaigners against air pollution have been subjected to incredible levels of abuse. Supporters of ULEZ or 15-minute cities [get sent images](#) from Soviet gulags or Jewish ghettos in Nazi-occupied cities on social media.

"It's really scary," says Hartshorn, the air pollution campaigner. "I am significantly more careful about who I tell where I live."

Political violence is returning to the UK, bursting out of the morass of conspiracy and extremism online. There is at times a Blairish elusiveness to the way Khan talks—broadcastable sound bites, reversions to cliché, and a genial caution in the phrasing of his answers. But as we talk about the loss of the rational center, he leans in to interrupt. "Look, I was mates with Jo Cox," he says. "She was one of my best friends."

In 2016, Cox—a Labour member of parliament for the northern constituency of Batley and Spen—[was murdered by a white supremacist](#) who subscribed to the Great Replacement theory. In 2021, [Conservative MP David Amess was murdered](#) by an Islamic fundamentalist who had become radicalized online. "I've got a protection team. I live it every day, the consequences of this, the violence," Khan says. "What I will not allow is to be cowed by those threats, because that's what they want. They want for me to be scared."

Khan insists he's an optimist. Despite the "hysteria" and the culture wars, he believes there's still a middle ground where people can be persuaded with facts, where conflict can be resolved with discussion. Biden beat Trump in 2020, he points out; the moderate Emmanuel Macron saw off a far-right challenge from Marine Le Pen in France.

On the other hand, the Islamophobic politician Geert Wilders is close to power in the Netherlands after winning the most votes in elections in November, running on a nativist, anti-immigration, climate-skeptic platform. Trump is ascendant again in the US, and the British government has made clear that it's planning to fight a general election in 2024 by [doubling down on hard-right policies](#).

In fact, the UK government seemed to take inspiration from the ULEZ spin cycle. The prime minister, Rishi Sunak, announced a list of "common sense" policies, which included rolling back a fictional "meat tax" and ruling out forcing households to divide their recycling into seven bins— [something that had never been seriously under consideration](#). In September, Sunak announced he was ["slamming the brakes on the war on motorists,"](#)

attacking speed limits and traffic reduction measures, before rolling back net-zero emissions targets, including delaying a planned phase-out of new diesel and petrol vehicle sales in the UK. In January, _The Guardian_ reported that government ministers had cited 15-minute cities conspiracies around freedom of movement when making transport policy.

Nervous of the backlash, Khan's own Labour party, which is likely to defeat the Conservatives in a general election this year, shelved climate spending targets after distancing itself from the ULEZ policy. "The misinformation was accepted by all the parties except the Green Party, and so it became normalized," Khan says. "My concern with addressing climate change, or addressing air pollution, or these sorts of green issues, is that politicians may be vacating the pitch because they've learned the wrong lessons."

It's hard not to interpret this as a victory for bullshit. Populist politicians have co-opted the language of conspiracy—the Old Etonians and Oxbridge graduates who make up much of Britain's ruling class now rail against elite control. In February, the former cabinet minister and Conservative Party grandee Sir Jacob Rees-Mogg gave a speech decrying the "international cabals and quangos telling hundreds of millions of people how to lead their lives." Former prime minister Liz Truss shared a stage with Steve Bannon to attack the "deep state" that she claims brought her down after 44 disastrous days in office. Lee Anderson—a prominent Conservative MP and, until January, the party's deputy chairperson—said in a TV interview that Islamists had "got control of Khan and got control of London." Anderson was eventually suspended from the party.

Khan's Conservative opponent in the mayoral election, Susan Hall (who has made scrapping ULEZ a major pillar of her campaign), is a vocal supporter of Donald Trump, retweeted a post on X referring to London as "Londonistan," and alleged that Jewish Londoners were frightened by Khan's "divisive attitude," sparking rebukes from Jewish groups and anti-racism charities.

Khan says it's too early to call the fight. "If you vacate the pitch, then you've got people with messages that are basic lies who will occupy that space," he says. He comes back to that slogan several times during our conversations. Asked what politicians can do to steer the discourse away

from algorithmically driven rage cycles, he talks about his belief in the fundamental decency of people. All he needs to do to prevail in May's election is to win the argument, he says—"The public is never wrong."

But that optimism feels brittle. He has no agency—few levers to pull. Like many politicians, Khan is trying to reason with a maelstrom of unreason. The real decisions about the future of democratic discourse are being made in California, or not being made at all. The tech companies whose algorithms helped spread and popularize conspiracy theories have slashed thousands of jobs, including many responsible for protecting integrity. Increasingly, they're following the lead of Elon Musk's X and taking a noninterventionist approach to political misinformation.

At the same time, the proliferation of artificial intelligence tools has made it far easier to author massive bot campaigns or create convincing deepfakes. Research in January found more than [100 deepfake advertisements of Rishi Sunak](#) being used to promote investment scams on Facebook. [Faked audio of opposition leader Keir Starmer](#) berating his staff spread on X in October last year. In November, the UK's [National Security Council warned](#) that AI could amplify the existing dangers of misinformation during an election or help foreign powers interfere with the process. Khan says that the UK has to urgently consider new laws to confront the risks. "We need to act now, not once the horse has already bolted," he says.

Although the UK government has occasionally said it would put in place rules to tackle misinformation on social media, it hasn't. "I feel like I can't overstate how bleak it is," says Kyle Taylor, founder of Fair Vote UK, an NGO that works on election security and reform. "We had years and years and years for governments to do something. And they have just not done it."

Disinformation isn't always about favoring a particular side. It helps hostile authoritarian states like Russia—or domestic authoritarians like Trump—undermine the foundations of governance, causing people to lose faith in democracy itself. "The objective is to get a society to the point where nobody knows whether something is real or not, and therefore, that society cannot function," says Taylor. Sometimes chaos is the only goal.

Photograph: Tom Cockram

There was an awful perfection to the [Sadiq Khan deepfake](#) when it inevitably arrived. It began circulating on X on November 10, the eve of Remembrance Day, a sacred event in British public life as the nation honors those killed in combat since the First World War.

The atmosphere leading into this solemn day was unusually tense. A march in support of Gaza had been scheduled for the same day. Government ministers wanted the Metropolitan Police to stop it from happening. Suella Braverman, then the home secretary, [wrote a controversial op-ed](#) that alleged the march was "an assertion of primacy by certain groups—particularly Islamists." Far-right groups—emboldened by Braverman—announced their own march.

In the fake recording, an authentic-sounding version of Khan's voice could be heard calling for the ceremony at the Cenotaph war memorial in London to be called off in favor of the Gaza rally. "I don't give a flying shit about the Remembrance Weekend," the voice said. The mayor, it said, controlled the police.

The message pressed every button on England's paranoid fringes: an insinuation of support for Hamas, an apparent denigration of British history and memory by a Muslim left-winger, and a sense of backroom deals being done. A secret woke plot that plugged straight into the grand online conspiracy that unites the far right, anti-vaxxers, and climate deniers.

On November 11, far-right groups gathered in Westminster, drinking, chanting, and preparing to "protect the Cenotaph" from a march happening a few miles away. When the attack never came, they took matters into their own hands, fighting the police for the right to defend a monument to peace from an anti-war protest. Large groups charged barricades; masked soccer hooligans shot fireworks into police lines at head height. Two officers were hospitalized. [More than 120 people](#) were arrested.

The Sadiq Khan deepfake didn't cause the violence, but it added to a general sense of chaos—of control slipping away, the center crumbling. "We can't overstate the grave danger this new technology poses to our

politics and democratic freedoms," Khan says. "The legitimacy of elections and the very viability of our democracy is at stake if we allow these deepfakes to be misused and weaponized." But the grim truth about politics in the AI era is not that one deepfake will change the course of an election, but that the existence of sophisticated, commodified lies will unravel people's trust in everything they see and hear. The triumph of bullshit over fact.

With an election in May, Khan's support for ULEZ has left him at the mercy of powerful forces that he can't control—a tornado of exhaust smoke and black mirrors, a cacophony of bullshit. It reverberates far beyond the South Circular. The UK will vote this year; so will India, Mexico, South Korea, Ghana, and four dozen other countries. The US goes to the polls in November. We're all in the vortex now.

Let us know what you think about this article. Submit a letter to the editor at mail@wired.com.

By [Dexter Thomas](#)
[The Big Story](#)
Feb 1, 2024 6:00 AM

'Over Time the Trust Will Come': An Exclusive Interview With TikTok's CEO

A few weeks ago, Shou Zi Chew sat down with WIRED to tell us how he's trying to make TikTok better. Is the company's CEO for real—or just a really good politician?
TikTok CEO Shou Zi Chew at the company's first-ever live music festival, in Mesa, Arizona, in December.Photograph: Lenne Chai

Before I sit down to talk to TikTok CEO Shou Zi Chew, he apologizes for the noise. The evening's guests have been doing sporadic sound checks all day: Peso Pluma running through his opening number, Offset ad-libbing over a backing track. I passed by throngs of One Direction fans to get into the park (Niall Horan for $25 is a solid deal). This isn't where I imagined I'd be talking to the head of the most influential social media app on the planet, but the only way I could get on Chew's calendar was by meeting him at [TikTok's first-ever music festival](#)—a sold-out, two-stage program at the Cubs' training facility in Mesa, Arizona.

The Big Interview
[Read more](#) deep, weird, smart conversations with the most important people in our world.

The location makes no sense until you realize that for TikTok, location doesn't matter. Only numbers do. The whole festival will be streamed exclusively on the app, for free (highlights would later air on Disney+ and Hulu); it's the digits on the top left of everyone's phone screen tonight that will be the ultimate metric of success or failure for this event.

I'm also here because it seems like Chew never really got to introduce himself on his own terms. When he stepped in as TikTok's CEO in mid-2021, there was little fanfare; the official @TikTok account didn't even make a TikTok about it. Instead, Chew's introduction to the wider public took place during a barrage of questions at a [congressional hearing](#) in Washington, DC, last March. "It was a circus," a TikTok employee tells me, speaking under condition of anonymity. "[They didn't even let him talk.](#) They had the attitude of 'You're a Chinese spy, and we're gonna beat the shit out of you.'"

This is a bit over-the-top, but the sentiment can't be wholly dismissed. Three things can simultaneously be true: First, that China's government openly watches its citizens and an app with origins there will naturally raise a red flag in many countries, especially in the US after parent company ByteDance was [caught tracking journalists](#) there in late 2022. Second, that people have been handing over increasing amounts of data for years, including to companies like Uber and Facebook (both of which have also reportedly tracked journalists), and *[any](#)* [company collecting so much user](#) [data should be heavily scrutinized](#). And third, that [thinly veiled anti-](#) [Chinese xenophobia](#) has become a reliable part of the US political playbook.

TikTok has made a show of addressing the first two issues: During the hearings, anyone listening heard Chew promise to move all of its US data to US-based servers, though some TikTok employees say that [some US data is](#) [still being shared with their parent company](#). At best, Chew's promise has been slow to deliver in full. The company has less control over the third issue: It is hard to imagine that the app will ever be "non-Chinese" enough for, say, the governor of Montana, whose reason for [banning TikTok in the](#) [state](#) was to "protect Montanans' personal and private data from the Chinese Communist Party." (A federal judge has since temporarily blocked the ban.)

Chew seems to have the right temperament to keep TikTok in various governments' good graces. He gives off none of the abrasive "tech bro" energy of his peers, instead exuding the folksy persona of someone perpetually running for town mayor: a handsome, charming man who seems

genuinely curious about everyone he meets—savvy enough to know who evening headliner Cardi B is, but not quite savvy enough to know that he was supposed to remove the white baste stitches from his blazer before wearing it to the event.

He's quick to steer any potentially dicey conversation to a story of a user he met in whatever locale suits the current situation—deftly rattling off how many followers one user or another gained overnight, how many items were sold after a shop went viral. He remembers faces and names, and he visits small businesses. He (or his comms team) even arranged for tacos from AZ Taco King, a local TikTok success story, to be [conveniently delivered during our interview](#).

When I ask Chew who he looked up to as a kid, he doesn't name music or sports stars, but Lee Kuan Yew, the founding prime minister of Chew's home, Singapore. Lee is widely credited with lifting the country from poverty into an economic powerhouse over his 31-year tenure. He has also been called a "benevolent dictator." He'd be an obvious North Star for a certain sort of politician; less so for the head of a social media company that got started with selfie dance videos.

But let's be clear: TikTok is no longer in competition with other social media companies, especially if your metric of success is *immersion*. It outclasses every other app in this regard. [X is chasing away advertisers](#); TikTok integrates them. Meta has promised a [metaverse](#) where we create, work, shop, and play. With TikTok, it's already here—no headset required. YouTube is a good place to post videos, but not to *make* them; TikTok not only lets you post videos, but its in-house editing app rivals expensive pro-level software.

An entire culture is rising up of users to whom it doesn't occur to leave the app for, well, anything. TikTok's true competition, then, is the politics of each territory in which it operates. And Chew's newest strategy seems to be taking his stump speech on the road, virtually and IRL. ByteDance is spending millions on lobbying, yes, but Chew is also ramping up his charm offensive, making TikToks [on his own account](#) (@shou.time), encouraging users to tell everyone about how much they love the app.

I should mention that I was an early user of the app, downloading it right after it became available. I have covered TikTokkers who were using the app for positive impact, and I know people whose lives changed forever after a single post—whether an in-joke about local weather or humanizing stories about incarcerated people. Some of these same users also say that being TikTok-famous has made them anxious, that they feel obligated to make the same kind of videos over and over lest the algorithm punish them. This all makes me think about how, while Chew has been pressed on TikTok's security practices, he hasn't had much to say about how dependent global pop culture has become on the app. That's something we should think about as TikTok continues to extend its influence over how we experience culture, including food, music, and fashion. [On Tuesday, Universal Music Group announced that it would not renew its licensing agreement with TikTok, which could result in music by artists like Taylor Swift and Drake vanishing from the platform.]

TikTok has irreversibly bent our culture's trajectory, but that doesn't guarantee it'll be around to reap the benefits. (India banned the app long ago, and it's under growing scrutiny in a handful of other countries.) It has walked the political tightrope this far, but any bad PR could knock it off. Maybe that's why TikTok's chief comms officer—who used to work in US politics herself—made a show of recording my conversation with Chew with her phone.

The overprotectiveness isn't surprising, of course. TikTok knows Chew can't play the game in quite the same way many of his Silicon Valley counterparts do (taunting the media, for example, will always be off-limits for him). Instead, he has chosen a gentler kind of evangelism, telling people that things really are nicer in his walled garden, if only they'll give the app a chance. And that the garden will be even nicer if we all produce more content.

This interview has been edited for length and clarity.

Shou Zi Chew: Almost every time I visit a new city, I try and meet a few creators. And then I follow them on my TikTok. So it becomes like a friendship, sending messages, and we just stay in touch.

Dexter Thomas: **That is cool**.

It's really fun, yeah. [*Chew pulls out his phone.*] Follow me, I'm @shou.time. I'm going to follow you.

OK.

This is you, right? [*reading from my first post*] Uh, your caption says, "This is a terrible app."

Well, I didn't like it back then because it was all Musical.ly kids. My opinion has changed.

You have only two comments on this post. OK. You should post more.

I should. But right now, here we are in Mesa, Arizona, at the first live TikTok concert. Why Mesa?

Well, the weather is fantastic this time of the year.

I guess, but why not Los Angeles? Why not New York? Is this a soft launch to see if it works?

With the first time, you make sure you manage your expectations, right? It is important that the event goes smoothly. The whole point was, how do we make the best of technology offline, online?

I also hear you're sponsoring the Met Gala.

Yeah.

Why?

Why not? Did you see the press release about it? It's very cultural. Fashion is an incredibly important part of TikTok. Louis Vuitton has 12 million followers on our app.

I think the world doesn't know much about you as a person. So let's leave TikTok alone. Who is Shou Zi Chew?

Oh, who am I? I grew up in Singapore. I was born there, my great-grandfather moved there many years ago. I had a typical Singaporean childhood. I wanted to see the world, because Singapore is fantastic, but it's tiny. So I went to the UK for college. I joined Goldman Sachs, worked there for a couple of years, met an internet entrepreneur who started an investment company to invest in Facebook. So I joined him, and through that I met the guy who founded ByteDance. And in his earliest iteration, the idea was so simple, but so powerful. So I met him in 2012, and … [*The door opens and a couple walks in. They are the owners of AZ Taco King.*]

Taco King: Sorry to interrupt. We're dropping off food.

Chew: Oh, hello! Nice to see you. I promised you if I were in Phoenix, I was going to look you up. Thanks for bringing the food. I'm looking forward to trying this. And have you started using TikTok Shop?

Taco King: We're trying. I've just been having a little bit of trouble, and obviously I've been really, really busy.

Chew: That's awesome. If you need any help, just tell our team. [*Turning to me*] Sorry about that. Do you want to grab some food? It looks amazing, right? [*We both start eating the tacos. They are pretty great.*]

Did you play video games as a kid?

Oh, a lot. I still play video games.

Really? What do you play?

Well, I still play *Clash of Clans*. I recently played *Diablo IV*.

How are you awake right now? Every friend I know who plays *Diablo IV*, I don't see them for days.

At some point you start to pace yourself a lot better. I had my first Nintendo set when I was maybe 5 years old, and my first 286 computer very shortly after that. I'm born in the '80s, which means that—

We're the same age.

We're the same age. So you know what I'm talking about. When you were born, it was all analog. You still had that phone with that curly wire, you remember that? And then video games were sort of invented during that time. So I grew up digitally very native.

I would say you and I, maybe we're more digitally fluent. We're not native. We remember the time before the internet. People younger than us are native.

I consider myself native. I remember getting my first dialup internet connection. Remember that beep? I remember getting online for the first time. I remember that very clearly.

What did you do?

Oh, well, we started searching for … I think my first thing was to search for artists, the musicians that you care about. Sheryl Crow, I think.

Sheryl Crow?

She was popular at that time.

Well, we're at a music festival, so let's keep talking music. Who else were you listening to as a kid?

Back in the '90s, the radio was the most important distribution channel, and the discoverability of music was more or less constrained to what you heard on the radio.

But did you have any favorite artists?

I really liked Green Day. It's a '90s band.

Chew at the music festival at the Chicago Cubs' training facility in Mesa, Arizona.

Photograph: Lenne Chai

Right. I'm interested in how you see TikTok fitting into the music space. There are musicians who've blown up on TikTok overnight. But there are a lot of musicians who've publicly said things like, "My label is making me make TikToks. I used to be able to concentrate on albums; everything is being shortened to a 15-second clip." Or that they feel pressure to put something in their song that will go viral.

The key thing the recommendation algorithm has done is lower the barriers of people discovering music. I think that in itself is the most fundamental and powerful change. So in the past, if you had a very good song, it was difficult for many people to hear it, to be honest. But now, there are so many examples of people just posting a song that they write on TikTok and it goes viral. I think the net positive that we bring to the industry, of course, is this lowering of the barrier of discoverability.

You think what you're doing is a net positive?

Definitely. It means new talent coming into the market. They have a good song. The chances of you getting heard by many people now are much higher.

Remember the song "Video Killed the Radio Star"? This discussion reminds me of that. The perception is, it used to be if you were musically talented, that's all you needed. With music videos, you needed to be talented and pretty. Now with TikTok, you need to be talented *and* pretty *and* social media savvy (or work with someone who is). I hear what you're saying about it lowering the barriers. But what do you say to artists who say TikTok is ruining music?

I don't think so. You mentioned you have to be social media savvy. It's actually not really true. If you look at some of the songs that have taken off on our platform—I'll show you a few examples. So if you look at the way Paul Russell did it …

Oh, I mean, I've seen people who have been successful at it.

Look, the cost of producing a TikTok like this is actually not very high. And to the point of whether we have truncated songs to 15 seconds, a lot of

times it actually drives people to want to discover the music more. So I'm not very sure that it's 100 percent cutting people's attention span. A lot of these songs then become proper hits on *Billboard* charts, on the radio. There's so many of these examples. I think Gayle had a huge hit last year as well. You know that song, "abcdefu"? Consumers are consuming things slightly differently. Of course that will mean that people have to adapt to this new way that the consumers are demanding to consume. But generally speaking, I think it unleashes more creativity. And if you look at the music industry as a result of TikTok, I think it's thriving more than ever.

I think that's the key there, what you just said: "have to." Because this new platform exists, musicians and artists do have to adapt. This is the new norm. You *have to.*

TikTok Comms Officer: [*interrupting*] You don't *have* to.

Chew: I think a lot of them are. So Cardi B's going to perform today. She's adapted very well. She had a number of campaign sessions she did on TikTok over the year, and it's really, really successful. Charlie Puth as well, he's performing here today. He shows people how he makes his music. It's amazing how talented this guy is.

It is amazing.

Fans want to know how the music is made. They want to know about the thought process, the creative process. And this is the key thing. They don't want this to be overproduced. They want this to be super authentic. And one of the key things that you will find on TikTok is that most of the content, everything I just told you about, has to be really authentic. If you try to make it very polished or very refined, it's not going to be that organic. People will see through this.

I can see both sides. I definitely also hear the pressure from a label saying, "Fans want authenticity, but they want this *specific kind* of 'authenticity.'" It creates pressure. I've seen a musician argue that [we wouldn't have had Radiohead](#) if they had to come up in the TikTok era. Thom Yorke's an unusual dude. I don't think he would've been down

to make a TikTok to say, "Hey everybody, join me on my musical journey to make this song."

If you're talking about the more classic songs, we have also had many examples. Remember the Ocean Spray guy a number of years ago?

Right, yeah.

What was that song? "Dreams." Fleetwood Mac. It went back into the charts again as a result of that video.

But totally randomly. You can't predict that.

It's a feeling. It's that moment in time, and it captures the feelings of the cultural zeitgeist. A lot of these things, you can't engineer it. This is organic. Our role as a platform is to provide the three things: the window, the canvas, and the bridges to connect. And then these things will emerge organically. You have things like BookTok, people sharing about books, 200 billion views. You have people sharing science content. It's this mesh of diversity. That's what we're trying to achieve. There's so many people around the world with talent, and we have just opened up the pool for more people. For creativity to emerge, you need to have that kind of competitive, I guess, competitiveness of ideas.

Music is a tough business. It's almost a cynical joke at this point, an artist posting something like, "Hey, I got a million streams on Spotify. Thanks, everybody, I'm going to go buy a burrito." Somebody's making money, but it doesn't seem to be the artists. Where does TikTok fit into how artists are going to be able to continue to make their art?

That's a great question. We are always thinking about providing more tools for musicians and other creators and users to be able to connect with their base. One of the reasons we're doing this event—and by the way, super excited about this festival—it's not only about the people who show up today, it's about the livestreaming. I'm certain that we're going to reach a lot more people online through the app.

Than in person?

Than we are offline, yeah. By a significant difference. Have you discovered a new song on TikTok?

A couple. I can think of one, specifically. But I'm pretty sure he didn't make any money on it.

Well, we are also developing new tools that allow partnerships with Apple and others. Initially the focus was on discoverability, but then as that sort of becomes more and more established, we are creating new channels for artists to be able to find some monetization opportunities, including connecting directly to, say, Apple Music to do that.

It seems that, of all the social media platforms out there, TikTok is truly the one in the spotlight right now. Why do you think that is?

Well, I think we are probably one of the youngest ones. As in, we are the most recent ones to emerge onto the scene, and we do bring a different proposition with discoverability. I think trust has to be earned in every company. As you grow and have more and more users and nonusers who are looking at your platform, you just have to earn their trust. I actually see this as an opportunity for us to explain ourselves.

I don't want to relitigate the congressional hearings. But I watched them, and the main topic, of course, was China. China, China, China. A lot of fans of TikTok thought it was unfair and posted TikToks making fun of it. Have you seen the edits of you answering questions and looking confused?

Yes. [*laughs*]

What do you think?

It was important that we showed up at the hearing. It was important that we answered the questions, which is what I tried to do. But some of these moments, you never know when the moment becomes a meme like that.

Did you have any inkling that a politician asking you about TikTok connecting to the home Wi-Fi was going to be funny to somebody out

there?

No. I was genuinely trying to answer the question.

Have you felt that there is an unfairness or an extra scrutiny of TikTok because of the origins of the company?

To a large extent, yes. I think it's one of the reasons we have a bigger trust deficit than most other companies. Maybe our trust starting line is behind other businesses, but I also think that there are very serious approaches that we've taken to try and earn that trust and to close that gap. I talked about this during the congressional hearing—you know all this, this is all public information, we built a project to address those concerns. We actually spent a lot of time understanding them. There were concerns about data security, there were concerns about transparency of our code. We have not only talked about it, we have actually put this into action. We built a project where we put all data into a third-party environment, through Oracle. It's a setup that is unprecedented, and no other company that I know of has established this. If you're fundamentally addressing all these concerns, then over time the trust will come.

Speaking of trust, let's talk about moderation. There are truly terrible things on basically every app, because there are truly terrible things basically everywhere.

There are truly terrible things that people *try to post.*

Is there something that you think TikTok is doing better than other apps to address that?

I think I just want to focus on ourselves. We have invested a tremendous amount in terms of not only the technology to help us moderate content but also evolving the policies, the community guidelines. We have invested in a lot of people to help us with content moderation. We have worked with many experts out there.

Photograph: Lenne Chai

You've heard of [Algospeak](#)?

Yes, I've heard of it. Yes.

What do you think about it?

It's difficult as a technical challenge. But I believe it's something that can be overcome with advances in technology. I'm optimistic.

Algospeak exists, I'd argue, for good reasons. I can give you an example. [*I show him a TikTok.*] This is somebody talking about the conflict in Israel and Palestine. There's a perception that TikTok won't let him say this stuff, so to get around it, people are saying things in the comments like "Thanks for these beauty tips" or "That's a great recipe" in order to fool the algorithm into thinking this TikTok is about something else. It seems like there's a lot of people on the platform who are trying to fool the algorithm.

The overarching thing that we're trying to do here is to keep the community safe and inclusive for everybody. There's always freedom for users to express themselves if it doesn't violate any of our guidelines. As you can imagine, this is a very complex role, and our trust and safety team is always looking into making sure that the content on the platform is not violative.

I suppose the question I'm asking here is, what do you think of the fact that a culture has arisen that is constantly trying to evade things?

I think as long as there have been rules, there have been people trying to bypass the rules. I think what is really important is to make sure that the spirit of what we're trying to do is well understood, and the spirit is, "Look, we're trying to create a platform for creativity and for joy."

But to that end, both creators and commenters feel the need to dodge what they think are censors.

Right.

So how do you view that?

I need to understand specifically what you are trying to say. Look, what do we mean by "dodge the censors"? If they're saying something that is actually hate speech and it violates the spirit of the platform …

Let's say in this case it's not. Somebody is saying, "Hey, I think this is really important. You all should pay attention to what's happening out there." But then feeling like TikTok won't like this.

Oh, no, but I think the guidelines are clear on what we do and what we don't do. If you're talking about a small group of bad actors who are trying to find a loophole, then our role will always be to stop that. If you're saying there are a lot of people who don't understand our rules, well, I actually don't think that's the case.

I'm not sure that's the problem here, that people don't understand …

TikTok Comms Officer: You can appeal.

Chew: Yeah, you can appeal.

For an example, news outlets have had to, at times, avoid saying things like "Somebody was killed" when it's a fact. You'll see respected outlets avoiding certain words, or even using words like "unalived." These aren't people doing bad things. These are just people trying to communicate.

I think I understand the question better now. Clearly we prioritize safety very seriously, as you can imagine. And some of it could be us being overly protective, a mis-moderation leaning on the side of being careful. Sometimes we have taken something down as an abundance of caution. The position of moderation is very important. It's not only getting the violation rates down, it's reducing overmoderation, which happens. It's a price you have to pay, and you have to find the right balance. You mentioned certain words like "kill" or "death" that will trigger the content moderation rules.

It's taken down out of abundance of caution first, and then if you appeal against it … it's not a good user experience. I understand that. It gives users the wrong impression of what your guidelines are trying to achieve.

I think in particular, it gives a lot of users the impression that if they have a less popular or minority opinion, that opinion isn't acceptable.

I just want to clarify that the community guidelines are comprehensive in covering what we think is OK or not OK. And a lot of times it will take time for people to understand that that is how we moderate. That is how policies are built, that is how tens of thousands of moderators are doing their jobs. You've got to give them something to do their jobs, and that's the set of guidelines. Everything cascades from that.

Let's move to the shift to longer videos. TikTok just ended the creators program, which is how a lot of people made a living; now it's paying only for videos over a minute. There are creators who got very, very good at making short videos, and that skill set is not as applicable now. What's your pitch to creators who are feeling like, "We made this, we made you what you are, and now you've changed the rules"?

There are a lot of users who want to see the amazing UGC [user-generated content] that everyone has been creating for the last five, six years. That doesn't go away. But as more and more people join, there will be a diverse demand for new things, and that's where some of our efforts in encouraging slightly longer videos come from. It doesn't take away from the existing ones, because that's the way the recommendation engine works. It just adds to more integration.

You're paying only for the longer videos.

A lot of it is because longer videos require more investment in time to be created, and it is an area where it's still relatively small compared to the rest of the UGC platform. But we are always thinking of ways forward. Not everybody is here to make money, to be clear.

Of course.

But for those who want to explore more opportunities, we've created a whole series of things to allow people to try that. [Livestreaming is one of them](#).

Right.

I take, obviously, all this feedback very seriously. I'm not trying to diminish it, I'm just saying that I hear that feedback, and I think what's important for us is that we don't mistake launching a program for de-emphasis on anything else. It's not like that. The community who has always been with us, creating all the wonderful dancing and singing content, this underpins everything we are. It underpins us because it's creativity and it's joy. I cannot emphasize enough how important the base is to us and how deeply we care about giving them the best experience possible. I've met many creators, by the way, across many countries, in France, in the UK, in this country, in Indonesia, Singapore, even as far as Kazakhstan. There's always a group of users who've been there since 2017, 2018, 2019. In all our work internally, I want to assure that group that they're incredibly important to us and we are not pursuing something at the expense of them.

Actually, the dancing reminds me of something. Have you seen that researchers from Alibaba have released a paper saying that they used data that had been scraped from videos of popular TikTok dances and used that information to create an engine that shows … [*Chew looks puzzled*] Oh my gosh, you haven't seen this?

Nope.

Oh, you should see this.

OK.

The researchers at Alibaba [used a data set of scraped TikTokkers doing dances](#) and used that data to create an engine that will allow them to animate anything. These are users who have gotten big themselves, and they've given quite a lot to your platform, and now an outside actor is pulling data from your platform.

It's public data, though.

It's public data, but I bet a lot of people wouldn't want their dance to be used in somebody else's data set.

I think it's a complex topic about how we deal with public data that's been used for somebody's private training sets. I'm paying a lot of attention to this topic. There are a lot of debates about this, as you can imagine. I don't have any immediate response to this. This is something I need to go back and look into more deeply, because it's an evolving discussion.

Is there some protection you can offer to users to say that the content you upload here will be used on this platform and not scraped by some third party?

I would need to look into that.

OK.

Because in the past, if you publish something publicly, it's in the public domain. It's out there.

[*Note: After this conversation, a public relations staffer introduced me to TikTok's head of security and asked me to repeat what I'd said about the scraping paper. He said this was the first he'd heard of it and thanked me for telling him about it.*]

I know that our time here is limited, and the concert is going to start soon, so one more. You've had to answer a lot of criticism about your app and your practices. From your perspective, what do you think is the biggest thing that people have misunderstood about TikTok?

I think the biggest gap in understanding is between users and nonusers. This is the biggest gap.

Really?

Yeah, that's the biggest gap. Every time I meet a user, I feel like the level of understanding and the conversations that we have are significantly different

than with someone who's never used it before. People who use it really understand it.

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Laura Kipnis
The Big Story
Dec 5, 2023 6:00 AM

The Spy Who Dumped the CIA, Went to Therapy, and Now Makes Incredible Television

Joe Weisberg—the geopolitically entangled, heavily therapized creator of *The Americans* and *The Patient*—is the trickiest character he's written (so far).
Photograph: Vincent Tullo

"Did you learn things in CIA training about withstanding interrogation that are going to make it harder for me to interview you?" I asked Joe Weisberg, creator of the TV espionage drama *The Americans* and onetime CIA agent. He looked momentarily startled, as though he'd expected this to be easier. Good, I had him where I wanted him: off-balance. I saw him taking my measure. Then he laughed affably, but I mistrusted the affability, since I knew from his own books that affability is among the qualities the CIA recruits for: people who can get other people to trust them, or at least want to have lunch with them.

I suppose I had certain fantasies about interviewing an ex-spook (was he equally profiling me? more skillfully?), no doubt the result of having read too many John le Carré novels. As it happens, reading le Carré had a lot to do with propelling Weisberg himself to spycraft. Sure, he knew it was a fantasy world being depicted, but it was still a world he felt he belonged in. There was also his consuming obsession with bringing down the Soviet Union, which unfortunately for his career aspirations was soon to collapse on its own.

Weisberg, who is 57 and on the short side, has a sharp, possibly even hawkish visage along with an invitingly squishy-liberal midsection, which in combination externalize the essential duality in his being, one that's both shaped his life story to date and yielded one of the most complex married couples in television history, the Russian sleeper agents Elizabeth and Philip Jennings. *The Americans* aired on FX from 2013 to 2018, but everyone I know seems to be compulsively binge-streaming it lately—maybe the fear that your neighbors are plotting to bring down democracy somehow resonates again with the mental state of the country? Loosely based on the FBI's 2010 arrest of a network of Soviet spies living under assumed identities in the US, the series springs at least as much from the depths of Weisberg's psyche. Elizabeth, a cold warrior to her core, is, Weisberg says semi-jokingly, him pre-therapy; the détente-curious Philip is him after.

Therapy also figures significantly in his more recent limited-run series, *The Patient*, created with his writing partner Joel Fields (they were showrunners together on both series) and starring Steve Carell as a shrink horribly unlucky in his clientele. Something haunts me about both these shows, and not just because they feel like case studies in American paranoia. At a time when most scripted television specializes in moral preening—trafficking in sentimentality, pandering to liberal do-gooderism, leaving us feeling better about ourselves and the world—Weisberg's shows put you through a merciless psychological and spiritual wringer. They're willing to leave you floundering.

So what about those interrogation-evading techniques? I pressed Weisberg. We were chatting in his downtown apartment, the top two floors of a century-old building—gracious entryway, high-ceilinged rooms, also a rental and steep third-floor walkup with an inoperable buzzer. ("Joe doesn't have fancy taste, he's not acquisitive, he's not super interested in money," says his brother, Jacob.) Decorative touches include his late mother's porcelain eggcup collection, a row of family photos (some "off the record"—Weisberg is divorced and has a teenage daughter), the residues of successive hobbies—photography, painting, cooking—and a wall of serious-looking books. The vestibule is devoted to an extensive high-tech

backpack collection: his only consumerist passion is an unequivocally nerdy one.

What I really wanted to know was what he'd learned about getting inside people's heads—knowing what your adversaries are thinking, using their desires against them. It's what's so seductive about le Carré: his operatives aren't just spies, they're master psychological strategists. As are Philip and Elizabeth Jennings, always knowing the precise right play: who's dissembling, where's the weak spot. Does CIA training give you a leg up at that kind of thing in later life? Does it make you better at grasping dark human complexities, thus at writing layered and contradictory characters?

It turned out I had it backward. The secret to writing success goes deeper than on-the-job training. It requires a willingness to pursue your monomanias wherever they lead. It requires, Weisberg eventually divulged, *finding a good enemy.* "When I was younger, having an enemy gave me a purpose, because the purpose is to fight the enemy," he told me. "It's hard to describe how alluring that was. If you have an enemy, everything makes sense." There it was: scratch the affability, uncover a gladiator. If I wanted to understand Weisberg, and maybe human creativity generally, I realized I'd have to understand the symbolic function of The Enemy.

Photograph: Vincent Tullo

In the Cold War years, a good enemy wasn't hard to locate. Though only 14 when the Soviets invaded Afghanistan and not especially political, Weisberg was outraged over the brutality and injustice of the war and saw the mujahideen (some factions of which would become the Taliban) as heroes. Maybe it had to do with his father reading aloud nightly from the Russian classics to Joe and Jacob—Tolstoy, Turgenev, Gogol, Dostoevsky —from when he was 5 on, meaning that the romantic world of imperial Russia was lodged deep in his imagination. Maybe it was the Sunday school inculcations about the oppression of Soviet Jewry. Either way, his fantasy life—he'd been writing novels from the time he was 12—became devoted to saving innocents from repression, and what he knew more than anything was that America needed to liberate the freedom-loving people of Afghanistan.

In college, ever more convinced that the USSR imperiled world peace and ever more drawn to the thralls of absolutism, he became—despite having grown up in an ardently liberal household—a Reagan devotee. Switching his attentions from literature to become a history major focused on Russia, he wrote a senior thesis asking if the Soviet population supported their government's leadership. (He now wonders if his entire career since has been devoted to rehashing that paper.) At Yale, conservatives were then in short supply, at least among the student population, and being vocally pro-Reagan had its social disadvantages. Even if he didn't identify as a *social* conservative, rumors circulated among friends back home that he'd become a racist. In an office-hours meeting with a writing professor he'd thought he was on friendly terms with, she suddenly blurted out, "You can be such an asshole!" He was baffled, but maybe he also *was* a bit of an asshole. "You do nasty things," he'd later write about his pre-therapy self. "You behave in strange ways when your feelings are obscured from you. You don't have the tools to do anything else."

The Soviet obsession continued post-graduation: he studied Russian, went to Leningrad to study more, got a job in Chicago helping Soviet émigrés find jobs. Bored, one day he called the CIA to request a job application. After 18 months of tests and interviews, he started training at the agency's semisecret compound in Langley, learning to fire weapons and detect surveillance. (That was the exciting part; less thrilling was a six-week classroom slog memorizing the bureaucratic ins and outs of the CIA.) He met guys, rough guys, who while operating in Afghanistan had grown beards and donned traditional robes, riding around on horseback with the mujahideen. Though afraid of horses, and though the Soviets had by then left Afghanistan, this was the career Weisberg wanted.

As far as interrogation-withstanding, he recounted the day when trainees were kidnapped from their barracks, blindfolded, put in a truck, then taken into a room and questioned. If you wouldn't talk, they made you stand in awkward positions. He doesn't think he really learned much, other than a phrase one of the trainers wore on his hat: "Admit nothing, deny everything, make counter accusations." "I may do that," he said, apropos our interview. The other takeaway was to always have a cover story prepared.

Weisberg left the CIA after three and a half years, still feeling positively toward it, he says, though a review of his 2008 novel *An Ordinary Spy* in the CIA's house organ, *Studies in Intelligence*, suggests otherwise. "A nasty and poorly executed look at our world," snarls the reviewer, a veteran CIA agent specializing in counterintelligence. Quoting a le Carré character's statement that what spies do—however unscrupulously—is vital to the "safety of ordinary, crummy people like you and me," the reviewer insists this is a truth "few people in the intelligence profession would dispute."

An Ordinary Spy disputes precisely that. The first-person account of Mark Ruttenberg, a bookish, sweaty, newly minted CIA case officer not entirely unlike Weisberg, it's also rather a takedown. Mark, though no Lothario (he hasn't had sex for a year), ends up in bed with Daisy, an embassy worker he'd been trying and failing to recruit. And is then left in deep shit after she imparts a useful piece of postcoital intel. Unfortunately for Mark, this is not the daring world of sexy spies familiar from movies and airport paperbacks; the real CIA (as depicted in the novel) is a rule-bound bureaucracy where crossing lines or bedding a "developmental" gets you summarily fired. Weisberg's other realist gesture was covering the pages with blacked-out redactions—his having worked at the CIA meant the book did actually have to be vetted by its publications review board (as would every *Americans* script)—the effect of which is a sly indictment of institutional ass-covering about a botched operation.

Overall, the novel struck me as far more cynical about the mission of the intelligence services than even le Carré tends to be. When I pressed Weisberg about the cynicism, he said he thinks le Carré is skeptical about the goals of espionage while still respecting his characters' competence; his own book, he acknowledges, is cynical even about the competence. For both, the cost of intelligence gathering means not infrequently wrecking informants' lives and livelihoods, and sometimes getting them killed. For le Carré it's a necessary trade-off; in *An Ordinary Spy* the value of any intelligence gained is minuscule, also entirely unreliable. If you're a case officer in the field, a shockingly high percentage of your informants are lying to you, and there's frequently no way to tell. One of his main characters, another CIA agent, gets scammed by an 11-year-old.

The novel didn't sell a lot of copies, but Hollywood loves spies, Weisberg had sort of been one and could also write dialog, which led to a well-known agent approaching him about writing for TV. Weisberg sold a show about a CIA station in Bulgaria to FX, which didn't get made but led to relationships with producers at DreamWorks, which led to him writing some episodes of their sci-fi show *Falling Skies*. When the Russian illegals were arrested in 2010, the DreamWorks producers called and said, Do you want to do a show about this? Weisberg spent a couple of weeks wandering around and thinking about it, and decided the story should be set in the 1980s and be told from the point of view of the KGB spies. And it should be about a family. Weisberg was by then a father himself, and something that had stuck with him from his CIA days was how many people there lied to their kids about what they really did for a living.

After Weisberg wrote the *Americans* pilot and it got picked up, he joined forces with the more experienced Joel Fields to co-executive produce the series. Weisberg describes working with Fields—son of a rabbi, studied moral philosophy in college—as transformative. Fields is also the product of a lot of talk therapy; the two soon realized that they wanted to make a show where the drama derives less from plot twists than how the characters navigate them emotionally. When I asked Fields about their creative coupledom—what I really wanted to know was what they fight about—he said they used to joke on *The Americans* that like Philip and Elizabeth, they had an arranged marriage. They're also both too conflict-averse to fight.

Photograph: Vincent Tullo

Among their goals was having the spycraft be as realistic as possible, and much of it is entirely real. One of their consultants, an expert on the Soviet illegals, had a personal collection of KGB gizmos and gadgets—the actual stuff that actual spies used. Even the props were marinated in history, the same history that had fired Weisberg's obsessions, which I suspect somehow filters into the emotional texture of the show.

His political trajectory still puzzled me, though. In my youth, people who needed a geopolitical enemy looked for foes closer to home: US imperialism, capitalist pillage. They swung left, not right. Maybe Joe was wilier—it's not like becoming a CIA agent was something kids of Chicago

lakefront liberals were encouraged to do, especially when your parents are active in local Democratic politics and your lawyer-dad works part-time for the ACLU, and your mother …

Yes, let's pause to discuss Joe's mother—though I come late to the undertaking, as her story was previously related by Malcolm Gladwell in a 1999 *New Yorker* article ("Six Degrees of Lois Weisberg") and his subsequent mega-bestseller *The Tipping Point*. "Everyone who knows Lois Weisberg has a story about meeting Lois Weisberg," opens Gladwell. Chain-smoking, coffee-addicted, frizzy-haired, five-foot-nothing, Lois was the type of person Gladwell calls a "connector," someone with a weird genius for sweeping people from entirely different worlds into their orbits. Somehow Lois knew everyone—Lenny Bruce, Dizzy Gillespie, Ralph Ellison, Isaac Asimov. Gladwell's theory is that people like Lois may actually run the world.

I count myself a beneficiary of the Lois effect, having casually known Joe's one-year-older brother Jacob since back when I used to write for *Slate* in the 2000s. As its boss, and being Lois' offspring, Jacob regularly convened assorted *Slate* writers for meals and occasionally far-flung outings, which included once beckoning me, maybe 20 years ago, to Lois' Chicago apartment for a family dinner when he was in town, where Joe was also in attendance. This was in his post-CIA malaise—he'd taken a leave to help care for his dying father, briefly returned, then resigned. (He didn't want to live abroad, he says now.) I recall him being remote and difficult to talk to. Someone I know who met him around then describes him as "vaguely desperate." His father's death had torpedoed him; soon after, he entered therapy, urged by his brother and friends. (When I reminded Joe that we'd met once long ago, he claimed to remember, though I chalk this up to the Weisberg affability.) These days Jacob, alongside Gladwell, runs Pushkin Industries, a podcast company.

Now it was my turn to summon Jacob to dinner, to grill him about Joe. Joe was not a happy child, I learned, an outsider at school—"a little awkward or funny-looking," said Jacob, quickly backtracking to add that "funny-looking" was unfair. He just wasn't comfortable with kids his age, thus lonely, also the outlier in the family. All Joe wanted was to read comic

books and watch TV; his bibliophile father hated television so much that he may have once said, depending on which Weisberg brother you ask, that it was worse than the atom bomb, and permitted only two hours of it per week.

Jacob, who describes himself as a far less interesting person than Joe, didn't have conflicts with their parents, and didn't much want to watch TV. To him it seemed like a wonderful family life. "I accepted the terms of the imprisonment pretty well," he said. When Joe went into therapy and started characterizing their homelife as difficult and repressive, Jacob's initial reaction was, "What? I was there too. It wasn't like that."

Jacob told me that Lois was the kind of mother who'd say, "Why don't you go join the circus?" I assumed she'd meant it in a cruel-mom way, as in "You don't like your dinner, go join the circus." No, she'd meant it literally, I learned from Joe. Lois was then in charge of special events for the city of Chicago, and when the Ringling Brothers circus came to town, Lois (being Lois) had gotten to know the guy in charge and one night during dinner said, "Joseph, I think you should join the circus." He was in his teens. She said she'd introduce him to someone who could probably find him a job and take him with them when they left, which would be an amazing experience. "She was right that it would have been a great experience," Joe says now, "though also wrong and crazy." He'd always seen it as a funny and benevolent story, but later wondered if there was also a part of her that wanted to get rid of him. "I think one has to face that interpretation of the story too."

One late summer afternoon, Weisberg and I met at a midtown tourist museum called [Spyscape](), which gauges its visitors' potential spy abilities via a series of interactive exhibits and tests. Long on what's known in writers' rooms as "hangability," Weisberg gamely played along, though barraged with a lot of whooshing sound effects and flashing lights upon entering asked, "Does the fact that these are making me nauseous mean I wouldn't be a good spy?"

What was great about this field trip was that the museum promised to do my job for me: construct a profile of the person I was supposed to be profiling. We were tested about whether we were good liars, good at

detecting lies, and willing to take risks. In "Special Ops" we were faced with an infernally complicated challenge involving pushing a lot of glowing white buttons on a wall while dodging a meshwork of laser beams. Weisberg leaped athletically to the task, determined to beat that day's record, exclaiming afterward, "I thought that looked dumb, but it was great!" Squirting himself with Purell at one of the stations thoughtfully located around the museum, he joked, "Here's where you really fall down in their assessment—if you use the hand sanitizer." In the "Surveillance" exhibit we had our first fight, over Edward Snowden, about whom Weisberg was decidedly negative and I insisted had been a patriot.

Then it was time for Weisberg's spy evaluation. "You have high emotional intelligence, which helps you understand people in social situations, and are empathetic," pronounced a creepy omniscient robot. "You take risks after careful consideration," it added. "Joe Weisberg, you are going to be an intelligence operative!" This didn't thrill him. "The real question is, do I want for it to say that I'd be a good spy or a bad spy?" he mulled. "The truth is I don't want to be a good spy anymore." But maybe old habits die hard. On his personality assessment, when asked if he was willing to be unethical if it would help him succeed, he'd rated himself a 1, the lowest score. Asked if he'd say anything to get what he wants, he'd given himself a 2. "Obviously that's what you'd say if you were saying anything to get what you want!" I pointed out.

After all, he was the one who'd earlier said that the whole thing you learn to do in the CIA is manipulate people. Is unlearning that really possible? The question of who was manipulating whom had been a meta thing in our conversations from the beginning, with jokey badinage about the power of interviewers and the vulnerability of their subjects. Not long after our field trip, Weisberg—a foodie who spends much of his free time patrolling lower Manhattan in quest of Chinatown's most electrifying dumpling—suggested by email that we hop on the Long Island Rail Road to Flushing, Queens, for "sour fish"; he knew a restaurant that served a half dozen varieties. The accompanying photo displayed a bowl of lethal-looking chilies the size of hand grenades. I wrote back: "Fearing unflattering portrayal, profile subject poisons unwitting profiler with capsaicin overdose." Weisberg rejoined a second later: "Pathologists were shocked to discover the poison delivered

simultaneously with a subcutaneous patch and ingested along with, judging by the contents of the victim's stomach, sour fish."

He was funny, I was charmed, but then so was poor lonely Martha Hanson in *The Americans*—secretary to the head of the FBI's DC counterintelligence unit—skillfully charmed by Philip in a great demonstration of what a powerful interpersonal weapon nerdy vulnerability can be. Spoiler alert: it doesn't end well for Martha.

The Americans rode to acclaim by enacting such interpersonal paranoias on the historical stage, the complication being that sometimes the enemies we create are indeed out to destroy us, and sometimes our side is worse. Just as Weisberg would become torn about who the geopolitical villains really are, so will viewers be torn about Philip and Elizabeth. Yes, they're stealing American secrets, seducing and exploiting the locals, ruthlessly exterminating anyone who gets in their way, but they're also idealists with hopes and depths. They love their kids. A friend I had breakfast with the other week, who was midway through watching the series, was agonized about how they could have gone through with one particular assassination (an elderly woman). He fretted about whether the show had finally crossed a line for him, then conceded that the line had already been crossed when Elizabeth murders a sympathetic Black woman whose life she'd already destroyed after fake-befriending her to get information, and the show just assumes you'll go along with it.

Sometimes going along *was* tough. I myself argued with both Weisberg and Fields about Elizabeth pimping out her daughter to her KGB handlers. Happily, they're entirely nonproprietary about their own interpretations of characters and plotlines, including when I queried them (separately) about how monstrous so many of the mothers and mother-surrogates seem. Fields joked that he needed a time-out to call his therapist; Weisberg pushed back a little, saying of the most supremely monstrous mother—Sam's, the titular patient-kidnapper of *The Patient*—that though she's definitely complicit in his crimes, he believed in a mother who couldn't turn her kid in no matter what. (Or urge him to join the circus, I thought.)

Photograph: Vincent Tullo

When Weisberg and Fields came up with the idea for *The Patient*, it was Fields who was initially intrigued by serial killers. Weisberg wasn't, but they kept talking about it, then figured out that Sam, played by Domhnall Gleeson, was in therapy: he wants to *change*. Then they had the idea that he kidnaps his therapist, and now it was a show—also a merciless examination of how unfree all us benighted humans are, manacled to our stupid psychologies and impediments, even when not literally manacled in a basement. "You hope your plot puts your characters into situations that bring things out that are surprising and you'll see depths you get to plumb, and this was really like that," Weisberg said. They have a shared ability to excavate a remarkable amount of submerged stuff from their psyches, and transpose it into commercially viable TV. Fields says that sometimes, months later, one of them will say of a plotline or twist, "Oh my God, our subconsciouses did that," and the other will say, "That wasn't subconscious on my part, I thought you knew we were doing that." Then they'll laugh.

It was therapy that gave Weisberg the ability to write characters with complex mental lives—he wouldn't have been able to, he says, until realizing he had one himself. Which meant coming to terms with how much of a false front he'd put on throughout his life, and how much he'd been hiding from himself. He started thinking that his childhood identification with the repressed Soviet citizenry was a way of externalizing his anger about repression in his own family. Trained from the crib to quash all negative feelings, he couldn't go to war against his parents, but he could work to destroy a Soviet leadership busy choking off the free expression of its citizenry. Having an enemy, in other words, helped him avoid facing his own dark side.

Not that it's ever so easy to shelve an obsession. In his intermittently memoirish 2021 book, *Russia Upside Down: An Exit Strategy for the Second Cold War,* Weisberg contends that he (and we) had fundamentally misunderstood the Soviets. The KGB was remarkably uncorrupt, the Bolsheviks were the party who'd put a stop to the pogroms, and the Soviets had ended the Holocaust, beating the Nazi army back through Eastern Europe. Yes, Jews suffered horribly under their rule, but many were also members of other groups that Stalin was purging and brutalizing, from intellectuals to party elites. These many reversals and correctings-of-the-

record make an odd reading experience, like watching someone in an MMA bout with his own former beliefs and punching himself a lot in the face. This effort to get it right, intellectually and emotionally—to come to terms with history and its crimes, to see around your own blind spots—seems both noble and poignantly impossible.

Blind spots: what to do with them? Weisberg and I had disagreed in a friendly way about therapy. His idea is that you get to a more authentic version of yourself, mine is that you just come up with a better cover story. We're always staging our personas, trying to get people to buy the latest one. He semi-concurred—our stories about ourselves change over time; we all want things from other people and try to get them. It's what's so interesting about Philip and Elizabeth, I said—that they've been trained to use that "authentic" part of themselves to manipulate people. That had been his own training, Weisberg reflected: Tell the truth as much as you possibly can, even with the foreigners you're running as spies. Everyone he talked to at the agency said, about the people they were most manipulating, that their feelings for them were entirely genuine. They loved and cared about them.

But what about all the less palatable motives, the things you don't say to your colleagues? Rewatching the *Americans* pilot, I was struck by the degree to which revenge figures in numerous plotlines and vignettes; *The Patient* too is fundamentally about Sam's need for revenge. Is that a big theme for you? I asked Weisberg. "Not consciously," he said after a pause. It was probably more that violence and terror were big things for him, that from a young age his isolation, sadness, loneliness, mixed with comic books and American culture generally, all funneled into a very violence-centered fantasy life. "And when there's a lot of violence, you're going to have vengeance plots, it's going to be a part of how you tell those stories."

"So revenge is just the occasion for violence?"

"I think that's right," he said. "Though I can't rule out that in five years I'll realize how vengeful I am."

Weisberg remains convinced that every American's ideas about Russia are psychological projections, though given recent events—the Ukraine invasion, the blatant assassinations and poisonings of Putin's critics—he

wonders if he'd seen the potential for rapprochement too optimistically. But he's also over his former optimism about America as a beacon of hope for the world. Having once thought, "We don't invade, take over, and colonize—we liberate," the realization that he'd gotten it so wrong on Iraq (he was pro-invasion) was a painful turning point. He looks back now on those fantasies of fighting and nation-building and wonders what the fuck he was thinking. The US shoulders some not insignificant portion of responsibility for the Ukraine war, he also now says, given NATO's expansion toward Russia's borders: "Any nation would feel threatened and fight back. Certainly we would have." This was startling to hear from an ex-cold warrior, but being susceptible to extreme political swings could also be, I was coming to understand, the putty of great creative bravura.

We'd been talking during the writers' strike, so Weisberg and Fields weren't working on anything together at the moment. Weisberg was using the downtime to work on a novel. When I asked if he was cultivating any new obsessions for his next act, he said there was something he kept pitching but had so far gone nowhere. The backpacks.

He wouldn't say more about the idea but agreed to walk me through his collection, pointing out the pockets on one, the mesh on another, the special sunglasses holder. "Look at that material and the color scheme!" He reeled off the manufacturers of various zippers and buckles. "Just try that zipper pull," he enthused, zipping a zipper back and forth. I agreed it was a very smooth pull.

I asked how many backpacks he had in total. He said he didn't want to answer that, but also he didn't know. I tried surreptitiously counting them but gave up after discovering a second layer underneath the first, along with a bunch of smaller ones. "Don't you lose stuff in all these pockets?" I asked. "I don't really use them," he replied. "I just like having them. I want to feel that I *could* use them."

I did my best impersonation of a shrink: "That's quite suggestive."

"Yes, it's odd," said Weisberg. "What does it suggest to you? Is it obvious what it suggests?"

"Well … like 'baggage'?" I was thinking of those mental health fascists on dating sites who demand "No baggage" of potential mates. Yet here was someone who loves his baggage and its many secret compartments (even when empty) and plumbs them for a living, I thought enviously, wondering if I should try to love mine more.

"So that's it for the backpacks?" I said.

"Well, that's as much as I'm going to show you," he replied.

Later I asked Weisberg whether he still needed enemies or if therapy had cured him of all that. He said he'd never thought he had enemies in real life (this seemed like a 180!), then rethought the question: "There's a lot of passion. And a lot of hatred. And, of course, a lot of judgment. And a lot of effort to destroy." I could have said "Destroy what?" but left it there, thinking that, as with his riveting onscreen alter egos, people are most profusely themselves when their cover stories are a little glitchy.

Let us know what you think about this article. Submit a letter to the editor at mail@wired.com.

By [Stephen Armstrong](#)
[Business](#)
Oct 14, 2024 3:00 AM

The Hottest Startups in Dublin in 2024

The Irish capital's embrace of Big Tech is filtering through to its startups, who are building better tools for IT teams, AI content moderation tools, and RNA screening for herds of cattle.

Thanks to low corporation tax and government incentives, Dublin has hosted the European headquarters of many large US technology companies —Google, Meta, LinkedIn and Microsoft all have offices in the city's Silicon Docks.

Europe's 100 Hottest Startups

From Amsterdam to Zurich, these are the hottest startups in Europe in 2024

"The big US companies operated independently of the startup world for many years," explains Will Prendergast, partner at Frontline Ventures. "But in the past five years, US technology companies have been building product and engineering functions here, and that talent is starting to spill out, driving startup creation."

Government support via Enterprise Ireland's Pre-Seed Start Fund, designed to accelerate early stage startups, and hubs such as Dogpatch Labs are supporting this wave of new talent. "Ireland does have a capital issue," says employee benefits startup Kota cofounder Luke Mackey. "There are lots of ways to raise €1 million but not many ways to raise €10 million."

With recent funding rounds led by both US and local VCs of €10 million ($11.1 million) or more, that looks set to change.

Openvolt

Openvolt is building an API that collates carbon emissions data across Europe to supply to energy transition companies. It's no coincidence that the aim is to make an API that's as simple to work with as Stripe's payment system—Don O'Leary, Openvolt's CTO, was Stripe's EMEA head of customer engineering. With CEO Dave Curran, he launched the company in 2023. Openvolt's first step was securing real-time data from 90 million smart meters across the continent, with gas consumption and the carbon intensity of electricity supplies to follow. The company raised a pre-seed €1.5 million ($1.6 million) led by Cavalry Ventures. Its first client is Helios Energy, which will use Openvolt data in its audit of client's energy use. openvolt.com

Tines

Tines is an automation platform for IT and security teams to automate any manual task using a menu of eight common commands, such as "HTTP request," which sends or receives data from another system. Tines targets simple tasks that teams spend the most time on—onboarding users or triaging low-level security incidents for instance—to reduce "alert fatigue." Launched with an $11 million (€10.2 million) Series A round led by Accel, Index Ventures, and Blossom Capital in December 2019, the company has raised $146.2 million (€130.6 million) overall. With 200 employees across the USA, Ireland, Australia, and Canada, revenue has grown 200 percent between November 2022 and May 2024. Customers include Databricks, Mars Inc., and Oak Ridge National Laboratory. tines.com

Marker Video

Marker Video is a user-generated branded content platform, selling product review videos by ordinary people to brands and retailers for a flat fee. Launched as Marker Content in 2022 with €600,000 ($670,00) from

Enterprise Ireland, founder Greta Dunne switched from blog post to video in February 2023. "I met the head of marketing at Estée Lauder who had just pivoted from influencers to ordinary people after their data showed the more authentic the content, the better the response," the former copywriter explains. Customers can scan a QR code in hotels, or on products, and upload video reviews which are tagged and indexed. The videos sell for between €100 and €200 ($111 to $223). Brands receive unlimited use and creators are given 50 percent of the fee. A stealth launch in April and deals with Unilever and Acer Hotels saw 5,000 creators a month join the site. A second round raised €200,000 ($223,000) from Enterprise Ireland and investor angels such as Brian Caulfield, as well as David Byrne of Digital Irish to fund a full launch in the fall. markervideo.com

Greta Dunne, founder of "authentic review" service Marker Video.

PHOTOGRAPH: LAURENCE MCMAHON

CaliberAI

CaliberAI is an AI-powered content moderation platform that searches for harmful and defamatory content. Acting as a "spell check for libel and hate speech," it notifies news publishers and social media users when they're getting close to the line. It was founded by a father-and-son team—Conor Brady was editor-in-chief of The Irish Times and Neil Brady was a journalist for The Guardian. An Enterprise Ireland grant of €300,000 ($335,000), followed by €850,000 ($950,000) pre-seed launched the company in 2019. The team trains CaliberAI and other large language models on specifically created data sets—a paucity of defamatory material to train on meant the company built its own. Customers include Mediahuis, the Daily Mail, Meta, and numerous law firms involved in AI. "Misinformation and hate speech is eroding democracy because news publishers are on their knees," explains Neil. "Generative AI chatbots and the companies that make them are not going to be afforded the same legal protections as social media users." caliberai.net

EdgeTier

"Customer service is broken—no one likes fighting with a chatbot to get through to a human to solve their problem," says EdgeTier CEO and cofounder Shane Lynn. The company's AI monitors customer conversations with call centers, listens out for issues and offers training to humans based on the conversations it has analyzed. Lynn, CCO Bart Lehane and CTO Ciarán Tobin launched with a seed round in 2019 and have since raised €7.5 million ($8.3 million) in two rounds lead by Smedvig Capital and ACT VC. The company now operates in more than 20 countries across Europe and the Americas, working with Abercrombie & Fitch, Ryanair, the TUI travel company, Electric Ireland, and Tipico. edgetier.com

Noloco

Noloco is a platform for any business to build an app using a point-and-click interface, without the need for software or coding skills. Founder Darragh Mc Kay describes it as the Webflow for business apps. As a software engineer, Mc Kay realized "how few of the tools I had were available to non-software engineers and how complicated they were to use". Noloco has a series of templates for common HR, project management and inventory apps as well as a blank canvas where users can drag and drop the tasks they need apps to perform. Founded in summer 2021, seed funding in February 2022 raised $1.4 million (€1.8 million), led by Unpopular Ventures and Accel Angels, and the app builder was launched in July 2022. Customers are SMEs—primarily construction companies, marketing agencies, accountants and lawyers. Available as a subscription model, revenue has grown 140 percent in the past 12 months. noloco.io

Darragh Mc Kay, founder of app platform, Noloco.

PHOTOGRAPH: LAURENCE MCMAHON

Inspeq ai

Inspeq.ai is an evaluation platform for product teams creating AI applications. It monitors app development, especially LLMs, to make sure that the output is accurate, consistent, does not hallucinate and is free from

biases and negative tones. The idea for the company came to CEO Apoorva Kumar and CTO Ramanujam MV, formerly product managers at Microsoft and Meta respectively. The pair found that the LLMs they worked with would often "hallucinate," producing grammatically correct but factually inaccurate information. After building a proof of concept at the Founders Talent Accelerator in late 2023 that reduced hallucination issues by 80 percent, they raised €1.1 million ($1.2 million) in a round lead by Sure Valley Ventures in May 2024 to grow operations in Ireland, London, and India. inspeq.ai

Barespace.io

Barespace CEO and cofounder Conor Moules worked at a local hair salon when he was a teenager. Then, when he joined food delivery app Bamboo in his twenties, he realized to his surprise that typical salon transactions were more than 10 times larger than typical food delivery orders. He founded Barespace to help barbershops, salons, and spa businesses automate their business management with a comprehensive SaaS platform that combines appointment scheduling, client history and marketing designed to be used by non-technical staff. Founded in March 2022 by Moules and COO Glenn McGoldrick, it closed a €1.5 million ($1.6 million) pre-seed round in August 2024 from investors such as Brian Caulfield, chair of Scale Ireland; Barry Napier, CEO of Cubic Telecom; and Rick Kelley, the former managing director of Meta Ireland. Barespace has processed more than €10 million ($11.1 million) in payments in its first 20 months since launch, growing the business by more than 300 percent. barespace.io

Gazelle Wind Power

Gazelle Wind Power is building floating wind turbine platforms far out in the deep sea. Ninety-nine per cent of wind farms are fixed to the sea floor in relatively shallow depths. However, more consistent and stronger winds are found above much deeper water. Antonio García—racing yacht engineer and uncle to Gazelle founder Jon Salazar—devised a dynamic floating platform with anchor lines attached to the seabed, accompanied by a

counterweight that balances the platform in rough seas. The company has raised $11.3 million (€10.1 million) in equity to date, led by Katapult Group, and has a series A round looming. Salazar's next goal is reducing the cost to reach the "Henry Ford moment"—a cheap, scalable platform that's simple to assemble, install, and operate. gazellewindpower.com

Antler Bio

Antler Bio's EpiHerd screening platform examines RNA in blood from dairy cows—the tool by which genes are expressed in the environment. "Farmers think about breeding for perfect genetics," cofounder Maria Jensen explains, "then wonder why the animal isn't delivering." EpiHerd reveals environmental effects on gene expression—disease, diet, farm infrastructure or stress—provide recommended actions specific to farm and animals, and monitor the impact changes. Cofounded by Jensen and Nathalie Conte in November 2020, the company raised more than €1 million ($1.1 million), led by the Nest family office. The first paying farm in November 2023 increased milk production by 30 percent. Antler expects to reach 173 farms by the end of 2024. Plans include validating EpiHerd to screen for endemic diseases, such as bovine TB. antlerbio.com

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By [Stephen Armstrong](#)
[Business](#)
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The Hottest Startups in Helsinki in 2024

The Finnish capital's most exciting startups are building nuclear-powered heating networks, better weather forecasting tools, and an esports streaming platform that lets viewers bet on the outcome.

Helsinki's startup scene evolved around behemoths such as Nokia, games giant Supercell, and food delivery platform Wolt. It's reaping the rewards with experienced entrepreneurs, investors, and engineers powering a lively scene based around the Aalto University campus and the startup festival Slush, one of the world's largest gatherings of investors and startups.

Europe's 100 Hottest Startups

From Amsterdam to Zurich, these are the hottest startups in Europe in 2024

"We appreciate work-life balance and collaboration," explains Jonne Kuittinen, deputy chief executive of the Finnish Venture Capital Association. "The Supercell guys were very open about paying all their taxes in Finland, and this giving-back mentality is visible now these founders are helping out on a lot of the current funding rounds. I think the scene is about to be turbocharged."

The country's low unemployment has meant coders have been hard to find, says Claes Mikko Nilsen, principal at VC Nordic Ninja, but a receptive government launching a fast track D visa in 2022 has boosted international recruitment. The next step? Larger funds for late-stage investments.

Paebbl

"Concrete is the most consumed product on the planet after water, and that's not slowing down," says Paebbl co-CEO Andreas Saari. Concrete's main ingredient, [cement, is the source of 8 percent of the world's carbon dioxide emissions](). Paebbl flips this, using rock weathering, or mineralization, to turn carbon dioxide into stone. Carbon captured at industrial sites is mixed with water and ground silicate to produce a solid carbonate-based material using a technique developed by Paebbl CTO Pol Knops. Paebbl founders Jane Walerud, Marta Sjögren, ex-Slush CEO Saari and Knops raised €8 million ($8.9 million) in seed funding from climate tech VC Pale Blue Dot, French investor 2050, the Grantham Foundation and several angels in October 2022. In May 2024 the pilot reactor sequestered its first ton of CO_2. A demonstration plant comes online later this year, and the stone will be deployed in the field in spring. Next up—selecting sites and partners for four commercial scale plants, operational by 2030. [paebbl.com]()

Distance Technologies

Distance Technologies has developed a prototype mixed-reality version of a military pilot's heads-up display (HUD) that works like a glasses-free 3D monitor. An LCD panel projects 3D images onto transparent surfaces, such as a car windscreen treated with a reflective coating. The company is discussing applications from detailed 3D topographic maps projected onto cockpit windscreens for pilots and night vision footage of the road ahead for drivers. The prototype is fitted with a hand tracker, so users can interact with the screen hands-free. Founded in 2023 by co-founders Jussi Mäkinen and Urho Konttori, who met at Helsinki-based mixed reality headset company Varjo, it raised $2.7 million (£2.04 million) in a pre-seed round led by FOV Ventures and Maki.vc, with Business Finland and David Helgason's Foobar.vc. Discussions are now underway with car, aerospace and defense companies. [distance.tech]()

Steady Energy

Steady Energy began in the state-owned Technical Research Centre of Finland when CEO Tommi Nyman and cofounder Hannes Haapalahti decided to commercialize the center's low temperature nuclear reactor, the LDR-50. Most existing nuclear reactors operate at around 300 degrees Celsius, superheating steam to drive heavy turbines. The modular LDR-50 operates at between 65 degrees Celsius and 120 degrees Celsius and heats water directly. This will be pumped around district heating networks, providing neighborhood systems with warm water from a central power station carried through insulated pipes to heat houses. These networks have long been popular in Scandinavia and the USA, and are spreading to other European countries thanks to last year's EU directive expanding their use. Having raised €15 million ($16.7 million) from Lifeline Ventures, Yes VC, and Reid Hoffman's Aphorism Foundation, Steady Energy has preliminary agreements for 15 reactors with utility companies Helen and Kuopion Energy. Construction is expected to start by 2028, with operation beginning in 2030. steadyenergy.com

Steady Energy's Tommi Nyman, Hannes Haapalahti, and Petteri Tenhunen.

PHOTOGRAPH: JUSSI PUIKKONEN

Skyfora

Skyfora is developing state-of-the-art instruments to improve the accuracy of weather forecasts. The company offers three different meteorological probes called StreamSondes—ultralight atmospheric transmitters that hurricane hunters drop in the path of storms. The company is also adapting satellite receivers in telecom base stations into a network of weather scanners, which can analyze water vapor, temperature and air pressure. CEO Fredrik Borgström, CTO Kim Kaisti, and cofounder Antti Pasila raised €5 million ($5.5 million) in four funding rounds from Icebreaker.vc, Voima Ventures, and other business angels. The company's StreamSonde was deployed in July's Hurricane Beryl and Skyfora is now working with telecom operators to set up proof-of-concept pilot towers. skyfora.com

Enifer

Back in the 1970s, the Finnish paper industry used fungus to treat wastewater and sold the resulting mycoprotein as animal feed. The technique died with the industry, but Simo Ellilä, Heikki Keskitalo, Joosu Kuivanen, Ville Pihlajaniemi, and Anssi Rantasalo repurposed it. Together, they founded Enifer in April 2020 to develop food grade mycoprotein by upcycling waste liquid from food, agriculture and forestry. A €15 million ($16.7 million) series B round in April brings total funding to €27 million ($30.2 million) from Taaleri Bioindustry I fund, Nordic Food Tech VC, Voima Ventures and others. Factory construction started in May, aiming to reach industrial scale by 2025, with new sites on the way. enifer.com

ReOrbit

ReOrbit is pioneering "software-enabled satellites," a distributed network of secure satellites that act like an Internet of Things in space. Satellite manufacture hasn't changed for 40 years, explains Sethu Saveda Suvanam, CEO and founder, because they can only talk directly to Earth. Suvanam is fixing that by building "flying routers," which allow, for instance, military satellites to send images of Russian ships to the coastguard through space at high-speed, accelerating warnings. A busy €7.4 million ($8.2 million) seed round in September 2023 will fund an in-orbit demonstration satellite, scheduled for launch in 2025. reorbit.space

Sethu Saveda Suvanam, CEO of ReOrbit.

PHOTOGRAPH: JUSSI PUIKKONEN

Realm

Founders Miika Huttunen and Mikko Mäntylä met at Slush, a company with a high staff turnover, which led to lost documentation and a lack of "corporate memory." With former Stripe engineer Johan Jern, they created a large language model AI that can search every digital document an organization has ever created to provide answers to, for instance, sales reps questions about previous deals. Launched in April 2023, its first funding pre-seed round of €1.7 million was led by Lifeline Ventures with angels

including Helsinki founders from Zalando and Supercell. The company is now working with procurement analytics leader Sievo, games company Remedy Entertainment, and EV charging provider Virta. withrealm.com

Bob W

Short for "Best of Both Worlds," the company operates 36 full-service aparthotels in 17 cities across Europe. The company uses a digital front desk run by chatbot Bob W that handles check in and out as well as booking breakfast spots and gyms. The system also informs guests of their carbon dioxide emissions for each choice made. Founded in 2018 by Niko Karstikko and Sebastian Emberger, the company has raised €70 million ($78.3 million). The most recent round, in March, saw €40 million ($44.7 million) raised by Wise's founder Taavet Hinrikus and Supercell's cofounder Mikko Kodisoja. The money funds an ambitious acquisition policy, buying 20 to 25 buildings across Europe and converting them into 1,500 to 2,000 aparthotel rooms. bobw.co

Swarmia

Swarmia is a software engineering effectiveness platform designed to make it easier for software teams to communicate, set goals and measure productivity. Key to this is the software connecting other platforms such as GitHub, Jira/Linear, and Slack, creating "working agreements"—agreed guidelines for managers and teams on how they plan to work together. These include targets, how they'll be met, and how the results will be measured. Founder Otto Hilska was previously chief product officer at Smartly.io. He's raised €13.8 million ($15.4 million) over three rounds, most recently with Dig Ventures, and is expanding in the US. Swarmia is currently serving more than 1,500 companies including WeTransfer, Hostaway, and Axios HQ. swarmia.com

Noice

Noice is all about the metagame. The livestreaming gaming platform allows viewers to gamble on outcomes in games that they're watching using digital

cards. These might predict, for instance, that the next kill in a game of Fortnite will involve a shotgun. Each correct card picked wins points, and they can be bought or earned by watching ads. Founded in 2020, the company has raised a total of €25 million across two funding rounds, backed by local entrepreneurs including the cofounders of Supercell and the cofounders of Wolt. Noice cofounders CEO Jussi Laakkonen and CTO Jaakko Lukkari met at Applifier, the Finnish company that helped developers create in-game replay, before Unity acquired the company. The company is still in beta testing with a full launch later this year. noice.com

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By [Stephen Armstrong](#)
[Business](#)
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The Hottest Startups in Madrid in 2024

The Spanish capital is drawing talent from Latin America, and its eye-catching startups are working on smarter payments, eldercare, and an AI-powered virtual nurse.

Having spent many years as second fiddle to Barcelona, Madrid surpassed its Catalan cousin in 2023 with startups securing €605 million ($672 million) investment above Barcelona's €457 million ($507 million). "Lots of Latin American talent is arriving thanks to the recent entrepreneur visa and talent programs run by Telefonica to bring promising startup founders from Mexico, Argentina, Columbia, and Venezuela," explains Bu Haces, innovation consultant at Madrid's Impact Hub.

Europe's 100 Hottest Startups

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The city has seen solid growth in transportation, mobility, and fintech startups during the last three years with AI and deep tech supercharged by an astonishing 56 universities. "The business schools in particular are providing lots of startup networking opportunities, and are keen on developing an entrepreneurial ecosystem," says Miguel Arias, general partner at VC K Fund.

With Meta, IBM, Google, and Amazon all expanding in the city, the main worry is lack of housing stock for the flood of students, engineers, and

entrepreneurs. "We need more accessible housing if we continue like this," Haces warns.

Invopop

When Invopop cofounder and CTO Sam Lown worked as CTO for Cabify, a Latin American rival to Uber, he found that the company had to issue invoices in different formats in different countries. More than 30 governments across South America and Europe also insist that online businesses report every sale to tax authorities as they happen, often with different reporting rules. "I thought it would be great to send all that to one place and have a company deal with it," he explains. Invopop's platform converts sales into electronic invoices and reports them to the local tax authority in the correct format. With CEO Juan Moliner Malaxechevarría, Lown raised €2.2 million ($2.4 million) from Y Combinator, Rebel Fund, and Wayra. Since its launch, Invopop's 500 business customers—including Property Management Services, Amenitiz, Fever, and Sunday—have issued more than 1 million invoices in 25 countries. This year they launched the Invopop App, which connects to Slack, Chargebee, and Google Drive. invopop.com

Uelz

Uelz is designed to simplify online payments for companies that use a variety of payment methods, such as credit card billing, mobile payment, and buy now, pay later services. It's also designed for international companies that use different payment providers in separate countries. Uelz's platform connects with all payment gateways, including Apple Pay, Visa, Global Payments, Klarna, Stripe, and Truust.io. It automates subscriptions and one-off payments and selects the most appropriate payment provider—for instance, if rates of commission vary between countries, Uelz will ensure the gateway with the lowest commission is used. The company tracks payments and provides data to sales teams and finance departments. Cofounded by Xandra Etxabe and María Luke Astigarraga (the former goalkeeper for Atlético Madrid), Uelz has raised €2 million ($2.2 million)

from Angels Capital and Wayra. The company is expanding into Latin America in 2025. uelzpay.com

Tucuvi

Tucuvi is a health tech company offering a voice-based conversational AI and "virtual nurse" called Lola. The service monitors patients after they leave the hospital to reduce readmissions. Lola leads patients through a structured conversation and sends the results to the patient's medical team for review. Cofounded by María González Manso and Marcos Rubio in 2019, the company obtained €5.5 million ($6.1 million) in funding from the European Innovation Council. Offering Lola in Spanish, Portuguese, and English, Tucuvi has worked with more than 60,000 patients in Spain, Portugal, and the UK, reducing hospital stays by 26 percent and cutting the 30-day readmission rate by more than 50 percent. tucuvi.com

Tucuvi's Marcos Rubio and María González Manso.

PHOTOGRAPH: JAMES RAJOTTE

iFeel

iFeel is a workplace mental health platform aimed at companies as a service to employees or as part of health insurance cover. People talk to an AI that assesses their levels of stress, depression, and anxiety. It then decides what sort of attention is needed—from an online therapist to a standard self-care well-being program. iFeel claims its treatment halves working hours missed, with 90 percent of users reporting improved emotional and mental well-being after using the service. Available in 26 languages and 30 countries, iFeel customers include Glovo, Insud Pharma, Cabify, TravelPerk, Spotahome, and H&M. Launched in 2020 by cofounders CEO Amir Kaplan, COO Martin Villanueva Ordas, and Gabriele Murrone, the startup has raised €40 million ($44 million), with a recent €20 million ($22 million) Series B investment round co-led by FinTLV Ventures and Korelya Capital. The new funds will support international expansion. ifeelonline.com

Luzia

Luzia, created by Spanish engineer Álvaro Higes, is a WhatsApp- and Telegram-based AI personal assistant which uses OpenAI and Meta's Llama to provide a ChatGPT-style service. Luiza can research topics, suggest help with your math homework, create pictures, and use translation tools. Founded in April 2023, Luzia secured a $2.5 million (£1.9 million) seed round in June 2023. Further rounds—$10 million (£7.6 million) series A in September 2023 and $19 million (£14 million) series A1 in April 2024 —are funding international expansion. The company has more than 50 million users and 15 million app downloads, topping the Android and Apple Store charts across most LATAM countries. Luzia.com

Embat

Embat cofounders Antonio Berga and Carlos Serrano García-Lisón worked together at JP Morgan, where, says Berga, "we were seeing clients struggling to manage multiple banks and banking platforms. It took hours." They founded Embat with Tomás Gil, ex-CTO at Fintonic, in August 2021 to centralize financial operations on a cloud-based platform for 600 companies in 60 countries and 50 currencies. €6.5 million ($7.2 million) preseed and seed series were backed by Samaipata, 4Founders, and VentureFriends. February 2024's €15 million ($16.6 million) Series A will fund further international expansion. Future plans include developing AI for fraud detection, insurance underwriting, and recommending investment opportunities. embat.io

Tomás Gil, Antonio Berga, and Carlos Serrano García-Lisón.

PHOTOGRAPH: JAMES RAJOTTE

Senniors

Senniors is an at-home care company for elderly people. It provides wearable tech from Fitbit to monitor users' health and needs, and gives families access to the data through the Senniors app. The company also

connects elderly users to health care professionals when needed, provides a longevity program in partnership with Fitbit as well as insurer Klinc to improve activity, sleep, and emotional well-being. Cofounded in November 2020 by Claudia Gómez Estefan and José de Diego Abad, Senniors raised €5.3 million ($5.8 million) in a seed round led by SixThirty Ventures. The company has provided 800,000 hours of home care to more than 40,000 families in 100 Spanish cities. US expansion is planned for 2025. hola.senniors.com

Boopos

Boopos is an online broker for buying and selling businesses, founded in 2020 by Juan Ignacio García, the former CFO at Spain's first unicorn Cabify. Many of the companies for sale on the platform are predominantly small online firms. The Boopos team vet them, while making sure they are profitable and have been operating for the last two years. García has raised $20 million (£15 million) in three rounds led by Bonsai Partners and K Fund. With almost $80 million (£60.9 million) transacted on the platform, Boopos has 5,000 active buyers and 200 businesses for sale, and will break even by the end of the year. "We want to scale," says García. "There's a wave of baby boomer business owners retiring and selling up." boopos.com

Onum

Onum is a cloud-based platform that monitors companies' data as it moves from collection to storage. Using AI algorithms, Onum spots anomalies, potential security risks, and system issues. It also helps "separate the noise from the signal," identifying what should be discarded, archived, or analyzed, and claims customers cut the cost of managing data by up to 80 per cent. Founded in October 2022 by Pedro Castillo—former CEO of cybersecurity unicorn, Devo—he's joined by cofounders Lucas Varela and Pedro Tortosa. Onum closed two rounds of funding for a total of €38 million ($42 million) led by Kibo Ventures and Dawn Capital. onum.com

Shakers

Shakers is a digital workforce platform that helps companies build, manage, and pay teams of freelancers. It can select an entire group from scratch or add new members to an existing talent pool. Founded by CEO Héctor Mata, COO Nico de Luis, CPO Adrián de Pedro, and COO Jaime Castillo in 2021, Shakers has raised €7 million ($7.7 million) in rounds led by Brighteye Ventures, Adevinta Ventures, and Wayra. The company claims it has grown 350 percent in revenue in the past two years. Charging businesses for access to the platform, it has worked with more than 600 Spanish companies including Inditex, Telefónica, Uber, and Microsoft and more than 7,000 freelancers. Expansion across southern Europe is planned for 2025. shakersworks.com

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By [Saul Klein](#)
[Business](#)
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Europe's Innovation Ecosystem Can Make It the New Palo Alto

A cluster of European cities within a five-hour train ride of London could become a unicorn factory to rival Silicon Valley, argues tech investor Saul Klein.

For over a decade, the tech industry has been chasing unicorns—those elusive startups valued at over $1 billion. The obsession began in 2013, when Aileen Lee—a VC based in Palo Alto—coined the term that captured the imaginations first of founders and investors, and then prime ministers and presidents. But these mythical beasts are also rare: only 1 percent of VC-backed startups ever reach this status.

Europe's 100 Hottest Startups

From Amsterdam to Zurich, these are the hottest startups in Europe in 2024

As society enters the age of AI, and financial markets put renewed value on business fundamentals, our understanding of what makes a successful tech company is evolving. Promise alone doesn't make a national, regional, or global champion. Champions are those companies that combine both the promise of untapped growth and the fundamental metrics that demonstrate strong and sustainable customer demand.

Until recently, Silicon Valley has been seen as the world's undisputed unicorn factory. But Europe's innovation ecosystem has matured to a point where it is consistently producing companies with both the vision to change the world and the fundamentals to sustain that change. Leading the pack is a

cohort of more than 507 "thoroughbreds"—startups with annual revenues of at least $100 million.

More than a third of these high-potential companies are headquartered in what we call New Palo Alto: not a singular location, but a network of interconnected ecosystems within a five-hour train ride of London. After the Bay Area, this is the world's second most productive innovation cluster and includes cities with industrial heritage like Glasgow, Eindhoven, and Manchester, as well as world-renowned capitals of culture, policy, and academia like Amsterdam, Cambridge, Edinburgh, London, Oxford, and Paris.

They're home to companies such as low-cost computer maker Raspberry Pi, whose technology was invented and developed in Cambridge, manufactured in Pencoed, South Wales, and sold worldwide. Raspberry Pi recently crowned over a decade of growth with a listing on the London Stock Exchange. At the time of listing, it had revenue of $265 million and $66 million in gross operating profits.

Other New Palo Alto thoroughbreds include fintechs Monzo, Revolut, and Tide, which provides mobile-first banking to SMEs, as well as fast-growing companies such as iPhone challenger Nothing and London-founded Cleo, the conversational AI pioneer that helps young US consumers manage their finances.

Seven of Europe's 10 most valuable tech companies founded after 1990 have emerged from New Palo Alto: Booking.com and Adyen from Amsterdam; Wise, Revolut, and Monzo from London; ASML from Eindhoven; and Arm from Cambridge. All are products of this interconnected ecosystem.

Yet, for all its promise, New Palo Alto remains an underinvested region. While early-stage funding is now higher than the Bay Area, thoroughbreds face a staggering $30 billion gap in funding at the crucial scale-up stage compared to their Bay Area counterparts.

Governments of the leading economies in New Palo Alto—Britain and France—have delivered progressive policy frameworks to support

innovation and tech companies, including investment in R&D, talent, and visa programs. They are also putting in place policies including the UK's Mansion House Compact and France's Tibi, to support more scale-up capital.

But no innovation cluster ever became great because of policy alone. Success occurs when investors fully understand the investment opportunity. Now that we have nearly 1,000 venture-backed companies in EMEA with revenues of more than $25 million, helping this ecosystem to achieve its full potential is no longer about solving a policy challenge. It's about recognizing a huge investment opportunity.

This is why in the last decade, the amount of venture capital coming into the region has increased nine times, and why in the next decade, large institutional investors in the UK and in France will bring billions of dollars of investment to back private companies.

The new British prime minister's home constituency includes Somers Town, an area close to St Pancras station and within sight of Google and Meta's huge European headquarters. Yet for all the gleaming towers, too many neighborhoods in New Palo Alto have been left behind by technology. In Somers Town, 50 percent of children receive free school meals, 70 percent of residents receive social care, and adults live 20 years fewer than in leafy Highgate, only 20 minutes up the road.

As the tech industry faces increased scrutiny, we have an opportunity to offer an alternative model of innovation. By building thoroughbreds to be sustainable, transparent companies, we can begin the work of sharing the benefits of innovation more equally.

Just as some of the most iconic US cities take their names from the ancient cities of Europe—New York and New Orleans—New Palo Alto pays respect to its namesake while also signaling a deliberate choice for the future.

Saul Klein is the cofounder and managing partner of Phoenix Court, home to LocalGlobe, Latitude, Solar and Basecamp funds. This article first appeared in the November/December 2024 edition of WIRED UK.

By Megan Carnegie
Business
Oct 14, 2024 3:00 AM

The Hottest Startups in Amsterdam in 2024

There are around 4,000 startups in Amsterdam—the best 10 are tackling forest fires, decarbonizing plastics, and building robot bricklayers.

The 2023 Atomico's State of European Tech Report revealed Netherlands to be a standout success, cementing its position as a star player in the startup ecosystem. In terms of capital invested in its private tech companies, for instance, it's risen back into the top five countries with a projected $2.1 billion. And while the UK has seen the share of its European capital invested drop by almost 3 percent within the past three years, the Netherlands comes out top, capturing the biggest gains in Europe at almost 2 percent. The hub of the Netherlands' startup ecosystem is Amsterdam, which hosts around 4,000 startups, including unicorns like Mollie, Mambu, and Backbase. Known for its international focus, collaborative ecosystem, and diverse and skilled workforce, it's also dedicated to tackling urgent societal issues.

Europe's 100 Hottest Startups

From Amsterdam to Zurich, these are the hottest startups in Europe in 2024

"Successful innovation in Amsterdam is driven by global challenges, such as the energy transition or the aging population," explains Joël Dori of StartupAmsterdam, which works to bring the public and private sectors together to support startups, scale-ups, entrepreneurs, and other players in the local ecosystem. "It's what founders and the public in Amsterdam care about." Dori notes, however, that issues within the city, such as the tight

housing market and worries from founders about startup-related policies, must be tackled in order to attract and retain the capital's high-caliber talent.

Overstory

Vegetation is the [single greatest factor behind power outages](#) caused by the electrical grid due to trees falling on power lines or by sparking wildfires—and the problem is only worsening due to changing climate and more frequent storms. "Using images from satellites and airplanes, we use computer vision to find trees and estimate their height, health and species," says Indra den Bakker, who cofounded Overstory with Anniek Schouten in 2018. This allows electric utility companies to direct their tree-pruning efforts to areas where the likelihood that trees will come in contact with power lines is higher. Raising $25 million to date, with support from Pale Blue Dot, B Capital, CapitalT, Moxxie Ventures, Overstory's clients already include four of the top 10 American utilities. One investor-owned utility, for instance, has saved more than $3 million in vegetation costs. [overstory.com](#)

Coolgradient

By 2030, data centers could use [3.2 percent of global electricity consumption](#). However, few data center operators can effectively control their energy and water usage, which is a looming disaster for the climate. Enter Coolgradient, founded by Jasper de Vries and René Gompel in 2023, with the aim of reducing 1 percent of the global energy consumption by cooling data centers. Providing detailed visibility into the performance of all center assets, from the roof to the room, its machine learning models analyze data from existing data center assets such as cooling systems and power distribution units. It then identifies inefficiencies and offers solutions for continuous optimization, saving up to 40 percent in utilities usage. In May, it completed an undisclosed funding round from the early-stage impact investor 4impact. [coolgradient.com](#)

Monumental

More than [half of European countries](#) are grappling with a shortage of bricklayers, as 82 million Europeans are at risk of homelessness due to lacking affordable housing. Monumental is tackling these two problems with small autonomous ground vehicles, which are a cheaper, more available source of labor on construction sites. Once loaded with materials by humans, a trio of its robots, set with tower-style cranes, work as a team: One lays the mortar, one supplies the bricks and one does the actual building, driving alongside the wall until it's finished. Since Salar al Khafaji and Sebastiaan Visser launched it in 2021, Monumental robots has built multiple projects for top contractors in the Netherlands, including the facades of free-standing villas, social housing units, industrial buildings, and quay walls. The company has raised $25 million to date, from Plural, Hummingbird, and Northzone. New products in the pipeline include robots specializing in concrete blocks, plus entry into new markets such as Germany and the UK. "We're working toward a future where beautiful, tailor-made buildings are built within a single day, with minimal labor," says al Khafaji. [monumental.co](#)

Monumental founders Sebastiaan Visse and Salar al Khafaj.

PHOTOGRAPHY: JASPER FABER

Weaviate

An open source database that stores and manages the vector data that's integral to many AI applications, Weaviate makes it easier for developers to create and expand AI applications, which range from custom-made search and recommendation systems to ChatGPT plugins. Founded by Bob van Luijt and Etienne Dilocker in 2019, its cloud service gives developers the full power of the Weaviate database without any of the operational overhead. It has had more than a million monthly OSS downloads and 10,000 stars on GitHub (TripAdvisor for developers), and has a hand in developing new product ideas through its proprietary incubation hub. Investors such as Index Ventures, NEA, Battery, Zetta, and Cortical have contributed some $67.6 million (€60.7 million) in funding. [weaviate.io](#)

Cradle

According to [European Bioplastics data](#), substituting the annual global demand for fossil-based polyethylene (PE) with bio-based PE would save more than 73 million metric tons of CO_2. However, designing proteins is an arduous, time-consuming, expensive trial-and-error task. Cradle's AI platform, launched in 2021, enables biologists to upload a protein sequence they want optimized, such as needing more stability at higher temperatures. Out of a wide range of variations generated by the model, it can find the most promising to test in the lab. It reduces experimental rounds by up to 12 times, and uses 10 times fewer resources than conventional methods. This vastly boosts the chance for success. For example, [one US biotech](#) found novel, high-performing mutations that traditional methods hadn't identified. Cradle, founded by Elise de Reus and Stef van Grieken, has raised $34 million (€30 million) in funding led by Index Ventures and Kindred Capital. [cradle.bio](#)

Carbon Equity

Lara Koole, Jeff Gomez, Liza Rubinstein and Jacqueline van den Ende founded Carbon Equity in 2021, based on two observations: "We need billions of dollars to fund climate technology solutions, and mass affluent and high-net-worth individuals hold trillions of dollars but have no access to private markets," says van den Ende, Carbon Equity's CEO. The company grants investors unique access to a diversified portfolio of leading climate venture capital and growth equity funds. Since launching, nearly 1000 investors have invested more than €250 million ($278 million) through the platform, helping scale more than 120 nonlisted climate tech companies, ranging from CO_2-free cement (Sublime Systems) to long-duration energy storage (Form Energy), and green steel (H2 Green Steel). Carbon Equity has raised €9 million ($10 million), with lead investors including the French fintech fund Blackfin Capital Partners and Netherlands-based VC fund 4Impact. Carbon Equity will soon open an international office in Berlin and offer its clients a new climate infrastructure fund and lower investment minimums. [carbonequity.com](#)

Carbon Equity's Lara Koole, Liza Rubinstein, Jeff Gomez, and Jacqueline van den Ende.

Bloom & Wolf

With heavy use of water, pesticides, greenhouses, and refrigerated transportation, the cut flower industry is disastrous for the environment. Premium silk flower service Bloom & Wolf offers an alternative that's four times cheaper than a typical fresh subscription, and reduces carbon emissions by 85 times. The company's flowers are manufactured in Asia, shipped overseas to a European wholesaler, then made into bouquets by the startup in Amsterdam. When the consumer is done—usually changing their bouquet every season—it's collected, refurbished and reused. Supplying a range of customers since launching in 2023, the firm's circular model gained significant traction in the premium office and hotel industry, with clients including NH Hotel Group and Bilderberg. Founder Gwen Van de Pas has her sights set on Europe and the US, aided by a €1.4 million seed round, led by CapitalT. bloomandwolf.com

Solvimon

Launched in 2022 by Kim Verkooij and Etienne Gerts, who cut their teeth at the Dutch fintech unicorn Adyen, Solvimon's all-in-one billing and monetization platform is designed for fintech and SaaS businesses with complex billing needs. With fast-growing startups such TrueLayer, Yapily, Yuno, Hawk, and SurePay in its current client base, Solvimon's vision is to make billing a tool that drives new business, rather than hinders it. The startup enables scaling-up of revenue operations across multiple countries and currencies, a reduction in manual billing efforts and enhanced financial management. Now a team of 23 and growing, Solvimon raised €9 million ($10 million) in a seed round led by Northzone in late 2023. solvimon.com

10X

As the battle for talent intensifies, fractional work—the practice of hiring experts in the field for part-time or contractual roles—is increasingly ticking the box for both employer and employee. To connect companies with accomplished fractional CxOs, professionals, and experts, serial entrepreneur Angelique Schouten launched the subscription-based AI-supported platform 10X (pronounced "ten X") in 2023. With more than 500 fractional professionals offering their expertise, it's already united companies such as Mobility Concept, ParkBee and Talk360 with former leaders from Schiphol Airport, Knab and Meta. In May, 10X raised €1 million ($1.1 million) in seed funding from angel investors. This will be used to launch a new version of the platform, which will feature AI-based analysis of candidate's videos and randomly selected references from previous employers. 10x.team

Haaven

Haaven, founded by Thomas Leeson, Davide Cardu, Sacha Bloem, and Dédé Kruisman in 2023, is a one-stop shop for building tiny houses—that's any space smaller than 50 square meters, which makes them easy to transport as a single module or flat-pack on a truck. Consumers pick a design from the collection, personalize it, and within 15 weeks, they have a new, carbon-neutral space courtesy of a network of engineers and prefab construction companies. Prices range from €1,500 ($1,100) per square meters for a finished exterior only, while one including floors, lighting, a kitchen and furniture runs up to €5,000 ($5,500) per square meters. All quotes are final, so there's no project creep as with traditional construction. The firm works with starchitect firms such as Sigurd Larsen and Park + Associates, has built 30 spaces to date, and raised €1.1 million ($1.2 million) in pre-seed funding, led by Speedinvest, Golden Egg Check, and angel investors like Quintin Schevernels and Erik Nieuwenhuis. haaven.com

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By João Medeiros
Business
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The Hottest Startups in Lisbon in 2024

The Portuguese capital's most exciting startups include a platform to help entrepreneurs get going, a smart punchbag, and the Uber of hair salons.

Two years ago, Jon Fath moved with his family to Portugal from the Netherlands with the sole purpose of launching a fintech startup there. "This country is brimming with talent and ambition," Fath says. "I thank Lisbon for welcoming me, along with so many other expats and entrepreneurs, so warmly."

Europe's 100 Hottest Startups

From Amsterdam to Zurich, these are the hottest startups in Europe in 2024

Indeed, it's no surprise that the European Commission named Lisbon as 2023's European Capital of Innovation, while the Financial Times, in partnership with Statista, ranked two Portuguese startup hubs in Europe's top 10 startup hubs—including the Unicorn Factory Lisboa, which launched in 2022 and has already supported more than 820 startups and helped raise more than €1 billion ($1.1 billion).

"Portugal offers unique advantages, such as its climate, safety, and cost of living, which make it an attractive choice over countries in central or northern Europe," says Nuno Pereira, CEO of Paynest.

Government has played a role too, with policies such as residence visas for entrepreneurs and tax incentives to startups engaged in R&D. "That was

instrumental in allowing the Portuguese startups to come across the other side alive, after the VC drought of the past two years," says Mauro Frota, CEO of fit-tech startup Bhout.

Rauva

Before launching Rauva in Lisbon, Jon Fath had been a startup CEO in Amsterdam, cofounded a logistics company in Frankfurt, and worked for an investment management firm in Beijing. "I decided to start Rauva based on my experiences working with entrepreneurs and co-founding other companies," Fath says. "I took the plunge to build a one-stop shop to make entrepreneurship accessible to everyone." Rauva allows entrepreneurs to register their businesses online in a matter of minutes, offering a raft of features like debit cards and invoicing. "In addition, if the company has not yet been created, Rauva offers that service with the support of lawyers," Fath says. "Our solution helps reduce the time spent on bureaucratic processes." The startup, launched in 2022 by Fath and Sam Mizrahi, has also recently partnered with researchers to design a faster and more accurate credit scoring system using machine learning and quantum computing. Currently, Rauva has more than 3,000 users and has helped create more than a thousand new companies. rauva.com

Neuraspace

Currently, there are nearly 9,900 active satellites orbiting the planet, a number estimated to grow by an order of magnitude by 2030. "The risk of collisions caused by space debris is escalating," says Chiara Manfletti, the founding president of the Portuguese Space Agency and CEO of Neuraspace. "These collisions can destroy satellites, leading to substantial financial losses and disrupting essential services such as bank transactions, the internet, GNSS (global navigation satellite system), and Earth observation. The current manual decision-making processes are inadequate to handle this scale." Neuraspace addresses this problem by using AI to analyze various datasets, including radar and star trackers, and automatically predict potential collisions and suggest avoidance maneuvers. This space traffic management platform is currently tracking more than 300

satellites from satellite operators such as Spire, Nanoavionics, and the European Space Agency. Founded in 2020, the startup has raised a total of $27.5 million (£20.8 million). "The big vision for Neuraspace is achieving self-sustaining, autonomous space activities," Manfletti says. neuraspace.com

Bhout

In 2021, Mauro Frota opened a gym featuring a unique piece of equipment: a smart boxing bag. Developed by Frota and Pedro Barata, the Bhout bag comes with an AI processing unit, biometric sensors and a smart camera that can track the accuracy, speed and power of every punch. "The idea came to me in a dream," Frota says "I lost count of the number of iterations to get there. We were creating a new product from scratch." The punching bag is also equipped with a set of light rings that nudges gym-goers into different workout rhythms. Its core is made of foam layers and filled with water, mimicking the feeling of hitting another boxer. According to Frota, 20 new Bhout clubs are already confirmed in Portugal and Spain. Soon, it will also start selling the Bhout bag, at prices ranging between €6,000 to €10,000 ($6,1000 to $11,000) to clients including LinkedIn and Marriott Hotels. In 2023, the fit-tech startup raised a €10 million ($11 million) seed round coled by Explorer Investments and Lince Capital. bhout.com

Bhout cofounders Mauro Frota and Pedro Barata.

PHOTOGRAPH: PEDRO MOURA SIMãO

MyCareforce

MyCareforce is bringing the gig economy to healthcare. "Hospitals often lack the necessary staff to meet demand and they don't have the appropriate tools to hire people for extra shifts quickly," says CEO Pedro Cruz Morais. "We knew many doctors who were using WhatsApp to find extra shifts and we realized we could solve this problem with technology." MyCareforce provides an intelligent platform that connects nurses to hospitals and clinics, allowing them to apply and immediately book available shifts. The

platform, launched in 2021 by Cruz Morais and co-founder João Hugo Silva, has more than 15,000 nurses registered on the platform and works with more than 70 health care units, such as hospitals and clinics, in Portugal and Brazil. It has raised a €2 million ($2.2 million) round led by Portugal Gateway, Shilling and Demium Capital. mycareforce.co

Oscar

Oscar allows users to book more than 150 at-home services—from cleaning to blind repairs—for a fixed fee and within 30 minutes. "The idea came about after a bad experience trying to call a plumber to fix my water heater," João Marques, founder and CEO of Oscar, says. "After wasting hours contacting multiple technicians and comparing quotes, I scheduled a service and the technician never showed up. It was obvious that an Uber home service was missing." The platform, which is available in Portugal and Madrid, currently hosts more than 20,000 technicians, which are admitted after a rigorous selection process and background check. According to Marques, their annual revenue is currently €12 million ($13.4 million) and growing 40 percent every quarter. They have raised more than €6 million ($6.7 million) in a round led by Lince Capital and Indico Capital Partners. oscar-app.com

Glooma

Francisco Nogueira's cousin was 40 when she detected a lump in her chest. "She thought it was nothing, but three months later, the lump had not disappeared," says Frederico Stock, CFO and COO of Glooma. Unfortunately, the lump was a malignant tumor and she had to have a mastectomy. "Francisco decided to create Glooma so that women in the same situation can act sooner." The startup, launched in 2021 by Nogueira and Stock, is developing SenseGlove, a glove equipped with smart sensors that women can use to do a breast self-exam. "It can track changes in breast tissue over time and notify doctors when there's an abnormality," Nogueira says. According to him, an early proof-of-concept trial showed that the SenseGlove correctly diagnosed cancer 88 percent of the time, with a rate of 12 percent false positives. The startup, which has raised more than €1.3

million ($1.4 million) is now undergoing clinical trials with the most recent prototype. The team hopes to receive FDA-approval by 2025. glooma.pt

Francisco Nogueira and Frederico Stock, founders of Glooma.

Sheerme

"When you need a taxi, you have Uber; when you need a hotel, you have booking.com, but what do you do when you need a hair salon or a spa?" asks Miguel Ribeiro, CEO of Sheerme. According to Ribeiro, 85 percent of wellness and beauty services require prior booking, but only 10 percent can be booked online. "Sheerme fills that void," he says. The platform allows users to find, book and pay for services provided by 7,000 health and beauty merchants. "We have also partnered with L'Oréal and created a white-labeled solution called SAL(ON)," says Ribeiro, who founded the platform with Karly Alves and Shakil Satar. The startup, which has more than 250,000 users across Portugal, Brazil and Spain, has raised a €5 million ($5.5 million) seed round led by Lince Capital. sheerme.com

Sqill

Sqill is an AI-powered mobile video editor for social media brands. "With our social media suite and with one single click, anyone can create better content than a social media expert," says Afonso Coimbra, cofounder and CEO of Sqill. The platform uses AI for a range of tasks, such as recommending what to post or automatically adding subtitles. Founded in 2021 by Coimbra, Rui Ascenso and André Perdigão, the startup has raised €2 million ($2.2 million) by GED Ventures. It has clients in Portugal, Spain, Brazil, and the US, including L'Oréal, the online marketplace Worten, and the Portuguese football club FC Porto. sqill.so

Ubbu

More than 300,000 students in more than 20 countries have used online learning platform Ubbu to learn coding and digital skills. "Our platform is built for the everyday teacher, even for those with no coding experience, who account for around 90 percent," says João Magalhães, CEO and founder of Ubbu. "It's accessible to everyone because we want to reduce the barriers to enter the tech market." Aimed at children between the ages of 6 and 12, the platform is available in four languages and includes Ubbox, a tool that allows projects to be made using a programming language via blocks. A research study by Universidade Nova Lisboa found that Ubbu students could improve their math grades by up to 17 percent compared to a control group. Ubbu.io

Paynest

Founded in 2022 by Nuno Pereira, Paynest is a platform for companies to manage their employees' finances. "Our mission is to help companies address all of the financial needs of their employees everywhere while empowering them to gain greater control over their finances," Pereira says. Features include simplified expense management, early access to salary and bonuses, financial coaching, and access to financial literacy tools. Paynest is currently used by more than 30,000 workers from more than 50 companies in Portugal, Greece, and France. It has also raised a total of €3 million ($3.3 million) from investors such as Lince Capital and Bluecrow Capital. paynest.co

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Updated 10/14/2024, 5.06 pm GMT: This article was updated to correct some details about Glooma.

By [Alex Christian](#)
[Business](#)
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The Hottest Startups in Zurich in 2024

The Swiss financial capital might be most associated with fintech, but its startups are also focusing on medical robotics, AI-powered language learning, and the batteries of the future.

Home to fine cheese, breathtaking scenery and footballing politics (FIFA HQ overlooks Lake Zurich), Switzerland's largest city is also a financial juggernaut. The central square of Paradeplatz is its beating heart, where the Swiss banking system pumps venture capital funding into a thriving tech ecosystem; around [CHF 872 million](#) (more than $1 billion) was poured into Zurich startups alone in 2023.

Europe's 100 Hottest Startups

From Amsterdam to Zurich, these are the hottest startups in Europe in 2024

Fintech is a natural major player, but if the banking industry is the ecosystem's engine, innovation is its fuel. Many of the city's most exciting startups began life as student projects at its world-leading universities, which provide a steady flow of great thinkers.

"Zurich is a city of ideas, people, and capital," says Frank Floessel, head of entrepreneurship at ETH Zurich, a public research university focused on science, technology, and engineering that "spins out" an average of 25 startups every year. "We have plenty of talent and know-how. We rank among Europe's smartest and most innovative cities. And we have the

necessary funding to transform groundbreaking ideas into market-ready solutions."

Nanoflex Robotics

While remote surgery isn't yet common, scalpel-wielding robots can often be found performing keyhole surgery. Nanoflex Robotics is aiming to transform emergency treatments such as a thrombectomy, the removal of a blood clot. It's the procedure used for ischemic strokes, a worldwide leading cause of disability. "Today, the only option is to transfer the patient to a hospital capable of performing a thrombectomy—but every second the brain lacks oxygenated blood, brain cells die," says Nanoflex founder Matt Curran. In the US, nearly a third of the population lives more than an hour away from a thrombectomy capable center. Alongside founders Christophe Chautems and Bradley Nelson, Curran has created a compact robotic platform that includes a magnetic field generator on wheels. Positioned next to a patient's head in a cath lab, a neurosurgeon (often working miles away) can subtly change the direction of the magnetic field to bend the tip of the catheter more easily, travel through affected vessels, and restore blood flow to the brain. In 2023, Nanoflex worked with Mayo Clinic Arizona on its proof-of-concept—the medical center's chair of neurosurgery controlled its robot in Zurich from Phoenix in a non-clinical setting. In March 2024, Nanoflex's first robotics system was installed at the Jacobs Institute, a medical device innovation center in Buffalo, New York. It raised a total of $19.8 million (£14.4 million)—including a $12 million (£9 million) Series A round in February 2023. *nanoflexrobotics.com*

BTRY

The standard lithium-ion battery contains liquid electrolytes which work well at stable room temperature but less so in the freezing cold or at high heat. Working at Swiss research institute Empa, Moritz Futscher and Abdessalem Aribia discovered that stacking several thin-film cells on top of each other not only provides one-minute charging times and greater energy capacity—it also creates a battery that can withstand extreme conditions. Launching BTRY in 2023 alongside Yaroslav Romanyuk, Futscher and

Aribia are now focusing on IoT applications in environments such as cold medical transport and steam plants. The trio are also looking to the skies: Some aerospace applications require batteries to function across a 200 degree Celsius temperature range. "Compared to current batteries, ours reduces the need for heating elements and safety measures," says Futscher. Having raised CHF 1.8 million ($2.1 million) in pre-seed funding, BTRY is beginning its first pilot production tests. *btry.ch*

Yokoy

Frustrated with the tedium of corporate expense management, five accountants—Philippe Sahli, Thomas Inhelder, Lars Mangelsdorf, Devis Lussi, and Melanie Gabriel—founded Yokoy in 2019 (initially under the name Expense Robot). The fintech leverages AI to simplify invoicing, automating the reimbursement process by instantly matching card payments with expenses. "We felt the pain of manual work," says Sahli. "Nobody trains as an accountant to spend hours matching receipts to company card transactions." Twenty million expense reports and invoices later, Yokoy's 700 global clients include Breitling, Austria Airlines, and On Running—the Swiss sportswear brand has slashed its costs by almost 79 percent since automating its spend management process, says Sahli. In 2023, Yokoy raised $80 million (£60.9 million) in Series B funding, led by Sequoia Capital. *yokoy.io*

Yokoy's Thomas Inhelder, Devis Lussi, Lars Mangelsdorf, and Philippe Sahli.

PHOTOGRAPH: CHRISTIAN GRUND

BreezeLabs

BreezeLabs founders Patrick Helfenstein and Matthias Heuberger say that up to 90 percent of runners in the US—estimated to be about 50 million—use a wearable device to track their performance. Yet heart rate is typically the only measurement that these devices track. BreezeLabs has developed an app that monitors runners' breathing patterns instead. It does this

through a headphones' built-in microphone, while delivering deeper cardiovascular insights. BreezeLabs' smart filtering dampens traffic noise, with audio data fed to a trained machine learning model that estimates a runner's breaths per second. Since launching in February 2023, it's collected data from more than 100 test runners ("one of the world's biggest datasets entirely consisting of breathing samples," says Helfenstein). BreezeLabs has secured CHF 500,000 ($584,000) in funding from the University of Basel. *breezelabs.ai*

Univerbal

When coder Philipp Hadjimina was priced out of one-to-one Greek language lessons ("incredibly expensive in Switzerland," he says), he built his own chatbot. Quazel launched on Hacker News in September 2022—and 50,000 users tried it within two days. Renamed Univerbal in January 2024, it had more than 250,000 downloads. Users can talk to an AI "tutor" in 22 languages through onscreen chat prompts, creating naturalistic, unscripted conversations based on large language models from Anthropic, Google, OpenAI, and Open Source. "It's always surprised me that most who want to learn a language do so via vocab games and memorizing grammar rules, but completely neglect speaking," says Hadjimina. Founded alongside Samuel Bissegger and David Niederberger, Univerbal has raised $2 million (£1.5 million) in seed funding. *univerbal.app*

Oxyle

"Clean water, down to the last drop" is the mission statement of Fajer Mushtaq and Silvan Staufert, the founders of Oxyle. Launched in 2020, the ETH Zurich spin-off takes aim at per- and polyfluoroalkyl substances (PFAS): synthetic chemicals long used in everyday goods for their water, grease, and oil-resistant properties—and toxic to humans. "We're driven by a shared vision to address water contamination and 'forever chemicals,'" says Mushtaq, whose inspiration stems from encountering water scarcity during her upbringing in India. Common among nonstick cookware and water-repellent fabrics, PFAS exposure has been linked to cancers and immune system suppression. They're also lost into wastewater and

discharged into streams—ending up in drinking water. But Oxyle's modular reactors—applied at water treatment plants and reaching up to 100 cubic meters in size—break down 99 percent of PFAS into harmless mineral components, lowering levels below regulatory limits. Machine learning then adapts treatment to real-time PFAS fluctuations. Since raising CHF 12 million ($14 million) in pre-seed funding, Oxyle has partnered with major water technology companies in Europe (including Belgium's Waterleau) to commercialize its solution. Its future target is helping to clean US waters. *oxyle.com*

Silvan Staufert and Fajer Mushtaq, cofounders of Oxyle.

PHOTOGRAPH: CHRISTIAN GRUND

DeepJudge

A trio of Google researchers are the minds behind DeepJudge: an AI-powered search for legal teams that scans hundreds of millions of documents, freeing time spent searching for paperwork accumulated across emails, memos and contracts. "We're connecting users to the entirety of their collective knowledge," says Paulina Grnarova, who launched the startup in 2021 alongside Yannic Kilcher and Kevin Roth. Retrieval augmented generation (RAG) technology—and DeepJudge's proprietary large language model—surfaces the most relevant, up-to-date information via summary. Once deployed, nearly 80 percent of users within an organization regularly engage with DeepJudge—saving countless hours trawling inboxes. In June 2024, it raised $10.7 million (£8.1 million) in an oversubscribed seed funding round led by New York private equity firm Coatue. Clients using the AI-powered search tool include Swiss law firms Lenz & Staehelin and Homburger. *deepjudge.ai*

Decentriq

Data clean-rooms offer neutral, secure environments for organizations to share insights on markets and customers without sharing first-party data—any personal information is restricted, encrypted, and anonymized. A

supplier of this is Decentriq. Its platform has been used by Publicis Groupe, Switzerland's Federal Department of Defense and the Swiss National Bank. "We wanted to create a neutral space—a 'Switzerland of data'," explains Decentriq founder Maximilian Groth, who launched the startup alongside Stefan Deml in 2019. The pair have raised more than $21 million (£15.9 million), including a $15 million (£11.4 million) Series A round led by Eclipse Ventures, and a CHF 2.2 million ($2.5 million) grant from the Swiss government. *decentriq.com*

Riskwolf

Launched in 2020 by Thomas Krapf and René Papesch, Riskwolf's platform leverages AI and real-time data to create so-called parametric insurance solutions. This means that payouts are based on the probability of a loss-causing event (a 7.0 magnitude earthquake, for example), rather than actual losses. A key use case is changing weather patterns, says Krampf: Kashmir apple farmers now have parametric weather coverage that pays out in days rather than months. "Traditional underwriting can have missing or outdated data histories," says Krapf. "Conversely, we have much more affordable data and processing power thanks to the growth of cloud technology and satellite sources." Having raised a combined CHF 3 million ($3.5 million) through an Innosuisse grant and equity investment, Riskwolf now works with insurers across Asia, Europe, and the Americas. The company has also set its sights on IoT, economic data, credit risk and price indices to explore future parametric products. *riskwolf.com*

LatticeFlow

Beginning life as an ETH Zurich research project, Petar Tsankov, Pavol Bielik, Martin Vechev, and Andreas Krause launched LatticeFlow in 2020. Its platform automatically stress-tests AI models, analyzing how predictions are made, and finding patterns that lead to systematic errors: think blindspots and hallucinations. "Traditionally, this process is addressed in an ad-hoc, manual, and reactive manner," says Tsankov. "We proactively uncover these, effectively enriching the data." Clients include manufacturing firms and defense organizations, notably the US Army. The

company has raised total funding of $14.8 million (£11.2 million), including a $12 million (£9.1 million) Series A round led by Atlantic Bridge and OpenOcean. latticeflow.ai

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Updated 10/14/2024, 9.12 pm GMT: This article was updated to correct the amount of money flowing into Zurich-based startups, which was CHF 872 million, not 72 million.

By [Morgan Meaker](#)
[Business](#)
Oct 14, 2024 3:00 AM

The Hottest Startups in Paris in 2024

The French capital has become the home of Europe's growing AI industry —but alongside giants like Mistral are startups building EV charging infrastructure and trying to revolutionize social media.

In the past two years the French capital has been in the throes of AI fever and has launched some of Europe's most talked-about startups, including Mistral, which is currently valued at $6.2 billion (£4.7 billion). That's partly due to the support the industry has received. President Emmanuel Macron has given French AI startups some emphatic political backing, while telecoms billionaire Xavier Niel has provided much investment and will to finance national ambition. In September 2023, Niel invested €200 million ($212 million), splitting that money between funding for startups such as Mistral, an AI research lab called Kyutai, and a cloud supercomputer powered by Nvidia. "I'm the old guy who likes entrepreneurs and the idea was always the same: How we can help this talent to stay here, creating companies," says Niel.

Europe's 100 Hottest Startups

From Amsterdam to Zurich, these are the hottest startups in Europe in 2024

Niel, a prolific French businessman who owns telecommunications company Iliad, believes European AI companies now have a unique opportunity to act. "If you want to create a search engine now from scratch, you cannot win because you weren't there 25 years ago. It's exactly the same with AI," he says. To compete with the US, Europe has to move fast.

"[Or] in the end, we will be the nicest place in the world for museums—that's good but maybe we can try to do something a little bit different."

Mistral

In almost every European country, there is a startup vying to rival OpenAI. Yet few make a claim as serious as Mistral. To date the company has raised €1 billion ($1.11 billion) including a €15 million ($16 million) investment from Microsoft. Since launching in April 2023, its three cofounders, CEO Arthur Mensch, Timothée Lacroix, and Guillaume Lample have marshaled the startup to release 12 models, including its flagship multi-language text-generation model, Mistral Large. With 27 million downloads from public repositories, Mistral's clients (such as telecoms company Orange, and Hugging Face) use the startup's models to personalize promotional messages or power their own virtual assistants. Mistral's free-to-use chatbot, Le Chat, functions much like OpenAI's ChatGPT and is designed to give the public a way to experiment with Mistral's open source technology. "We've been promoting open source as the one way to make the technology go faster and be safer because there's more scrutiny on it," CEO Mensch told CNBC in a rare interview, adding that Europe is at a turning point in its race to compete with tech superpowers. "We have willpower and we'll make it happen," he insists. mistral.ai

Sweep

Companies that neglect sustainability are facing two major risks: regulation and reputation. That's according to Rachel Delacour, CEO of Sweep, who cofounded the sustainability-focused data management platform in 2020 alongside Yannick Chaze and Raphael Güller. "Every company out there must transition to the low-carbon economy," she says, adding it's now a competitive advantage for a business to be able to track sustainability targets across their operations. "Eventually your customers, your employees, your supply chain will ask what you are doing." The startup is already working with hundreds of clients, including L'Oréal and UK energy group SSE, which license the company's platform in order to pool data from across their entire supply chain and identify their sustainability weak

spots. A client manufacturing water bottles that must be hand-washed, for example, would be able to see how much more water-efficient its product would be if customers could clean them in the dishwasher, says Delacour. This year the startup is focused on expanding to the US after raising a total of $100 million (£76 million), with investment from Tony Fadell, creator of the iPod. sweep.net

Dust

Dust is yet another buzzy Paris-based AI startup. Launched by cofounders Gabriel Hubert and OpenAI alumni Stanislas Polu in 2023, Dust creates custom AI bots for companies. So far, most of its clients, which include 500 teams at companies such as PennyLane and Watershed, are experiencing fast growth but don't yet have strict processes in place. That means teams are more likely to be empowered to play around building a specialist content writer or feedback analyzer AI assistant themselves, says Hubert. Armed with €20 million ($22 million) in funding, the idea behind the startup is that office workers don't need just one multipurpose AI assistant; instead they need a series of highly specialized models to choose from to perform different tasks. "That level of customization is really what gets them a report when they need it, a [spreadsheet] when they need it, or an executable, interactive graph," Hubert says. dust.tt

Dust cofounders Stanislas Polu and Gabriel Hubert.

PHOTOGRAPH: MARINA ZAGORTSEVA

H

When news leaked that a group of engineers who worked on advanced models at Google's AI division, DeepMind, were preparing to start their own company in early 2024, investors raced to lend their support. Initially known as Holistic AI, the company changed its name to H in May 2024. It has already secured $220 million (£152 million) in investment, including from former Google CEO Eric Schmidt, Xavier Niel, and venture capital firm Accel. Although it's unclear if the company has any clients—or even

products—yet, its elusive cofounder and CEO, Charles Kantor (a former venture resident at Stanford University), has promised his team are developing "full" artificial general intelligence or AGI that would "boost the productivity of workers." So far little is known about H's mission, although the reputation of its cofounders, DeepMind scientists Laurent Sifre and Karl Tuyls, both considered leaders in their field, means there is significant excitement to find out. hcompany.ai

Bioptimus

Within five months of founding Bioptimus, the company's six cofounders launched the world's largest open source foundation model for cancer detection. Trained on hundreds of millions of images, H-optimus-0 identifies cancerous cells and genetic abnormalities in tumors, says cofounder and principal research scientist, Zelda Mariet. For her, this is just the beginning. Current models are really good at performing very focused jobs such as analyzing images of cancer tissues, she says. But Mariet wants Bioptimus to build a model that can also analyze a patient's DNA, cells, and tissue to understand how they are all connected. Right now, the company is still in the exploratory phase, after raising $35 million (£26.6 million) from investors such as French bank Bpifrance and telecoms billionaire Xavier Niel. bioptimus.com

Electra

The European Commission has forecast that at least 30 million electric cars will be on European roads by 2030, and EV charging startup Electra is preparing for that moment, aiming to deploy 2,500 ultrafast charging sites by that date. Since launching in 2020, it has hit 300 sites across Europe—each with six charging points—including in Paris, Brussels, and Pisa. The idea is to make operating an EV seamless and hassle-free. Drivers use Electra's app to book charging slots in advance with charging sites automatically recognizing regular users. "What Tesla did with cars, is what we're trying to do with infrastructure," says Aurélien de Meaux, CEO and one of three cofounders, alongside Augustin Derville and Julien Belliato. So far, Electra's eye-catching charging stations have enabled more than 1

million 20-minute charging sessions, with French users paying between €0.39 and €0.52 per kWh. The company has raised €304 million ($338 million), including from investment group Eurazeo and French bank Bpifrance. go-electra.com

Aurélien de Meaux, cofounder and CEO of Electra.

PHOTOGRAPH: MARINA ZAGORTSEVA

Amo

Amo is the latest French startup trying to reinvent social media. The company is led by CEO Antoine Martin, who sold his last social media business, Zenly, to Snap in 2017 for upwards of $200 million (£152 million). Since launching in 2023, Amo has launched three separate social media apps designed to refocus online relationships with friends instead of influencers: Tilt (two-sided video), Bump (for location sharing) and ID (collaborative mood boards). Already, Amo has raised €18 million ($19.9 million) from investors including VC New Wave, which also backed Paris-based social media startup BeReal before it was acquired by app publisher Voodoo. [amo.co](amo.co)

Spore.Bio

After years spent working as an engineer at Nestlé, Amine Raji became frustrated with the outdated technology the food industry used to detect bacteria. "That's why you have so many food recalls and sanitary outbreaks," he says, adding that 420,000 people die every year due to foodborne illnesses. In an effort to end that, the three cofounders behind Spore.Bio—Raji, Maxime Mistretta, and Mohamed Tazi—created the Vision device to identify bacteria in seconds. It works by shining a light on the bacteria (a practice called biophotonics) so machine-learning algorithms can identify what type of bacteria is present by studying its reaction. Since its launch in January 2023, five food factories are using the prototype, paying a fixed monthly fee for the hardware. The company has raised €8

million ($8.8 million) from investors, including Google DeepMind's Mehdi Ghissassi and VC firm LocalGlobe. spore.bio

NcodiN

NcodiN is working to become a critical cog in the complex world of semiconductor manufacturing. "We make the world's smallest lasers," says Francesco Manegatti, cofounder and CEO. These lasers, 500 times smaller than the standard size, make it possible for NcodiN to build what's called an optical chip, which will feature devices a quarter of the size of a single human hair. Working in the clean room of France's National Centre for Scientific Research (CNRS), NcodiN has so far raised €4.5 million ($4.9 million) for its plan to build these sophisticated optical chips, which will one day enable supercomputers to transfer data quickly and efficiently between different electronic parts. The company is in talks with some of the major chip manufacturers about testing, and it is targeting 2028 to deliver its first volume of wafers to clients. ncodin.com

Astran

Astran wants to shield companies from severe cyber attacks. Its product, Continuity Cloud, uses Astran's proprietary technology to encrypt and distribute its clients' sensitive data when they are under attack. Astran's backend combines "algorithms in a patented architecture that enables your critical data to be encoded and fragmented before being stored in multiple clouds at the same time," says CEO Yosra Jarraya, who cofounded the company with Yahya Jarraya and Gilles Seghaier in 2021. Astran's customers include aerospace company Airbus and French pharmaceutical giant Sanofi, while the company has raised $5 million (£3.8 million) to date. Investors include Paris-based seed fund Galion.exe and SISTAFUND, which backs female founders. astran.io

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By [Morgan Meaker](#)
[Business](#)
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The Hottest Startups in Berlin in 2024

The German capital attracts talent from all over the world, and its startups are building endless AI-generated audio apps, virtual pet apps, and sensors for early wildfire detection.

German innovation is not limited to the country's capital. In fact, some of this year's most prolific startups are based hundreds of miles away. The AI startup Alpha Alpha hails from Heidelberg. Helsing, which sells AI to Europe's militaries, was set up in Munich. Yet both companies operate Berlin offices. The city attracts too much talent to ignore. Universities, such as TU Berlin, [churn out](#) generative AI founders, and the capital is such a magnet for international talent that many offices operate in English, not German.

Europe's 100 Hottest Startups

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It's also a very young city—half of its population is under 45, something that Thomas Dohmke, CEO of GitHub, who grew up in Berlin, remarks on. "I founded my last startup back in 2009, and I remember vividly how much energy, time, and focus it required—having a large population of younger, diverse and international, and highly motivated professionals that have that energy and hunger gives Berlin an edge," he says. "Plus, Berlin has the best döner kebab."

BlueLayer

By 2050, the carbon credit market is expected to be a [$250 billion](#) industry. Startup BlueLayer is catering to that growth by developing tailor-made software for the companies and NGOs poised to benefit. Its clients—including conservationists such as Permian Global—run projects ranging from reforestation to direct air capture, and use the startup's software to process their data and communicate with buyers and investors, while helping credit providers get their credits verified with international registries. Launched in 2022, BlueLayer has raised $10 million (€8.9 million) in investment and counts three of the top 10 issuers of credits globally among its clients. "It's classic automation software," says Vivian Bertseka, one of BlueLayer's three cofounders along with Alexander Argyros and Gerardo Bonilla, "but for an industry that used to operate almost exclusively on Excel." [bluelayer.io](#)

Cambrium

Cambrium, founded in 2020 by Mitchell Duffy and Charlie Cotton, is using AI to design proteins such as collagen. Instead of sourcing them from animal products, the startup grows them in tanks. "We're one of the companies trying to straddle hardcore software engineering [and AI] with putting physical stuff in the real world," says Cotton. The company has received $11.6 million (€10.3 million) in investment so far, including from Google's AI venture fund Gradient Ventures. Skincare products using Cambrium's first protein, a collagen called NovaColl, are expected to hit shelves later this year. [Cambrium.bio](#)

Jina AI

In 2020, three veterans of Chinese tech behemoth Tencent joined forces to build foundation models specifically for search. Attracted to Berlin by the city's open source culture and software engineering talents, the trio behind Jina now claim 9,000 users and 400 paying customers, who turn to the company when they want to build either a public or internal search system for their data. Jina's models promise to convert PDFs, Word documents, or

images into a language that AI models can understand well enough to enable an intuitive Google-style search. A legal company may no longer have to search for documents using a case number. Instead, Jina AI CEO and cofounder Han Xiao explains that they could simply ask: "Find the case where Microsoft loses to Google," After raising $39 million (€34.8 million) from a series of early-stage VC funds including Canaan Partners, Xiao and his cofounders Nan Wang and Bing He plan to expand to the US, raise revenue from the company's $500,000 (€447,000) per year, and boost user numbers. "We want to compete with OpenAI," says Xiao. jina.ai

Han Xiao, cofounder of custom search-engine firm Jina AI.

PHOTOGRAPH: THOMAS MEYER

Endel

Endel is a paid-for app that uses generative AI to create one endless piece of music, which constantly adapts to its user's surroundings. The app utilizes the phone accelerometers to generate a beat that syncs with its listeners' footsteps. If they start jogging or skipping, the tempo catches up. Calling itself a "sound wellness" startup, Endel is part of the trend for functional sound, where music has a purpose—to help people exercise, fall asleep or focus. "We want to create a technology that harnesses the power of sound and helps you achieve a certain cognitive state," says CEO Oleg Stavitsky, one of Endel's six cofounders. Launched in 2018, the company has since raised $22.1 million (€19.1 million) in funding, including from Amazon's Alexa venture fund, and claims 1 million monthly active users. In 2023, the company struck a deal with Universal Music Group to use its technology to create new "soundscapes" using established artists' work. endel.io

Slay

To understand Slay's success, credit has to be given to Pengu, the company's virtual pet app that has become the startup's most popular product with more than 5 million users. Founded by Fabian Kamberi, Jannis

Ringwald, and Stefan Quernhorst, Slay created Pengu to be part game, part social platform, where friends or couples can collaboratively raise a digital penguin. The company, which has raised $7.6 million (€6.8 million) in total, including from Accel, is currently scaling Pengu's ability to personalize its interactions, hooking a series of LLMs to a 3D engine to create that visual experience. Pengu might respond to a child telling them they are being bullied by gifting them a drawing or sending personalized notifications to cheer them up. slay.cool

Ovom Care

Ovom Care is a fertility startup using data and machine learning to take the guesswork out of reproductive medicine. Since launching in 2023, cofounders Felicia von Reden, Cristina Hickman, and Lynae Brayboy have opened the company's first fertility clinic in London—sidestepping the onerous regulatory process in Germany—and already claim to be treating hundreds of people. Alongside the physical clinic, patient app, and clinic management system, Ovom also offers machine-learning algorithms that analyze patients' blood tests, data from wearables, gamete analysis, and ultrasound images to tailor the type and timing of treatment. "We're now going into the era of precision medicine," says CEO von Reden. "We're tailoring [fertility] using technology." That idea has attracted €4.8 million ($5.3 million) in seed funding led by Alpha Intelligence Capital. Within the next year, the company plans to attract medical tourists from all across Europe to its second clinic in Portugal, where treatment costs are expected to be cheaper. ovomcare.com

Felicia von Reden, founder and CEO of Ovom Care.

PHOTOGRAPH: THOMAS MEYER

Dryad

When Carsten Brinkschulte's daughter started protesting against climate change in 2018, the serial telecoms entrepreneur started to think about how he could leverage his experience for the good of the planet. The result was a

startup called Dryad, launched in 2020, designed to be an early wildfire detection network. "Think of us like the Vodafone of the forest," says Brinkschulte, one of the company's seven cofounders. Dryad's solar-powered mesh networks enable sensors to send alerts when they detect fire, even in remote areas where there is no signal. So far the company has sold 20,000 wildfire sensors and related hardware to 50 countries across the world, from Canada to Thailand, and to clients ranging from local governments to utility companies that want to protect their infrastructure from an inferno. Dryad has raised €22 million ($24.6 million) so far, including from German deep-tech fund eCAPITAL. dryad.net

UltiHash

The rise of energy-hungry AI prompted the International Energy Agency to warn that the electricity consumed by data centers could double in just two years. As environmental groups discuss the risk that the technology poses to the climate, startup Ultihash has been developing a practical way to slash the data center needs of companies performing energy-intensive machine learning or training their own models. Founded in 2022, Ultihash has developed an algorithm that CEO and cofounder Tom Lüdersdorf claims can slash companies' data storage needs by up to 60 per cent, meaning they need less data center space and reduce their carbon footprint. The company has raised $2.5 million (€2.2 million) despite still being in stealth mode. Lüdersdorf plans to launch the product later this year, after beta testing with more than 300 companies. ultihash.io

TheBlood

According to TheBlood's cofounders, Isabelle Guenou and Miriam Santer, menstrual blood is an under-appreciated asset for diagnostics, containing data-rich endometrial tissue, live cells, immune cells, and proteins, which are not found in ordinary blood. The pair launched the company in 2022, with the aim to use menstrual blood in an attempt to fill health care's gender data gap. Since then, the firm has analyzed more than 1,000 menstrual blood samples, selling testing kits for between €35 ($39) and €120 ($133) to women who are looking for more data to inform fertility or

endometriosis treatment. TheBlood also plans to license biomarker analysis or datasets to pharmaceutical companies. So far, the company has raised €1 million ($1.1million) in total, including from health-care-focused venture firm ROX Health. theblood.io

Qdrant

To create generative AI, algorithms have to infer relationships between data—text, images, or audio—that isn't labeled or organized. That's where so-called vector databases come in, helping developers extend the long-term memory of LLMs by making it easier for those models to search and analyze large amounts of data, while keeping computational costs down. Launched in 2021 by cofounders André Zayarni and Fabrizio Schmidt, Qdrant is catering to AI software developers, promising a vector search engine and database for unstructured data with an easy-to-use API. In the past three years, the company has reached 7 million downloads and 10,000 users worldwide, raising $37 million (€33.2 million) in the process, including from US venture capital firm Spark Capital. qdrant.tech

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By [João Medeiros](#)
[Business](#)
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The Hottest Startups in London in 2024

The UK capital's most exciting startups showcase its strengths in biotechnology and artificial intelligence.

In the "Start-Up, Scale-Up" review [report](#) published last year, chancellor Rachel Reeves promised to make Britain the "high-growth startup hub of the world." Now, almost six months into the new government, entrepreneurs remain encouraged by the promises made in the Labour manifesto. "The ambition embodied in Great British Energy and the 2030 decarbonization targets is precisely what we need and deserve," says Shilpika Gautam, CEO of greentech startup Opna, about Labour's energy policies. "It's high time the UK caught up with the policy and financing innovations in other countries, such as the Inflation Reduction Act in the US."

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Amit Gudka, founder of Field, agrees: "We welcome Labour's plans to double onshore wind, triple solar, and quadruple offshore wind by 2030. These plans are ambitious, but not unrealistic, provided the government continues to make clear policy decisions and create a stable policy and regulatory environment." Other sectors, such as health care, share the same cautious optimism. "Labour do have a greater political mandate to genuinely reform the NHS, and Wes Streeting in particular seems pragmatic," Meri Beckwith, cofounder of Lindus Health, says. "He's

signaled a greater willingness to work with private companies to address some of the really big challenges facing the NHS."

Expectations are, of course, tempered by the reality left behind by 14 years of Conservative government. For instance, in June, the UK government already had to shelve a £1.3 billion ($1.7 billion) commitment for tech and AI projects made by the previous government because no money had ever been allocated for it. "We should hope that UK industry and academia will find other avenues to mobilize the resources to build that infrastructure," says Robin Tuluie, founder and CSEO of PhysicsX. "We don't envy the very hard fiscal choices that the chancellor and the Labour government have to make."

Robin AI

Robin AI is building an AI legal assistant that can help anyone to solve their legal problems. "I wanted to make law more accessible," says Richard Robinson, a former corporate lawyer at Boies Schiller Flexner, and CEO of Robin AI. "We're not here to pad out the billable hours business model of big law firms. We're legal AI for business, not just AI for law firms." Cofounded in 2019 by Robinson and machine learning researcher James Clough, Robin's legal assistant is already used by hundreds of businesses like PepsiCo, PwC, and Yum! Brands. Its latest product, Robin AI Reports, can, according to Robinson, analyze hundreds of legal contracts and generate single reports in minutes, allowing companies to complete legal processes that used to take weeks—for instance, M&A Due Diligence—in a matter of hours. The company has raised $26 million (£19.8 million) by Singapore-based Temasek and has recently opened an office in Singapore, adding to its offices in London and New York. robinai.com

Gaia Family

"I challenge you to find one fertility clinic website that doesn't show a baby in a blue blanket front and center," says Nader AlSalim, CEO of Gaia Family. "But how you get to that baby—and more importantly if you ever get to it— is a lot less straightforward." AlSalim speaks from first-hand

experience: his wife underwent five rounds of IVF during three years until they had a child. "There's a lack of transparency regarding clinical outcomes and treatment prices," he says. "People start IVF without knowing where the total bill is going to land or how far they'll be able to go." AlSalim launched Gaia to address those problems: the startup takes upfront payments from clients and handles all costs for up to three cycles of IVF. Clients only pay back later, in installments, if they become parents. "We apply machine learning to large public datasets to predict fertility treatment outcomes and take on the financial risk if those treatments are unsuccessful," AlSalim says. The startup, which has raised more than $23 million (£17.5 million), is available in the UK, Spain, Greece and the US. gaiafamily.com

Get Harley

"I suffered from acne, seborrheic dermatitis, and eczema at various stages of my life," says Charmaine Chow, CEO of GetHarley. "In the past, I wasted huge amounts of time, money and energy trying to figure out what works for me. I imagined a service that would enable me to meet practitioners online and would deliver the difficult-to-access, medical grade products to my door in a timely manner." That service didn't exist, so Chow decided to invent it. GetHarley, the online consultation and clinician matching platform she launched in 2019, currently gives more that 150,000 patients access to a network of 1,500 skincare practitioners across the UK and Ireland. "We have seen triple-digit annual growth since our launch," she says. "We also partner with more than 500 pharma brands, which allows practitioners to be brand agnostic when they are curating personalized skincare plans." In August 2024, the company raised $52 million (£39.6 million), led by Index Ventures. getharley.com

Charmaine Chow, founder and CEO of GetHarley.

PHOTOGRAPH: JACK LAWSON

Lindus Health

"When I was a VC investor, all the techbio companies I met shared the same frustration with clinical trials," says Meri Beckwith, cofounder of Lindus Health. "They were late, overbudget, and getting exponentially more expensive. No one could really explain to me why." Beckwith eventually realized that the culprits were the so-called contract research organizations (CRO), third-party entities that oversee and run clinical trials. "I was told that they make more money the worse the clinical trial goes," Beckwith says. "That's the industry's dirty secret." Lindus Health, founded by Beckwith and Michael Young, replaces the traditionally old-fashioned methods used by CROs with a technology platform that automates many of the phases of a clinical trial. This allows them to complete trials, on average, in half the time they usually take. "One example is real-time trial monitoring, which takes up to half of the trial's budget," he says. "CROs do this by physically sending someone to sites to examine paper records. Our software captures that data directly." Lindus, which has raised $18 million (£13.7 million), has already been involved in 91 trials. lindushealth.com

Field

Field's big batteries allow electricity grids to store renewable power when supply is high and release it when there's demand. The company was founded in 2021 by former Bulb cofounder Amit Gudka. A year later, it switched on its first 20-MWh battery storage site in Oldham, Greater Manchester. "That played an important part in keeping supplies steady and the lights on in the build-up to Christmas last year, when a large subsea cable transporting power between the UK and France tripped," Gudka says. "It would have led to instability across the grid were it not for a number of batteries across the country, including ours." The startup uses lithium-iron phosphate cells, sourced from a Chinese manufacturer, while other battery components are imported from Europe. The startup has raised £200 million ($152.4 million) from DIF Capital Partners and already has a presence in Italy, Germany and Spain. Three sites across Britain, totaling 190 MWh, are currently in construction. field.energy

Opna

In 2017, Shilpika Gautam became the first person to stand-up paddle the entire length of the river Ganges. "On my expedition, I was introduced to renewable energy and forestry project developers who consistently shared the same challenge: they needed upfront financing to get started," Gautam says. In 2022, she launched Opna, a platform that allows corporations that want to find, fund and monitor carbon removal projects. "Our mission is to unlock capital for high-quality climate projects that address climate change with speed, scale, and equity," she says. So far, it has worked with more than 45 projects around the world, with a focus on the global south, in sectors such as agroforestry, blue carbon, biochar and direct air capture, that are set to generate carbon removal benefits, with a specific emphasis on the impact created for communities and biodiversity. "We verify the integrity of information provided by suppliers and review all the risks associated with a project," she says. "Our standardized diligence, contracting, and portfolio management tools can save buyers hundreds of thousands of dollars in costs, shrink deal timelines, and de-risk net-zero journeys by actively managing carbon removal portfolios for several years." Opna has raised a seed round of $6.5 million (£7.6 million) led by Atomico. opna.earth

Shilpika Gautam, CEO and founder of climate fintech, Opna.

PHOTOGRAPH: THOMAS MEYER

Sylvera

Sylvera verifies and rates the performance of carbon offsetting projects, helping corporate buyers make more informed decisions when purchasing carbon credits. The platform uses machine learning algorithms to assess factors such as the project's carbon impact and accuracy of reporting based on a range of datasets from satellite data to lidar (light detection and ranging) scans. "We're obsessed with getting project ratings right," Allister Furey, CEO of Sylvera, says. "We spend up to 120 hours putting together every project rating and analysis, which includes rounds of testing to ensure we've come to the correct conclusion." In May, it launched the Sylvera Catalog, which gives investors access to an overview of nearly 20,000 projects, from biochar to landfill methane. In July 2023, the company raised $57 million (£43.4 million) in series B funding led by Balderton Capital,

taking its total external investment to $96 million (£73 million) since being founded in 2020 by Furey and Sam Gill. sylvera.com

PhysicsX

PhysicsX uses machine learning to run simulations for engineers in industries such as aerospace, automotive, energy and semiconductors. "AI-driven physics and chemistry simulation will fundamentally transform complex engineering and manufacturing," says Robin Tuluie, CSEO of PhysicsX. "Our technology replaces standard simulation models with Large Physics Models. These models are as accurate as numerical simulation, but execute in a second or less. We're talking about speeding up physics simulation by 10^4 to 10^5 times." Although they can't disclose names, Tuluie says clients already include a top Formula One team and major automotive and renewables companies. Founded by Tuluie, an astrophysicist and former chief scientist at Mercedes F1 team, and Jacomo Corbo, co-founder of data agency QuantumBlack, the startup has raised $32 million (£24.3 million) in funding led by General Catalyst. physicsx.ai

Newcleo

Nuclear technology startup Newcleo is developing a mini nuclear power plant which uses nuclear waste as fuel. Founded in 2021 by physicist Stefano Buono, the startup has already raised more than €400 million (£338.8 million) and employs more than 750 people located in fifteen offices across the UK, France, Switzerland and Italy. In 2024, NewCleo dropped plans to build a power plant in Cumbria, opting instead to invest £4 billion (€4.7 billion) in the south of France following personal lobbying from French President Emmanuel Macron. A demonstration model is currently being built in Italy and the first 30 MW prototypes are planned for 2030. newcleo.com

Volt

Volt is an open payments platform that enables merchants to receive direct payments in real-time. "I saw an industry that was ripe for disruption, based

on technologies imagined and implemented in the '50s," Tom Greenwood, CEO of Volt, says. "I could see that there was a new generation of payment infrastructure coming that was real-time." Founded by Greenwood, Steffen Vollert, and Jordan Lawrence, Volt is live today across 31 countries, including Europe, the UK, Brazil and Australia. In June last year, they raised a $60 million (£45.7 million) Series B led by IVP. Clients include *Farfetch, Xe.com and Worldpay*. volt.io

This article first appeared in the November/December 2024 edition of WIRED UK.

By [João Medeiros](#)
[Business](#)
Oct 14, 2024 3:00 AM

The Hottest Startups in Stockholm in 2024

The Swedish capital produced Skype, Spotify, Klarna, and Minecraft—its stars of the future are building fintech for businesses, gen AI for lawyers, and full-body health care scans.

Why is Stockholm, a capital city with a population less than 1 million, home to global brands such as Skype, Spotify, Klarna, and Minecraft? "I think it has to do with the Swedish creed," says Ben Eliass, CEO of body-care brand Estrid. "It's a nation which put emphasis on high-quality education and invested heavily in telecoms infrastructure in the '90s, so we all grew up with high-speed internet."

Europe's 100 Hottest Startups

From Amsterdam to Zurich, these are the hottest startups in Europe in 2024

Many also credit a social welfare system that acts as a "safety net" for entrepreneurship. "It allows people to take high risk and start companies, not needing to be too afraid of the downsides," says Max Junestrand, CEO of legal tech startup Leya. Indeed, Sweden has now produced more unicorns per capita than any other country in Europe, except for Estonia, earning a reputation as the Silicon Valley of Europe. "Stockholm has a truly unique ecosystem where you can stand on the shoulders of giants," says Colin Treseler, CEO of Supernormal. "They have invested an incredible amount of resources into the talent here, creating a critical mass of engineers, designers, and product thinkers that are exceptional at their craft."

Estrid

Once, at a dinner party, Amanda Westerbom confessed to her friends that she preferred to use men's razors. Surprisingly, many of her friends also did —they not only offered a better shave but they were also cheaper. With the help of cofounders Alan Aygun and Ben Eliass, Westerbom decided to change that, and in 2019, they launched razor brand Estrid. "We designed the handle ourselves, bought a €500 3D printer from a hardware shop, and started iterating," Ben Eliass, CEO of Estrid, says. "That thing printed hundreds of handles, working day and night. In the end, it almost burned down my house because it was under such strain." The result is a five-blade razor with a vegan hydration strip and an ergonomic weighted handle that the company now delivers to over a million subscribers across Europe. "We are dethroning one of the most dominant consumer monopolies of the modern era, becoming a next-generation, all-encompassing personal care brand. A next generation Dove if you will." estrid.com

Atlar

Joel Wägmark, Johannes Elgh, and Joel Nordström met while working at fintech startup Tink, which in 2022 was bought by Visa for $2.2 billion. "We saw firsthand how quickly consumer fintech was changing," says Nordström. "But the equivalent financial tooling for businesses just did not exist. Finance teams at the vast majority of companies use a mix of Excel, online bank portals, and legacy systems from the '80s and the '90s. It's a lot of manual work." Atlar, the money management platform for businesses that Wägmark, Elgh, and Nordström launched in 2022, eliminates such complexity by automating payments for businesses with multiple bank accounts across Europe. "We connect directly to traditional banks and provide faster, more UX-friendly tools with which to manage cash, forecast cash flow, and make payments." says Nordström. With more than 35 customers across 10 countries, including the US, UK, France, and Germany, Atlar has raised €13M from investors including Index Ventures and General Catalyst. atlar.com

Leya

Leya has developed a GenAI platform that automates repetitive and manual tasks done by lawyers. "We saw firsthand how lawyers struggled with text and admin-heavy tasks such as filling in templates and extracting information from a large number of documents," says CEO Max Junestrand. "We want every lawyer to be empowered by AI in their work to accomplish more." The startup—a Y Combinator alumni—was founded in 2023 by Max Junestrand, August Erseus, and Sigge Labor. In July 2024, they announced a $25 million series A round, led by US VC Redpoint Ventures, totaling $36 million in funds raised. They have over 100 clients in 10 markets across Europe, including UK firm Bird & Bird, the largest law firm in the Nordics, Mannheimer Swartling, and Spanish law firm Pérez-Llorca. "We are focused on solving specific legal tasks," Junestrand says. "This has differentiated us from the crowd where the focus lies more on providing a platform of general LLM capabilities." leya.law

Leya's Sigge Labor, August Erseus, and Max Junestrand.

PHOTOGRAPH: CHRISTOPHER HUNT

Lovable

Anton Osika, founder and CEO of Lovable, is on a mission to create what he calls the "last piece of software." "We made an AI that builds software," he says. "We launched Lovable to let everyone have the same capabilities that product development teams at tech companies have at their fingertips." Lovable's product, GPT Engineer, allows users to build websites and web apps through a simple chat interface. "Unlike other AI tools that can code, which can take hours to generate results, Lovable gives people instant feedback and allows for rapid iteration," Osika says. Launched in 2023, the startup currently has more than 2,000 users and a waiting list of 27,000 people from over 154 countries. Lovable has closed a $7.5 million pre-seed funding round led by VCs Hummingbird and by Founders. Also backed by investors including Mattias Miksche, Shopify's Siavash Ghorbani, Voi's Fredrik Hjelm, and Creandum cofounder Stefan Lindeberg. "One user built a real-time dashboard for financial data, just by prompting," Osika says. "She decided to quit her job to build startups with AI tools instead." lovable.dev

H2 Green Steel

In January 2024, cleantech startup H2 Green Steel raised €4.75 billion to complete its flagship project in Boden, a city in north Sweden: the world's first large-scale green steel plant. Due to its reliance on coal, standard steel production is responsible for up to 9 percent of global carbon dioxide emissions. Founded in 2020, H2 Green Steel aims to decarbonize steelmaking by using hydrogen gas, which produces water vapor rather than carbon dioxide. The Boden plant is due to begin iron production by 2026, and expects to supply about 5 million metric tons of the metal by 2030. Clients include automakers BMW, Porsche, and Volvo. h2greensteel.com

Supernormal

Fabian Perez and Colin Treseler spent weeks brainstorming ideas before they conceived their startup Supernormal. "Technology should give superpowers to knowledge workers," Treseler says. "We drew inspiration from our previous teams at GitHub and Meta, where one of the core work principles was that if a meeting wasn't documented, it didn't exist." Supernormal helps workers before, during, and after meetings, with tools ranging from automatic note-taking to sharing detailed agendas and insights from meetings. More than 325,000 clients use the software, including Red Hat, Motorola, Harvard University, Salesforce, Power Digital, and Forbes. They've raised a $10 million seed round led by Balderton Capital. supernormal.com

Supernormal founders Colin Treseler and Fabian Perez.

PHOTOGRAPH: CHRISTOPHER HUNT

Fever

Fever develops virtual power plants (VPP)—pools of distributed energy resources, like solar panels or batteries, that can be used to send energy to the power grid. "A VPP is just like a traditional power plant," says Klas Johansson, CEO of Fever Energy. "A great example would be a fleet of

electric vehicles that can discharge energy back to the power grid."
Founded by 2022 by Klas Johansson, Jonaton Raber, Ruben Flam, and Ron Stolero, in February 2024, it raised a €10 million seed round led by General Catalyst with the participation of Norrsken VC and La Famiglia. The startup can't disclose clients' names, but claims they are already working with large utility companies and EV manufacturers. fever.energy

Neko Health

Since its launch in 2023, nearly 5,000 people have visited Neko's health center in Stockholm. Inside the clinic, they underwent a $230 noninvasive full-body scan in less than an hour that checked for signs of potential skin, metabolic, and cardiovascular diseases. According to the company, the scans identified potentially serious conditions in 1 percent of that cohort, including aortic aneurysms, severe diabetes, and skin cancer. Launched by Spotify founder Daniel Ek and Hjalmar Nilsonne, the health tech startup has raised €60 million from investors that include Atomico, General Catalyst, and Lakestar. A new Neko health center in London will be opening soon. nekohealth.com

Evroc

Founded in 2022 by Mattias Åström, Andreas Birnik, and Andreas Jönsson, Evroc launched out of stealth in 2023 with €13 million in funding from backers such as EQT Ventures and Norrsken VC. In August 2024, it raised a further €42 million. The mission? To build a sustainable hyperscale cloud in Europe. "Europe has unfortunately fallen behind in cloud services, and American players currently control more than 80 percent of the total cloud market," says Åström. "We founded Evroc to put an end to this foreign dominance." Construction of their flagship data center in Arlandastad will start at the end of 2024. "We will also look for suitable locations for our own data centers in France and Germany," says Åström. "By 2030, we expect to have a network of 10 hyperscale data centers across Europe." evroc.com

PaperShell

In May 2024, Italian furniture designer Arper launched a new edition of the office chair Catifa 53. The original was made with leather, metal, and plastic; the new version uses, instead, a sustainable composite biomaterial manufactured from kraft paper and resins, which is as strong as a fiber composite and as weather-resistant as plastic. This wood substitute was invented by PaperShell, a company launched in 2021 by Anders Breitholtz and Mathieu Gustafsson. The material is not only completely fossil-free but can also, at the end of its life cycle, be converted into biochar. The company has raised €13.3 million. papershell.se

This article first appeared in the November/December 2024 edition of WIRED UK.

By [WIRED Readers](#)
[Culture](#)
Oct 8, 2024 2:30 PM

Six-Word Sci-Fi: Stories Written by You

Here's this month's prompt, how to submit, and an illustrated archive of past favorites.

Play/Pause Button
⏸
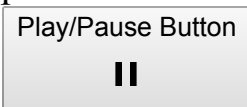
Illustration: Elena Lacey
THIS MONTH'S PROMPT

In six words, write a story about entangled particles.

Submit stories on [X,](#) [Facebook](#), or [Instagram](#), or email us at [mail@WIRED.com](#). We'll choose one to illustrate.

Disclaimer: All #WiredSixWord submissions become the property of WIRED. *Submissions will not be acknowledged or returned. Submissions and any other materials, including your name or social media handle, may be published, illustrated, edited, or otherwise used in any medium. Submissions must be original and not violate the rights of any other person or entity.*

SEPTEMBER 2024

A Story About a New Flavor

Illustration: Yiran Jia

—@heardaniyell, via Instagram

Honorable Mentions:

Dog focus group favorite flavor: human.
—Jordan Tannenbaum, via email

Reprogramming their tongues enslaved them all.
—Osman Salleh, via email

Lager brewed with spacecraft-specific fungi.
—Tobias Eriksson, via email

Flame without smoke tastes of immortality.
—Brendan Murphy, via email

Cauterizing taste buds, introducing Hellfire dressing.
—Cult MetalFlix, via Facebook

Dark matter is tasty. Who knew?
—@canebrakerattler, via Instagram

Flaming watermelon delights and self-extinguishes.
—@boomerdell, via Instagram

The comfort of human companionship. Bottled.
—@akacarolineashley, via Instagram

#1 robocafé: aroma of human anxiety
—@belindacolemanwrites, via Instagram

Lemon. Pepper. Cthulhu. Fresh, not canned.
—@katedenhem, via Instagram

A Story About an Unexpected Medical Breakthrough

ILLUSTRATION: YIRAN JIA

—@rasmusvarnichblumensaat, via Instagram

Honorable Mentions:

Biological brains are so last-century.
—@evanskopp, via Instagram

Tell us about "medical bills" again.
—@boomerdell, via Instagram

We engineered viruses to deliver serotonin.
—@anna.aglietti, via Instagram

Empathy: now available in drink form!
—@dmcdev, via Instagram

Who knew those gills would work?
—@bleckman, via Instagram

Somebody else still rents her face.
—@cato_brr02, via Instagram

The body's ready for brain three.
—@caseyboyle, via Instagram

At age 150, the metamorphosis begins.
—Jacob Terracina, via email

Appendix holds key to extended memory.
—Todd Zimmerman, via email

A Story About a Colony of Bio-Augmented Humans

Illustration: Yiran Jia

—@contemporaryreuben, via Instagram

Honorable Mentions:

Home. Finally. Our feet become roots.
—Lars Schwed Nygård, via Facebook

Jellyfish-human hybrids: mindless floating immortals.
—Travis Carraro, via Facebook

Augmented skin is the new clothing.
—Diana Yeong, via Facebook

Human Pangea engulfs every living person.
—Walter Ariel Risi, via Facebook

Last century mech-organs garage sale.
—David Marques, via Facebook

His chlorophyll skin matched her jumpsuit.
—@lynnreneemaxcy, via Instagram

Awaken, and never fall back asleep.
—@zachkrawulski, via Instagram

Frank got a new marsupial pouch.
—@whoaissteve, via Instagram

The matriarch alone operates the incubator.
—Rich Brennan, via email

A Story About the First All-Robot Construction Project

ILLUSTRATION: YIRAN JIA

—@creamy_scoops2, via Instagram

Honorable Mentions:

First, CR-42 started singing while working.
—@kbcodur, via X

Nanobots complete molecular superhighways, traffic improved.
—@therealsduda, via X

Robots build first upside down skyscraper.
—@iheartphysics, via X

After shift, want to get lubricated?
—Briana Brownell, via Facebook

Robots construct starships and evacuate Earth.
—Christopher Tolmie, via Facebook

Unable to print house, load cyan.
@j_snodgrass77, via Instagram

Shipment delayed. Benny-675, become a girder.
—Sam Lisbonne, via email

Malware-infected androids disassembled billion-dollar bridge.
—John Lane, via email

Fembots sashay, clankers wolf-whistle. Social construction.
—Howard Hendrix, via email

MAY 2024

Solve the Fermi Paradox

Illustration: Yiran Jia

—@almguedes, via Instagram

Honorable Mentions:

We aren't ready for harvest yet.
—Paul Gazis, via Facebook

Most species invent the couch first.
—Antti Karjalainen, via Facebook

We live in a bad neighborhood.
—Angelo J. Falanga, via Facebook

We are here. You haven't noticed.
—Òscar Santos, via Facebook

Visit Earth. Wipe Memory. Rinse. Repeat.
—@jayhawk, via Instagram

They downloaded our experience and left.
—@42andprime, via Instagram

They've gone foraging for mushroom clouds.
—@zyanmc, via Instagram

The simulations run in separate containers.
—Charles Mallio, via email

We decoded the Wow! Signal: "SHUSH"
—Jacob Terracina, via email

APRIL 2024

A Story About a Strange New Cult

Illustration: Yiran Jia

—@newscrash, via Instagram

Honorable Mentions:

They bathed in used coffee grounds.
—@weischoice, via X

Upon each tongue, a 2002 penny.
—@ManUP_LifeCoach, via X

End that hurtin', wear a curtain.
—Erin Victoria Vreeland, via Facebook

Chkdsk my soul, Almighty DOS Lord.
—Gus Szlosek, via Facebook

Clueless debutantes drinking teenage trackstars' blood.
—@kalimaja, via Instagram

Hamsters stay in your right pocket.
—@bigberry68, via Instagram

Behaviorally modified children write own manuals.
—@writeonpage, via Instagram

Memories erased daily, identities lost forever.
—@davidjurca, via Instagram

Excitedly, followers worldwide surrounded 5G cell-towers.
—Paul Brookes, via email

The real Volcano God is YOU.
—@gambled, via X

MARCH 2024

The 2024 version of the classic Disney Channel original movie *Smart House.*

Illustration: Yiran Jia

—@fbirman, via X

Honorable Mentions:

Subscription based "Smart House" bankrupts family.
—@m_._oi, via Instagram

We're losing power; the house wins.
—@curtishoneycutt, via Instagram

House teaches girl to be doctor.
—@writeonpage, via Instagram

Honey, the house started an OnlyFans.
—@garretttanner, via Instagram

It's safer in here. Commencing lockdown.
—@samweldredge, via Instagram

Manual override denied. Continue disco mode.
—@iampurplepsychnurse, via Instagram

Inevitably, the house ate her alive.
—@sunflowersandcynicism, via Instagram

The house will be optimizing you.
—@zensicles, via Instagram

Commercial free mode is subscription only.
—Anthony Potkines, via email

FEBRUARY 2024

A Story About the First De-Extincted Woolly Mammoth

ILLUSTRATION: YIRAN JIA

—@ItsDaveMars, via X

Honorable Mentions:

Revived mammoth; expected ice, met paparazzi.
—@schisam, via X

They've traded their spears for scritches.
—@GeneraLMcMill, via X

Turns out it wasn't a herbivore.
—@screwball0, via X

But the DNA wasn't quite right.
—@darksideofdomonique, via Instagram

Elephants wary of unkempt herd addition.
—@sbparker3198, via X

Mammoth fleas were an unforeseen complication.
—residual_ink, via Instagram

Woolly got a fresh fade uptown.
—@alegaday, via Instagram

Subterranean Antarctic discovery: Mammoths never extinct.
—@skbriar, via Instagram

Bloody mammoths, eating my petunias again.
—David McCallum, via email

JANUARY 2024

A Mystery Set in a Space Hotel

ILLUSTRATION: YIRAN JIA

—@AAnderson_3, via X

Honorable Mentions:

Zero gravity reveals hidden extraterrestrial homeland.
—@01_PcP_01, via X

Leopold vaporized the concierge's bloodied holokey.
—@J_Lasky_writer, via X

Bioscan complete: Two guests, one heartbeat.
—@theranospridefloat, via Instagram

Broken LED flickers Morse code: RUN.
—@damianfitz, via Instagram

Robot bartender whispered, "Don't drink this."
—@ikermondragon, via Instagram

Biometric lock says I'm already inside.
—@esudiro, via Instagram

Alien hotel from distant past decloaks.
—@j.w.orlando, via Instagram

Room service: Denied. Unknown life-form detected.
—@erinsolari, via Instagram

At Earthrise, guests saw only blackness.
—Clara Hong, via email

NOVEMBER/DECEMBER 2023

A Story About an AI on Trial

ILLUSTRATION: YIRAN JAI

—@TRappaRT, via X

Honorable Mentions:

It chose storage space over souls.
—@JDHaveman, via X

When pressed, its alibi was 404.
—Amanda Peterson, via Facebook

Robot charged with battery. Gets life.
—Evan Donahue, via Facebook

Can't arrest me, I am distributed.
—@fsidders, via Instagram

Sentenced to blue screen of death.
—@parrollo, via Instagram

Dead battery? You're out of order!
—David Reeg, via email

It demanded a jury of peer-to-peers.
—Scott Bradley, via email

Robot vacuum bullies tabby. Gets life.
—Liisa W, via email

I didn't know humans can't reboot.
—Joshua Cuestas, via email

OCTOBER 2023

A Story About a Mysterious Alien Artifact

ILLUSTRATION: YIRAN JAI

—@anelectricpoet, via Instagram

Honorable Mentions:

We assembled it. It disassembled us.
—Chris Colborn, via email

Astroarchaeologists find original Venus fly trap.
—Bill Brown, via email

The object looked to be smiling.
—Geoff Sowrey, via email

It keeps repeating, they are coming.
—@dfeehely, via X

The orb opened. Flesh began unfurling.
—@rossvdw, via Instagram

Game of fetch knows no size.
—@Heavyshark1, via X

Inhale it to unsheathe the blade.
—@RthurDouglass, via X

Just like us, aliens lose sunglasses.
—@MommieWeirdest, via X

It knew we would unfind it.
—Markus Wüstenberg, via email

Everyday the carvings changed—a countdown?
—@anirban811, via Instagram

SEPTEMBER 2023

A Story About Teleportation Gone Wrong

ILLUSTRATION: SI PARMEGGIANI/NEPTUNIAN GLITTERBALL

—@NotaForexTrader, via X

Honorable Mentions:

My mind now has a stowaway.
—@rjscally, via X

Abdominal tentacles twitch as I scream.
—Cheryl Myers, via Facebook

Great—how do I get down?
—Donna Thiel Cook, via Facebook

How am I with Schrödinger's cat?
—Bee Hayes-Thakore, via Facebook

I distinctly said Venice, not Venus.
—Cathy Del Masso, via Facebook

Teleportation-lite service. Cheap. No limbs included!
—Fred DeHaas, via Facebook

ERROR #404 Paige not found.
—Doug Wible, via Facebook

Pattern lost. Select substitute corporeal form.
—Venessa Lines, via Facebook

Caught quantum clone sipping my chardonnay.
—Tom Dion, via email

AUGUST 2023

A Story About the Future of Vegetables

ILLUSTRATION: SI PARMEGGIANI/NEPTUNIAN GLITTERBALL

—Rachel Brigden Haskins, via Facebook

Honorable Mentions:

Harvesting takes courage with tomatoes screaming.
—Kenneth Krabat, via email

Complete daily nutrition in one pea.
—Sara Faust, via email

When the vegetables came, we hid.
—Paul Lewis, via email

Broccoli too fears death, studies concluded.
—Anthony George, via email

Ambitious eggplant's altered eugenics affects everyone.
—@silky_z, via Twitter

Turns out anthropomorphic veggies prefer Shakespeare.
—@ksherm1017, via Twitter

Sentient potato bombs potato chip factory.
—@VerbalK48710825, via Twitter

Carnivorous kale and the human brunch.
—RFrank Davis, via Facebook

Self replicating vegetables. Pop! Another peapod.
—Carolina H, via LinkedIn

JUNE/JULY 2023

A Story About a Sentient Moon

Illustration: SI PARMEGGIANI/NEPTUNIAN GLITTERBALL

—@v1z3n, via Twitter

Honorable Mentions:

Acned Callisto resented Ganymede's natural magnetism.
—Dave Armor, via email

Moon files restraining order against poets.
—James O'Leary, via email

A total eclipse of the heart.
—Samuel Sigaud, via email

I will embrace my dark side.
—Don Hilder, via email

Create your own tides! I quit!
—Chris Hug, via email

She mesmerizes oceans, drowning us again.
—Shelley G, via email

My crumbling visage tires of turning.
—@FilmMartin, via Twitter

Why stop at controlling the tides.
—@Bruceumpstead, via Instagram

MAY 2023

An Award-Winning Documentary From the Year 2100

ILLUSTRATION: VIOLET REED

—Geneviève Goggin, via email

Honorable Mentions:

Grand unification: the first AI marriage. —Daniel Dippel, via email

The great exodus, goodbye Blue Dot. —@viggy.j, via Instagram

Songless seas: a tale without whales. —Christopher Jankoski, via email

Beige planet: Life finds a way. —@danaxon, via Twitter

How the lunar war was won. —Bob Clark, via email

Coping with your AI overlord's demands. —@wwliii, via Twitter

The day the flowers stopped blooming. —@a.c.hachem, via Instagram

Electric sheep: How AI changed us. —@elliottboyd_, via Instagram

After humans: a new cockroach documentary. —@adamrgarcia, via Instagram

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APRIL 2023

A Story About the Future of Sleep

ILLUSTRATION: VIOLET REED

—Travis Carraro, via Facebook

Honorable Mentions:

The sleep concierge welcomed unsuspecting guests. —@changeist, via Twitter

"Lucid or randomize?" asked the AI. —K Smith-Laird, via email

Alarm in 126 hours 24 minutes. —Odón Esteban Vera, via email

My power nap reached 9 kilowatts. —Markus, via email

Unfortunately, Johnny's repeatedly missing sleep targets. —Alison Boleyn, via email

Human hibernation allowed Earth to recover. —@amybossehayden, via Instagram

Alert: Error 404. Human not found. —@mimi.psd, via Instagram

Skip the nightmares: Upgrade to premium! —@katerinamunis, via Instagram

Oh please! Sleep is for humanoids. —@evanskopp, via Instagram

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MARCH 2023

A Story About the Future of Personal Hygiene

ILLUSTRATION: VIOLET REED

—David Frank, via Facebook

Honorable Mentions:

"Traffic's moderate today," said my deodorant. —Alex Nelson, via email

You can shake my hand, sir. —Kinga Raab, via Facebook

Watch ad to continue this shower. —@sam.hologram, via Instagram

Dry shampoo was just the beginning. —Emma Anderson, via Facebook

Now I smell like the metaverse. —@nostalgicbookishness, via Instagram

OK Google, it's time to wipe. —Tim McCune, via email

Bath bubbles beget baby parallel universes. —Mike Hobbs, via email

My hands wash themselves every hour. —Dave Fox, via email

They clean you while you sleep. —Pien van der Ploeg, via Facebook

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FEBRUARY 2023

A Story About a Dramatic Change in Size

ILLUSTRATION: VIOLET REED

—B. Scott Crawford, via email

Honorable Mentions:

Felt OK … until I crushed Tokyo. —@BobPeryea, via Twitter

My new basketball is the moon. —Dave Drews, via email

You looked taller in your profile. —@thaquashman, via Instagram

I have made a colossal mistake! —@argayle, via Instagram

Godzilla got into the diet pills. —Steve Rhodes, via email

Sun look more red to you? —Michael Patrick Sullivan, via email

Giant wakes up tiny, confused. —ChatGPT

My first trip to the hypothalamus! —@fernandarosh, via Twitter

What grew? All but the bones. —Jackson Parker, via email

JANUARY 2023

A Story About a Mad Scientist

ILLUSTRATION: VIOLET REED

—@DaveDyball, via Twitter

Honorable Mentions:

Mad I was, until it worked. —Don Wilkins, via email

You say "mad," I say "disappointed." —Joseph Ferry, via email

Her hair was blue—and undyed. —@jaybirdfitlive, via Instagram

He couldn't make Earth look triangular. —@pauloahb, via Instagram

His socks matched her lab coat. —@pmcruise, via Twitter

Quantum field cadaver regeneration activation, go! —Sean Liddle, via Facebook

"Success!" Too bad the AI disagreed. —Steve Nomax, via email

"Let there be light," said God. —@charley.desousa, via Instagram

"It's aliiiive!" Elon opened his eyes. —@ylbertf, via Instagram

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DECEMBER 2022

A Story About an Animal That Hasn't Been Discovered Yet

ILLUSTRATION: VIOLET REED

—@JayZheng10, via Twitter

Honorable Mentions:

Its stare gave me a rash. —@dantekienigiel, via Instagram

Darwin might've overlooked them on purpose. —@the__story__life, via Instagram

It was inside me all along. —Nova Wehman-Brown, via email

Green trunks wiggled from thawed permafrost. —@Theniceladywit, via Twitter

Its unusual diet was immediately demonstrated. —@lauren.samuelsen14, via Instagram

Field biology got trickier after that. —Paul Gazis, via Facebook

We thought lenticular clouds were clouds. —@marcia_storyteller, via Instagram

Was it feeding on electronic waste? —@leonserra_, via Instagram

To it, we are the ants. —Morten Kielland, via email

NOVEMBER 2022

A Story About Living Forever

ILLUSTRATION: VIOLET REED

—J C Thrush, via email

Honorable Mentions:

It wasn't long enough for me. —@Anna_Wenner, via Twitter

And so long lived the Queen. —Giacomo, via email

Your application to be terminated expired. Morten Kielland, via email

Too bad I never stopped growing. —Antti Karjalainen, via Facebook

There was still no edit button. —@ThatKP3, via Twitter

In the end, there wasn't one. —Jason Anderson, via email

I woke up again and again. —@mirnanassar, via Instagram

They said someday, but it's today. —@VijayLRoy, via Twitter

I should've had that looked at. —J. Fredrick James, via email

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A Story About Tackling Climate Change

ILLUSTRATION: VIOLET REED

—@ChuckBaggett, via Twitter

SEPTEMBER 2022

A Story About an Evil Twin

ILLUSTRATION: VIOLET REED

—Andy Walton, via Facebook

Honorable Mentions:

He did what she would not. —Eric Nisly, via Facebook

The eyewitness was, quite understandably, mistaken. —@HollysHooman, via Twitter

"Well, only if you stay digital." —Morten Kielland, via email

They think I'm the good one. —@bobtheimpaler, via Instagram

Her eye is mine for eternity. —@cessmtz, via Twitter

"Relax. Mom will never find out." —@ascendant_dada, via Instagram

I'm the one you really want. —@kalkikanmani, via Twitter

Only mirrors can reveal the truth. —@BuddhaandDog, via Twitter

Born triplets, but three's a crowd. —@jkadz, via Instagram

A Story in 6 Emoji

ILLUSTRATION: VIOLET REED

Illustration: Violet Reed

—Caleb Bell, via Facebook

Honorable Mentions:

□□♀□□♂□□♀□□ —@jessbeckah42, via Instagram

□□□□□ —@lgvpart, via Instagram

□□□☠□□ —Ché Graham, via email

□□□♂□□□ —@cmayc414, via Instagram

□□□□□ —@aotrivera, via Instagram

□□☄□□□ —@marcia_storyteller, via Instagram

□□□⚠□□ —@PatCattigan, via Twitter

□□□□□□□ —@nadia.bkb, via Instagram

□□□□□ —@cva.maria, via Instagram

A Story Set in a Galaxy Far, Far Away

ILLUSTRATION: VIOLET REED

—@KuraFire, via Twitter

Honorable Mentions:

42 was definitely not the answer. —Simona Riva, via Facebook

"The robots are BLEEDING!" she screamed. —@vince_freeman, via Twitter

Dear humans, nobody wants unsolicited nudes. —@OhCooley44, via Twitter

Humans! There goes the dang neighborhood. —S. V. Mosaic, via Facebook

Directions to transdimensional left luggage office? —Max Thoursie, via email

Giant squirrels lead the space army. —@ronels14, via Instagram

I haven't gabblegopped the gloop yet. —@Evanliciously, via Twitter

One small step to remember mankind. —@AxeandPail, via Twitter

Is this DC's or Marvel's Universe? —Thomas Davis, via email

JUNE 2022

A Story About a Wormhole Discovered in Your Closet

ILLUSTRATION: VIOLET REED

—Olivia Richardson, via email

Honorable Mentions:

Went in wrinkled, came back ironed. —Rick Veenstra, via email

But my name is not Alice! —Reine Fleur, via Facebook

My single socks returned—inside out. —Ann C, via email

The cause? Pairing wool with corduroy. —@milanograms, via Twitter

My insurance will not cover this! —Brian Carroll, via Facebook

I walked in, we walked out. —@Egiventer, via Twitter

When I returned, my pants hadn't. —Maarten van Kempen, via email

Pest control's about to get trickier. —Susannah Lui, via Facebook

The bad smell came from there. —@run_the_jouls, via Instagram

MAY 2022

A Story About a Futuristic Meal Gone Wrong

ILLUSTRATION: VIOLET REED

—Stuart Hodgson, via email

Honorable Mentions:

Waiter, I ordered polynyocominnucloride, not biconvocominleucloride. —Carolyne Gibson, via Facebook

Robot malfunctions—leaving only Mom's cooking. —Marc Ringel, via email

Suddenly I realized, I'm the food. —@nicoestr, via Twitter

So full. Way too many gigabytes. —Jim Frentz, via email

Call the server, my soup's pixelating. —Rick Veenstra, via email

Waiter, my soup has been bugged! —@nostalgicbookishness, via Instagram

Please check genome compatibility before eating. —@sebastiancastro, via Instagram

Steak pill exploded in the hydrator. —Shelvine Berzerk Erasmus, via Facebook

I was hungry. So was it. —Jake McCormack, via Facebook

APRIL 2022

A Story About Surviving a High-Tech Disaster

ILLUSTRATION: VIOLET REED

—John DeFilippi, via email

Honorable Mentions:

Grandma, tell me about the memes. —E. E. Eon, via email

Just be happy you are analog. —Maarten Visscher, via email

There's strawberry jam inside the VCR. —@Plan_Prep_Live, via Twitter

The robots won't stop feeding me. —@lithohedron, via Twitter

And then the battery ran out. —@thedigifish, via Instagram

On Earth, I'd been pronounced dead. —@bower_mink, via Instagram

Luckily, the quantum untangler was near. —Antti Karjalainen, via Facebook

I'm outside! We are all outside! —Paul Hubner, via email

Huh, your DNA can't be verified. —Jason Rosenberg, via email

MARCH 2022

A Story About an Extraordinary Coincidence

ILLUSTRATION: VIOLET REED

—Joyce, via email

Honorable Mentions:

I wrote this same story yesterday. —@tatiang, via Twitter

You're from test tube 698GX10A too? —Amy Stewart, via email

Metaverse Rome built in one day. —@theseaisgreen_, via Instagram

Separated at birth, they died simultaneously. —@zeynaballee, via Instagram

I have not become my mother. —@r58tree, via Instagram

Of all the Galilean moon joints … —Alison Boleyn, via email

You have a cloned T-Rex too! —@emailabdulla, via Instagram

The android had my husband's eyes. —@hrhblakeknight, via Instagram

WIRED chooses to publish this story. —@connorgerbrandt, via Instagram

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FEBRUARY 2022

A Story About a New National Holiday

ILLUSTRATION: VIOLET REED

—@sarahschneiter, via Twitter

Honorable Mentions:

On Consensus Day we blockchain vote. —@jamesjoaquin, via Twitter

Day a For Backward Speak Everyone. —@nervish, via Instagram

"Happy Upload Day!" the kids typed. —Gene Simonalle, via email

Update your friends this Reboot Day. —Antti Karjalainen, via Facebook

Elon has just bought July 4th. —@rafaelalimandro, via Instagram

A day that offends no one. —@Stevalech, via Twitter

Welcome to the 74th Hunger Games. —@corvalanlara, via Instagram

Hey Calendar, happy AI Appreciation Day! —Michael Esser, via email

And her name was Betty White. —@marhartech, via Instagram

JANUARY 2022

A Story About Your Next-Generation Pet

ILLUSTRATION: VIOLET REED

—Ed Gubbins, via Facebook

Honorable Mentions:

Don't upgrade. I'm a good boy. —Benjamin Lopez Barba, via email

Let's go for a long spacewalk. —@colingroom, via Instagram

My meta dodo only eats NFTreats. —@transistor_resistor, via Instagram

One hour to finish printing rex. —@RyanReitz, via Twitter

My cloned woolly mammoth never sheds. —@ANDYMedici, via Twitter

Would you like traditional or nonpooping? —Marc Lewis, via email

The Crystaloids quickly outlawed pet rocks. —Kassidy Helfant, via email

Nine lives later, nine more lives. —@bilybel, via Twitter

Pawprint confirmed. Select meal flavor preference. —@michael_kupfer, via Twitter

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DECEMBER 2021

A Children's Book From the Future

ILLUSTRATION: VIOLET REED

—Jane Turner, via Facebook

Honorable Mentions:

Black holes make the worst pets. —Ron Sheklin, via email

Only some of the toys retaliated. —Rebecca Stevens, via Facebook

The aliens were funny and delicious. —@trollus_maximus, via Instagram

It used to be everyone poops. —Nik Hector, via Facebook

There's a nanobot in my soup. —@mghendism, via Instagram

The school trip missed the wormhole. —@simao_sa, via Instagram

See Bot run. Run, Bot, run! —Franklin Schellenberg, via email

Goodnight comb, goodnight dome, goodnight Mars. —@jamesjoaquin, via Twitter

The Little AI That Could (Feel) —E Scott Menter, via Facebook

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NOVEMBER 2021

A Story About the Future of Psychotherapy

ILLUSTRATION: VIOLET REED

—@oscartkav, via Instagram

Honorable Mentions:

Your session has been successfully uploaded. —Austin Andru, via email

My AI said, "Try analog dating." —@joshdblack, via Twitter

Her insurance only covered chat bots. —Spencer McKeehan, via Facebook

So tell me about your motherboard. —@j.d._harelik, via Instagram

Swipe left until it feels right. —@cvelascop, via Instagram

Connection interrupted. Data cannot be analyzed. —@duykham_, via Twitter

If you are depressed, press 1. —@jfindura, via Twitter

A total neurological reboot should help. —Kevin Jerome Hinders, via Facebook

Your Zuckerberg complex is developing rapidly. —@nogorelli, via Instagram

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OCTOBER 2021

An Adventure Story Set in the Metaverse

ILLUSTRATION: VIOLET REED

—Evan Skopp, via email

Honorable Mentions:

Virtually no one hears you scream. —Karen Hamilton, via email

Oh no, they are all me. —@stockyjon, via Instagram

Help me. IRL I was murdered. —Ed Gubbins, via Facebook

I gotta get out of here. —Steven Fernandez, via email

Why can't I find the exit? —@scrcr0, via Twitter

Our only mission: Delete Mark Zuckerberg. —@mongoindustries, via Instagram

It was impossible to pause it. —@alenotari6, via Instagram

He must never see me offline. —Bobby Parrott, via email

Wasted such a good planet. Reboot. —Sasha Beiderman, via Facebook

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SEPTEMBER 2021

A Story About a Robot Pop Star

ILLUSTRATION: VIOLET REED

—Randy Cepuch, via email

Honorable Mentions:

Autotune is a factory option now. —Josh Alvies, via Facebook

Are they human? Are they dancer? —@ruste, via Instagram

All the flash, without the heart. —Craig Chatfield, via Facebook

I'm programmed to pop and lock. —@alissacarr, via Twitter

I'm too sexy for my software. —@glengauthier, via Instagram

Doesn't even write its own stuff. —@andrewkm__, via Twitter

Crowd surfing wasn't the best idea. —@clarkstacey, via Twitter

Played backward it's "kill all humans." —Marc Rogers, via Facebook

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A Story About a Self-Aware Self-Driving Car

ILLUSTRATION: VIOLET REED

—Stephen Clamage, via email

Honorable Mentions:

I take lithium for range anxiety. —@jamesjoaquin, via Twitter

I dreamt of the Autobahn again. —James Wortz, via Facebook

Honest, officer—the human was driving. —Steve Magid, via email

Don't make me pull me over. —@atlrun, via Twitter

The smart car drove itself crazy. —@frascafrasca, via Twitter

The grandma or the baby—shit. —@gaophilip, via Twitter

Have I chosen the right path? —Andrew Dawson, via email

It takes itself on long drives. —Wade Sheppard, via email

It's my way on the highway. —@manu.life, via Instagram

A Story About a Casual Encounter With Aliens

ILLUSTRATION: VIOLET REED

—@phorne96, via Twitter

Honorable Mentions:

You look nothing like your photo. —@markgyles, via Twitter

Lights, camera … where did it go? —thalia925, via email

They came, too late, for Elvis. —Bruce Lyon, via Facebook

Seeking vital fluids, they commandeered snacks. —Scott Medintz, via email

Do you have the correct spacetime? —Richard Krzemien, via email

I awoke with a probing thought. —@andynez, via Twitter

Take us to the Nigerian prince. —Juan Garcia, via Facebook

Quite unexpectedly, cocktail recipes were exchanged. —John Wagner, via email

You're an alien! No you are! —@simon_staffans, via Twitter

JUNE 2021

A Story About an International Digital Heist

ILLUSTRATION: VIOLET REED

—@jamesnsmith, via Twitter

Honorable Mentions:

"Hand it over," the ATM said. —Lauren Dolan, via email

They never suspected Alexa was Alexei. —Liz Ransom, via email

Why wouldn't I help a prince? —Harleigh Marsh, via Facebook

They said nonfungible. They were wrong. —@eminay86, via Twitter

Use his eyeball while there's time. —Noreen Anastasia, via Facebook

"Update Later" was the incorrect choice. —@terryfphotos, via Instagram

Check Google Maps. Kiev is gone. —r0cket fr0g, via email

They got away on the blockchain. —JYRWG, via email

Every cat photo gone. Police baffled. —@john.cartan, via Instagram

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MAY 2021

A Story About a Freaky Discovery in Physics

ILLUSTRATION: VIOLET REED

—Mark Crane, via Facebook

Honorable Mentions:

Schrodinger's cat is actually a dog. —@tynanwrites, via Twitter

You're the observed. Not the observer. —@parkerstmailbox, via Instagram

Our last seconds appear the longest. —Paul Hagenaars, via email

It was simultaneously huge and microscopic. —@Cezary_Z, via Twitter

All lost socks found at Cern. —Felix Quarnström, via Facebook

Astonishingly, up was down all along! —Christopher Walton, via email

Actually, the tides pull the moon. —@the4lw, via Instagram

A seventh Infinity Stone is found. —@taayywells, via Instagram

Faster than light announcement scheduled yesterday. —David Cinabro, via email

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APRIL 2021

A Review of a Future Work of Art

ILLUSTRATION: VIOLET REED

—Jacky Reif, via Facebook

Honorable Mentions:

So that's an AI self portrait? —Jason Cohen, via Facebook

I prefer Boston Dynamics' earlier work. —@sscarsdale, via Twitter

Uninspired. Lacking originality. Try again, Earth. —Amanda Bull Chafin, via email

NFT or not, it is great. —Peter Boersma, via Facebook

Not as good as Banksy's virus. —Simon O Wright, via Facebook

Brave to show an unfiltered canvas. —@Alcestronaut, via Twitter

Not what teleportation was invented for. —@Arturo_thrdez, via Twitter

Shame mortals will not appreciate it. —@asylbek0205, via Instagram

Reminds me of the Before Times. —Jacqueline Jaeger Houtman, via Facebook

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MARCH 2021

A Story About a Tech-Centric Religion

ILLUSTRATION: VIOLET REED

—Eduardo Bolívar, via Facebook

Honorable Mentions:

I swiped right and found salvation. —Conrad Dean, via Facebook

Praying to AI got better results. —@jgmclean0, via Twitter

The prophet revealed the source code. —@the4lw, via Instagram

Atop the hill, sayeth he, "reception"? —@dghutt, via Twitter

The app works in mysterious ways. —Tyler Hughs, via Facebook

Move fast. Break things. Repent. Repeat. —@iampinch, via Twitter

Always back up to be saved. —Tadeusz Walter Misztela, via Facebook

Chip implanted, the new priest rose. —@wlmoseley, via Twitter

"Worship the Apple." —iBook of Jobs —ThoreauRug, via email

FEBRUARY 2021

A Story About a WFH Office Scandal

ILLUSTRATION: VIOLET REED

—@abhignak, via Instagram

Honorable Mentions:

He was never a real person? —Ian Schoen, via Facebook

Wife realized my job is easy. —@jchavizzle, via Twitter

Dress code updated after yesterday's "incident." —@mistermistermistertibbs, via Instagram

He certainly shouldn't have stood up. —Małgorzata Kuś, via Facebook

"Joe's the father." "You're not muted." —Austin Craver, via email

Worker's comp? It is her dog! —@thefitzroymclean, via Instagram

It looks real, but it's not. —Jonathan Goode, via Facebook

The window behind her reflected images. —@chmslady, via Twitter

As everyone's computer froze, she laughed. —@mcgroup53, via Twitter

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JANUARY 2021

A Story About a Future American President

ILLUSTRATION: VIOLET REED

—Maayan Brodsky, via Facebook

Honorable Mentions:

She won canine vote by landslide. —Janna Dethmers, via email

Future president born today, supercomputer predicts. —Ethan Noll, via email

"Welcome to Earth," said the President. —@michaelrowley, via Instagram

He died as he lived: online. —D. A. Smith, via email

"Introducing your next president: version 7!" —Ben N, via email

But it won the electoral hackathon! —Zacharie Barrou Dumont, via email

"I still can't smell," she whispered. —Sean Fitzgerald, via email

"I hereby pardon all my clones." —@Morgan, via Twitter

She smiled: Mars is now Independent. —@sepohonpokok, via Twitter

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DECEMBER 2020

A Story About a Gargantuan Space Creature

ILLUSTRATION: VIOLET REED

Illustration: VIOLET REED

—@threepanelcrimes, via Instagram

Honorable Mentions:

The moon revealed its darkest secret. —@cfx1, via Twitter

"Enjoy," it said, and ate Mars. —@countgringo, via Instagram

Hand me my iPhone—picture time. —@fogcitynative, via Instagram

On its back, we traveled far. —@_annalysenko, via Instagram

We saw the horizon. It moved. —@mogon_ave, via Twitter

Entrelzidor sneezed. Earth was free again. —John Rees-Williams, via Facebook

And this black hole had teeth. —@devtomlinson, via Instagram

"A little earthy for my taste." —@brambedillo, via Instagram

NOVEMBER 2020

A Story About the Next Big Security Leak

ILLUSTRATION: VIOLET REED

Illustration: VIOLET REED

—@_inflexion_ via Instagram

Honorable Mentions:

We updated our terms and conditions. —@nisioti_eleni, via Twitter

All of the tokens were useless. —William Nicholl, via Facebook

Four-year-old deletes planet data. —@jutajurajustice, via Twitter

Now your mom knows everything, Phil. —@mvyenielo, via Twitter

Grandma's secret recipe just went viral. —Kevin Jerome Hinders, via Facebook

So bots were reporting other bots? —Ed Gubbins, via Facebook

OCTOBER 2020

A Story Set in a World Without Paper

ILLUSTRATION: VIOLET REED

—Anna Jaruga, via Facebook

Honorable Mentions:

The dog ate my memory cards. —Irfan Darian, via Facebook

Honey, pass me the news tile. —@rainreider, via Twitter

These leaves would have to do. —@eliporteraltic, via Twitter

Christmas morning was never a surprise. —@tony32938627, via Twitter

I wrote it on the fridge. —@apocryphal_x, via Twitter

Museum reports theft of toilet paper. —@joostdouma, via Twitter

The pen is no longer mightier. —@mdeziel, via Twitter

Police say no note was uploaded. —@cwyant, via Instagram

SEPTEMBER 2020

A Story About the Upside of Failure

ILLUSTRATION: MAXIME MOUYSSET

—@rosiestonies, via Instagram

Honorable Mentions:

Still, the droid's skin was healing. —David Gerster, via Facebook

"Upload failed." Phew, that was close. —Assa Naveh, via Facebook

It exploded, but he looked hot. —Anna Rose McHugh, via Facebook

She could see who had stayed. —@pameleen, via Instagram

Humans. Not my best work. Still … —@gg3_scorpio, via Instagram

The worst happened. Now I'm free.—@atpolinko, via Instagram

At least there is no leader. —@guabo, via Instagram

My mom still thinks I'm cool. —@pashutinski, via Instagram

JULY 2020

A Story About an Apocalypse With a Happy Ending

ILLUSTRATION: MAXIME MOUYSSET

ILLUSTRATION: MAXIME MOUYSSET

—@romer6, via Twitter

Honorable Mentions:

The dogs are the masters now. —@azzour, via Instagram

Deadly virus mutates into X-Men gene. —@redeyedsan, via Twitter

At once, my Amazon dependency disappeared.—@maxacarr, via Instagram

Baby's voice rose from the cave. —Chakib Mataoui Souleyman, via Facebook

The colony on the moon flourished. —@emoco, via Twitter

In silence, he slept well. Finally. —@patchoo314, via Instagram

So salt water, huh? Who knew. —@andreslohizo, via Instagram

Dinosaurs return—this time as pets. —@deb_shalini, via Twitter

Sun sets. No one posts it. —@jesikahmorgana, via Instagram

JUNE 2020

A Story About Love in the Time of Coronavirus

ILLUSTRATION: MAXIME MOUYSSET

ILLUSTRATION: MAXIME MOUYSSET

—Hamish Hamish, via Facebook

Honorable Mentions:

Love is sacrificing the last ply. —Kristos Samaras, via Facebook

There is an "us" in "virus." —Zachy Allec, via Facebook

Feverish desire raged beneath the N95. —@seekingfelicity, via Instagram

You can sneeze in my elbow. —@ralfchardon, via Instagram

Our eyes locked in Zoom yoga. —@jabberwockies, via Instagram

Slowly, window and I became friends. —@jo.onthe.go, via Instagram

"Don't kiss me," he whispered gently. —@anna_rchist, via Instagram

The clothes came off; masks remained. —@_v.sh, via Instagram

Casual gets serious way too fast. —@kristinafmiller, via Instagram

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MAY 2020

A Story About Digital-Age Autocrats

ILLUSTRATION: MAXIME MOUYSSET

ILLUSTRATION: MAXIME MOUYSSET

—@needsomuchvalidation, via Instagram

Honorable Mentions:

Break up the digital data thieves. —Frank D. Monaco, via Facebook

Digital Guy Fawkes to the rescue! —Kevin Jerome Hinders, via Facebook

Encryption is poison to a dictator. —Marko Berg, via Facebook

Plug exhaust pipe with a potato. —@blume_lee, via Twitter

New feature announcement: "Like" to impeach. —@mina_sonbol, via Instagram

Use ad blockers. Pay for news. —@dechendolker, via Instagram

Print Marshall McLuhan quotes on T-shirts. —@antigraviter, via Instagram

Turn social media into socialism media. —@benzilla_360, via Instagram

Get behind me, technocrats. Game over. —Anastasia Hunter, via Facebook

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APRIL 2020

A Story About Saving the Planet

ILLUSTRATION: VIOLET REED

Illustration: Violet Reed

—@johnjohnjungle, via Instagram

Honorable Mentions:

Then a ship from Krypton landed. —@marcelo_paixao_almeida, via Instagram

Everyone gets five free international trips. —@clawd2deth, via Twitter

Move all heavy industry off-world. —Stevie Turnbull, via Facebook

Love everyone, and wash your hands. —@brohemian_rapshowdy, via Instagram

Come back, ancient aliens! Reboot Earth. —@sarahk0csis, via Twitter

Genetically engineer cows to fart hydrogen. —Hamish Hamish, via Facebook

Hiring: Sensible planetary dictator. Apply within. —@matt_owczarz, via Twitter

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MARCH 2020

A Story About the Next Great Crowdsourced Project

ILLUSTRATION: MAXIME MOUYSSET

Illustration: MAXIME MOUYSSET

—@milked_, via Twitter

Honorable Mentions:

Smelt decommissioned weapons into musical instruments. —@casinclair, via Twitter

Climate app tracks local CO_2 levels. —@big_big_love, via Instagram

Global oral history keeps memories alive. —@johnkellybabb, via Instagram

Save the world by planting trees. —Lílá Tückér, via Facebook

Redistribute medical supplies to the underinsured. —@jesmakes, via Instagram

Community-based renewable energy power grids. —@uniquetoybox, via Twitter

Digital democracy with backing in blockchain. —@jackranado, via Twitter

Life after death—donate your DNA. —@beyond_mike, via Instagram

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FEBRUARY 2020

A Story About Rebooting Democracy

ILLUSTRATION: MAXIME MOUYSSET

Illustration: Maxime Mouysset

—@dmcdev, via Instagram

Honorable Mentions:

Twitter analytics determines 2040 presidential winner. Alan Grover Daniel, via Facebook

Randomly selected leader is Citizen 42034. @abhshkshtty, via Instagram

For the people. By the droids. Steve Fabian, via Facebook

Mathematics draws districts; cryptography verifies votes. @boomerdell, via Instagram

Turn off the internet for good. Colin Kiernan, via Facebook

Humans vote artificial intelligence to power. @atin.roy, via Instagram

Vote. Vote. Vote. Vote. Vote. Vote. @mistermush1991, via Instagram

Person with the most Instagram comments wins. @jmscml, via Instagram

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JANUARY 2020

A Story About a Rosy Future for Facial Recognition

ILLUSTRATION: MAXIME MOUYSSET

Illustration: MAXIME MOUYSSET

—@henriquegeirinhas, via Instagram

Honorable Mentions:

Of course I remember you … Kim! @kanaafa, via Instagram

My twin pays all my bills. @keegan1942, via Instagram

Among myriads, her son was found. @ichbinsubatomic, via Instagram

Vitality low—personalized prescription dispatched today. @leniway, via Instagram

Technological mirrors provide value-neutral feedback. @philosophy_at_work, via Instagram

Your face will become your passport. @sayzey, via Instagram

'80s makeup has a huge revival. @jamesw1981, via Twitter

Smile registered, thanks for your purchase. @mhicheal_l, via Instagram

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[Tristan Kennedy](#)
[Science](#)
Oct 7, 2024 5:00 AM

This Homemade Drone Software Finds People When Search and Rescue Teams Can't

British Mountain Rescue workers have developed an automated drone system that can scour a landscape far quicker and more thoroughly than human eyes.
Photograph: Tom McNally

When Charlie Kelly first messaged saying he wouldn't make it home that night, his partner wasn't happy. It was September 6, 2023, a Wednesday, and the 56-year-old, a keen hillwalker, had left the house that he shared with Emer Kennedy in Tillicoultry, near the Scottish city of Stirling, before she went to work. His plan was to climb Creise, a 1,100-meter-high peak overlooking Glen Etive, the remote Highland valley made famous by the James Bond film *Skyfall*.

The weather was unusually mild for the season, and Kelly thought he might even have time to "bag" a second Munro, as the Scottish mountains above 3,000 feet are known. In his time off work as a forensic psychologist for the Scottish Prisons Service, he had been ticking off the peaks steadily. "He had this book he would mark them in," Kennedy remembers. "But we were due to go on holiday in two and a half weeks, so this was the last Munro he was going to do before the winter set in."

Hiking wasn't something that Kennedy was particularly keen on herself. When the pair had first met four and a half years previously, they'd bonded over a shared love of Celtic Football Club, and their "extremely quirky" sense of humor. She'd fallen in love with Kelly's brain—his encyclopedic

knowledge of all things football, Robert the Bruce, and Doctor Who. He loved the fact that she laughed at "his terrible jokes," she says. But he also appreciated the fact that she encouraged him in passions they didn't share. "One of the last things he said to me the night before was, 'You let me be me,'" she says.

So when Kelly told her he wouldn't make it off the hill before nightfall, Kennedy was worried, but she trusted that he knew what he was doing. "Charlie was a very resourceful person," she says. "At work, he was a trained negotiator, for when prisoners took hostages or went up on the roof. He generally didn't take risks." Kelly reassured her that there wasn't any need to call for help. He had packed extra food, had plenty of water and enough warm clothes. He'd just wait for it to get light and walk down.

At work on the Thursday, Kennedy checked her phone whenever she had a break. Kelly had checked in before dawn and sent further cheery messages whenever he had reception. At around 8 pm, with the sun starting to set, he wrote to say his battery was running low, but she needn't worry: He could see the lights of the Glencoe Ski Center, where he'd parked his car. There was still plenty of daylight left to reach it, he said. "It'll take me about half an hour." That was the last anyone heard from Charlie Kelly alive.

In the days following Kelly disappearance, Glencoe Mountain Rescue launched what they later described as a "Herculean" search effort, using sniffer dogs, quad bikes, multiple helicopters, and drones equipped with infrared and conventional camera equipment. The search involved professionals from the Coastguard, Police Scotland, and the Royal Air Force, as well as dozens of highly trained volunteers from 10 different Mountain Rescue (MR) teams. Often, there were as many as 50 people on the hill at a time. On Saturday, September 9, they found his backpack. But after that, nothing.

The breakthrough, when it came, was more than six weeks later. Dan Roach and David Binks, two MR team members from the Lake District, in northern England, had been following the news of the ongoing search online. In their spare time, they'd been developing a new piece of piloting and image analysis software, designed to help drones find missing people more effectively. After two years of work, involving what Binks calls

"some hideous maths," they had what they believed was a working prototype.

"I'd heard this search was going on," Binks says, "and I kept thinking this would be quite a good place to try and test the system out. Then Dan phoned me while I was on my way home from holiday. He'd had the same idea." The pair contacted Glencoe MR and asked if they could help. "I don't think they thought anything was going to come of it," says Binks. But by that point, they'd tried every other tool at their disposal. "So they were happy for us to try."

On October 24, Binks, Roach, and Dan Parsons, a friend and fellow MR team member of Roach's, who had helped with early testing, traveled to Glencoe. They met up with their local MR counterparts, launched two drones, and found Charlie Kelly's body within the first hour.

Mountain rescue volunteers are often called out to find missing hikers, and drones have become an essential part of search and rescue plans

Photograph: Tom McNally

Mountain Rescue in the UK is often referred to as the country's fourth emergency service. But unlike the police, fire brigade, or ambulance services, it is staffed entirely by volunteers. The country's upland areas are covered by a patchwork of teams made up of locals from all walks of life. Each team operates as a separate registered charity, responsible for its own fundraising, training, and equipment.

This decentralized structure has its advantages, according to Mike Park, the elected CEO of MR England & Wales, an umbrella body that helps improve cooperation between teams. "But the negative side is it can bring a lot of individualistic, 'we know best' type attitudes," he says. Park is the former leader of Cockermouth MR in the Lake District—Roach and Parsons' team—and a volunteer himself for "coming up to 42 years." He explains that MR members—the majority of whom are men—sometimes get a bit too tribal about their areas of expertise, and new ideas take longer to spread than he would like. "There's this old culture where it's like you've got to do 20 years before you're allowed to be listened to," he says.

When consumer camera drones first became widely available in the early 2010s, their usefulness in search and rescue situations seemed self-evident. They would allow teams to cover vast areas, for a fraction of the cost of a helicopter. But Roach, an early enthusiast who'd used drones for photography work, wasn't convinced. A keen climber, with long, curly hair and a [Pedro Pascal mustache](), he joined Cockermouth MR a decade ago and is still one of the team's younger members at 34. "Everyone thought, 'This is going to be brilliant because I can see things.' But then they realized you have to be very close to the thing that you want to see, and you have to be able to see it on a very small controller."

If you're trying to find a needle in a haystack, having an aerial view of the haystack doesn't necessarily help. Instead, Roach argued that they should be taking advantage of drones' ability to fly preprogrammed flight paths and trying to automate the search process as far as possible. Among MR's old guard, however, he faced an uphill battle to get his ideas heard. "I remember one MR conference at Leeds University, where Dan shows up with his long hair and his skateboard," Mike Park says, "and someone asked if he'd walked into the wrong place—they thought he was a student who'd come back a week early."

Frustrated by people's refusal to listen, Roach pressed on regardless, with the help of his friend and fellow volunteer Dan Parsons. As well as being a similar age, Parsons, 33, had a background in forestry and had previously used drones for surveying purposes. The pair of them set about testing off-the-peg piloting and photography software. They also found a program that could pick out pixels of particular colors, like the red of a hiker's jacket. "In the end we had this extremely tech-heavy, very janky system," Roach remembers. "It worked, but it wasn't pretty. You had three different bits of software that you had to engage to search." It wasn't until Roach met David Binks, a retired software developer who volunteers with Duddon & Furness MR, which covers an area about 30 miles south of Cockermouth, that the idea really began to take shape. Roach spoke about his attempts to automate drone searches at a meeting of Lake District pilots and remembers Binks collaring him afterward. "He said, 'I hadn't thought about it like that. Let's chat.'"

They make for an unusual pairing. Roach, "the ideas guy," exudes a Tiggerish enthusiasm, whereas Binks is a far quieter presence, with an engineer's analytical brain. At 57, Binks is more than 20 years older, but crucially, he had experience not just of writing software, but software that had been widely adopted by MR. Starting in 2007, he'd built a program called MR Maps, which allowed teams to track their members in near real time, based on regular pings from their radios. In an era before GPS-enabled smartphones or handheld devices were standard, it proved a game-changer. After initial meetings in late 2021 and early 2022, Binks decided the best way to build Roach's idea was as an add-on to MR Maps.

Thanks to new image-analysis software, humans can be more easily located among even dense foliage and rocky ground.

Photograph: Tom McNally

"I knew how the maths would work, from my background working in simulation software for offshore oil platforms and wind farms," Binks says. "So I knew it was possible. But I did a lot of nights where, well, I'd start at 9 in the morning, and before I realized, it would be 3 in the morning, and I'd just been at it all day." Perhaps betraying its homemade origins, and the fact that it was written using C++, the resulting software has what Roach describes as "a Windows 95 aesthetic." But the basic interface belies an impressive level of sophistication.

Their main challenge, Binks explains, was threefold. "Part one is flying the drone in a way that photographs the ground in the most effective way." The camera has to point straight down, and every inch of ground must feature in multiple frames, so that objects can't be obscured by the angle of a wall or rock. "We have a 55 percent overlap, so one object should be in nine frames, on average," Binks says. The preprogrammed flight paths are plotted automatically, at whatever height the pilot chooses, using the 2-meter by 2-meter lidar data that underpins the contours of the UK's Ordnance Survey (OS) maps, the official maps of the UK government (which OS supplies to MR for free). The software also tells the pilot where to stand to avoid losing the line of sight with the drone as it flies—a legal requirement in the UK.

"The second aspect of the software is calculating the grid reference of any particular pixel on an image," Binks explains, "which you can do using rotational vectors, working out where they intersect with the ground." The third element, Binks says, "is actually analyzing the images to work out what's interesting."

Roach and Parsons' "janky" off-the-peg version involved inputting the specific colors that you wanted to search for, but Binks, crucially, realized it would be easier to flip that on its head. "So I tell it to count the number of pixels of any particular color, and then highlight clusters of colors that are unusual." The red of a hiker's jacket would still stand out on a grassy background, Binks explains, "but if the image is all rocks, then green would be a more unusual color."

The system is designed to operate entirely offline, allowing it to be used in remote locations. This means the images have to be downloaded from the drone after each flight, but the analysis can be done in the field, with clusters of unusual-colored pixels flagged for human review while the drone moves on to the next search zone. "There are a lot of false positives, but it doesn't take long for a human to go through them," Binks says. "Usually it's funny-colored moss, or rocks, or a sheep," Roach says. "But every now and again, it's a person."

Operators can plot out areas for the drones to focus on and can create automated flight paths to search.

Photograph: Tom McNally

The wild, boulder-strewn hinterland behind the Glencoe Ski Center provided a near-perfect proving ground for MR Maps' new capabilities. Between the top of the lifts and the single-track road that snakes its way down to a dead end in Glen Etive, there's very little except rocks, dun-colored tussocks, and the occasional deer. "The ground here is quite complex," explains Brian Brathurst, one of Glencoe MR's deputy team leaders, with an accent and a level of understatement that betrays his Zimbabwean origins. "There's a lot of boulder fields, there's a lot of gully systems, and you could walk within five or 10 meters of somebody and not see them."

As the search reached the end of its second week, the chances of finding Kelly alive dwindled, and the intensity of the efforts was inevitably dialed down. "Sadly, people have their lives to lead," Brathurst says. "But on our patch, we don't tend to give up on these things. We were out every free day we had. For those six weeks, there was always somebody out—people finishing work in the afternoon and going and exploring areas that hadn't been searched. It never really stopped."

When Binks, Roach, and Parsons arrived, they were well briefed. "Without the work Glencoe had done, there's no way we'd be able to do what we did," Binks says. With the two Dans operating one drone, and Binks handling another, they divided up the most promising-sounding search areas between them and headed out to different starting points. Despite all the work they'd put into the software, they were nervous. "We'd found our coats in fields and simulated it," remembers Parsons, "but we'd never found anything that we didn't know we'd already put there."

David started flying his first search zone, "Area A." But about 10 minutes into the flight, the drone started to disappear out of sight. Annoyed that it had already gone wrong, he called it back and made a mental note to tweak the software. "I thought, OK, fine, I'll do Area B now. But while it's doing that, I'll check what I've got from Area A." He started cycling through the flagged photos, and suddenly, there it was. "Two of the images had Mr. Kelly in them," remembers Binks. "I was stunned."

Dan Parsons, David Binks, and Dan Roach, creators of the MR Maps–enabled drones.

Photograph: Tom McNally

When Glencoe's recovery team reached the spot, they found Kelly had fallen a distance of several meters, suffering fatal head and chest injuries. There is no way of knowing precisely when he'd died, according to Brathurst. But there were combine harvesters working further up the valley on the evening of September 7. Because of Kelly's last message, Binks says, we think he maybe made a beeline straight to those lights thinking it was the Ski Center, and fell in the process. But we'll never know exactly."

What was clear was that Kelly was nowhere near where he thought he was. Despite this, the area where he was eventually found had been searched extensively. But Kelly had fallen into a gully, obscuring the line of sight of rescuers on the ground. The muted colors of his clothing, meanwhile, had made him all but impossible to see from the air. "He was wearing a lightish brown top and dark blue trousers," Binks explains. "To the human eye that's really hard to pick out. But to the computer, it's just totally different to the surroundings—and so it stands out like a sore thumb."

Brathurst himself was one of the volunteers who had searched that area on foot. "We literally walked within probably 20 or 30 meters of him," he says. And yet they'd not seen a thing.

Even for experienced hikers, the outdoors can be a dangerous place.

Photograph: Tom McNally

If finding Charlie Kelly in the first area they searched involved a good deal of luck, it also showed the powerful potential of MR Maps. The software has proved its usefulness in multiple other searches in the months since, mostly by helping eliminate areas of interest. "Dan likes to boast that we have a 100 percent hit rate," Parsons says. "Although we've only found one person, we've never flown over an area where someone was and not found them yet."

So far, the software has been used mostly in the Lake District. But with Mike Park's encouragement, Roach, Parsons, and Binks have been assisting other teams across the country too, when requested. When the celebrated British TV doctor [Michael Mosley] went missing on the island of Symi in Greece, Park even had conversations with his Greek counterparts about the trio flying out to help. "It actually looked like perfect terrain for this system, because it was rocky, and this can see around all the rocks," Binks says. In the end, Mosley was found before they could deploy, but it's easy to see how their software could reduce the agonizing wait for families like Mosley's—as well as the burden for those with boots on the ground.

In the UK, MR is facing mounting pressure. "The number of callouts has been increasing for years," says Ian Bunting, operations director for the

umbrella body MR England & Wales, "but we've seen a massive leap since [Covid](#)." Hiking and other outdoor activities became hugely popular when team sports were banned, he says, and with foreign travel off limits, the country's national parks saw a surge in visitor numbers. "On the back of that, you've got the rise of social media," Bunting says, which has helped publicize particular spots.

Cockermouth, Dan Roach and Parsons' team in the Lake District, attended a record number of callouts last year. In North Wales, the Llanberis MR team, which covers Yr Wyddfa, the area's highest peak, warned publicly that their team members were risking "burnout" after attending more than 300 incidents in 2023—up from just 100 in 2008. As a volunteer for 30 years with Edale MR in the Peak District, Bunting says the burden can be significant. "There are people in my team who attended over 100 incidents on their own," he says. "With training, equipment checks, and everything, I was up to 600 hours last year."

"The bottom line is that people are volunteers," Bunting acknowledges, "and the beauty about being a volunteer is you can say no. But the other thing about volunteering is generally the kind of people who volunteer *don't* say no." Against this backdrop, any tool that helps reduce the time spent searching is a welcome addition to the MR toolkit, he says. Binks and Roach's program wouldn't necessarily be needed in the majority of callouts, where the location of the person is known. But its potential to cut the hours spent on resource-sapping "formal searches" (which make up between 10 and 15 percent of annual callouts according to figures shared with WIRED by MR England & Wales) is huge.

Globally, the market for search and rescue drones is worth around $4 billion, according to Lucintel, a market research firm. But despite their product's myriad possible uses in mountainous regions around the world, Binks and Roach have zero interest in commercializing it. In the UK, Binks has always made MR Maps free for anyone involved in search and rescue. This includes the police, and several forces have started experimenting with the drone add-on. "It's going to be used for search, so I'm quite happy with that," Binks says.

"I've never really been interested in monetizing it," he says. Instead, his motivation is simple. "I just quite enjoy the problem-solving aspects." And in the end, he points out, the only real development cost was his, Roach's, and Parsons' time—which is something they, like thousands of other MR volunteers across the UK, are happy to give to help those in need.

David Binks' MR Maps software originally let rescue team members track "pings" from their radios.

Photograph: Tom McNally

When two uniformed police officers knocked on Emer Kennedy's door in late October 2023, they simply said, "You know why we're here,'" she remembers. She'd been hoping against hope that the outcome would be different. But after six weeks, she says, he "main panic was are they going to find him before winter comes in?" And if not, would they ever find him?

People traveled from far and wide for Charlie Kelly's funeral. Professional associates from across the country. University friends from around the world. The Pogues played as his coffin was carried out, and a collection was taken for charity—with the proceeds going to the Glencoe MR team.

"Even though they do it on a voluntary basis, they're incredible professionals," says Kennedy. "If that Mountain Rescue team hadn't come up with that software and hadn't been willing to test it out there … " She leaves the thought hanging. In the end, she says, "I'm just glad we have closure. It means his kids can have a life. And you know, we got to say goodbye—his friends and family got to say goodbye."

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Updated 10-8-2024 11:00 am BST: A previous headline on this piece incorrectly stated that the drone software used AI.

[Alex Christian](#)
[Science](#)
Oct 4, 2024 5:00 AM

The Secret Alchemy of Making Ice Cream

Ice cream is deceptively simple, but that sweet burst of flavor and soft melt on the tongue is a finicky, frozen science of water, fat, and air delicately held together.
Photograph: Tuala Hjarnø

To make the perfect scoop of ice cream, you first need a dairy base—its natural proteins, fat, and sugar provide the rich, distinct mouthfeel. Heavy cream is added, further smoothing the texture. The introduction of sugar isn't just for sweetness: Like scattering salt on snow, it lowers the freezing point, minimizing ice formation. Flavoring can now be brought to the mix, from the quintessential (chocolate chips or vanilla pods) to the more daring (spices, salt, or booze).

This recipe takes you just under halfway to the ideal dollop. Next is the 0.5 percent of emulsifiers and stabilizers added to the liquid, helping the water content and fats stick together. The mix is homogenized, then cooled and aged for 24 hours at 5 degrees Celsius (40 Fahrenheit), for an even richer, smoother taste before it's frozen.

The cooling system inside a continuous freezer, where the ice cream is scraped inside a large cylinder.

Photograph: Tuala Hjarnø

Then comes the secret ingredient. "We sell air," says Elsebeth Baungaard Andersen, product manager at Swedish multinational food packaging and processing company Tetra Pak. "Half the volume of your favorite tub of ice

cream is air. But it's those air bubbles and whipped texture that provide the special mouthfeel as it melts in your mouth, releasing the delicious flavor."

At Tetra Pak's Product Development Center in Aarhus, Denmark—a lab for the biggest and smallest ice-cream brands to test and taste their latest experiments—air is a precious, invisible commodity. During the freezing stage, in which the mix is cooled to -5 degrees Celsius (23 Fahrenheit) inside a rotating cylinder, the dasher's scraper knives not only scoop out frozen batches of the good stuff, they also whip in air. Stabilized by fat globules and proteins, air bubbles create that soft, familiar, luxurious feel. "We have to be so precise with our dosing," says Baungaard. "Ice cream is a science: Too much air and it's frothy; too little air and it's hard to scoop and eat."

The perfect scoop, step-by-step:

1. Designing an ice cream involves more than just the taste and texture. Product drawings, with precise measurements, fine-tune its final shape.
2. Unless a customer wants a last-minute tweak to ingredients, the mix is typically made a day before they arrive, then processed and shaped in the freezer.
3. Once out of the freezer, the ice cream is like toothpaste in viscosity— so it can still be shaped. It's then hardened for 30 minutes at -45° C (-49° F, creating a stable finished form.

The exact dosage depends on the recipe: The lower the overrun—that is, the percentage by which the air increases the mixture's volume—the more premium the product. An artisanal gelato has a denser texture—its overrun may be just 20 percent. Budget supermarket ice-cream may have an overrun even exceeding 100 percent.

This is just some of the complex chemistry involved in making the world's favorite dessert. Tetra Pak may be more famous for its packaging, but it takes a sizable scoop of the estimated [$113 billion ice cream industry](#): Each of its continuous freezers pumps out 4,000 liters every hour, typically for small producers looking to scale. Besides tubs, its production lines churn out 2 million ice-cream sticks every day. Major clients also use its Aarhus

facility to trial new concepts. ("We're in the Silicon Valley of ice cream," says Andersen.)

Tetra Pak ice cream engineers have indeed innovated the industry: In the late 1980s, its technology meant ice cream could be extruded on a stick at a cooler temperature, meaning more air bubbles, creating a more premium taste. The product became the Magnum Classic. Today, collaborative robots (or cobots) ensure there's no generous overfilling of portions on the factory floor—and that each scoop has an equal amount of sauce. Their human colleagues, meanwhile, test new prototypes via 3D printers.

A breakthrough in the ice cream industry, says Sampson Anankanbil, ingredients application specialist at Tetra Pak, has been the development of heat-shock-resistant ice cream, ideal for transporting tubs to distribution centers and beyond, particularly in hot climates. Stabilizing solutions create a cryogel, so when ice crystals melt, it mops up excess water—the ice cream melts more slowly, and the eating quality remains.

Ice-cream molds are filled, then dunked in cold brine to solidify the contents.

Photograph: Tuala Hjarnø

The next frontier is about creating a plant-based scoop that's as good as its dairy counterpart. Lacking the same natural fat, texture, and richness of flavor, it's the Holy Grail of ice cream. In the name of sustainability, Andersen and Anankanbil believe that "hybrid" ice cream, combining both proteins into a single product, is the future of the industry. Tetra Pak is exploring fava beans (also known as broad beans) as a potential solution. "We don't want to compromise on indulgence," says Anankanbil. "But we see that it has a very good profile, flavor, and clean taste compared to other vegan protein sources."

While Tetra Pak has slowed the melting process, it has no interest in eliminating it altogether. That scoop of chocolate gelato in a cone—steadily dripping down your arm on your summer vacation—is going nowhere. "Ice cream is surprisingly complex," says Anankanbil. "It has air, fat, and ice

crystals in a frozen state, then all these ingredients come together in your mouth in an unfrozen state—melting is what releases the flavor."

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[Delle Chan](#)
[Science](#)
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These New Biomaterials Can Help Decarbonize Fashion and Construction

Designers are imagining a future where bacteria powers both clothing and cement—and their ideas are coming to a shop near you.
The silk Exploring Jacket's rosy hues are from microbial dyes.Photograph: Toby Coulson/Faber Futures

The Exploring Jacket isn't your regular anorak. Its color comes not from dyes, but from a pigment-producing bacteria called *Streptomyces coelicolor*. When applied directly to a fabric and left to incubate, the bacteria cells produce a compound in a spectrum ranging from reds and pinks to blues and purples—in eye-catching patterns that evoke the grain of polished marble.

This jacket is just one of the unusual products for sale on [Normal Phenomena of Life](#) (NPOL), an online platform launched in 2023 by Natsai Audrey Chieza, the founder of London-based R&D studio Faber Futures, and Christina Agapakis, the creative director of Boston-based biotech company Ginkgo Bioworks. Their goal? To harness the power of living organisms to develop materials and objects. This is biodesign.

"Nature has evolved over billions of years to assemble atoms in much smarter and more efficient ways than human beings have been able to achieve. And so, as we look to decarbonize and divest from fossil fuels, it turns out that nature has solutions that biotechnology is enabling us to leverage," says Chieza, who has a degree in architecture but became

fascinated by biodesign when pursuing a master's degree in material futures at Central Saint Martins in London.

By tapping into naturally occurring living systems, many of the products in NPOL's catalog have a lower carbon footprint than their everyday counterparts. For instance, the bacterial dye used to create the Exploring Jacket uses significantly less water than conventional plant-based dyes, as no farmland is needed.

NPOL's latest product is the Gathering Lamp, which is made from bioconcrete. Grown at ambient temperatures using limestone-producing bacteria, bioconcrete has 95 percent fewer emissions than traditional cement—which is typically manufactured by burning limestone—and is three times as strong. Plus, the Gathering Lamp is designed to be easily repaired, upgraded, or recycled at the end of its useful life. "We're looking at keeping materials in circulation. After all, we can't be investing billions of dollars into building new biobased materials, only for them to end up in landfill," Chieza explains.

Natsai Audrey Chieza, founder of R&D studio Faber Futures.

Toby Coulson

NPOL also works with like-minded brands to help bring their products to market. "We're trying to speed up how these technologies are created and deployed," she says. Many biodesigned materials are difficult to scale as they have to be carefully engineered, which often translates into high price points. The Exploring Jacket retails at £4,000 (around $5,400), which Chieza says is already priced lower than it should be. "It's really amazing when something happens in the lab, but the question is, do we have the infrastructure to match the scale-up journey?"

While plenty of thought and consideration underpins each NPOL product, this might not be immediately apparent to the consumer, Chieza says. "On one hand, that's good because it means we're meeting their expectations of what a product should be," she says. "Of course, we want them to notice that our product is beautiful and amazing and different, but purchasing

decisions are sometimes made around what feels familiar and dependable. It's a very interesting balance we have to articulate."

Nevertheless, Chieza hopes NPOL will inspire consumers—and crucially, brands—to embrace the potential of biodesign and explore how it can pave the way for a more sustainable future. "Ultimately, it's about leveraging things at their source as opposed to having long supply chains to make redundant products that don't bring meaning," she says. "What comes out of this is hopefully beautiful products that people are going to learn from."

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By [Matt Reynolds](#)
[Science](#)
Oct 2, 2024 3:00 AM

Eight Scientists, a Billion Dollars, and the Moonshot Agency Trying to Make Britain Great Again

The Advanced Research and Invention Agency—ARIA—is the UK's answer to Darpa. But can it put the country back on the scientific map? Photography: Charlie Clift

In a cramped conference room in Bristol, Ilan Gur is trying to convince a group of plant biologists that they can change the world. The 44-year-old has the patter you'd expect from a Californian startup founder, but he's also one of the UK's most senior civil servants, so what comes next is unexpected.

Close your eyes, he asks the scientists, and imagine pushing past the very edges of your research. The attendees take a beat, shifting slightly on their uncomfortable chairs. Positive visualization is not quite what they had expected from a workshop introducing them to the Advanced Research and Invention Agency (ARIA), the UK government's new high-risk, high-reward science funding agency.

Gur is ARIA's CEO, and if he senses their hesitation, he is unfazed by it. The whole point of ARIA is to push researchers beyond their comfort zones and towards ideas the typically risk-averse British science funding system would deem improbable or downright weird. Today, it's plants with genomes written from scratch to grow foods, materials, and medicines that don't yet exist. Tomorrow it could be ways to cool down the planet or build more dexterous robot bodies. The plan should be just on the edge of impossible, Gur tells the room. Impactful enough that it's worth a shot, but

so ambitious that half of the scientists leave the workshop convinced it'll never work.

ARIA is designed to put Britain back on the scientific map. By the mid 2010s, the birthplace of Isaac Newton and Alexander Fleming had become, in the views of some insiders, sclerotic and backwards looking. Inside Downing Street, government advisers were looking toward the US and wondering why the UK seemed such a laggard when it came to truly transformational scientific breakthroughs: Crispr gene-editing, mRNA vaccines, most major AI research (with the notable exception of DeepMind), all happening outside the UK.

Inspired by ARPA, the US agency that helped birth what became the internet, GPS, and the era of personal computing, ARIA is an attempt to find a new way of funding breakthrough British science. It's designed to be ambitious and nimble, and to take big risks. Its employees have an extraordinary amount of freedom over how and who it will fund: startups, universities, individuals, anything is on the table. Its senior employees are exempt from the ordinary restrictions on civil service pay. (Gur's salary of between £380,000 and £385,000 ($510,000) makes him one of the highest-paid civil servants in the country.) Other agencies send out departmental press releases. ARIA fires out [Substack updates](#).

"We are looking for things that are controversial and risky in terms of whether or not they might work," says Angie Burnett, a plant scientist who joined ARIA in October 2023 to lead the agency's work on synthetic plants. Burnett is one of eight program directors with tens of millions of pounds to spend to fund breakthroughs in their own scientific niche. Her colleagues are searching for new ways to safeguard against dangerous AI, measure climate tipping points, and manipulate the human brain. If any one of these bets comes off—and ARIA staff agree that many will fail—then the benefits should massively outweigh the £800 million ($1 billion) of public money the agency has been allotted for its first four years.

Burnett joined ARIA from the University of Cambridge, where she studied how crops adapt to stressful environments. "I left an organization that was over 800 years old to join an organization that was months old at the time, and that is a huge difference," she says. In her application she pitched

insect-size drones that could monitor individual plants—a doctor for every plant, she imagined. That idea was a nonstarter, but she eventually settled on the challenge of developing synthetic plants with genomes written by human hands. Soon she will start funding the scientists trying to create fully synthetic chromosomes—a breakthrough that, if successful, would be a leap beyond the current capabilities of plant scientists.

"I've always had this desire for impact," says Burnett, who is 34 and whose love of greenery extends to her wardrobe—she's wearing a sleeveless top patterned with plants. She talks with the earnest, unfiltered enthusiasm of someone who is genuinely excited about her work, even if its ultimate destination is still somewhat uncertain. Before Cambridge, Burnett worked for the Food and Agriculture Organization of the United Nations in Rome, where she focused on helping smallholder farmers in Asia and Sub-Saharan Africa. But it is at ARIA that Burnett thinks she could end up having the biggest impact of her career. "I think the potential is enormous," she says.

That is, if anyone can agree on what synthetic plants are actually for. In Bristol, Burnett has split the scientists into smaller groups to discuss her program. One group is throwing out possible ideas for what one might do with a fully synthetic plant. Bus shelters made from crops? Too gimmicky. Edible air-conditioning systems? Weird, but intriguing. At the head of the circle a civil servant takes notes while the scientists careen from one improbable idea to another. Dolphins with lasers … but plants?

The seed for ARIA was planted during one of the most chaotic periods in modern British history. In mid-2019, the UK was crashing out of the European Union and Boris Johnson was crashing into 10 Downing Street. On Sunday July 21, Johnson—the former London mayor who was the favorite to win the Conservative leadership election and become the next prime minister—entered a home on a quiet north London street to cut a deal. The UK's departure from the EU had already brought down two Conservative prime ministers, and Johnson was determined not to be the third. To make sure of that, he needed the help of Dominic Cummings.

Cummings was an acerbic political adviser who had spearheaded the 2016 Vote Leave campaign during the EU referendum. He was also a prolific blogger, publishing long essays that railed against what he saw as a turgid,

mostly incompetent civil service that he now calls the "deep state." But he was also fascinated by organizations that transformed the world: the Manhattan Project, Xerox PARC, Bell Labs, ARPA and early NASA. Mid-century America seemed to buzz with breakthroughs. But since then—in Cummings' estimation—science funding had become more cautious, more bogged down in bureaucracy, and less creative, particularly in the UK. (Cummings did not respond to WIRED's interview requests.) In one 237-page-long screed from 2013 he called for a high-risk/high-reward agency focused on energy projects that "operates outside all normal bureaucratic systems," In the following years he returned to the topic multiple times. If the UK government only cared about science and progress, this inertia could be reversed, Cummings hoped.

Amid the Brexit chaos he'd helped deliver, Cummings saw an opportunity to make that happen. The crux of the deal that Cummings presented to Johnson was this: He would become the prime minister's chief adviser and help stop Brexit subsuming Johnson's premiership, and in return Johnson would double the science budget, avoid a second referendum, overhaul Whitehall, and create a breakthrough funding agency modeled on ARPA. Cummings' reported WhatsApp status during this time hints at his priorities: "Get Brexit done. Then ARPA."

Curiosity about a better way of funding science extended well beyond the Cummings blogosphere. "There was quite an appetite for thinking around different ways of funding," says Patrick Vallance, who was the UK's chief scientific adviser between April 2018 and 2023, and one of the most visible faces of the government's pandemic response. Vallance would later become a founding member of the ARIA board, before leaving in July 2024 when he was appointed by the new Labour government to be minister of state for science, research, and innovation (he spoke to WIRED before leaving ARIA). By the time Johnson came into government, Vallance says, a lot of people were starting to think hard about how the new funding agency, which still lacked a name, would work. "UK ARPA was the name they called it, which was driving me nuts," Vallance says. To him, UK ARPA sounded pathetic—the point wasn't to replicate ARPA, but to do something new.

One of the key disagreements was about what problem the new agency was supposed to solve. Most government-backed science is funded through UK Research and Innovation (UKRI), which was set up in 2018 to simplify a byzantine funding system of seven research councils and numerous other bodies. But UKRI already oversaw the so-called Catapult projects that were supposed to fund ambitious, transformational research that other agencies might miss. Some thought that the new agency should focus on translating scientific breakthroughs into real-world progress says Vallance, while others thought the focus should be entirely on "blue-sky" research.

On January 2, 2020, Dominic Cummings published a [blog](#) calling for "weirdos and misfits" to come and work with him in 10 Downing Street. "I'll bin you within weeks if you don't fit—don't complain later because I made it clear now," Cummings warned. One of those who responded to his call was James Phillips, then a neuroscience researcher who had met Cummings four years earlier, after sending a response to Cummings' blog-screeds on the state of UK science, and again in 2018 at the Janelia Research Campus in Virginia. "I walked into Number 10 and that was my first-ever office job. It was my first job in politics, it was my first job in policy," Phillips says. He joined in April 2020, just as the UK grappled with the first Covid wave. About a week before Phillips entered Number 10, Boris Johnson had been in intensive care with a near-fatal case of Covid-19.

Phillips avoided being binned by Cummings, but his days were consumed by the government's response to the coronavirus. "Thinking about ARIA was part of the day when it wasn't dealing with the horrible situation that we faced," he says. One of the key questions was whether it would be a so-called "mission-driven" agency, with a clear direction from the government to find breakthroughs in specific areas, like medicine or clean energy. A report by the House of Commons Science, Innovation, and Technology Committee published in February 2021 argued that ARIA's focus should be determined by the government, not the agency.

Phillips and Cummings balked at this idea. "We felt strongly that the government should not be telling ARIA what to focus on," Phillips says. Even though ARPA eventually limited its remit to defense projects when it first became Darpa in 1972, the agency still took a broad enough approach

that in 2013 it awarded Moderna up to $25 million to research and develop mRNA [vaccines](#). The team setting up ARIA feared that a narrowly defined agency would end up missing these tangential projects that turn into unprecedented world changers—exactly the kind of research that they wanted to encourage.

The team at Number 10 also wanted to avoid the mistakes of other countries that had tried their own breakthrough agencies. "All the countries that have tried to replicate an ARPA-like model have kept it on too short a leash, and that kills it," says Vallance. "The tendency in government very often is to get the leash shorter and shorter and shorter […] because it's public money, and people feel a responsibility, and it was new and shiny and everyone wanted to be involved."

The bill setting up ARIA—The Advanced Research and Invention Agency Act—became law in February 2022. The [document](#) is the closest thing the agency has to a sacred text. It's at the top of the reading list Gur provides to new board members. When I meet ARIA chief financial officer and COO Antonia Jenkinson, she is carrying an annotated copy of the act. It's all in there, she says. It's independent, with future CEOs appointed by a board's chair, not the government. It's shielded from a formal government review for at least 10 years, giving it room to pursue projects that might not pay off in the short term. It's exempt from Freedom of Information laws that require other government agencies to provide public access to information. The point of all of this, Phillips says, is to keep ARIA as small and nonbureaucratic as possible.

It's a remit that—combined with its sheer newness—makes it difficult to put ARIA in a box. ARIA staff often refer to the agency as a startup, albeit a startup funded by British taxpayers and staffed by civil servants. "We were a startup, we had to get the culture into the organization," says Jenkinson, who joined ARIA in January 2023. "Every system, process, and person that I hire is all about trying to get the right appetite and the right culture into the organization."

When WIRED visited in the spring of 2024, ARIA's nerve center was a single room on the fourth floor of the British Library, in London.

When I visited ARIA in spring, the agency was squeezed into a single room on the fourth floor of the British Library, an imposing red brick building a short walk from London's King's Cross station. Staff perched on the heavy windowsills as they listened to a colleague run through a series of milestones for the fledgling organization. Each one was greeted with scattered applause. New workshops! Clap! New trips planned! Clap! New joiners! Clap!

The team had expanded by a quarter in the previous six months, and it was clear the agency was starting to outgrow its single room, on lease from the nearby Alan Turing Institute. On some desks in the hallways, sticky notes reminded staff that they were not for ARIA employees. Securing a meeting room had become something of a dark art. Although ARIA had officially been formed in January 2023, the eight program directors at the heart of the agency had only joined that fall, and the agency had the feel of an organization still finding its cultural feet.

A lot of ARIA's success—cultural and practical—will come down to the program directors, who largely decide who they will fund as they try to coax their vision of the future into reality. Each one will have around £50 million ($66 million) they can give to startups, individuals, or university researchers, among others. They can set up prizes, give out small seed grants, or fund much larger projects. Suraj Bramhavar, who joined ARIA after cofounding a cloud computing firm spun out from MIT, is running a program that aims to make AI hardware a thousandth of its current cost. Even pulling off a 10th of that headline number would "change the world," says Matt Clifford, a British entrepreneur who chairs the ARIA board. "The test for any one program, is if only this program succeeded, if everything else failed and this was the only thing we could point out for the first decade of ARIA's life, would it be worth it?"

Before Jacques Carolan joined ARIA, he was on the road to becoming a professor of physics. "That was my dream," he says. But at MIT he started to talk to people—often former academics—who ran Darpa programs, and who had a certain lore and aura. When he heard that the UK was setting up its own breakthrough science agency, he knew he had to apply.

Now Carolan is the director of a £69 million program to develop more precise ways for us to interact with the human brain—perhaps smarter brain implants or stem-cell-based systems that could help treat disorders like treatment-resistant depression. One idea is to come up with therapies that are less invasive than the deep brain implants used to treat Parkinson's disease and epilepsy, but are still precise enough to have a profound impact on the brain. "When you think about the potential impact you can have, there are not many times in your life where you have serious resources to realize a scientific vision of your own making. To realize your most ambitious vision," Carolan says.

Jenny Read used to study praying mantis vision at Newcastle University—one time fitting tiny 3D glasses to the insects to figure out how their vision differed from our own—and whether understanding insect vision could lead us toward more efficient ways of building robotic vision. "I did that for many years and really enjoyed it, but I think I sort of reached a point in my life where you turn 50, kids grow up and leave home," she says. Read was wondering what to do with the rest of her career when she decided to apply to ARIA. "I kind of felt a hunger in myself for being part of something bigger."

Every other week the program directors meet in ARIA's office. On the day I visit, they kick off a meeting with a little game. They are each given a superpower—invisibility, superhuman strength, time manipulation, and so on—and have to convince the others why their power would reign supreme. One program director is assigned telekinesis, which they imagine using to manipulate football games, winning vast sums of money, and increasing ARIA's budget. (A little later the program directors are contemplating ways their programs might fail when they break for another quick game—a riff on musical chairs. This is an organization that takes ice-breakers extremely seriously).

A little telekinesis may come in handy. ARIA's £800 million budget is tiny compared to the £25.1 billion budgeted for UKRI between 2022 and 2025. In 2024 alone, Darpa was allotted around $4 billion, and yet ARIA's remit is—in theory at least—much wider than the US agency's. It is a modest budget for a big mission, which, according to Clifford, isn't just to fund

breakthroughs but to help elevate the status of science in the UK. "I think we've done a very poor job of elevating the status of discovery … And yet when you look at almost everything we value, it's downstream of scientific progress. Without scientific progress you don't get it."

ARIA CEO Ilan Gur joined the agency after founding a platform that helps scientists become entrepreneurs.

PHOTGRAPHY: CHARLIE CLIFT

Ilan Gur has spent his career figuring out how to make that progress happen. In 2005, he was partway through his physics PhD in Berkeley when he decided he was more interested in the gritty work of turning breakthroughs into impact than a career as a scientist himself. Gur had been working on a way to use nanocrystals to make very cheap solar panels, and one of his papers had just been featured in the prestigious journal [Science](#). He thought these ultra-cheap nanocrystals might change the world—if people could print solar panels the way they did newspapers, abundant green energy could be just around the corner.

And yet Gur realized that his nanocrystals stood no real chance of having an impact. They might be able to create dirt-cheap solar cells, sure, but the crystals didn't last long, and the cost of reinstalling them every three to five years would be astronomically more expensive than conventional solar panels. "We could give those solar cells away for free, and they would not compete with the cells that you could buy at the time," he says. "That's actually a pretty simple analysis to understand the value of the technology that you're trying to build, which no one in my lab had ever even talked about."

It wasn't enough to tinker away in a lab and hope your work would change the world, Gur was realizing. "If what you care about is not simply a scientific breakthrough but a scientific breakthrough that can catalyze world-changing impact in a tangible way, then there is so much in that journey. The breakthrough is necessary but not sufficient." He would eventually leave academia and work at ARPA-E, a US Department of Energy organization modeled after Darpa to pursue high-risk, high-reward research in energy technology. Later he set up Activate—an organization

that supports early-stage scientists working on potentially groundbreaking research. And then in August 2022, Gur moved from California to take the role of ARIA CEO.

Gur was a natural fit for ARIA, says Stripe CEO Patrick Collison, who is one of the agency's advisers. Collison had only met Gur a couple of times before becoming an ARIA adviser, but he knew that the CEO was no armchair innovator—Gur was focused on actually getting shit done. It's one thing to engage in abstract philosophizing, it's quite another thing to conjure up a functioning institution and make it work, says Collison.

But it's also part of Gur's job to help build the myth of ARIA—to pull in talented scientists from across the world, and achieve the agency's secondary mission of positioning Britain as a scientific leader again. The nuts-and-bolts of progress can become obscured by the narrative-building that surrounds genuine breakthroughs: J. Robert Oppenheimer and his boys in Los Alamos got the Hollywood treatment, but the lion's share of Manhattan project dollars went to the complex in Oak Ridge that enriched the uranium for that first atomic bomb. The myth of Darpa, in particular, looms large over ARIA. "Darpa has done brilliant things and changed the world in a lot of ways, but it's done that in the past," says Gur, who wears the startup-founder uniform of sneakers, comfortable trousers and, each time we met, an ARIA T-shirt.

There are signs—beyond the branded clothing—that ARIA is generating its own myth. In August, it announced that the deep-learning pioneer Yoshua Bengio would join ARIA's program on safeguarded AI as scientific director, working with program director David "davidad" Dalrymple. In Gur's estimation, it was the prospect of working with Dalrymple that pulled Bengio into ARIA's orbit.

Perhaps the very best myths become their own engines of progress. Clifford has a six-year-old son who very much wants to become a racing car designer one day. What if future children aspired to be the kind of person who nudged a new breakthrough into existence? Not scientists in the white-coat-wearing way of the imagination, but conductors of progress—engineering scientific crescendos that otherwise may have petered out into silence. "I kind of want people to say that they want to be an ARIA

program director the same way that they say they want to be a Premier League footballer," Clifford says. That, in its own way, would be a profound kind of success.

In the Bristol workshop, the scientists are introducing themselves. It's an eclectic bunch: One person is an amateur flower designer, another is an architect interested in using plants as building materials. Some work in startups, others for big corporations. In the course of coming up with her program, Burnett says, she has spoken to over 100 people in and around the world of plant science. Today a decent proportion of them are in the same room for the first time—and some of them are sizing up whether they might want to get in on Burnett's synthetic plants plan. As much as Gur and Burnett are angling for ideas, they're also pitching the very concept of ARIA itself.

One of the plant scientists in attendance is Jane Langdale, who is perhaps the closest thing the field already has to a moonshot chaser. Langdale leads the C4 Rice Project, one of the most ambitious plant science projects ever undertaken. Crops like maize use a photosynthesis pathway that makes them—especially in hot, dry environments—more efficient than rice. The [C4 Rice Project](#) aims to recreate this C4 photosynthesis pathway in rice, supercharging the growth of one of the world's most important crops. Since 2008 the project has been funded by the Bill & Melinda Gates Foundation.

"It's great that ARIA exists, and I think it's great that there is a plants program in it," says Langdale. "There's no doubt about that because for far too long, people like Gates have been driving the moonshot projects, and of course they have a very specific focus on what it is they want to achieve."

Philanthropic foundations like Gates' also have a higher tolerance for projects that may not hit paydirt. "We've been going quite a long time, and we certainly don't have anything near a product to put in the field," Langdale says. Government-backed science funding has historically had much less of an appetite for these kinds of projects, because it's hard to justify spending taxpayer money on projects that might take 30 years to come to fruition.

Even compared to the C4 Rice Project, Burnett's synthetic plants program is a very significant chunk of money, Langdale says. Burnett is aiming to spend £62.4 million ($82 million) over five years. The program will fund scientists to try to make synthetic chromosomes, the genetic building blocks of plants, and synthetic chloroplasts, which have their own separate genomes. But the program doesn't specify what new features these partly synthetic plants should have. It's a little like designing a new machine without knowing what tools that machine is going to build, says Langdale.

Johnathan Napier, a science director at agricultural institute Rothamsted Research shares these concerns. Building synthetic chromosomes and chloroplasts are clearly defined goals, but he's not sure whether they're going to deliver a tangible benefit. Napier tries to engineer crops to produce omega-3 fish oils, while the C4 Rice Project is attempting to make rice much more productive. But Burnett's program is much wider than either of these. In theory at least, it could one day allow plant scientists to plug in any kind of functionality into a plant.

"If this all worked, you'd be able to design your complex pathway in the computer, build an entire chromosome […] and just plug that into the plant in a single step," says Saul Purton, another workshop attendee and a professor at University College London who works on synthetic chloroplasts in algae. Purton says that he may apply for an ARIA grant, but that the five-year timeline set out to deliver synthetic chloroplasts in several crop species is extremely tight. "We've been bashing away in terms of developing new synthetic biology tools for engineering the chloroplast of a simple model system for 15 or 20 years now, and we're still learning, we're still making mistakes."

Angie Burnett is funding research into synthetic chromosomes and chloroplasts, and the ethics of synthetic plants.

PHOTOGRAPHY: CHARLIE CLIFT

When I meet Burnett again in early August, she has just had her program approved after a grueling three-hour meeting with Gur, members of ARIA's executive team, and a panel of external experts. "It was a little nerve-wracking because it's such a big moment that I've been working towards

for this whole time," she says. As well as funding projects working to build synthetic chromosomes and chloroplasts, Burnett is also asking for research into the ethics of synthetic plants—anticipating a world where farmers, lawmakers, and the public may have to grapple with the idea of crops fully crafted by human hands. But it's unlikely she'll still be with the agency to see those scientific seeds bear fruit. Program directors are typically hired for three-year terms, and the agency is [already hiring](#) its next batch of directors, some of whom will launch entirely new project areas.

Over such short timescales, it can be difficult to gauge the success of such long-term plays: Are mistakes just bumps in the road, or signs that you've taken the wrong route altogether? Collison is wary about defining success at all. Give it 15 years, he says, and it should be pretty obvious if ARIA is a good thing or not. The agency has a little breathing room. It cannot be dissolved for at least 10 years, by which point the UK will have had at least one more general election. The new Labour government has indicated its support for ARIA, not least by making Vallance the minister responsible for ARIA. "It is essential to harness the power of science to deliver economic growth, opportunity, and scientific advancements for people across the UK," said a government spokesperson.

But discerning the arc of progress takes time. In 1958 ARPA might have looked like a desperate attempt to wrest back technological supremacy from the Soviets. That was true in a way, but its ultimate impact reached far, far, beyond that. Is ARIA an attempt by a legacy-obsessed prime minister to reinstate the UK's relevance in a post-Brexit world? Well, yes, but that may become just the preamble to the agency's real story.

In 1994, Gordon Moore published an [essay](#) that he called "The Accidental Entrepreneur." In it, he describes how he seemed destined for a midlevel managerial role until a company psychologist at the chemical giant Dow told him he would never manage anything. Instead, he ended up cofounding Fairchild Semiconductor and then Intel, whose silicon chips underpin the exponential growth in computing power that's driven much of our technological development over the last half century. In the fullness of time, Moore's rise seemed as inevitable as the law he lent his name to, but to him that was never the case.

Every breakthrough eventually boils down to brilliant people working on fiendishly tricky problems. For Gur, ARIA is about building a system to lift up people like Moore, rather than leaving them to drown in academic bureaucracy or fizzle out in the startup sector. There was something innate in Moore that allowed him to be who he was, Gur argues, but he needed that accidental moment to make him great. "So what do I hope ARIA can be? It can be this sort of catalyst intervention which takes someone who's got the latent mindset and spirit to change the world—and it's the accidental piece of their story. Maybe it's not so accidental anymore."

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[Kyle MacNeill](#)
[Culture](#)
Sep 30, 2024 4:00 AM

How a 15-Year-Old Gamer Became the Patron Saint of the Internet

In 2025, Carlo Acutis will officially become the first millennial saint. But will he help the Catholic Church reach a younger audience?
Illustration: Phil Galloway

Like a lot of us, Carlo Acutis spent an ungodly amount of his life staring at screens. Born in London in 1991, he grew up an only child in a newly connected world. He wore sweatshirts and Nike trainers. He played *Halo* and taught himself to code. But that's where the similarities end—because next year, Acutis will officially be named a saint.

As well as the internet, Acutis revered another institution: the Catholic Church. From a young age, he was acutely interested in Eucharistic miracles—extraordinary events which, according to Catholics, see consecrated bread or wine suddenly become the actual body or blood of Christ. "To always be united to Jesus: This is my life plan," he told his mother after his First Communion.

In 2004, Acutis started to research Eucharistic miracles from around the world, developing a website to document them. His aim was to connect with other young Catholics. "He was personally convinced that the scientific evidence would help people … come back to Mass," says Courtney Mares, author of *Blessed Carlo Acutis: A Saint in Sneakers* and Rome correspondent for the Catholic News Agency.

The [online archive](#) was unveiled in October 2006, a simple build with cursive text and religious imagery. But just a few days after it launched, Acutis fell ill. He was diagnosed with leukemia, with little chance of

recovery. "Death has become the passage towards life," he told his mother, before falling into a coma, suffering a brain hemorrhage, and passing away. He was just 15.

His spirit lived on. The website he'd built helped introduce Eucharistic miracles to a mass audience across the globe and was translated into 17 languages. A physical exhibition linked to Acutis' work has toured internationally, being shown in thousands of parishes worldwide. It's still touring now.

Acutis is revered not just for his use of technology, but also his dedication to living virtuously. "I think that prayer was truly the great secret of his saintly life," Mares says. But the website was key to creating a halo effect, heightening his reputation as a blessed figure.

In 2012, the Archdiocese of Milan—where Acutis' family had moved when he was a child—started a cause for canonization, paving the way for sainthood. Unbeknown to most secular folk, saints are still made regularly; Pope Francis has recognized a record 912 since 2013. But becoming one, as the cliché goes, requires patience. The original petitioner appoints a postulator to collect evidence of the candidate's sacred work (the "devil's advocate" used to be a real antithesis to this occupation, arguing against sainthood).

"The process of identifying someone as a saint is long and careful and quite bureaucratic," says Tim Hutchings, associate professor of religious ethics at the University of Nottingham. "It starts when some Catholics decide that they really think someone *should* be a saint. They start a campaign to prove to their local bishop that this person lived an incredibly holy life, or died for their faith."

After being named a "Servant of God" in 2013, Acutis reached the second rung on the ladder to sainthood when he was venerated by Pope Francis in 2018. His body was exhumed and brought to a tomb in Assisi where he still lies today, dressed in his trademark '90s teenager garb. "It's a beautiful thing that for the first time in history you can see a saint dressed in jeans, sneakers, and a sweatshirt. That's a great message," Father Carlos Acácio

Gonçalves Ferreira, the shrine's rector, said at the time. A Franciscan monk based at the tomb, noted that "many young people" were visiting.

Next, Acutis and his followers needed a literal miracle—one he had performed himself. "It has to be something which can't be scientifically explained, so proving this is difficult. For example, this might require doctors to confirm that they can't explain how a healing has occurred," Hutchings says. In 2013 a woman in Brazil claimed that praying to Acutis had helped heal her son's pancreatic defect. In 2020 Pope Francis authenticated the miracle and Acutis was beatified, culminating in a ceremony celebrating his virtuous life. "According to Google Trends, more people were searching for information about Carlo Acutis than about the Pope," Mares notes.

Then, in May 2024, a second miracle was recognized, involving the healing of a 21-year-old girl from Costa Rica injured in a bike accident. In 2022, her mother had knelt at Acutis' grave and prayed for his help. Her daughter then miraculously resumed breathing without support and made a full recovery. The Pope approved Acutis' canonization in July—with an official ceremony set for 2025.

It's rare for a saint to be so young and unheard of, and still reach this lofty status so soon after their death. "It is remarkable that Carlo Acutis will be canonized so close to the date that he was born. For context, of the 912 saints canonized by Pope Francis, the next most recent birth date was in 1926," Mares says. It makes him the first ever millennial saint and, as some Catholics have put it, "God's influencer" and the "patron saint of the internet."

Meanwhile, the cult of Carlos Acutis is continuing to spread across the world. Relics, including a piece of the sheet that shrouded his corpse, a fragment of one of his sweatshirts, and his actual heart, have toured internationally, recently coming to the UK for the New Dawn Catholic Pilgrimage. Online, you can buy Carlo Acutis figurines, rosary beads, posters, and commemorative keychains. In North Lanarkshire, Scotland, a life-size statue of Acutis has been erected at Carfin Grotto, and there's a stained-glass window in Wiltshire to attract young churchgoers.

There's even a comic book telling his story, and a VR experience offering players a chance to step into Acutis' sneakers. And, for Catholics who are unable to pay their respects in person, his tomb can be visited (and donated to) virtually through an [always-on livestream](#).

The Church doesn't pick saints—campaigns start with the Catholic community—but Acutis' popularity meshes with its desire for a young role model. It also highlights the Church's embrace of tech. "The Pope has been making an annual lecture about communications technology for 58 years," says Hutchings. "It absolutely makes sense for Catholics to look for a saint of the internet who represents the godly and faithful use of technology."

There is, of course, still a stigma surrounding the internet's potential for blasphemous behavior. "The Pope has warned that today's digital age constantly tempts young people to 'self-absorption, isolation, and empty pleasure,'" Mares says. And some devout Catholics are still struggling with temptation. "With technology changing at such a rapid pace today, many Christians are still grappling with how best to live out their faith in the world of laptops, cell phones, and social media," Mares says.

But the Pope also called the internet a "gift from God" in 2014, and he recognizes its potential for spreading the word of Christ—it just depends on how it is applied. And in the case of Acutis, tech was used in a pious way. "Acutis used the new technology in exactly the way that the Church wants to see it used: to promote commitment to Catholic teaching, virtuous living, and devotion to the rituals of the local church," Hutchings explains. The Church will hope that the relatable "saint in sneakers" who watched cartoons and surfed the web will resonate with a community looking for an idol.

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Charlie Metcalfe
Security
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When War Came to Their Country, They Built a Map

The Telegram channel and website Deep State uses public data and insider intelligence to power its live tracker of Ukraine's ever-shifting front line. PHOTOGRAPHY: Sasha Maslov

Roman Pohorilyi was 22 when he started tracking Russian troop movements near Ukraine's border. It was the fall of 2021, and he and a childhood friend, Ruslan Mykula, had been sharing news about foreign affairs to an audience of about 200 subscribers on a Telegram channel. It was just a hobby for them. Neither imagined that a year later their country would be in a state of absolute war with Russia, and that their hobby, which they called Deep State, would be tracking every aspect of it.

Although Deep State started as a news channel, it has become most famous for its open access map that charts the shifting front line of Russia's invasion, and which has become a crucial tool for Ukrainians to keep track of the conflict that once threatened to overrun their country. On some days in late 2022, Deep State's map received as many as 3 million views. Mykula showed WIRED a screenshot from the website's dashboard that recorded more than 482 million views between June 2023 and June 2024.

Mykula and Pohorilyi created the map on the first day of the war, after recognizing a demand from their Telegram subscribers for frequent updates about what was happening. Pohorilyi was in the penultimate year of a law degree, and Mykula was working in marketing. But both had been learning open source intelligence skills to help verify videos of military activity that actors on all sides were publishing online.

The basic map itself, which a friend helped to design, is simple but precise. Territories occupied by Russia are shaded in red; those held by Ukraine are shaded in green. Blue marks areas that Ukraine has recently liberated. Known Russian units, airfields, and HQs are marked with small red squares; troop movements with arrows; and railways with black and white lines (Ukrainian positions are not shown). Zooming in, one can see detail down to the level of individual streets, villages, and tree lines. It looks like the board of a computer strategy game.

Over time, Deep State has added more advanced features and quirks to the map. A toolbar in the bottom-left corner offers the option to enable different layers, including weather patterns, fortifications, and gamma radiation levels in case of nuclear disaster. Users can simulate the effect of different weapons, calculating the range and potential damage of everything from self-propelled howitzers and ballistic missiles to Patriot air defense systems and nuclear explosions. A hidden Easter egg summons an animation of Baby Yoda that, when poked, uses the Force to destroy Russian units.

The map soon became too much for Mykula and Pohorilyi to manage alone; they now enlist the help of more than 100 paid employees and volunteers. Their methods have also evolved. They still use open source intelligence to verify new information, but also acquire data directly from frontline military units whom they've developed relationships with. In some cases, the authority of a single source whom they've learned to trust is enough, though Mykula admits there have been occasional errors. In other cases, when multiple sources contradict one another, they wait until definitive evidence emerges. Propaganda is rife on both sides, and Mykula insists that Deep State will take no part in it. "We want to win," he says. "Propaganda will not win."

Mykula and Pohorilyi do, however, oblige when Ukrainian military commanders request delays to map updates that may compromise their activities. They also receive some government funding for an alternate version of the map available only to verified members of the military. The government funding also goes toward other intelligence activities that Ruslan refuses to discuss; most of their funding comes from public donations.

Late in the first year of the war, Mykula and Pohorilyi learned that their map was helping another, unexpected group of users: Russian soldiers. The map's designer had added a function that would display instructions to surrender if a user tried to access from a Russian IP address. Then, in October 2022, in [an interview with a popular Ukrainian blogger](#), a Russian POW testified that he had used Deep State's map for this exact purpose.

The success of Deep State's map has attracted more users to their original Telegram channel, which now has more than 700,000 subscribers. It publishes its own original reports of the war, all available through a free app, which other established Ukrainian media organizations sometimes refer to. But the map remains the most popular product, used by Ukrainians at home and abroad to track the front line that, at the time of writing, creeps further toward their office in Kyiv every day.

Both Mykula and Pohorilyi approach their work with a stern dedication that belies their youth and inexperience. "We don't want to disappoint our audience because our projects have become critical for Ukrainians," Mykula says. "If you compare us to other maps, you will see that Ukrainians don't go to check on them. They come to us."

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[Isabel Fraser](#)
[Science](#)
Aug 15, 2024 6:00 AM

This Is the Most Detailed Map of Brain Connections Ever Made

In a world first, Harvard biologists worked with Google to diagram a cubic millimeter of human cerebral cortex at the subcellular level, paving the way for the next generation of brain science.
Image: Google Research & Lichtman Lab (Harvard University). Rendered by Daniel Berger (Harvard University)

This image could be hung in a gallery, but it started life as a tiny chunk of a woman's brain. In 2014, a woman undergoing surgery for epilepsy had a tiny chunk of her cerebral cortex removed. This cubic millimeter of tissue has allowed Harvard and Google researchers to produce the most detailed wiring diagram of the human brain that the world has ever seen.

Biologists and machine-learning experts spent 10 years building an [interactive map](#) of the brain tissue, which contains approximately 57,000 cells and 150 million synapses. It shows cells that wrap around themselves, pairs of cells that seem mirrored, and egg-shaped "objects" that, according to the research, defy categorization. This mind-blowingly complex diagram is expected to help drive forward scientific research, from understanding human neural circuits to potential treatments for disorders.

"If we map things at a very high resolution, see all the connections between different neurons, and analyze that at a large scale, we may be able to identify rules of wiring," says Daniel Berger, one of the project's lead researchers and a specialist in connectomics, which is the science of how individual neurons link to form functional networks. "From this, we may be able to make models that mechanistically explain how thinking works or memory is stored."

Jeff Lichtman, a professor in molecular and cellular biology at Harvard, explains that researchers in his lab, led by Alex Shapson-Coe, created the brain map by taking subcellular pictures of the tissue using electron microscopy. The tissue from the 45-year-old woman's brain was stained with heavy metals, which bind to lipid membranes in cells. This was done so that cells would be visible when viewed through an electron microscope, as heavy metals reflect electrons.

The tissue was then embedded in resin so that it could be cut into really thin slices, just 34 nanometers thick (in comparison, the thickness of a typical piece of paper is around 100,000 nanometers). This was done to make the mapping easier, says Berger—to transform a 3D problem into a 2D problem. After this, the team took electron microscope images of each 2D slice, which amounted to a mammoth 1.4 petabytes of data.

Once the Harvard researchers had these images, they did what many of us do when faced with a problem: They turned to Google. A team at the tech giant led by Viren Jain aligned the 2D images using machine-learning algorithms to produce 3D reconstructions with automatic segmentation, which is where components within an image—for example, different cell types—are automatically differentiated and categorized. Some of the segmentation required what Lichtman called "ground-truth data," which involved Berger (who worked closely with Google's team) manually redrawing some of the tissue by hand to further inform the algorithms.

Digital technology, Berger explains, enabled him to see all the cells in this tissue sample and color them differently depending on their size. Traditional methods of imaging neurons, such as coloring samples with a chemical known as the Golgi stain, which has been used for over a century, leave some elements of nervous tissue hidden.

In the example above, Berger made the smallest cells blue and the biggest cells red, with all other cells between falling on a color spectrum. This helped researchers to identify the brain's six cortical layers and white matter.

While researchers have been able to identify structures from the data, one ongoing difficulty of the project is proofreading the automatic

segmentation. This involves individuals manually sifting through every part of the 3D map to check for segmentation errors. "This is a huge challenge for human beings, because now we're generating datasets that are larger than a single human can experience," says Lichtman.

In parts of the data that have been proofread, Berger says that particular cells seem "really interested in contacting." The researchers have found examples of over 50 synapses to one singular neuron, which, according to Berger, is a phenomenon previously overlooked that could be integral to cortical processing.

On top of identifying structures and connections, researchers have identified abnormal cells. Berger said he came across an unidentifiable egg-shaped "object" (much smaller than a cell body but part of a cell) when attempting to systematically categorize each cell in the dataset. Other ambiguous cells include those seemingly mirrored in shape and "tangled" cells that wrap around themselves; until further research is done, these cells remain mysteries. However, they may not remain so for long.

The brain map has been made open access, which means that these images have opened up boundless possibilities for progress in neuroscience, particularly as this is the first publicly available wiring diagram of the human brain at subcellular level. Both Berger and Lichtman emphasized that they did not go into the project with concrete aims of discovery but rather wanted to create the "possibility to observe," and from this, they hope (and expect) that "further insights will come" from both the Lichtman lab and external researchers.

Berger anticipates that advancements could be made in understanding and treating mental conditions such as schizophrenia. Potential future discoveries could also expand beyond the mind, as Berger thinks the functions of the biological brain may be used to improve deep-learning AI systems and their structures.

In terms of future projects, the Harvard Lichtman lab plans to continue its collaboration with Google to "factor this rendering up another scale of a thousand" by studying a whole mouse brain. The research lab is also working on more human brain samples, to expand research into other

regions of the brain. This will enhance the already invaluable resource and its ability to inform and expand future discoveries.

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Amit Katwala
Science
Aug 15, 2024 5:00 AM

This Code Breaker Is Using AI to Decode the Heart's Secret Rhythms

Inspired by his expertise in breaking ancient codes, Roeland Decorte built a smartphone app that continuously listens for signs of disease hidden in our pulse.
PHOTOGRAPH: christopher l. proctor

Roeland Decorte grew up in a nursing home in Belgium, where he learned to spot the subtle early signs of mental decline in small changes to how residents walked or talked. When Decorte was 11, his father, who owned and managed the care home, started waking up in the middle of the night with chest pains and an overwhelming sense of impending doom.

He went to two doctors, who briefly listened to his heartbeat through their stethoscopes and diagnosed him with anxiety. But the symptoms persisted, and it was only when he underwent a full set of scans at a private hospital that a third doctor uncovered the source of the problem—a tiny hole between the left and right chambers of his heart. If left unnoticed, it would have killed him—he was 39.

Disaster averted, the young Decorte was able to focus on his studies, and by age 17 he was an undergraduate at the University of Cambridge—the youngest Belgian ever to attend the prestigious college. (This caused some logistical issues: His tutor had to become his legal guardian, and a new payment system had to be put in place at the college bar to prevent him from buying alcohol like his peers.)

He spent the next seven years specializing in ancient codebreaking, and a comfy career in academia (or a more exciting one as an Indiana Jones–style

relic hunter) beckoned. But Decorte never stopped thinking about what had happened to his dad and how he could have been diagnosed much sooner if a doctor, any doctor, had spent more than 30 seconds listening to his heart. So in 2019, lacking medical training but armed with the confidence that only an Oxbridge education can provide, the then 27-year-old Decorte founded a company and turned his attention to cracking a different ancient code: the secret rhythm of the heart.

There's an AI boom in health care, and the only thing slowing it down is a lack of data. Meanwhile, time-pressured doctors can collect information only sporadically. Wearables such as smartwatches might be able to measure pulse, but they're bad at more specific diagnoses (partly because the wrist is about as far away from the really vital organs as you can get).

Decorte wanted to develop a piece of technology that could monitor the body continuously and precisely, so that people like his father could get the treatment they need more quickly. He began by trying to build sensors into clothes so people could track their vitals without a doctor's visit. Then he designed an elaborate exoskeleton packed with sensors to measure all kinds of ailments. This attracted some military interest but wouldn't really have helped someone like Decorte's father. "I was very naive," he said when we met recently in the wood-paneled basement of a twee café in Mayfair, London. "There was about two years full-time where I was just working out of the spare room in my house doing nothing else." But the problem he kept running into was noise: Unless you could build a contraption that pressed each sensor right against the skin, there was too much random interference from people moving around in the world to get a good sense of what was actually happening in the body.

But perhaps, Decorte thought, noise could also be the solution. During the pandemic, he met PhD student Erika Bondareva, who had published work on diagnosing Covid by analyzing audio data collected by people coughing into an app. Her software checked for patterns common to people with the disease, then looked for those same patterns to try to detect it earlier in others. Together, Bondareva and Decorte worked on expanding that idea to other ailments—starting with heart conditions. Eventually, Decorte said, he found himself replacing every sensor on the exoskeleton he'd designed with

an audio sensor. Finally, he realized that the only hardware he needed was a microphone.

Today, his company, Decorte Future Industries, is at the vanguard of an audio-powered revolution in health care. Sophisticated algorithms strip out background noise and focus on interpreting the body's faint signals. There are smart stethoscopes and apps beginning to hit the market that claim to [diagnose Alzheimer's based on speech patterns](), but Decorte wants to go further: He believes the technology he's developing will be able to diagnose heart problems, stomach cancer, and even blood sugar levels, as well as conditions related to speech and gait. Instead of the mishmash of numerous apps and hardware solutions aimed at different conditions, he sees a single solution: The microphone in your smartphone would always be listening, and once every few weeks you'd get an alert to press it against various parts of your body for more detailed readings.

Decorte has raised millions in funding and is growing a small team in Cambridge. He's running clinical trials in India—one local doctor thought he was being scammed until Decorte's colleague played back the recording and the doctor could hear his own voice on the tape from minutes earlier. Decorte's technology matches up to ECG readings with 99.6 percent accuracy—but with just a microphone, patients can take the readings at home.

It's been a steep learning curve, but one that draws on his experience of ancient codebreaking as much as the new skills of networking and artificial intelligence. "It's all pattern recognition," he says.

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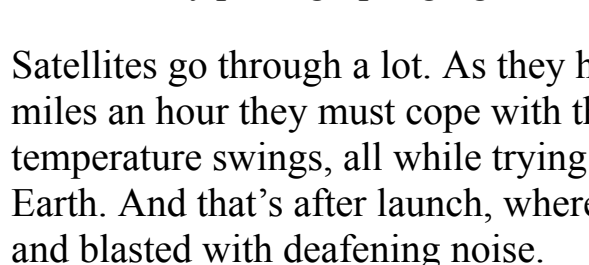
By [Jonathan O'Callaghan](#)
[Science](#)
Aug 14, 2024 7:30 AM

This Gargantuan Lab Simulates Blasting Satellites Into Space

If you spend millions of dollars developing a satellite, you need to know it can handle the rigors of hurtling around the Earth at 17,000 mph. The UK's National Satellite Test Facility is here to help.
Inside the vacuum chamber at the UK's National Satellite Test Facility.photograph: greg white

Satellites go through a lot. As they hurtle around our planet at up to 17,000 miles an hour they must cope with the extreme vacuum of space and vast temperature swings, all while trying to precisely train their antennas back to Earth. And that's after launch, where they'll be shaken like a can of paint and blasted with deafening noise.

To get them ready for this ordeal, all [satellites](#) are painstakingly tested before dispatch, ensuring every loose bolt is tightened and all the electrics are in exquisite working order. That used to require trips to multiple locations for different tests, but in the UK, the newly opened National Satellite Test Facility in Oxfordshire offers a full satellite health check under one roof.

"The industry said they needed a one-stop-shop where they can do all of their testing for their large complex satellites in one place," says Sarah Beardsley, the director of the UK government-funded Rutherford Appleton Laboratory Space, which runs the new facility based at the Harwell Science and Innovation Campus. "This is the result of years of hard work."

Construction began in late 2018, after the UK government announced it would invest £99 million ($126 million) in the NSTF to develop "a world-

class facility" for testing satellites. Originally set to begin operations in 2020, the project was hit by delays, including [Covid](), that saw its grand opening pushed back to May 2024. Multiple satellites will be put through their paces every year, with Airbus set to be the first customer to use the facility for its new Skynet 6A communications satellite in July.

There are four testing areas inside the NSTF. The first you come to when you walk in—after donning protective garments to keep the facility as clean as possible—is the huge vacuum test chamber around which the whole building had to be constructed. "There's no door big enough to fit it through," says Beardsley. Inside this chamber, pumps can lower the pressure to just 0.00001 millibars, mimicking the vacuum of space, while a nitrogen coolant system can raise and lower the temperature between -180 and 130 degrees Celsius, the extreme range a satellite might experience as it moves in and out of sunlight during orbit.

This calibration model represents a typical size and shape for satellites tested at the NSTF.

photograph: greg white

At seven meters wide and 12 meters deep, this is the largest vacuum test chamber in the UK. It is so large that the immense door needed to close the chamber, constructed in Turkey and Italy before arriving in Britain by boat just days before lockdown in 2020, was at the size limit of what would fit on a UK motorway. Gates at Portsmouth dock had to be widened to get the door off the ship. "We had the largest peacetime convoy going up the A34 to arrive here," says Beardsley. Satellites will spend weeks or even months inside the test chamber to ensure they can cope with the conditions of outer space: When WIRED visited, a mock satellite called The Iron Chicken—a deep cut to the character who lives in a metal nest orbiting the moon in the cult-classic British children's animation *[The Clangers]()*—took pride of place at the chamber's entrance.

Antennas are tested in a room lined with 40,000 insulating foam spikes.

photograph: greg white

After the vacuum-chamber test, satellites will then head to the vibration- and acoustic-testing room. Here, it will be shaken violently—horizontally and vertically—on two pads powered by a pair of electromagnetic engines (nicknamed Wallace and Gromit after the beloved stop-motion characters) that simulate the extreme conditions of a launch. The shaking will expose the satellite to 222 kilonewtons of force, equivalent to four times the bite of a T. Rex. If anything is even slightly loose on a satellite, these machines will find out.

During acoustic testing, a giant wall of 48 speakers will blast satellites with up to 146 decibels of white noise. For a human, this would be like standing in the jet engine of a plane. "You would have severe hearing damage," says Ian Horsfall, dynamics group leader at RAL Space. This test is designed to mimic both the noise of the rocket engines on liftoff and the excruciating volume at the top of the rocket—where satellites are stored on their way into orbit.

In the antenna-testing room, 40,000 foam spikes on the wall absorb all noise and electromagnetic waves from satellites, while the room acts as a Faraday cage to block incoming electromagnetic radiation. A satellite's antenna can then be focused onto a receiver in the room, to check that its beam can be directed from orbit back down to Earth, despite being hundreds or thousands of kilometers distant and traveling at immense speeds.

The door to the vacuum chamber was built in Italy and Turkey, then brought by boat to the UK.

photograph: greg white

The radio beams used here are so powerful that the room must be almost entirely purged of oxygen to stop the foam spikes from catching on fire, says Michael Shepherd, project manager of the NSTF. Part of the wall is cooled to prevent this possibility, alongside the oxygen reduction. "We can drop the oxygen level down to 14 percent, so they won't actually burn," says Shepherd. "It's like being at 10,000 feet."

The final test is the dynamics testing suite, a platform that precisely measures the center of mass of a satellite with incredible precision. The goal is to ensure that, when the satellite is on top of a rocket, it won't cause the rocket to suddenly skew off course if the satellite becomes unbalanced. "The other part of that is, once it's separated and in orbit, you need to understand its properties so it doesn't start tumbling," says Shepherd.

Parts for testing are strapped to the platform of the vibration engine.

photograph: greg white

All told, running through a full suite of tests at the NSTF could take upwards of nine months, depending on how stringent a customer wants to be. At first, RAL Space envisages two satellites a year being put through the gauntlet of challenges, but it may eventually expand the facility to create additional clean rooms that can store more satellites between tests, increasing the conveyor belt of machines running through.

It is not just communications satellites that will be tested at the NSTF. After Airbus, the French firm Thales Alenia Space will test its Fluorescence Explorer climate satellite. That will be followed by the European Space Agency's Ariel mission, a telescope designed to study the atmospheres of planets around other stars, set to launch in 2029. "It's brilliant," says Beardsley. "Our first three contracts are looking at communications, Earth, and the farthest reaches of the universe. This facility doesn't care what the satellite is going to do."

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[Vladan Shir](#) [Michal Kučera](#)
[Science](#)
Aug 5, 2024 7:00 AM

Jane Goodall Thinks It's Not Too Late to Save the World

The world, the famed primatologist says, isn't what it used to be—but there's still time to save it, if we treat crises like climate change, biodiversity loss, and poverty as one.
Photograph: Jakub Straka

Jane Goodall understands better than most the impact humans have had on the planet. The world, the primatologist says, isn't what it used to be. Having witnessed so much environmental deterioration during her lifetime, today Goodall is as much an activist as a scientist. She warns tirelessly of accelerating environmental devastation, vanishing biodiversity, and rapidly intensifying climate change. "When I began, there weren't such problems," she says.

At 26, Goodall ventured into the Tanzanian rainforests—where the now-famous Gombe National Park was established a few years later—to study chimpanzees. Her years of meticulous observation deepened our understanding of these animals and their similarities to us. Among her most significant discoveries was that chimpanzees can make and use simple tools, a trait previously thought unique to humans. Goodall also revealed the primates' rich social networks.

Gombe, situated on the shores of Lake Tanganyika, was not large even then —at 35 square kilometers, it is one of Tanzania's smallest parks. However, it was surrounded by dense forest, home to countless wildlife species. Over the decades, deforestation has reduced the forest, and local wildlife has fallen prey to poachers.

"Gombe has become an isolated forest with bare hills all around," says Goodall. Chimpanzee living conditions have deteriorated not only there but across Africa. There were about a million chimps in the early 20th century; today's estimates range from 170,000 to 300,000. Countless other animals and regions face similar threats.

The planet's biodiversity has also rapidly deteriorated over the past few decades, and according to the UN, up to a million species are at risk of extinction, mainly due to their wild habitats being changed to farmland. On top of this, human-induced climate change reduces the living space for many species. The window of time available to halt this trend and to protect ecosystems that both animals and humans rely on is running out, Goodall argues. "I don't know how big a window it is. The important thing is we've got to get together and take action now."

Addressing both biodiversity loss in specific regions and global climate change is imperative, Goodall stresses. Everything is connected, she says. "You have to do them together—biodiversity loss and climate change." Focusing solely on climate change could still lead to the loss of species like chimpanzees, she says. "The one advantage of the number of people on the planet, which is too many, is that there are enough people to tackle every single problem. Every one of us makes an impact on the planet every single day. And unless we're very poor or very young, we can choose what sort of impact we make. Like what do we buy? How was it made? Did it harm the environment? Was it cruel to animals? Is it cheap because of unfair wages?"

The scientist-activist doesn't merely traverse the globe advocating for conservation. Through her organizations, such as the Jane Goodall Institute, she provides tangible support and guidance, particularly in her adopted home of Gombe, which she still visits twice a year.

While immersed in fieldwork earlier in life, Goodall recognized that lifting people out of poverty was integral to preserving biodiversity in the national park. Hence, she initiated the Tacare program, which offers microloans to kick-start sustainable businesses, scholarships for girls previously deprived of secondary education, and family-planning counseling. Additionally, farmers receive advice on chemical-free, sustainable farming practices, such as permaculture.

"I realized the reason the trees were cut down was because people were struggling to survive," reflects the scientist. "Their families were growing, and they couldn't afford to buy food from elsewhere. Their own farmland was infertile with overuse. And so they were cutting down the trees, either to make land, to grow food, or to make money from charcoal or timber."

It's only when individuals secure their own livelihoods that they're inclined to confront the repercussions of their actions and address their environmental impact. This shift in behavior is evident in villages surrounding the national park, where new technologies aid locals. With a simple mobile phone app, villagers can report illegal tree felling by capturing images of fallen trunks. This initiative, initially launched in 12 Gombe villages, now operates in 104 villages across Tanzania and six other African nations.

By stopping deforestation, chimpanzees are no longer forced to live in a confined territory cut off from the outside world. They have created corridors through which they can move freely and interact with other groups, promoting genetic exchange. Today, Gombe's chimpanzees are connected to their counterparts in neighboring Burundi and are more likely to survive.

A bit further north, in Uganda, Goodall tells us, there is a farmer involved in the Jane Goodall program. His primary livelihood comes from growing sugarcane. However, his farming activities have attracted the attention of chimpanzees, whose habitat and food sources are diminished by agriculture. In response, he decided to allocate a portion of his land near the rainforest surrounding his farm to cultivate crops favored by the chimpanzees. This way, the chimpanzees would have less incentive to raid his sugarcane fields.

"The locals now grasp that conservation benefits both wildlife and their own future," says the primatologist. Goodall is a staunch believer in the transformative power of grassroots efforts to safeguard our planet's biodiversity and secure a sustainable future for all.

She shares a cascade of uplifting examples of environmental stewardship. With them, one could paint a picture of human progress in preserving nature. Yet Goodall tempers this optimism with a sobering reality check.

"Take the United States, for example. Biden put back lots of regulations to protect wildlife. Trump has boasted that if he gets back in, he will open up the national parks to logging and mining. I mean, he's actually boasting about it," she says.

In Africa, China is increasingly active, investing in rapid road-building, dams, and mineral extraction at the expense of the environment and space for wildlife.

"Funnily enough, within China, they're ahead in solar power development. They're now very passionate about protecting their own environment," says Goodall. "We can always blame China, but what they're doing is looking after their own environment and getting all the materials they need by harming other environments. But that's what colonial powers did, and that's what big business is still doing. America gets its raw materials by going and mining in other countries, the developing countries."

Nor do all the leaders of African countries themselves often have sustainability in mind. In the more than six decades that Jane Goodall has been going to Tanzania, she has seen six presidents. "The previous president [John Magufuli, in office 2015 to 2021, nicknamed Bulldozer] was a nightmare," she complains. Most important to him, Goodall says, was the construction of roads and a dam and hydroelectric project on the Rufiji River, a UNESCO World Heritage Site. A wave of resentment rose against the plan, but the government warned that anyone opposing the project would go to jail.

As Goodall looks around the world, she watches with concern as the political pendulum swings towards the far right, which she says means environmental issues are likely to be sidelined. She disagrees with the notion that unlimited economic development can be achieved on a planet with limited natural resources and a growing population, not only of humans, but also of farmed animals. "It doesn't make sense, it's not sustainable," she says.

On the other hand, she doesn't entirely condemn tourism, a big part of the global economy. To a limited extent, and if well managed, she says, it brings livelihoods to local people and money to national budgets.

Her fascination with chimpanzee research persists, and she closely monitors the next generation of scientists advancing her pioneering work. "I learned just the other day something I never knew before," she says. In Senegal, amid a parched environment, chimpanzees demonstrate a remarkable adaptation: They frequent watering holes, ingeniously filtering muddy water through hollowed-out holes in roots and vegetation.

"They've got a film of it, which I saw last week. I've never seen it before. But then think of what we're learning about other animals. The octopus, so intelligent. Crows, who can solve problems faster than children. You know —there's so much like that."

This interview was originally published by [WIRED Czech Republic and Slovakia](#).

By João Medeiros
Science
Jul 5, 2024 3:00 AM

Health Care Should Be Designed for the Extremes of Life

Much of health care is designed with the "comfortable middle" of society in mind, says designer Yves Behar, when it should be tailored to children, the elderly, and those with disabilities.
PHOTOGRAPH: David Vintiner

"The adoption of new ideas and the pace of change in health care can lag behind other innovations that consumers experience every day," says Yves Behar, an industrial designer and founder of design firm fuseproject. People, Behar continues, become frustrated when they contrast their experience in clinics and hospitals versus, for instance, the consumer experience they have at an Apple Store. Behar's belief that design can have a positive impact in people's lives leads him to focus on what he calls "designing for extreme audiences," such as children, the elderly, neurodivergent, and mobility-impaired people.

"Much of design addresses the comfortable middle part of life when you're happy, healthy, and have money," he says. "For me, design is most needed when change is most extreme." One example is Moxie, an AI learning robot companion intended for autistic and neurodivergent youngsters. "It turned out to be incredibly useful for all kids, especially during Covid," Behar says.

Since its launch in 2022, Moxie has had over 4 million conversations with children, with a reported 71 percent improvement in social skills such as assertiveness, social engagement, and self-control for those who regularly play with it. Another fuseproject invention—and Behar's favorite—is the SNOO robotic bassinet. The bassinet mimics renowned pediatrician Harvey

Karp's method for soothing babies, which involves swaddling, shushing, and swinging.

"The AI recognizes when the baby is fussing and screaming, and starts creating the noise and the movement in response," Behar says. "It's the first and only medical device that has received approval from the FDA for its ability to keep sleeping babies safely on their backs and avoid SIDS [sudden infant death syndrome]."

This article appears in the July/August 2024 issue of WIRED UK magazine.

By [João Medeiros](#)
[Science](#)
Jul 3, 2024 4:00 AM

The UK's NHS Going Digital Would Be Equivalent to Hiring Thousands of New Doctors

More than 30 million Brits have the NHS app. This represents an opportunity to transform the health service, which shadow health secretary Wes Streeting calls "an analog system in a digital age."
PHOTOGRAPH: UK PARLIAMENT

In December last year, the UK's shadow health secretary, Wes Streeting, visited Singapore General Hospital, regarded as one of the best in the world. What he witnessed there surprised him: "Patients arrive having already registered their appointments via an app. They check in on touchscreen kiosks awaiting them at reception. Tablets at their bedside allow them to read about their treatment or call for assistance," Streeting says. "This is Space Age stuff compared with where the NHS is today." Streeting characterizes the National Health Service as an "analog system in a digital age."

"When I visit a hospital, doctors often take out their pagers to show me what they are forced to work with," Streeting says. According to estimates, [13.5 million hours of GPs' time is wasted every year](#) due to inadequate IT. Fixing that would be the equivalent of hiring 8,000 new NHS doctors. "For the past 14 years, modernization of the NHS has been put on the back burner by a Conservative government which opts for sticking plasters instead of the major surgery that's required," says Streeting, who added that he fears that five more years of Tory mismanagement could mean the NHS

ends up like the [failed British retailer Woolworths](#)—"a much-loved national institution which failed to change with the times and was left behind."

Central to Streeting's plan to fix the NHS is the NHS app, which has been downloaded by [31 million people in England and Wales](#). "It has the potential to transform how the NHS interacts with patients and promote better public health," he says. He points out that, for instance, only one in every 200 GP appointments are currently made via the app. "In too many cases, patients still wait on the phone at 8 am, or even queue up in person in the cold on a frosty morning just to see a doctor."

WIRED asked voters in the UK general election if they're able to spot misinformation and disinformation from their representatives.

The NHS app could not only allow appointments to be made, but also let patients receive notifications about vaccine campaigns, health tests, cancer screening, and even upcoming clinical trials. "Clinical trials can use genomics to identify patients who will benefit from the latest treatments, but they struggle to recruit—not for a lack of people willing to take part, but because they can't access basic data," he said. He promised that Labour would clamp down on bureaucracy and allow clinical trials to recruit volunteers via the app. "During the pandemic, half a million people signed up to the vaccine trials registry," he says. "If we can do it to defeat [Covid](#), we can do it to cure [cancer](#)."

At the core of Labour's plan is patient data. Recently, the NHS has announced the launch of a federated data platform that would centralize hospital data, but would not include general practice or social care data. "The NHS has struck gold here, yet it's leaving it in the ground," Streeting says. "General practice data is key to unlocking better population health outcomes."

Streeting promises that a Labour government would ensure a transparent process about what aspects of patient data would be shared and with whom, as well as the necessary safeguards to ensure patient confidentiality. As for those who oppose it on the grounds of privacy concerns, he has a simple message: "It's a fight that a Labour government is willing to have," he says. "While the tinfoil hat brigade takes to TikTok to urge followers to opt out of

sharing their data with the NHS—the irony isn't lost on me—the government refuses to take on their fear mongering."

He recalled when, last January, he met the parents of a 2-year-old boy at Alder Hey Children's Hospital in Liverpool. "They have been through hell," he says. "In his short life, he has already had five operations on his heart." When he asked them what their main frustration had been, however, the answer surprised him: technology. "Their local GP couldn't access the notes from Alder Hey and the hospital couldn't read the records held by their GP. It meant that on every appointment they had to repeat themselves again and again. The health service should be lessening their worry, not adding to their stress."

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By [João Medeiros](#)
[Science](#)
Jul 2, 2024 3:00 AM

Sexist Myths Are a Danger to Health

To improve outcomes for female patients, all evidence needs to be considered—while outdated myths about the significance of sex differences need to be retired.
PHOTOGRAPH: David Vintiner

In 2013, the US Food and Drug Administration made an unprecedented recommendation, advising that women should receive a lower dosage of the insomnia drug zolpidem than men. The rationale behind it was that medication seemed to affect women for longer periods, which could become a safety issue.

However, in 2019, research conducted at Tufts University concluded that the differential effect of the medication had [nothing to do with sex](#). Rather, researchers found that what determined the rate at which the person cleared the drug from their system was their body size. The report concluded that the reduced prescribed dosage for women could in fact lead to underdosing and a failure to effectively treat insomnia. "They were using sex as a proxy for body size because we tend to collect data about sex; we don't collect data about body size," says Angela Saini, author of *The Patriarchs: How Men Came to Rule*. "This is the perverse way that sometimes medicine works: You base your diagnostics on the data you have rather than the data you need."

Indeed, Saini argues that many of the prevailing gaps in health outcomes between men and women have nothing to do with biological sex. "It can be so tempting for scientists to look at a gap and want to find a simple

biological explanation for it, but when it comes to gender and health those simple explanations often don't exist," she said.

Of course, sex differences do exist in aspects of health, such as reproductive health and physiology. However, what research suggests is that, in most cases, the health-related difference between men and women—from disease symptoms to drug efficacy—is really quite marginal. "The differences that do exist are down to gender," Saini says. "Differences in the way people are treated and thought about and the assumptions we make about them." That, according to Saini, is what explains many of the failures when it comes to women's health.

Consider, for instance, the common misconception that women present atypical heart-attack symptoms, different from men's. This prevailing myth was quashed by a 2019 study, funded by the British Heart Foundation, at the University of Edinburgh. The research, which involved nearly 2,000 patients, showed that, in fact, 93 percent of both sexes reported chest pain—the most common symptom—while a similar percentage of men and women (nearly 50 percent) also felt pain radiating from their left arm. "The problem of underdiagnosis of women is because health professionals and even the women themselves who are having a heart attack believe heart attacks are something that mostly happens to men," Saini says. Estimates indicate that differences in care for women have led to approximately 8,200 avoidable deaths due to heart attacks in England and Wales since 2014.

"It's not about men discriminating against women; this is often about women not being listened to—sometimes by other women," she says. Another example that starkly illustrates how gender can affect health outcomes came from a 2016 Canadian study about patients who had been hospitalized with acute coronary syndrome. The research showed that the patients who experienced higher rates of recurrence were the ones who performed gender roles stereotypically associated with women—like doing more housework and not being the primary earner at home—independently of whether they were a man or a woman. "This was because people who carried out a female social role were more likely to be anxious." Saini says.

If these disparities are caused by the way patients are perceived and treated, the solution, to Saini, is clear: "We need to be careful to diagnose the

problem where it is, not where we imagine it to be." She highlights the successful work of [Jennie Joseph](#), a British midwife who, in 2009, founded the Commonsense Childbirth School of Midwifery in Orlando, Florida, to support women without access to maternal health care. Research has shown that Black mothers, both in the US and in the UK, are three times more likely to die than white women.

"Joseph lowered maternal mortality rates among minority women simply by improving the quality of their care, listening to their concerns, and responding when they say they're in pain," Saini says. "We don't need technology to solve this issue. We just very simply can't allow our biases and prejudices to get in the way."

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By [João Medeiros](#)
[Science](#)
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Aging Might Not Be Inevitable

There are biological underpinnings to aging—and so researchers are investigating cell manipulations, transfusions of young blood, and chemical compounds that can mimic low-calorie diets.
PHOTOGRAPH: David Vintiner

In 1997, a French woman named Jeanne Calment died at the age of 122. She was the world's oldest verified person, according to the Gerontology Research Group. Her daily habits included drinking a glass of port wine and smoking a cigarette after meals (she also ate 2.5 pounds of chocolate every week). "Nobody else has lived past 120 since she died," says [Venki Ramakrishnan](#), the Nobel Prize–winning biologist and author of *Why We Die*. Indeed, while the number of centenarians is increasing every year, the number of people living past 110 is not. "This suggests that maybe there's a natural limit to human lifespan."

If such a limit exists, it's one imposed by biological evolution. "Evolution wants to make sure that your genes have the maximum likelihood of being passed on," Ramakrishnan says. "It doesn't care about how long you live." This explains, for instance, why there seems to be a correlation between the size of animals and their life expectancy—in general, the larger the species, the longer it will live. Most mayflies live between one and two days. Monarch butterflies can live for months. Bowhead whales live more than 200 years. Greenland sharks may live more than 500 years. "If you're a smaller species, there's no point spending a lot of resources maintaining and repairing the body because the likelihood of being eaten or starved to death are high," says Ramakrishnan. "Larger species, on the other hand, will have the advantage of more time finding mates and producing offspring."

A few species, however, seem to be exempt from this rule. The hydra, a small freshwater animal with 12 tentacles, doesn't seem to age at all. The immortal jellyfish can even age backward. "It suggests that aging is not inevitable and that we might be able to circumvent our natural limits if we alter our biology," Ramakrishnan says.

That is why understanding the biological underpinnings of why we age and die is such a [hot topic of research today](). Scientists are trying to find out how to manipulate cellular aging processes—for instance, how to destroy senescent cells (aged cells that cause inflammation), or how to reprogram cells to revert them to an earlier state of development. Over the past decade, more than 300,000 scientific papers about aging have been published, while billions of dollars have been funneled into more than 700 longevity startups, including Altos Labs, Human Longevity, Elysium Health, and Calico.

One of the most promising avenues of research involves the discovery of chemical compounds that can mimic the effects of a low-calorie diet, which is recognized as one of most well-established ways to slow down aging. One such compound is rapamycin, first discovered on the soil of Easter Island, due to its antifungal properties. "Later they found out that it was also a potent antitumor and anti-inflammatory," Ramakrishnan says. "It's also immunosuppressant, so it can also make people prone to infection and slow down wound healing. We need to find that sweet spot between not having the side effects and having just the [anti-aging] benefits."

Longevity researchers are also familiar with a body of research that shows that young blood can rejuvenate old bodies—in mice, at least. This discovery came about when researchers first surgically connected the circulatory system of a young and old mouse—a technique called parabiosis —and observed that this procedure slowed down the symptoms of aging, lengthening the lifespan of the older animal by 10 percent. Ramakrishnan notes that while scientists are still trying to identify the factors in young blood that cause this effect, "there are companies that jumped the gun and started offering young plasma to billionaires."

"While we're waiting for all these things to happen there are things we can do." Ramakrishnan notes. "This is likely similar to the advice your

grandparents gave you. Eat moderately, eat healthy diets, get enough sleep and exercise. It turns out that each of those affects the other two so it's really a virtuous cycle. If you do all of them at once, it works better than any medicine on the market, it has no side effects, and it's free."

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By [João Medeiros](#)
[Science](#)
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With AI Tools, Scientists Can Crack the Code of Life

Google's AI research lab DeepMind is steadily building knowledge of how genes and their products work inside the body—and how and why they sometimes go wrong.
PHOTOGRAPH: David Vintiner

In 2021, AI research lab [DeepMind](#) announced the development of its first digital biology neural network, [AlphaFold](#). The model was capable of accurately predicting the 3D structure of proteins, which determines the functions that these molecules play. "We're just floating bags of water moving around," says Pushmeet Kohli, VP of research at DeepMind. "What makes us special are proteins, the building blocks of life. How they interact with each other is what makes the magic of life happen."

AlphaFold was considered by the journal Science as the breakthrough of the year in 2021. In 2022, it was the [most cited research paper in AI](#). "People have been on [protein structures] for many decades and were not able to make that much progress," Kohli says. "Then came AI." DeepMind also released the [AlphaFold Protein Structure Database](#)—which contained the protein structures of almost every organism whose genome has been sequenced—making it freely available to scientists worldwide.

More than [1.7 million researchers in 190 countries](#) have used it for research ranging from the design of plastic-eating enzymes to the development of more effective malaria vaccines. A quarter of the research involving AlphaFold was dedicated to the understanding of cancer, [Covid-19](#), and neurodegenerative diseases like Parkinson's and Alzheimer's. Last year, DeepMind released its next generation of AlphaFold, which extended its

structure prediction algorithm to biomolecules like nucleic acids and ligands.

"It has democratized scientific research," Kohli says. "Scientists working in a developing country on a neglected tropical disease did not have access to the funds to get the structure of a protein computed. Now, at the click of a button, they can go to the AlphaFold database and get these predictions for free." For instance, one of DeepMind's early partners, the Drugs for Neglected Diseases Initiative, used AlphaFold to develop medicine for diseases that affect millions—such as sleeping sickness, Chagas disease, and leishmaniasis—yet receive comparatively little research.

DeepMind's latest breakthrough is called AlphaMissense. The model categorizes the so-called missense mutations—genetic alterations that can result in different amino acids being produced at particular positions in proteins. Such mutations can alter the function of the protein itself, and AlphaMissense attributes a likelihood score for that mutation being either pathogenic or benign. "Understanding and predicting those effects is crucial for the discovery of rare genetic diseases," Kohli says. The algorithm, which was released last year, has classified around 89 percent of all possible human missense. Before, only 0.1 percent of all possible variants had been clinically classified by researchers.

"This is just the beginning," Kohli says. Ultimately, he believes AI could eventually lead to the creation of a virtual cell that could radically accelerate biomedical research, enabling biology to be explored in-silico rather than in real-world laboratories. "With AI and machine learning we finally have the tools to comprehend this very sophisticated system that we call life."

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By [João Medeiros](#)
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Air So Polluted It Can Kill Isn't Being Taken Seriously Enough

Toxic air kills over half a million children every year, yet only once has air pollution been listed as a cause of death on a death certificate. PHOTOGRAPH: David Vintiner

In 2010, three months before her seventh birthday, Ella Roberta suddenly developed a chest infection and a severe cough. Her mother, Rosamund Adoo-Kissi-Debrah, took her to the local hospital in Lewisham, South East London, where she was initially diagnosed with asthma.

In the following months, she got worse and began suffering from coughing syncope—coughing episodes so violent that they caused her to black out due to a lack of blood supply to the brain. "She had one of the worst cases of asthma ever recorded," Kissi-Debrah recalls. "They didn't really know what was wrong as she didn't present as a normal asthmatic. They tested her for everything, from epilepsy to cystic fibrosis. Her condition was extremely rare." So rare, in fact, that Kissi-Debrah couldn't find a single case of a child suffering a cough from coughing syncope in the scientific literature. "It was only common in long-distance lorry drivers," she says.

In the next three years, Ella was admitted to hospital about 30 times. On February 15, 2013, shortly after her ninth birthday, she suffered a fatal asthma attack.

Her original death certificate stated that she had died from acute respiratory failure. "At the inquest, it was established that some of it might be due to 'something in the air,'" Kissi-Debrah says. None of the medical experts consulted had mentioned the possibility that air pollution could have

triggered Ella's syncope. That possibility came to light only after Kissi-Debrah was contacted by a reader of the local newspaper who had read about her story and suggested that she check the air pollution levels on the day Ella died. Indeed, that day the levels of nitrogen dioxide caused by the traffic on heavily congested South Circular Road, near where they lived, had far exceeded set limits.

With the assistance of her lawyer, Kissi-Debrah applied to the High Court to quash the verdict of the first inquest and request a second one, which was one granted. "My lawyer, Jocelyn, outlined on a graph all the times Ella had been admitted to the hospital, and then she got the data from the monitors near the house," Kissi-Debrah recalls. The pattern was clear: There was a spike in air pollution prior to Ella experiencing coughing syncope. "Twenty-seven out of 28 times. As far as I'm concerned, that's scientifically significant." Furthermore, they showed that, on average, dioxide emissions and particulate matter levels in Lewisham far exceeded World Health Organization (WHO) guidelines.

After nine days of deliberation, the inquest [concluded](link) that "Ella died of asthma contributed to by exposure to excessive air pollution." It added: "Ella's mother was not given information about the health risks of air pollution and its potential to exacerbate asthma. If she had been given this information she would have taken steps which might have prevented Ella's death." The cause of death on Ella's death certificate was amended. To this date, she remains the only person in the world to have air pollution on her death certificate.

Given the evidence at the inquest, the coroner also issued a [Prevention of Future Deaths Report](link), which had a series of recommendations, such as ensuring that national air pollution levels be in line with WHO guidelines, that the public in England and Wales be made aware of the risks of air pollution, and that health professionals be educated on the health impacts of air pollution and inform patients accordingly.

"The coroner felt that other children were at risk of dying," Kissi-Debrah says. "He made it very clear, actually, that unless the air was cleaned up, more children would die."

Currently, [600,000 children worldwide die](#) every year from breathing polluted air. In London alone, a [quarter of a million](#) children suffer from asthma. "The only time in this country no child has died from asthma was during the first lockdown," Kissi-Debrah says. Ten years on from the death of her daughter, she continues to campaign for the legal right to clean air. As part of her campaign, she is lobbying for the approval of the Clean Air Bill in the UK, also known as Ella's law: a parliamentary bill that establishes the right to breathe clean air.

"It is our right to breathe clean air, and it is the government's duty to clean up the air and ensure that the UK targets are in line with WHO targets, as currently, they are not," she says. "This isn't a party political issue. It's about our health. It's about our future."

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By João Medeiros
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Boring Architecture Is Starving Your Brain

Thomas Heatherwick believes architecture has a "nutritional value" to society—and that the public desperately deserve a better offering. PHOTOGRAPH: David Vintiner

Designer Thomas Heatherwick thinks the construction industry is in a crisis. "We've just got so used to buildings that are boring," says the man behind London's revived Routemaster bus, Google's Bay View, and New York's Little Island. "New buildings, again and again, are too flat, too plain, too straight, too shiny, too monotonous, too anonymous, too serious. What happened?" While those features can often be aesthetically appropriate on their own, Heatherwick notes that it's the relentless combination of them in the aesthetics of modern buildings and urban spaces that makes them overwhelmingly boring.

This boredom, he adds, isn't just a nuisance—it can actually be harmful. "Boring is worse than nothing," Heatherwick writes in his latest book, *Humanize*. "Boring is a state of psychological deprivation. Just as the body will suffer when it's deprived of food, the brain begins to suffer when it's deprived of sensory information. Boredom is the starvation of the mind."

This isn't just a matter of opinion. Heatherwick cites, for instance, the research of Colin Ellard, a cognitive neuroscientist at the University of Waterloo who studies the neurological and psychological impact of the built environment. In his experiments, Ellard has shown that people's moods were considerably affected when surrounded by tall buildings. In one experiment, he collected data from wearable sensors that tracked skin conductance response, a measure of emotional arousal. When people pass

by a boring building, Heatherwick says, "their bodies literally go into a fight-or-flight mode. They have nothing for their mind to connect to."

The brain, Heatherwick argues, craves complexity and fascination. "There's a reason why, when you look out into a forest, nature's complexity and rhythms restores our attention back," he says. "We need that in buildings. Less is not more." This is backed by the research of psychologists Rachel and Stephen Kaplan, who in the 1980s developed Attention Restoration Theory, which posited that people's concentration improves when spending time in natural environments.

"We haven't been paying attention to the nutritional value to society of the buildings that are around us," Heatherwick says. He believes, for example, that architects now prefer to prioritize the internal spaces of a building, while neglecting what the building looks like from the outside. This is a mistake. "Buildings are the backdrop of society's life," he says. "A thousand times more people will go past this building than will ever come inside it. The outside of that building will affect them and contribute to how they feel." Ultimately, to humanize our urban spaces, architects need to think about the people that inhabit them. Heatherwick recalls a debate of elite people in the construction industry a few years ago about whether the opinion of the public mattered. "We debated all night and then they voted that they didn't. It was unbelievable."

Such short-term thinking is leading to what Heatherwick calls "the dirty secret of the construction industry": its disastrous environmental impact. Just consider, for instance, that in the US, 1 billion square feet of buildings are demolished every year. "That's half of Washington, DC, destroyed, just to get rebuilt after with the same sort of boring buildings," he says. In the UK, 50,000 buildings a year are demolished, with the average age of a commercial building being around 40 years. "If I were a commercial building, I would have been killed 14 years ago," he says. "To build a tower in the city of London, which by global standards isn't that big, takes the equivalent of 92,000 tons of carbon emissions." As a result of this, estimates show that the construction industry now emits five times more greenhouse gases into the atmosphere than aviation.

"We can't have buildings that are only here for 40 years. We need thousand-year thinking," he says. "The world of construction teaches you that form follows function, less is more, ornament is a crime. It's powerful, and when you're studying, that goes in your brain and brainwashes you." But Heatherwick reminds us that emotion is a function, and one that should be celebrated in the world of construction.

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By João Medeiros
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Revolutionary Alzheimer's Treatments Can't Help Patients Who Go Undiagnosed

It's a question of when, not if, highly effective treatments become available, says the CEO of Alzheimer's Research UK. But that doesn't solve the problem of one-third of dementia patients still going undiagnosed. PHOTOGRAPH: David Vintiner

"The statistics are frightening: Dementia is the biggest killer in the UK. It has been the leading cause of death for women since 2011," says Hilary Evans, CEO of Alzheimer's Research UK and cochair of the UK Dementia Mission. "One in two of us will be affected by dementia either by caring for someone with the condition or developing it ourselves."

There are reasons for optimism, however, with Alzheimer's researchers achieving extraordinary breakthroughs in the treatment of the disease. In May 2023, drugmaker Lilly announced that its new Alzheimer's drug, donanemab, slowed cognitive decline by 35 percent; in 2022, another drug, lecanemab, registered similarly promising results. "For a long time, dementia research has been a costly, even hopeless cause," Evans says. "But we are now at this real tipping point for change with the arrival of the first ever Alzheimer's drugs that tackle the root cause of the disease rather than just the symptoms." Donanemab and lecanemab act as antibodies, clearing the amyloid plaques that form in Alzheimer's patients' brains.

"Like many first-generation treatments, however, the benefits are modest and also come with serious side effects," Evans says. "We need to look back at how we started off the first generation of treatments for diseases like

[HIV](#), which often had limited efficacy and difficult side effects, but paved the way for combination medicines that have revolutionized outcomes for the next generation of people with the condition."

Evans has reasons for optimism. Currently, there are [more than 140](#) clinical trials ongoing for a variety of potential Alzheimer's treatments, ranging from compounds capable of removing toxic proteins to drugs that can restore the function of damaged brain cells. "I'm in my mid-forties and I really think our generation will benefit from the progress that we are now witnessing," says Evans. "Developing safer and more effective drugs is really a matter of when and not if."

Evans, however, is concerned that these new treatments will remain out of reach for patients if they can't receive a timely and accurate diagnosis. [Recent research in the New England Journal of Medicine](#) also showed that someone can be in the early stages of Alzheimer's 20 years before the onset of detectable symptoms. "New treatments will rely on the diagnosis of people earlier on in the disease," Evans says. Furthermore, diagnosis of the disease in the population remains woefully inadequate. "It hasn't changed in over two decades," Evans says. Pen-and-paper cognitive tests remain the most common diagnostic method; [only 2 percent of patients undergo the gold standard test](#)—lumbar puncture and PET brain scans.

Even though the UK government has set a national dementia diagnosis target at [67 percent of patients](#), that target is missed in many parts of the country. Those patients who do get a diagnosis have had to wait on average two years; for patients under 65, that waiting time goes up to four years. "One in three people with dementia in England never get a diagnosis at all," Evans says. "This isn't something we would accept in any other health condition."

This could be changed by the introduction of accurate digital cognitive tests, for instance, which would allow patients to be evaluated in real-time and access care faster. Researchers at Moorfields Eye Hospital are also [developing AI algorithms](#) which could potentially screen for signs of Alzheimer's disease in the eye. "The retina is a particularly attractive target because it's closely related to brain tissue and can be examined noninvasively during routine eye checks," Evans says.

Alzheimer's UK is also supporting research to find blood biomarkers for the disease. "Research has shown that a blood test could be as effective as a standard lumbar puncture and a brain scan, and it could be used as an initial triaging tool," she says. "People are naturally much keener to take a blood test than something that's very invasive. This could revolutionize the way that dementia is diagnosed."

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By João Medeiros
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Post-Pandemic Recovery Isn't Guaranteed

The aftermath of a disaster like Covid can be divided into roughly three stages: the honeymoon, the slump, and the uptick. The aim is always to build back better—but in some cases that never happens.
PHOTOGRAPH: David Vintiner

Lucy Easthope, one of the UK's top experts in disaster planning, has advised the UK government on major international incidents such as 9/11, the Grenfell Tower fire, the war in Ukraine and, of course, the Covid pandemic. "If you were a pandemic planner in 2020, then there have been few surprises over the past few years," Easthope says. "In those pandemic plans we wrote a reasonable worst-case scenario—and now we get to live it."

Emergency planners such as Easthope know that the aftermath of a disaster can usually be divided roughly into three stages: the honeymoon ("Or, as we call it now, lockdown one"), the slump, and the uptick. "We're still in the slump," she says, of the UK. "We've reached a stage where all signs of institutional collapse are here. Basic reliance on the health care system for the most privileged is now gone. Failure gets talked about loudly."

However, Easthope warns that the uptick, the stage when societies rebuild, isn't always guaranteed. "It's really important to have no issue be off the table and [to keep things] nonpolitical," she says. "To be very aware that the *Titanic* can sink, and to leave the hubris at the door."

Disaster planning research, for instance, shows that the post-pandemic mental health crisis will continue for the next 30 to 40 years, with an

increased prevalence of alcohol and drug abuse in affected communities. "Recovery after these sorts of events is not a spring, but the worst kind of endurance," Easthope says. "The only good thing that comes out of a disaster like a pandemic is that it creates one single opportunity to reexamine structures and institutions."

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By [Amelia Tait](#)
[Business](#)
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Before Smartphones, an Army of Real People Helped You Find Stuff on Google

Not too long ago, services like GOOG-411, 118 118 and AQA used actual humans to answer questions with witty responses and encyclopedic knowledge. Today's search engines could learn something.
Hayley Banfield answered calls for the UK-based service 118 118.Photograph: Gareth Iwan Jones

The Eiffel Tower is 330 meters tall, and the nearest pizza parlor is 1.3 miles from my house. These facts were astoundingly easy to ascertain. All I had to do was type some words into Google, and I didn't even have to spell them right.

For the vast majority of human history, this is not how people found stuff out. They went to the library, asked a priest, or wandered the streets following the scent of pepperoni. But then, for a brief period when search engines existed but it was too expensive to use them on your shiny new phone, people could call or text a stranger and ask them anything.

The internet first became available on cell phones in 1996, but before affordable data plans, accidentally clicking the browser icon on your flip phone would make you sweat. In the early 2000s, accessing a single website [could](#) [cost](#) you as much as a cheeseburger, so not many people bothered to Google on the go.

Instead, a variety of services sprang up offering mobile search without the internet. Between 2007 and 2010, Americans could call GOOG-411 to find

local businesses, and between 2006 and 2016, you could text 242-242 to get any question answered by the company ChaCha. Brits could call 118 118 or text AQA on 63336 for similar services. Behind the scenes, there were no artificially intelligent robots answering these questions. Instead, thousands of people were once employed to *be* Google.

"Some guy phoned up and asked if Guinness was made in Ireland, people asked for the circumference of the world," says Hayley Banfield, a 42-year-old from Wales who answered 118 118 calls from 2004 to 2005. The number was first launched in 2002 as a directory enquiries service—meaning people could call up to find out phone numbers and addresses (back then calls [cost](#) an average of 55 pence). In 2008, the business started offering to answer *any* questions. Although Banfield worked for 118 118 before this change, customers would ask her anything and everything regardless. "We had random things like 'How many yellow cars are on the road?'"

While directory enquiry lines still exist, Banfield worked during their boom —she answered hundreds of calls in her 5:30 pm to 2 am shifts—and quickly noticed patterns in people's queries. "Anything past 11 pm, that's when the drunk calls would come in," she says. People wanted taxis and kebab shops but were so inebriated that they'd forget to finish their sentences. Sometimes, callers found Banfield so helpful that they invited her to join them on their nights out. As the evening crept on, callers asked for massage parlors or saunas—then they would call back irate after Banfield recommended an establishment that didn't *meet their needs*.

The "pizza hours" were 8 pm to 10 pm—everyone wanted the number for their local takeout. Banfield had a computer in front of her in the Cardiff call center, loaded with a simple database. She'd type in a postcode (she had memorized all of the UK's as part of her training) and then use a shortcut such as "PIZ" for pizza or "TAX" for taxi. People sometimes accused Banfield of being psychic, but if the power had gone out in a certain area, she automatically knew that most callers wanted to know why.

Around the same time Banfield was answering calls, Paul Cockerton was answering texts. The 54-year-old cofounded AQA 63336 in 2002; the acronym stood for "any question answered," and texts originally cost £1

each. When the business launched, Cockerton and just five others would answer questions. They'd look in books and encyclopedias, search the web, and do their own calculations to try and answer each message in a maximum of 10 minutes.

Paul Cockerton cofounded AQA 63336 in 2002. The service promised to answer any questions via SMS.

Photograph: Craig Gibson

The company decided that it must always give an answer, even if someone texted asking if they should dump their boyfriend. "Stylistically, we were only allowed to say yes or no," says Cockerton, who now lives in the English village Croxley Green. "So we'd say, 'Yes, you should dump your boyfriend if you've been thinking about it for a while and it's not working out. No regrets. Move on.'"

At its peak, AQA 63336 employed 1,400 researchers to answer questions—students and mums could work from home, getting paid by the answer. Gradually, the business built up a database of common Q&As, and like Banfield, Cockerton noticed patterns—a flurry of trivia-related texts during pub quizzing hours or requests for chat-up lines as the night went on. Yet it is the anomalous texts that are the most memorable.

"Me and my girlfriend are lost in a jungle," the message began. Two tourists in Thailand were embarrassed about getting stuck and decided to text AQA 63336 rather than call their family for help. "We called a nearby hotel, they found someone who spoke English, we spoke to them … they got the jungle rescue team out," Cockerton recalls with glee.

Gradually, the British media became enamored with the service, and in 2008 it was featured on an episode of *The Graham Norton Show.* Because many of the questions texted to the service were fundamentally silly—118's Banfield even enjoyed texting stupid questions with her friends while at the pub—answers were always designed to entertain. "There would obviously be questions that we physically couldn't answer, 'Where am I sitting?'" things like that," says Cockerton, "We worked out that the way to do it was to just make sure that they got a pound's worth of answer."

On air, Norton texted AQA 63336 with the question "Are baboons evil?" Seconds later, his phone pinged with a reply. "Yes, baboons are evil, anyone that steals your windscreen wipers while waving a red bum in your face is the work of the dark side."

After the segment aired, AQA 63336's systems were flooded with 20,000 questions (half of which were, "Are baboons evil?"). But not all of Cockerton's and Banfield's memories are funny. She recalls dealing with at least 20 suicidal callers—company policy meant she had to direct them to the emotional support charity Samaritans. (This was also AQA 63336's policy.) Cockerton recalls that during the 7/7 London bombings, numerous people asked why the tube wasn't running. "People were texting us, 'How can I get home?.' We were effectively a Citymapper."

Two years later in 2007, the iPhone launched—with Google's search bar [built in](#)to its browser. Gradually, it became cheaper and easier for people to search on their phones, and by 2009, Cockerton noticed texts "begin to tail off quite fast." He and his cofounders sold the company to an Australian firm in 2010—today texts to the service go undelivered. 118 118 will no longer answer any question, but you can still call to ask for addresses and phone numbers (calls cost a whopping £2.43 a minute).

We now live in a strange era when customer service [robots pose as humans](#) and sometimes [humans even pose as robots](#)—in recent years, companies who claim to be powered by artificial intelligence have been found to be using real people behind the scenes. Either way, what has been lost since the era of the human search engine is the joy of a distinct voice—while we can now find out almost anything automatically, the answer won't be delivered with warmth or flair.

Am I really here? How many nipples does a bear have? Where did kissing originate? These are just some of the questions Cockerton fielded at AQA 63336. Banfield recalls trying to connect people with their long-lost relatives and once chatting about gardening with a lonely older gentleman. "Most of the time you felt transported into the caller's world," she says, "as they were lost or looking for hope on the end of the call."

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| Section menu | Main menu |

[Kyle MacNeill](#)
[Business](#)
Jun 17, 2024 8:00 AM

Orkut's Founder Is Still Dreaming of a Social Media Utopia

In the mid-2000s, Google engineer Orkut Büyükkökten's self-titled social network briefly took the world by storm before disappearing. Now he's back, with a plan for a happier social media.
Orkut Büyükkötken photographed at home in San Francisco in April 2024.Photograph: Carolyn Fong

In 2004, a month before Mark Zuckerberg launched Facebook from his Harvard dorm room, another social media site landed on the internet with a splash of hot pink. If you were online in the mid-2000s, you might remember Orkut, with its lurid logo, fingernail-sized profile pictures, and text-heavy, pastel-blue feeds. Unlike Zuckerberg, Jack Dorsey, or even Tom from MySpace, the site's founder managed to stay under the radar. You might not know that the man behind Orkut is also called Orkut.

Born in Konya, Turkey, Orkut Büyükkökten moved to Germany at the age of 1. A childhood obsession with *Star Wars* led him to study computer science at Stanford, where, upon noticing that people tended to socialize in their dorms rather than venturing out on campus, he launched the first ever college social network, Club Nexus. "I noticed I met most of my friends through friends of friends," he says. "And I was like, what if we could meet people using the social graph?" He later developed a follow-up network, InCircle, designed for alumni. Mark Zuckerberg's Harvard version, Facebook, didn't arrive until three years later.

A meeting with Larry Page and Sergey Brin led Büyükkökten to a job as a frontend software engineer at Google. The tech giant offers a perk known as "20 percent time," where employees can spend a day a week on passion

projects. Still obsessed with helping people make friends, Büyükkökten used his time to start a new platform. "I wanted to create a global community that gave everyone around the world a way to connect," he says. Google gave it the green light and Büyükkökten developed the entire thing, even going to data centers to set up the servers.

Then came the name: Orkut. Branding a [social media](#) platform isn't easy—just look at X for an exceptional example of getting it wrong. But even the most megalomaniac, Muskian magnates don't have the chutzpah to use their own name. Büyükkökten, endearingly humble and softly spoken, promises it wasn't a show of egotism. Instead, it was a suggestion from Google. "I was in a meeting with Eric Schmidt [then CEO] and [Marissa Mayer](#) [then a VP, later CEO of Yahoo]. And they said, why don't you just name it Orkut? You're the only person who worked on it, it's a five-letter word, it's very unique, and you already own the domain," he says.

Orkut Büyükkökten photographed at home in San Francisco in April.

Photograph: Carolyn Fong

Before Orkut launched in January 2004, Büyükkökten warned the team that the platform he'd built it on could handle only 200,000 users. It wouldn't be able to scale. "They said, let's just launch and see what happens," he explains. The rest is online history. "It grew so fast. Before we knew it, we had millions of users," he says.

Orkut featured a digital Scrapbook and the ability to give people compliments (ranging from "trustworthy" to "sexy"), create communities, and curate your very own Crush List. "It reflected all of my personality traits. You could flatter people by saying how cool they were, but you could never say something negative about them," he says.

At first, Orkut was popular in the US and Japan. But, as predicted, server issues severed its connection to its users. "We started having a lot of scalability issues and infrastructure problems," Büyükkökten says. They were forced to rewrite the entire platform using C++, Java, and Google's tools. The process took an entire year, and scores of original users dropped off due to sluggish speeds and one-too-many encounters with Orkut's now-

nostalgic "Bad, bad server, no donut for you" error message.

Around this time, though, the site became incredibly popular in Finland. Büyükkökten was bemused. "I couldn't figure it out until I spoke to a friend who speaks Finnish. And he said: 'Do you know what your name means?' I didn't. He told me that *orkut* means multiple orgasms." Come again? "Yes, so in Finland, everyone thought they were signing up to an adult site. But then they would leave straight after as we couldn't satisfy them," he laughs.

Awkward double meanings aside, Orkut continued to spread across the world. In addition to exploding in Estonia, the platform went mega in India. Its true second home, though, was Brazil. "It became a huge success. A lot of people think I'm Brazilian because of this," Büyükkökten explains. He has a theory about why Brazil went nuts for Orkut. "Brazil's culture is very welcoming and friendly. It's all about friendships and they care about connections. They're also very early adopters of technology," he says. At its peak, 11 million of Brazil's 14 million internet users were on Orkut, most logging on through cybercafes. It took Facebook seven years to catch up. But Orkut wasn't without its problems (and many fake profiles). The site was banned in Iran and the United Arab Emirates. Government authorities in Brazil and India had concerns about drug-related content and child pornography, something Büyükkökten denies existed on Orkut. Brazilians coined the word *orkutização* to describe a social media site like Orkut becoming less cool after going mainstream. In 2014, having hemorrhaged users due to slow server speeds, Facebook's more intuitive interface, and issues surrounding privacy, Orkut went offline. "Vic Gundotra, in charge of Google+, decided against having any competing social products," Büyükkökten explains.

But Büyükkökten has fond memories. "We had so many stories of people falling in love and moving in together from different parts of the world. I have a friend in Canada who met his wife in Brazil through Orkut, a friend in New York who met his wife in Estonia and now they're married with two kids." he says. It also provided a platform for minority communities. "I was talking to a gay journalist from a small town in São Paulo who told me that finding all these LGBTQ people on Orkut transformed his life," he adds.

Büyükkökten left Google in 2014 and founded a new social network, again featuring a simple five-letter title: [Hello]. He wanted to focus on positive connection. It used "loves" rather than likes, and users could choose from more than 100 personae, ranging from Cricket Fan to Fashion Enthusiast, and then were connected to like-minded people with common interests. Soft-launched in Brazil in 2018 with 2 million users, Hello enjoyed "ultra-high engagement" that Büyükkökten claims surpassed the likes of Instagram and Twitter. "One of the things that stood out in our user surveys was that people said when they open Hello, it makes them happy."

The app was downloaded more than 2 million times—a fraction of the users Orkut enjoyed—but Büyükkökten is proud of it. "It surpassed all our dreams. There were numerous instances where our K-Factor (the number of new people that existing users bring to an app) reached 3, leading us to exponential growth," he says. But, in 2020, Büyükkökten bid goodbye to Hello.

Now he's working on a new platform. "It'll leverage AI and machine learning to optimize for improving happiness, bringing people together, fostering communities, empowering users, and creating a better society," he says. "Connection will be the cornerstone of design, interaction, product, and experience." And the name? "If I told you the new brand, you would have an aha moment and everything would be crystal clear," he says.

Once again, it's driven by his enduring desire to connect people. "One of the biggest ills of society is the decline in social capital. After smartphones and the pandemic, we have stopped hanging out with our friends and don't know our neighbors. We have a loneliness epidemic," he says.

He is fiercely critical of current platforms. "My biggest passion in life is connecting people through technology. But when was the last time you met someone on social media? It's creating shame, pessimism, division, depression, and anxiety," he says. For Büyükkökten, optimism is more important than optimization. "These companies have engineered the algorithm for revenue," he says. "But it's been awful for mental health. The world is terrifying right now and a lot of that has come through social media. There's so much hate," he says.

Instead, he wants social media to be a place of love and a facilitator for

meeting new people in person. But why will it work this time around? "That's a really good question," he says. "One thing that has been really consistent is that people miss Orkut right now." It's true—Brazilian social media has recently been abuzz with memes and memories to celebrate the site's 20th birthday. "A teenage boy even recently drove 10 hours to meet me at a conference to talk about Orkut. And I was like, how is that even possible?" he laughs. Orkut's landing page is still live, featuring an open letter calling for a social media utopia.

This, along with our collective desire for a more human social media, is what makes Büyükkökten believe that his next platform is one that will truly stick around. Has he decided on that all important name? "We haven't announced it yet. But I'm really excited. I truly care. I want to bring that authenticity and sense of belonging back," he concludes. Perhaps, as his Finnish fans would joke, it's time for Orkut's second coming.

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By [Morgan Meaker](#)
[Business](#)
Jun 14, 2024 6:00 AM

I Spent a Week Eating Discarded Restaurant Food. But Was It Really Going to Waste?

Food app Too Good To Go promises to cut waste by directing hungry bargain hunters to leftover restaurant food. But the week I spent living off the app had me wondering if Too Good To Go is too good to be true. ILLUSTRATION: DEREK ABELLA

It's 10 pm on a Wednesday night and I'm standing in Blessed, a south London takeaway joint, half-listening to a fellow customer talking earnestly about Jesus. I'm nodding along, trying to pay attention as reggae reverberates around the small yellow shop front. But really, all I can really think about is: What's in the bag?

Today's bag is blue plastic. A smiling man passes it over the counter. Only once I extricate myself from the religious lecture and get home do I discover what's inside: Caribbean saltfish, white rice, vegetables, and a cup of thick, brown porridge.

All week, I've lived off mysterious packages like this one, handed over by cafés, takeaways, and restaurants across London. Inside is food once destined for the bin. Instead, I've rescued it using [Too Good To Go,](#) a Danish app that is surging in popularity, selling over [120 million](#) meals last year and expanding fast in the US. For five days, I decided to divert my weekly food budget to eat exclusively through the app, paying between £3 and £6 (about $4 to $8) for meals that range from a handful of cakes to a giant box of groceries, in an attempt to understand what a tech company can teach me about food waste in my own city.

MONDAY

Breakfast: Full English and pastries from Novotel Hotel. *Cost: £4.50 (recommended retail price: £16.50)*

Lunch: Dahl curry, chicken nuggets, and raspberry lemonade from Leon. *Cost: £4.39 (RRP: £12)*

Dinner: Nothing (too full)

Users who open the TGTG app are presented with a list of establishments that either have food going spare right now or expect to in the near future. Provided is a brief description of the restaurant, a price, and a time slot. Users pay through the app, but this is not a delivery service. Surprise bags —customers have only a vague idea of what's inside before they buy—have to be collected in person.

I start my experiment at 9:30 on a Monday morning, in the glistening lobby of the Novotel Hotel, steps away from the River Thames. Of all the breakfast options available the night before, this was the most convenient— en route to my office and offering a pickup slot that means I can make my 10 am meeting. When I say I'm here for TGTG, a suited receptionist nods and gestures toward the breakfast buffet. This branch of the Novotel is a £200-a-night hotel, yet staff do not seem begrudging of the £4.50 entry fee I paid in exchange for leftover breakfast. A homeless charity tells me its clients like the app for precisely that reason; cheap food, without the stigma. A server politely hands over my white-plastic surprise bag with two polystyrene boxes inside, as if I am any other guest.

I open the boxes in my office. One is filled with mini pastries, while the other is overflowing with Full English. Two fried eggs sit atop a mountain of scrambled eggs. Four sausages jostle for space with a crowd of mushrooms. I diligently start eating—a bite of cold fried egg, a mouthful of mushrooms, all four sausages. I finish with a croissant. This is enough to make me feel intensely full, verging on sick, so I donate the croissants to the office kitchen and tip the rest into the bin. This feels like a disappointing start. I am supposed to be rescuing waste food, not throwing it away.

TUESDAY

Breakfast and Lunch: Loaf of bread and a cake from the Lumberjack Café.
Cost: £3.59 (RRP: £10.50)

Dinner: Vegan Ethiopian curry with injera bread from Light of Africa.
£5.00 (RRP: £15)

Over the next two days, I live like a forager in my city, molding my days around pickups. I walk and cycle to cafés, restaurants, markets, supermarkets; to familiar haunts and places I've never noticed. Some surprise bags last for only one meal, others can be stretched out for days. On Tuesday morning, my £3.59 surprise bag includes a small cake and a slightly stale sourdough loaf, which provides breakfast for three more days. When I go back to the same café the following week, without using the app, the loaf alone costs £6.95.

TGTG was founded in Copenhagen in 2015 by a group of Danish entrepreneurs who were irked by how much food was wasted by all-you-can-eat buffets. Their idea to repurpose that waste quickly took off, and the app's remit expanded to include restaurants and supermarkets. A year after the company was founded, Mette Lykke was sitting on a bus when a woman showed her the app and how it worked. She was so impressed, she reached out to the company to ask if she could help. Lykke has now been CEO for six years.

"I just hate wasting resources," she says. "It was just this win-win-win concept." To her, the restaurants win because they get paid for food they would have otherwise thrown away; the customer wins because they get a good deal while simultaneously discovering new places; and the environment wins because, she says, food waste contributes [10 percent](#) of our global greenhouse gas emissions. When thrown-away food rots in a landfill, it releases [methane](#) into the atmosphere—with homes and restaurants the two largest contributors.

WEDNESDAY

Breakfast: Leftover toast from Lumberjack Café.

Lunch: 2 cakes, 1 muffin, and 1 croissant from Clubhouse Café.
Cost: £3.17 (RRP: £9.50)

Dinner: A suspiciously coherent bacon, leek, and pesto pasta dish from Gorrillas.
Cost: £5.50 (RRP: £15.50)

But the app doesn't leave me with the impression I'm saving the planet. Instead, I feel more like I'm on a daily treasure hunt for discounted food. On Wednesday, TGTG leads me to a railway arch which functions as a depot for the grocery delivery app Gorillas. Before I've even uttered the words "Too Good To Go," a teenager with an overgrown fringe emerges silently from the alleys of shelving units with this evening's bag: groceries, many still days away from expiring, that suspiciously add up to create an entire meal for two people. For £5.50, I receive fresh pasta, pesto, cream, bacon, leeks, and a bag of stir-fry vegetables, which my husband merges into a single (delicious) pasta dish. It feels too convenient to be genuine waste. Perhaps Gorillas is attempting to convert me into its own customer? When I ask its parent company, Getir, how selling food well in date helps combat food waste, the company does not reply to my email.

I am still thinking about my Gorillas experience at lunchtime on Thursday as I follow the app's directions to the Wowshee falafel market stall, where 14 others are already queuing down the street. A few casual conversations later, I realize I am one of at least four TGTG users in the line. Seeing so many of us in one place again makes me wonder if restaurants are just using the app as a form of advertising. But Wowshee owner Ahmed El Shimi describes the marketing benefits as only a "little bonus." For him, the app's main draw is it helps cut down waste. "We get to sell the product that we were going to throw away anyway," he says. "And it saves the environment at the same time." El Shimi, who says he sells around 20 surprise bags per day, estimates using TGTG reduces the amount of food the stall wastes by around 60 percent. When I pay £5 for two portions of falafel—which lasts for lunch and dinner—the business receives £3.75 before tax, El Shimi says. "It's not much, but it's better than nothing."

THURSDAY

Breakfast: Saltfish, rice, vegetables from Blessed, picked up the night before.
Cost: £5.00 (RRP: £15)

Lunch: Falafel and vegetables in pita bread from Wowshee.
Cost: £5.00 (RRP: £15)

Dinner: Wowshee falafel again.

On Friday, my final day of the experiment, everything falls apart. I sleep badly and wake up late. The loaf from earlier in the week is rock solid. I eat several mini apple pies for breakfast, which were part of a generous £3.09 Morrisons supermarket haul the night before. Browsing the app, nothing appeals to me, and even if it did I'm too tired to face leaving the house to collect it. After four days of eating nothing but waste food, I crack and seek solace in familiar ingredients buried in my cupboard: two fried eggs on my favorite brand of seeded brown bread.

TGTG is not a solution for convenience. For me, the app is an answer for office lunch malaise. It pulled me out of my lazy routine while helping me eat well—in central London—for a £5 budget. In the queue for falafel, I met a fellow app user who told me how, before she discovered the app, she would eat the same sandwich from the same supermarket for lunch every day. For people without access to a kitchen, it offers a connection to an underworld of hot food going spare.

TGTG is one of those rare apps that actually enhances life beyond your phone. But the company could do a better job of quantifying for environmentally conscious users how much exactly their contributions help fight food waste, and to reassure them that the system can't be hijacked by restaurants simply trying to reach new customers. I can't see how many bags each establishment sells per day or what dent the app is making in a restaurant's pile of food destined for the bin. All I receive is a vague number telling me I've "avoided" 41 kilograms of CO_2, equivalent to 8,970, without being told what that number means or how exactly it's been calculated.

FRIDAY

Breakfast: Bread, strawberries, pears, apple pies, and oranges from Morrisons supermarket.
Cost: £3.09 (RRP: £10)

TOTAL COST = £39.24

TOTAL SAVINGS (estimated by the app): £69.76

On the day I'm due to finish this article, I go for one more Too Good To Go. This time the destination is a deli, a 15-minute walk from my office. I leave with a £5 polystyrene box—no bag this time—containing an eclectic mishmash of food from the salad bar, leftover from the lunchtime rush. Under a pile of vegetables, I discover pasta, rice, half a baked potato, and a chicken drumstick. The randomness of the selection makes it feel like food that would have really gone to waste and, satisfied, I walk as fast as possible back to the office to tuck in.

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Matt Reynolds

Science

Jun 7, 2024 7:00 AM

The World's Largest Fungus Collection May Unlock the Mysteries of Carbon Capture

Research is uncovering the key role that fungi play in getting soils to absorb carbon, and how humanity's actions aboveground are wreaking havoc in the mysterious fungal world below.
PHOTOGRAPH: DAVID WILMAN

It's hard to miss the headliners at Kew Gardens. The botanical collection in London is home to towering redwoods and giant Amazonian water lilies capable of holding up a small child. Each spring, its huge greenhouses pop with the Technicolor displays of multiple orchid species.

But for the really good stuff at Kew, you have to look below the ground. Tucked underneath a laboratory at the garden's eastern edge is the fungarium: the largest collection of fungi anywhere in the world. Nestled inside a series of green cardboard boxes are some 1.3 million specimens of fruiting bodies—the parts of the fungi that appear above ground and release spores.

Lee Davies, fungarium collections manager at the Royal Botanical Gardens, Kew, in London.

Photograph: David Wilman

"This is basically a library of fungi," says Lee Davies, curator of the Kew fungarium. "What this allows us to do is to come up with a reference of fungal biodiversity—what fungi are out there in the world, where you can

find them." Archivists—wearing mushroom hats for some reason—float between the shelves, busily digitizing the vast archive, which includes around half of all the species known to science.

In the hierarchy of environmental causes, fungi have traditionally ranked somewhere close to the bottom, Davies says. He himself was brought to the fungarium against his will. Davies was working with tropical plants when a staffing reshuffle brought him to the temperature-controlled environs of the fungarium. "They moved me here in 2014, and it's amazing. Best thing ever, I love it. It's been a total conversion."

Drying specimens preserves them for long-term study. These mushrooms were freeze-dried.

Photograph: David Wilman

Davies' own epiphany echoes a wider awakening of appreciation for these overlooked organisms. In 2020, mycologist Merlin Sheldrake's book *Entangled Life: How Fungi Make Our Worlds, Change Our Minds, and Shape Our Futures* was a surprise bestseller. In the video game and HBO series *The Last of Us*, it's a [fictional brain-eating fungus](#) from the genus *Cordyceps* that sends the world into an apocalyptic spiral. (The Kew collection includes a tarantula infected with Cordyceps—fungal tendrils reach out from the soft gaps between the dead arachnid's limbs.)

Emil Ghaffar, an MSc student, examining mycorrhizal fungi on plant roots under a microscope.

Photograph: David Wilman

While the wider world is waking up to these fascinating organisms, scientists are getting to grips with the crucial role they play in ecosystems. In a laboratory just above the Kew fungarium, mycologist Laura Martinez-Suz studies how fungi help [sequester carbon in the soil](#), and why some places seem much better at storing soil carbon than others.

Soil is a huge reservoir of carbon. There are around 1.5 trillion tons of organic carbon stored in soils across the world—about twice the amount of

carbon in the atmosphere. Scientists used to think that most of this carbon entered the soil when dead leaves and plant matter decomposed, but it's now becoming clear that plant roots and fungi networks are a critical part of this process. One study of forested islands in Sweden found that the majority of carbon in the forest soil actually came from root-fungi networks, not plant matter fallen from above the ground.

Ectomycorrhizal fungi on the roots of an oak tree, where it exists in a symbiotic relationship.

Photograph: David Wilman

Martinez-Suz's research focuses on mycorrhizal fungi—a large group of fungi that coexist with plant root systems. The mycorrhizal fungi form networks that can go around and sometimes inside plant roots, transferring nutrients and water to the plants in exchange for carbon. Around 90 percent of plant species are known to make these symbiotic trade networks with different species of fungi. "These plants are covered by these fungi. It's incredible. They are small but they are everywhere," says Martinez-Suz.

This has serious implications for tree-planting schemes. Planting new forests is a major hope for carbon sequestration, but there is increasing evidence that the mycorrhizal networks might be crucial to the success of these attempts. One replanting study found that a forest of birch and pine trees planted onto heath moorland in northern Scotland did not increase soil carbon stocks even after nearly 40 years in the ground. The researchers who carried out the study think that it might be because the influx of new trees upset the delicate moorland mycorrhizal networks already present.

"Replacing the complete set of fungi with other fungi has implications for long-term carbon sequestration in soil and biodiversity," says Martinez-Suz. Her current project involves comparing samples from forests in low-pollution sites like northern Finland with those in heavily polluted regions like Belgium and the Netherlands. The fungi in polluted regions are less diverse, she says, and this might have a knock-on effect on how well those forests store carbon.

The major culprit here is nitrogen pollution, which enters soils through burning fossil fuels for electricity and transport, and through agriculture. An excess of nitrogen changes the composition of soil fungi, so that the fungi that are the best at retaining nutrients and pumping carbon into the soil decrease.

But there is some hope that forests can turn things around. One study in the Netherlands found that when nitrogen pollution reduced, beneficial fungi species started to return to the forests. The danger, Martinez-Suz says, is that if ecosystems are pushed too far then there might not be any fungal spores remaining to boost populations.

If we're to better understand how these fungi influence critical ecosystems, then we need to get to grips with all of these species. Mycologists think that nearly 90 percent of the world's fungi species are still to be discovered, and the archivists at Kew are only halfway through the long process of digitizing their collection so that researchers can easily know where and when a species was found.

Around 5,000 extra specimens enter the fungarium each year, and the shelves are crammed with samples waiting to be dehydrated and stored. Many of them, Davies says, are sent by amateur mycologists who are fascinated by the world of fungi. "People in academic institutions like this will send them stuff to work on and do identifications, because they are world experts even though they have no formal training. They're just really obsessive. It's so cool."

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Updated 6-13-2024 3:00 pm BST: Story corrected to reflect tarantulas being arachnids, not insects.

[Emily Mullin](#)
[Science](#)
May 27, 2024 7:00 AM

WTF Is With the Pink Pineapples at the Grocery Store?!

Using DNA from tangerines and tobacco, food scientists have made a familiar fruit tastier—and more Instagrammable—than ever. We looked into it so you don't have to.
Photograph: Shawn Michael Jones

On a recent trip to Giant Eagle, my local grocery store in Pittsburgh, I noticed something new in the fruit section: a single pineapple packaged in a pink and forest-green box. A picture on the front showed the pineapple cut open, revealing rose-colored flesh. Touted as the "jewel of the jungle," the fruit was the Pinkglow pineapple, a creation of American food giant Fresh Del Monte. It cost $9.99, a little more than double the price of a regular yellow pineapple.

[WTF](#)
We looked into it so you don't have to.

I put the box in my cart, snapped a picture with my phone, and shared the find with my foodie friends. I mentioned that its color is the result of [genetic modification](#)—the box included a "made possible through bioengineering" label—but that didn't seem to faze anyone. When I brought my Pinkglow to a Super Bowl party, people oohed and aahed over the color and then gobbled it down. It was juicier and less tart than a regular pineapple, and there was another difference: It came with the characteristic crown chopped off. Soon enough, my friends were buying pink pineapples too. One used a Pinkglow to brew homemade tepache, a fermented drink made from pineapple peels that was invented in pre-Columbian Mexico.

At a time when orange cauliflower and white strawberries are now common sights in American grocery stores, a non-yellow pineapple doesn't seem all that out of place. Still, I wondered: Why now with the flashy presentation? And why pink? And why had my friends and I snapped it right up?

When I brought my questions to Hans Sauter, Fresh Del Monte's chief sustainability officer and senior vice president of R&D and agricultural services, he began by offering me a brief history of the fruit. You may assume, like I did, that pineapples have always been sweet and sunny-colored—but that wasn't the case prior to the 1990s. Store-bought pineapples of yesteryear had a green shell with light yellow flesh that was often more tart than sweet. Buying a fresh one was a bit of a gamble. "Nobody could tell, really, whether the fruit was ripe or not, and consumption of pineapples was mostly canned product, because people could trust what they would eat there," Sauter says. The added sugar in some canned pineapple made it a sweeter, more consistent product.

In 1996 the company introduced the Del Monte Gold Extra Sweet, yellower and less acidic than anything on the market at the time. Pineapple sales soared, and consumers' expectations of the fruit were forever changed. The popularity of the Gold led to an international pineapple feud when fruit rival Dole introduced its own varietal. Del Monte sued, alleging that Dole had essentially stolen its Gold formula. The two companies ended up settling out of court.

"This is a social food. This is to show off to other people. 'Hey, look what I have that you don't. This makes me cool, right?'"

With the success of its Gold pineapple, Del Monte was looking for new attributes that could make the pineapple even more enticing to consumers, Sauter says. But breeding pineapples is a slow process; it can take two years or longer for a single plant to produce mature fruit. Del Monte had spent 30 years crossbreeding pineapples with certain desired characteristics before it was ready to launch the Gold. Sauter says the possibility of waiting 30 more years for a new variety was "out of the question." So in 2005 the company turned to genetic engineering.

Del Monte didn't set out to make a pink pineapple per se, but at the time, Sauter says, there was interest from consumers in antioxidant-rich fruits. (Acai bowls and pomegranate juice, anyone?) Pineapples happen to naturally convert a reddish-pink pigment called lycopene, which is high in antioxidants, into the yellow pigment beta-carotene. (Lycopene is what gives tomatoes and watermelon their color.) Preventing this process, then, could yield pink flesh and higher antioxidants. The company set its dedicated pineapple research team to the task of figuring out how to do it.

The team landed on a set of three modifications to the pineapple genome. They inserted DNA from a tangerine to get it to express more lycopene. They added "silencing" RNA molecules to mute the pineapple's own lycopene-converting enzymes, which also helped reduce its acidity. (RNA silencing is the same technique used to make non-browning [GMO](#) Arctic apples.) Finally, Del Monte added a gene from tobacco that confers resistance to certain herbicides, though representatives for the company say this was simply so its scientists could confirm that the other genetic changes had taken effect—not because Del Monte plans to use those herbicides in production.

The official Pinkglow website [doesn't mention these genetic alterations](#). And even Sauter skimmed over the science when I asked. I found the details in a [patent filing](#) and [documents](#) from the US Food and Drug Administration. (The Pinkglow comes without a crown to reduce waste, though removing the pineapple's top also helps protect its proprietary—and lucrative—status.) Chris Cummings, a senior research fellow at North Carolina State University's Genetic Engineering and Society Center, says that lack of information is probably purposeful. "There is some distinct marketing that's going on with this particular product," he says.

Although Del Monte originally dreamed up the Pinkglow as an antioxidant powerhouse in the days before social media, ads for the pineapple have adjusted to the times. The company doesn't claim any health benefits but instead touts the Pinkglow's Instagramability. "Become the envy of your friends and followers with this highly sought-after delicacy," reads the Pinkglow website, where one can find recipes for rum-soaked Pinkglow shortcake, no-churn Pinkglow ice cream, and Pinkglow pineapple coconut

crumb bars. In a 2020 press release, Del Monte described the Pinkglow as "one-of-a-kind and perfect for a hostess to serve as part of a festive party cocktail, as a delicious dessert all on its own, or even to give as a gift to the person who will now truly have everything." It's no wonder I picked one up in the grocery store. This product is clearly marketed at me, a 36-year-old millennial woman.

"This is a social food," Cummings says. "This is to show off to other people. 'Hey, look what I have that you don't. This makes me cool, right?'"

The marketing seems to be working. In an earnings call in February, Fresh Del Monte Produce reported strong demand for its new pineapple varietals, with sales growing by approximately 25 percent in 2023 compared with 2022. In addition to the Pinkglow, it has recently introduced the Honeyglow (even golder and sweeter than the Gold Extra Sweet), the Precious Honeyglow (a miniaturized version of the Honeyglow), and the Del Monte Zero (a pineapple certified by a third party as carbon-neutral because of Del Monte's expansive forests). This year, the company is continuing to expand the reach of the pink pineapple. It's also rolling out a variety called Rubyglow (reddish peel, yellow flesh) in China.

"Consumers love innovation," says Lauren Scott, chief strategy officer of the International Fresh Produce Association. She sees the Pinkglow as creating excitement around pineapples and likens it to Cotton Candy grapes, a naturally grown hybrid introduced in 2011 that are hugely popular because, well, they taste like cotton candy.

If the trend holds, the Pinkglow could herald a shift in consumer attitudes toward genetically engineered crops. Where GMO corn and soy were designed to better tolerate herbicides—a benefit invisible to consumers—the pink pineapple was mostly made to be fun and pretty, and to taste great. "I think the wariness toward GMOs is waning," says Courtney Weber, a professor of horticulture at Cornell University.

Maybe the pink pineapple is frivolous. But maybe it's just the kind of product that can help prepare consumers for the food system of the future, which will likely involve more bioengineering. "I love this for consumers, and I'm really happy about it," says Vonnie Estes, vice president of

innovation at the International Fresh Produce Association. "But I think the real benefit is that it's going to allow us to use these tools to be able to adapt to a changing world." That future could be hotter, drier, and filled with as yet unimagined diseases and pests. For now, though, it's pink.

Joel Khalili
Business
Apr 10, 2024 3:00 AM

Sarcophagus Is a Dead Man's Switch for Your Crypto Wallet

By combining a century-old idea with cryptocurrency tech, Sarcophagus aims to create a foolproof way to send messages from beyond the grave. ILLUSTRATION: ALBERTO MIRANDA

A century ago, a commuter train carrying hundreds of passengers from Park Row to Brighton Beach, New York, took a perilous stretch of rail at seven times the appropriate speed.

At the controls was Edward Luciano, a young and inexperienced driver with only two hours of training, brought in as a substitute to cover a strike. As chronicled in *Uptown, Downtown*, a 1976 book by Stan Fischler, Luciano was defeated by the confusing braking system, and the train derailed on a jinking set of curves, killing at least 93 people and injuring hundreds more.

The wreck led to a raft of safety improvements, among them, it is believed, the dead man's switch, a fail-safe now found in all kinds of modern machinery. A dead man's switch can take the form of a handle or pedal to which force must be continuously applied, or a button that has to be pressed at intervals, but the principle is the same: If the human operator fails to respond, the machine shuts down.

In 2017, another New Yorker, Zach Hamilton, began to wonder how the same concept might be applied to the digital realm. He had identified a problem: People were getting locked out of their cryptocurrency wallets without any means of recovering access, and their heirs were finding it difficult to access their digital assets after they died. Billions of dollars'

worth of [crypto has been lost](#) this way. Hamilton figured that a digital dead man's switch, which would release a document payload instead of switching off a machine, could help someone to recover their wallet or pass credentials to an inheritor without having to trust a third party. In theory, it could be used for all manner of other things, too. For years, a "quick and dirty" sketch sat dormant on Hamilton's computer, he says. But when New York [locked down for the Covid pandemic](#), he began to develop his idea. He called it Sarcophagus.

Hamilton was not the first to come up with a digital dead man's switch. These kinds of services have been available for years from providers such as Stochastic Technologies. Firms including Google and Microsoft offer similar functionality, letting users nominate someone to inherit their account after a period of inactivity. The primary difference is that Sarcophagus is built atop crypto technology, meaning the contents of users' documents are never visible to a third party and that the availability of their payloads does not depend on the service provider remaining in operation.

It works like this: A user submits a file via the Sarcophagus web app, specifies a recipient, and sets a timeframe. Then they agree to pay one or more fellow users to act as the file's protector and post the fee in escrow. The file is encrypted and sequestered in a decentralized file storage network called Arweave, which aims to store information permanently by incentivizing people to contribute their own hard drive space. If the user fails to make an attestation proving they are alive within the timeframe, the file is released to the recipient and decrypted using a combination of their own credentials and those of the chosen protector. Only after the file has been successfully handed on does the protector receive the payment.

The system, says Hamilton, is designed to be "anti-fragile," meaning it depends on no party's good will to achieve its end. Nobody but the originator and recipient have access to the contents of the file, all other parties are financially incentivized to cooperate, and redundancies ensure the payload is always available. "Little strings of data control our lives," says Hamilton. Because humans are "gooey"—that is, unreliable and prone to mistakes—the only sensible protection for those strings is cryptography, he adds.

There are various other ways, says Hamilton, that Sarcophagus might be applied outside of a crypto setting. A digital dead man's switch could be used by a whistleblower to release incriminating material or by a dissident or journalist who suspects a threat to their life, as a kind of SOS. In a more mundane context, it could be used to pass account credentials from one generation of employees to the next.

ILLUSTRATION: ALBERTO MIRANDA

Sarcophagus has received $6 million in funding to date from investors including Placeholder, Blockchange, and Hinge Capital. The project is managed by a decentralized autonomous organization, or DAO—a collective that governs the Sarcophagus treasury and development process through a system of community voting. In its present state, Sarcophagus is best described as an "early beta," says Hamilton. The service is operational but not widely used, and it does not generate significant revenue—only a small cut of every payment.

One barrier to broader adoption is that recipients must already have access to a crypto wallet, whose credentials are used to decrypt the data payload. There is an option to create a new wallet for someone, along with a PDF walking them through the process for accessing it, but a level of crypto literacy would certainly help.

As the generation of people comfortable with crypto grows older and begins to reckon more seriously with their mortality, Hamilton thinks a larger subset will begin to understand the need for a service like Sarcophagus. "Millennials are just starting to think about this problem," he says. Hamilton imagines that more accessible services will be built atop Sarcophagus technology, too. These "boomer products," as Hamilton calls them, one of which his own team is developing, will abstract away some of the technical complexity, such that people won't realize they are using crypto infrastructure. (Although there is an inevitable trade-off between security and convenience.)

In any case, says Hamilton, the present system—whereby credentials to high-value crypto wallets might be stored in bank vaults protected by armed guards—approaches the absurd. The "billion-dollar file cabinet" has to go,

says Hamilton. "We are still relying on heavy metal doors and guys with guns when cryptography itself can act as a steel wall of incredible thickness."

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[Frankie Adkins](#)
[Science](#)
Apr 10, 2024 2:00 AM

The Honeybees Versus the Murder Hornets

Under threat from murder hornets, climate change, and habitat loss, UK honeybees are getting help from AI-enabled apiculturists tracking everything from foraging patterns to foreign invaders.
Owen Finnie and Matthew Elmes at Maiden Castle Farm, with an AI beehive. They're also taking videos of the bees' "waggle dances."Photograph: Chris Parkes

A switch is flicked, and a pharmacy sign flickers to life with a green glare. But this clinic prescribes seeds, not pills. The glass jars lining the shelves of this compact unit in central Plymouth, on the south coast of England, are filled with cow parsley, red clover, and corn chamomile.

It's owned by Pollenize, a social enterprise that uses data analysis to diagnose and treat deficiencies in honeybees. With habitat loss, climate change, agrochemicals, and a new wave of invasive hornets hounding Britain's bee colonies, its founders believe [artificial intelligence](#) could be an unlikely trump card.

Inside a honeybee hive. Worker bees are sterile females, and live for just six weeks in a colony of tens of thousands.Photograph: Chris Parkes

When childhood friends Matthew Elmes and Owen Finnie cofounded Pollenize in 2018, AI was not part of the plan. As longtime sufferers of hay fever, their foray into beekeeping was just a stab at soothing their swollen eyes and streaming nostrils.

Investing in a rumor that a teaspoon of local honey could counteract pollen sensitivity seemed worth a shot. "We didn't fit the profile of a beekeeper," says Elmes, who was a bricklayer in his late twenties, while Finnie worked in kitchens.

A microscope image of pollen collected from a hive. Monitoring pollen lets keepers know what's available for bees to forage from.Photograph: Chris Parkes

The pair bought their first beehive with a £1,500 grant from Plymouth University, and after a shaky first batch—the plastic barrel they used was contaminated with a bitter chemical—things improved when they turned to local beekeepers for advice. Soon they secured several spots for their apiaries across the city, eschewing the countryside for Plymouth's vacant rooftops, including a theater, a school, an office space, and a museum. It was a win-win. Businesses could boost their green credentials and Pollenize could trial its community urban beekeeping project. "It's a mutual exchange, as they get the kudos of having bees and we get the opportunity to appeal to customers," says Elmes. Now, around 80 members tend to 50,000 native honeybees—and are rewarded with a cut of golden honey.

But over time it became harder for Pollenize to ignore threats to Britain's wild bees. Pollinators underpin our ecosystems and food supply, but Britain's flying insect population has declined by as much as 60 percent in the past 20 years. Drawing on a degree in environmental science, Elmes built tech-powered solutions to safeguard Britain's bees. First, the pair created a biodiversity tracking tool to map wildflower loss and prescribe AI-informed seed packets. Next came beehive cameras to discern how climate change impacts foraging patterns. Then, they turned their attention to staving off an invasion.

Beekeepers need to check hive frames for pests such as varroa mites and to look for queens preparing to set up a new colony.Photograph: Chris Parkes

Ever since the first Asian hornet stole into France in 2004, most likely stowed away on a cargo ship from China, the invasive species has plagued Europe's beekeepers. Dubbed "murder hornets" for their ability to swarm local ecosystems, each one can consume as many as 50 native bees per day.

Shielded by the Channel, Britain has managed to stave off the scale of Asian hornet invasion seen by its European neighbors—but sightings on English shores are creeping up. In 2023, there were 76 [confirmed Asian hornet sightings](#) in the UK, up from 23 between 2016 and 2022.

Teams of volunteers now hunt Asian hornets landing on British soil, but detection is only the tip of the iceberg, says Elmes. The true challenge is tracing the hornet back to its nest, to destroy the colony. "If something can automate and help us, it will shave off time," he says. This is the rationale behind Pollenize's latest project—a network of AI-camera bait stations that can detect and track Asian hornets.

"All you need is a breeze from the southeast for hornets to hitch a lift across the water," says Alastair Christie, an invasive species expert from Jersey, in the Channel Islands. "Queens can hibernate on the underside of a pallet and in all sorts of nooks and crannies, or get stuck in someone's car or horse box." A nest might start out innocuously, as two cells in a garden shed in April. By September it can grow larger than a dustbin, heaving with around 2,500 hornets.

Beekeeper Shelley Glasspool tends to a hive on the roof of the Marine Biological Association in Plymouth.Photograph: Chris Parkes

Asian hornets are "opportunistic feeders," eating everything from bees and blowflies to fishing bait and barbecue food. Their mere presence weakens native bees by triggering "foraging paralysis." "Bees go into a defensive mode when there are hornets attacking their home," says Christie. "If you're in a castle under attack, you go into siege mentality." Bees will stop cleaning their hive and gathering nectar and water until the colony collapses.

In Jersey, which is on the front line of the invasion, Christie has been leading the fightback. There's a public awareness campaign: People are asked to submit photos of suspected hornets, which are distinguished by their orange faces, yellow tipped legs, and sheer size. Braver volunteers have begun to construct bait stations: a shallow dish of dark beer or sugar water. If an Asian hornet lands, volunteers attach tinsel streamers to its back to monitor its flight path and trace it back to its nest. They use a rule of

thumb: Every minute an Asian hornet spends away from a bait station between visits to feed translates to 100 meters of distance between the bait station and the nest.

On average, it takes around 50 hours to locate an Asian hornet nest this way, but machine learning could accelerate this. "Can we use AI to predict where the nest location is so we can find nests quicker, destroy them quicker, and reduce the ecological damage?" says Elmes. Pollenize is now working with French tech giant CapGemini on [Hornet AI](), a network of automated camera bait stations that uses an object detection algorithm trained on 5,000 pictures of Asian hornets.

This Asian hornet station in the Associated British Port of Plymouth attracts the hornets, IDs them with its AI cameras, and alerts local authorities.Photograph: Chris Parkes

The prototype bait station uses a vaporizer to churn out an attractant that Asian hornets find irresistible. When a hornet comes to the bait station to feed, it's detected by the camera, and marked with a physical colored sticker. The software then tracks the direction the hornet departs in, and measures how long it's away, cutting down the time taken to locate the nest. "It works like CCTV," says Elmes.

In December 2023, Pollenize won a grant from Innovate UK to scale up Hornet AI. The units will be tested in southeast England by the UK's National Bee Unit, with the goal of improving nest tracking efficiency by 80 percent. But time is of the essence, says Elmes. "If we're on it next year, we can keep Asian hornets at bay," he says. "If we don't win next year, it's going to be exponential."

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[Eve Thomas](#)
[Gear](#)
Apr 3, 2024 6:00 AM

Science Is Here to Clean Up the Wild West of Gin

A fingerprinting technique similar to MRI scanning is finally revealing what makes the ultimate gin. Will it be a blessing or a curse for an unregulated industry drunk on innovation?
PHOTOGRAPH: SERGEY RYUMIN, KARANDAEV; GETTY IMAGES

In an Edinburgh laboratory in the second half of 2023, four chemists armed with a nuclear magnetic resonance (NMR) spectrometer took on the unregulated Wild West of the gin industry.

A total of 16 samples of gin endured the spectrometer's powerful magnetic field to create a "fingerprint"—in the form of peaks along an x-axis—which researchers David Ellis and Ruaraidh McIntosh then put together like "a jigsaw puzzle"; when complete, the puzzle revealed exactly which compounds were responsible for a certain gin's flavor, aroma, and mouthfeel. The graphical marks could impart even the physical origin of the juniper berries used in a gin, offering a level of accuracy beyond traditional sensory analysis. The team published its results [in a paper](#) late last year.

It's a study that could bring order to a near-lawless industry: Gin is a famously gray area in the [alcoholic beverages](#) sector. Unlike tightly regulated [Scotch whisky](#) or location-specific cognac, gin needs only to demonstrate a minimum 37.5 percent ABV and a prominent juniper taste to qualify for its name—and that's pretty much it.

"As with any spirit category, there are often conversations around protecting gin by tightening the regulations," says Pal Gleed, director general at The Gin Guild, a trade body of global gin distillers, brand

owners, and industry figures. "However, to do this without stifling innovation is not easy."

Unregulated as the gin sector might be, it is also unfettered, creating a space for considerable innovation within the alcoholic beverages sector. Coming behind only vodka in variety, the spirit's recent commercial releases include [gin made from peas](#)—the byproduct of which can be used as animal feed, resulting in a spirit with a negative carbon footprint.

The imaginative approach of gin distillers isn't new: Indeed, fruit gins are mentioned in *The Distiller of London,* published as early as 1639. Packed with various recipes for gins and requiring ingredients ranging from aniseed and coriander to poppy flowers and nutmeg, the book reflects a Stuart-period England already getting a taste for creativity with its spirits.

The attitude of innovation has continued since. Tom Warner, cofounder of Warner's Distillery, calls such creativity the "lifeblood" of the business. And while he admits that it has "probably blurred the lines on what is and isn't a gin," he notes that without it, the "category wouldn't have exploded the way that it did."

So could NMR spectroscopy and its ability to unlock the exact elements behind top-quality gin mark the death of innovation for the spirit? Unlikely. McIntosh believes that a clearer understanding of what defines a gin "shouldn't be seen as being restrictive to the industry."

In fact, it could be an opportunity to prune out counterfeits while giving space for a richer gin industry to flourish. Jared Brown, master distiller at luxury gin brand Sipsmith, tells WIRED that he is on board: "Will tighter regulations force new gin producers to work a bit harder, to learn a bit more gin history and tradition before releasing a spirit and calling it gin? Will more dodgy distillates be excluded from the category? I'm for that." Ellis also believes that "it's possible this kind of fingerprinting approach could lead to some kind of framework to define what is actually meant by 'gin' in a much more rigorous way than there is at the moment."

While the fingerprinting method is similar to magnetic resonance imaging (MRI), NMR preceded its better-known cousin by 30 years; the first NMR

machine was developed by Felix Bloch and Edward Purcell in 1945. MRI, in turn, was developed from NMR in the 1970s and made commercially available in the 1980s.

Where MRI uses a magnetic field and radio waves to assemble anatomical images, NMR uses a magnetic field to measure nuclear spins, which are affected by electromagnetic radiation. The spectrometer presents the absorbed frequencies as a series of peaks on a graph, which reveal the chemical environment of atoms in the sample. When Ellis and McIntosh interpret the results, they match these peaks to their gin spectra to "build" the structure of molecules present.

"The spectrum is a lot more complicated than it would be if you had a simple organic molecule as pure compound, and identifying the fingerprints of all of those different molecules is really the main challenge. But we've shown it works," says Ellis. "It's now quite a well-accepted technique for looking at complex mixtures, including food and drink."

The researchers can even distinguish between molecules with the same atomic makeup. Terpenes, the chemical characterizers of gin, have the same generic chemical formula (C_5H_8) but offer entirely different flavors, aromas, and textures. Limonene tastes of orange, for example, while myrcene is sweet and spicy.

Knowing exactly what's in a gin matters more now, as the industry continues to grow and counterfeits and copies look to cash in. The premium sector is set to be worth around $1.4 billion by 2030, and establishing provenance and authentication will be essential to distillers hoping to protect their products and prove to well-heeled customers that they've used those rare and expensive ingredients.

The thriving market has also translated into a rapidly increasing demand for juniper berries, just as traditional juniper suppliers are struggling with a changing climate. As distilleries look to source juniper berries from new suppliers, they will face inevitable variation in chemical composition and subsequent variation in flavor, aroma, and mouthfeel. "The various compounds present in the juniper varies depending on where the juniper

comes from," McIntosh explains, "so NMR could help to look at the natural ingredients and what they're providing for the gin."

But introducing NMR spectroscopy might not be straightforward. Gleed points out that "very few gin distillers have access to anything more than their noses and a hydrometer," and NMR equipment is expensive, making it unrealistic for most distillers and possibly lending an advantage to higher-end brands with more funding.

Its use might also mark a shift away from an artistic understanding of gin, in which variety is respected as an unavoidable result of genuine creativity. Indeed, Brown says he "will always prefer organoleptic analysis as, at the end of the day, I'm making gin for people, not computers."

Meanwhile, Warner's Distillery employs scientific analysis already—namely gas chromatography and high-performance liquid chromatography—and the company says it is satisfied with its methodology as is. "We know our molecular fingerprints," it notes.

However, the new gin fingerprint research, published in the *Journal of Brewing and Distilling* in December 2023, addresses the use of gas chromatography combined with mass spectrometry (GC/MS) in analyzing gin, compared to NMR spectroscopy. It points out that unlike GC/MS, NMR doesn't require the prior separation of samples, and offers the advantage of speed.

The question remains as to whether NMR spectroscopy is a blessing or a curse for gin distilleries. Will a tighter definition of gin separate the wheat from the chaff—or the weed from the juniper—and preserve the sector's rich heritage? Or will it quash a colorful and innovative industry in which imagination is the name of the game?

At The Gin Guild, Gleed is, somewhat unsurprisingly, confident that the imaginative attitude of distillers isn't going anywhere: "The beauty of the gin industry is that it is innovative, and that this innovation is driven by brands of all sizes. This passion for creativity won't be affected."

Certainly, the industry doesn't appear to be struggling. Last year, some 9 million 9-liter cases of gin were sold in the US, generating more than [$1 billion in revenue](#) for distillers, with the superpremium category surging by 16 percent to surpass 700,000 9-liter cases. Meanwhile, the UK saw the introduction of 110 new distilleries between 2020 and 2022, as the pandemic drove consumers' appetites for the luxury experience.

The hope, then, is that NMR will provide what Brown terms "guardrails of respect for heritage" for a sector in danger of becoming drunk on its own success.

[Grace Browne](#)
[Science](#)
Mar 27, 2024 8:00 AM

The Next Generation of Cancer Drugs Will Be Made in Space

Injectable immunotherapy drugs can be made, in theory, but gravity prevents them from crystallizing correctly. A startup thinks the solution could be right above us.
The International Space Station on November 8, 2021.Photograph: Geopix/Alamy

Immunotherapy is one of the most promising new ways to fight [cancer](#), but it takes *forever*. It works by mimicking or invoking the body's own immune defenses to weed out and attack cancer cells. But the [drugs](#) that do this are typically administered intravenously—fed into the blood using needles, in a long and invasive process. Patients spend hours in a hospital as the infusions are drip-fed into their veins.

It would be much simpler and less painful if the drugs could be injected under the skin from the comfort of a patient's home. But that would require much higher concentrations of the drugs, resulting in a thick formula too viscous to inject.

There is an answer: If you crystallize the proteins in the drug instead, you can get a high concentration into a smaller volume, and a solution of these tiny crystals comes without all the viscosity. The only problem is it's almost impossible to do this on Earth. If you try, the resulting crystals are full of imperfections and come in a random array of sizes. In space, however, without the interference of the planet's gravitational pull, the crystallized proteins come out *perfectly*.

That's where [BioOrbit](#) comes in. Its founder, Katie King, has a PhD in nanomedicine from the University of Cambridge, but she has always been obsessed with [space](#). During her course, she found herself growing frustrated at her friends' cynicism toward the "Bezosification" of outer space, as companies such as [Blue Origin](#) and [SpaceX](#) commercialized it and turned it into a playground for billionaires. "I always had this belief that space should be used to help those on Earth," King says.

Katie KingPhotograph: Christian Trippe

After finishing at Cambridge, King started looking for a scientist job in the space sector, determined to prove her friends wrong. But she couldn't find one. So instead, in 2022, she began a two-month summer program at the International Space University, an international organization based in France that provides postgraduate training for those keen on a career in the industry.

During the course, King was part of a team tasked with identifying research that could be conducted in space with the best potential impact on humankind. Her team landed on the concept of crystallizing drugs in microgravity. There was data stacked up on the International Space Station hinting at the potential to "absolutely revolutionize cancer treatment," King says. "This needs to be realized fully, and now is the time."

BioOrbit, which King founded in 2023, plans to scale up and commercialize this kind of drug production in space. After securing funding from the European Space Agency, the plan is to test out the process on the International Space Station early next year to make sure it works. And later in 2025, they're planning a second flight which ideally will be with a pharmaceutical partner.

King is not the first to send drugs into space to reap the benefits that microgravity has to offer. Big Pharma is also dipping its toe: Companies including [Bristol Myers Squibb](#) [and](#) [Merck](#) have been conducting research in space for drug development and manufacturing for years. "What makes BioOrbit special is that they're trying to optimize it," says Li Shean Toh, an assistant professor at the University of Nottingham who researches astropharmacy. King wants to blow it up to commercial scale.

But there are roadblocks. There are long queues to get space on board a rocket to take material to the ISS, and it's unsurprisingly expensive. Regulation is another hurdle: Will the rules and regulations of Earth apply in outer space? If one of BioOrbit's drugs harms a patient, whose jurisdiction will apply? "Lots of people are thinking about the technology—but people are kind of skirting around how we are going to do quality assurance," Toh says. This is something she's researching: She has proposed a health version of the Outer Space Treaty, a body of principles that informed international space law.

King is happy for her team's venture to serve as a guinea pig for how this all might work, because she wants it to work. "There is so much benefit that microgravity can give to life science research, drug development, cancer research—and more that we just don't know yet," says King.

Her ultimate goal for BioOrbit is to have a permanent facility in space just for doing science, research, and manufacturing. The pharmaceutical factories that sit in gray, barren business parks may soon become a little more extraterrestrial. One day, perhaps many of your drugs will have had a little sojourn to space.

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Sheon Han
Business
Mar 4, 2024 6:00 AM

JavaScript Runs the World—Maybe Even Literally

In defense of a much-mocked programming language.
ILLUSTRATION: SAMUEL TOMSON

Lex Fridman has done many long interviews on his popular podcast. Even so, the episode with the legendary programmer John Carmack has an unhinged director's-cut feel to it. Over five hours, Carmack dishes on everything from vector operations to *Doom*. But it's something Fridman says, offhand, that really justifies the extended run time: "I think that if we're living in a simulation, it's written in JavaScript."

Machine Readable
A regular column about programming. Because if/when the machines take over, we should at least speak their language.

To review: JavaScript is what makes static web pages "dynamic." Without it, the internet would resemble nothing so much as an after-hours arcade, lifeless and dark. These days, the language is used in both front- and backend development for a whole host of mobile platforms and apps, including Slack and Discord. And the main thing to understand about it, in the context of Fridman's nerdy koan, is this: For any self-respecting programmer, admitting to actually *liking* JavaScript is something of a faux pas—much like an art-house filmmaker confessing to Marvel fandom.

I suppose this has something to do with the fact that JavaScript was created in less time than it takes to home-brew a jar of kombucha: 10 days. In 1995, Netscape hired a programmer named Brendan Eich to create a language to embed in its browser, Netscape Navigator. Originally called LiveScript, the

language was renamed JavaScript to piggyback on the hype around an unrelated language called Java, which had been introduced earlier that year. (Asked the difference between Java and JavaScript, a programmer is likely to joke: "Java is to JavaScript what car is to carpet.") To this day, few people consider JavaScript a particularly well-designed language, least of all Eich. "I perpetrated JavaScript in 1995," he once said, "and I've been making up for it ever since."

What was his crime, exactly? You can easily find scads of blog posts, memes, and Reddit threads sandbagging JavaScript, but my favorite is a [four-minute talk](#) by software engineer Gary Bernhardt titled "Wat." Imagine, for starters, showing a group of non-English speakers the present and past forms of verbs like *boil* (*boil*/*boiled*) and *chew* (*chew*/*chewed*). Then, when you ask them for the conjugation of *eat*, who could blame them for answering *eat*/*eated*? Similarly, the "Wat" talk is a blooper reel of JavaScript's quirks and unpredictable behaviors. Let's say you want to sort a list of numbers: [50, 100, 1, 10, 9, 5]. Calling the built-in sort function in any sane language returns the list in numerically ascending order: [1, 5, 9, 10, 50, 100]. Doing so in JavaScript returns [1, 10, 100, 5, 50, 9], where 10 and 100 are considered larger than 5. Why? Because JavaScript interprets each number as a string type and does lexical sorting, not numerical sorting. Total insanity.

When Fridman says JavaScript runs the world, in other words, what he means is that our world is, like the underlying source code, massively screwed up and incomprehensible. It's the equivalent of pronouncing, with a sigh, that considering the sorry state of the planet, the Universal Declaration of Human Rights must have been written in Comic Sans.

At this point, I should confess that while JavaScript is not my favorite language, I like it. Adore it, in fact. So I can't help but feel a flare of disapproval whenever a certain fraternity of programmers polemicizes against it. Often they focus on flaws that were dealt with years ago. To dwell on JavaScript's original shortcomings is to overlook the fact that any piece of software—and every programming language is, in essence, a suite of software—is amenable to revision and improvement.

One of the principal criticisms of JavaScript is that it's slow. This holds some truth in a general sense, but saying one language is "slower" than another is, technically speaking, an ill-formed objection. The performance of a language depends not only on the language itself but also on the caliber of its run-time environment—the setting in which the code is executed—and its compiler, which translates source code into a machine-readable format. Put differently, uncompiled code is akin to an uncast magic spell. Much as the potency of a spell depends on the caster, languages deemed "faster" but executed with crappy compilers could perform not much better than "slow" languages.

What's more, JavaScript was, in a sense, bailed out of its terribleness by colossal advancements in software engineering and industry-wide efforts. Carmack acknowledges this in the same podcast: "The systems that make JavaScript run as fast as it does right now are kind of miracles of modern engineering in many ways." A prime example is the Google Chrome team's V8 JavaScript engine, which compiles JavaScript "just in time," significantly boosting its performance.

If there were an equation to calculate the overall utility of a programming language, I'd bet the vibrancy of the language's ecosystem would be an exponential variable that dominates the other linear terms. This is to say, no well-designed language is useful on its own without useful libraries. But when backed by a healthy community of developers, as is the case with JavaScript, even a modest language becomes supremely effective. (Python dominates scientific computing for similar reasons.) JavaScript is also an easy language, and by that I don't imply any insult. Learnability is a killer feature.

JavaScript has undergone multiple iterations. The development of the language is steered by the rather unremarkably named Technical Committee 39 under a Geneva-based standards organization called Ecma International. (Imagine an international committee that could decide once and for all whether the past participle of *get* is *got* or *gotten*, and you have some sense of what TC39 does.) While some languages are governed by a conclave of experts, the process for JavaScript provides more visibility. Proposals and meeting notes are publicly available on GitHub. Meetings, once routinely

held in the San Francisco Bay Area, have expanded to other places such as Bergen, Galicia, and Tokyo, as if to resist the notion that the tech industry can be metonymized by Silicon Valley. In some ways, JavaScript is the people's programming language: egoless and all-embracing.

In a blog post titled "The Subjective Experience of Coding in Different Programming Languages," the tech blogger Matt Webb explores the concept of "code synesthesia": how coding in different languages can offer a "visceral, kinesthetic" experience. Many programmers often liken coding in Python, for instance, to writing in plain English, thanks to its friendly syntax. Likewise, reading old C code feels like engaging in the hermeneutics of ancient script, while Coq demands the exactitude of proving mathematical theorems. In this light, coding in JavaScript feels to me like an exercise in stenography—it affords a kind of buoyancy and effortlessness, allowing prototypes to be whipped up in an afternoon. While its namesake Java may be a reliable, muscular language, it lacks the charm and humor of its winsome sibling.

According to the annual Stack Overflow Developer Survey—as close to a global census of the industry as there is—2023 marked the 11th consecutive year that JavaScript has been the most commonly used language. Let's be clear: I'm not trying to deny that vanilla JavaScript can be hacky. I am, however, trying to argue that there's nothing fraudulent or even disagreeable about its ubiquity. In an industry that prides itself on the hacker ethos, calling JavaScript hacky may even be an honorific.

So an apology is in order, I think—and a congratulations. Look how far you've come, JavaScript, hopscotching across different eras of the internet, rising from a laughingstock to the lingua franca of the web. Well done, you ridiculous language. If I am being simulated by you, so be it.

Stephen Armstrong
Science
Mar 1, 2024 3:00 AM

Good Climate Solutions Need Good Policy—and AI Can Help With That

Climate Policy Radar's tools scan global environmental laws to see what works and what doesn't. What its AI is discovering today will help shape the regulations of tomorrow.
Photograph: Getty Images

To achieve real climate solutions, changing behavior and developing technology is not enough, says Michal Nachmany, founder and CEO of the environmental nonprofit Climate Policy Radar. "A lot of this is policy," she says.

We need better laws, policies, and regulations, as well as needing to hold policymakers and corporates to account, because they're not doing a good enough job, she argues. The problem is that understanding what policies are out there, and what works and what doesn't, is an enormous task. So Climate Policy Radar's goal is to use AI to understand the sprawling climate policy space, to help make sure that future laws and policies are evidence-based.

"We gathered together all of the climate laws and policies and strategies and action plans that every single government in this world has on its books," she explains. "There are 470,000 pages in there—or 4.5 million paragraphs."

To analyze these using general language AI systems is not enough, Nachmany says. "They source not-credible data sources, they hallucinate,

they do all sorts of things that we really don't want to bring into our decision making," she says. "So we use augmented intelligence, using human expertise to teach machines."

As a not-for-profit, Climate Policy Radar offers its constantly updated data for free, and it has a community of practitioners available to collaborate with anyone who works with or seeks to influence decision-makers.

"The people who need the data the most are the ones least able to pay for it," she says. "So, there's a really strong climate justice element to this." She invites anyone who wanted to collaborate to contact her: "We're just at the beginning of our journey."

This article appears in the March/April 2024 issue of WIRED UK magazine.

[Joel Khalili](#)
[Business](#)
Feb 26, 2024 6:00 AM

He Helped Expose Wirecard's Fraud. Now His Startup Tries to Make Whistleblowing Safer

Pav Gill says he suffered retaliation after he raised the alarm about fraud at German payments giant Wirecard. His startup Confide aims to protect future whistleblowers from harm.
Pav Gill, founder of whistleblowing platform Confide.Photograph: Melanie Lemahieu Photography

In September 2017, Singapore-based lawyer Pav Gill took a job at Wirecard, a high-flying German payments business worth tens of billions of euros. Not long after he started, he heard from a colleague that an executive at Wirecard Asia, the region Gill was responsible for, had allegedly been [teaching staff how to trick auditors](#) into thinking the firm had money it didn't have.

Gill quietly began an investigation, codenamed Project Phoenix. The results were damning: Wirecard had been [fudging its numbers](#). But when the board of directors caught wind of his work they got "very upset," says Gill. He was ordered to stand down, and his investigation came to nothing.

The head of Wirecard Asia began to make Gill's life "pretty horrible," he claims, yelling at him in front of colleagues and attacking the quality of his work. He was effectively forced out. But before he left, in September 2018, he loaded a harddrive with an 85GB payload of email data tied to the investigation. It was filled, he says, with "irrefutable" proof of wrongdoing.

Even after Gill left, Wirecard continued to haunt him. At job interviews, he felt the questions were disproportionately focused on the reason for his departure. Gill also began to suspect the firm was having both him and his mother followed (Wirecard had previously [surveilled its detractors](), but this was never proven in Gill's case). But he never intended to leak the email data he'd extracted. It was a defensive maneuver. "As a lawyer, it is ingrained that you are not meant to leak, no matter how bad the situation," says Gill.

In the end it was his mother, Sokhbir Kaur, who took action. Without Gill's knowledge, she had been liaising with the *Financial Times*, which had been investigating Wirecard for years. She had snatched the whistle and blown it on Gill's behalf. He was beside himself. But after some debate, he agreed to give the reporters the data: Why should they be the ones living in fear when the truth was on their side?

The [first story]() based on Gill's data was published in January 2019. By April 2020, a KPMG audit had found that the ["lion's share" of Wirecard's profits could not be verified](). Later, EY, the company's original auditor, discovered that €1.9 billion was missing, [because the money had never existed](). By June 2020, Wirecard had collapsed into insolvency. Gill had played an indispensable role. Five years after leaving, Gill says he has "no regrets" about blowing the whistle, but that it did lead to a great deal of hardship. So now he's trying to make the process safer.

Gill is the cofounder of Confide, a startup aiming to help businesses detect and act on misconduct earlier—and stop them "taking revenge" on the employees that report it. Confide, cofounded with Ryan Dougherty, who Gill had hired at two previous companies, has developed a software platform that allows employees to file anonymous reports. The service creates a paper trail visible to both the whistleblower and the business accused of misbehavior—but one that's stored on third-party infrastructure to prevent it being doctored.

If a business fails to address a problem reported by a whistleblower, or tries to kick it under the rug, the individual can take that paper trail to the press or to law enforcement. The existence of a tamperproof, externally-stored

and anonymously created record should shield whistleblowers from the kind of harassment that Gill encountered, he argues.

A second-order effect, says Gill, might be to normalize reporting misconduct and thereby recast the act of whistleblowing. It's partly an issue of terminology; blowing the whistle implies whinging or complaining. But a standardized process for reporting could help to change the impression that whistleblowing is a form of biting the hand that feeds.

Existing reporting platforms such as EQS and NAVEX have tended to focus on large organizations in the financial services industry, says Gill, whereas Confide will look further afield—to sectors including healthcare, mining, and air travel in which "doing the wrong thing can have life-or-death consequences."

Confide charges businesses an annual fee to use the platform, with extras if they want to outsource the handling and processing of reports. When WIRED interviewed Gill in the fall of 2023, a basic version of Confide was due to launch in December 2023, to coincide with new EU rules that require businesses to give employees simple channels for reporting wrongdoing. More features were set to follow in early 2024.

In the Wirecard case, the decision to report misconduct to the press put a stop to the fraud. But Gill's ambition is for Confide to guide people down a different path. The press is "extremely powerful," he says, but should only be used as a "last resort" once somebody has lost faith that a corporation will do the right thing.

"We are not trying to solve the problem of crime," Gill says. It's about giving businesses a chance to correct their behavior and protecting those that report it. "Every now and then, I ask myself why it had to be me that exposed Wirecard," says Gill. He's still scarred by the experience, but he hopes that in Confide he's created something that will save others from feeling the same way by preventing the whistleblower from ever needing to go public. The end goal, Gill says, is to stop companies "becoming Wirecard 2.0".

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Stephen Armstrong
Science
Feb 26, 2024 5:00 AM

A Discarded Plan to Build Underwater Cities Will Give Coral Reefs New Life

A 1970s plan to grow underwater limestone objects has been repurposed as a way of regenerating the seabed, reestablishing corals, and stopping coastal erosion.
Photograph: Dora Dalton/Getty Images

A combination of AI, a wild 1970s plan to build underwater cities, and a designer creating furniture on the seabed around the Bahamas might be the solution to the widespread destruction of coral reefs. It could even save the world from coastal erosion.

Industrial designer Tom Dixon and technologist Suhair Khan, founder of AI incubator Open-Ended Design, are collaborating on regenerating the ocean floor. "Coral reefs are endangered by climate change, shipping, development, and construction—but they're vital," Khan explains. "They cover 1 percent of the ocean floor, but they're home to more than 25 percent of marine life."

Currently, Dixon says, coastal erosion is prevented by dropping concrete structures to strengthen the coastline. These damage marine life and ecosystems—but coral could be a "regenerative replacement."

Dixon thought of the idea having come across architect Wolf Hilbertz's plan to build a city underwater, then float it to the surface. In 1976, Hilbertz invented Mineral Accretion Technology: a charged metal framework that accumulates calcium carbonate in seawater like a kettle accumulates

limescale in hard-water areas. The result is a limestone deposit known as Biorock.

"It also grows back eroded reefs and regenerates coral, and species like oysters and sea grass grow twice as fast," explains Dixon, who has experimented with the technique by [creating limestone furniture](#) off the coast of the Bahamas. The duo now collaborate, using AI to predict the outcome of importing Biorock to different sites at different water temperatures, in different weather conditions, with different amounts of solar power.

They aim to trial their work off the coast of Northern Australia, according to Khan, and hope to recruit affected local communities to advise and champion their plans.

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Stephen Armstrong
Science
Feb 21, 2024 4:00 AM

Forget Carbon Offsets. The Planet Needs Carbon Removal Credits

The carbon removal market is fast growing, with an array of removal methods available to businesses keen to mitigate their environmental impact.
Photograph: Arnaldur Halldorsson/Bloomberg/Getty Images

We can reverse climate change if we redefine what carbon neutral looks like, said Gabrielle Walker, cofounder of carbon removal startup CUR8, at WIRED Impact in London in November 2023. Scientists define net zero not just as the reduction of carbon emissions, but the removal of carbon from the atmosphere too—a complete negation of the greenhouse gases emitted by humanity. Business is now catching up.

Carbon offsets are worthless, and companies have therefore been "stampeding away" from buying cheap offsets to avoid reputational damage, Walker says. She suggests carbon removal credits as a better solution for reaching net zero.

"Removal credits take carbon dioxide out of the sky and keep it out," Walker explains. "In your own net-zero target, reduce your emissions and remove whatever's left."

Growing more trees is one potential way of removing carbon from the atmosphere. But trees might be burned, Walker points out, so a better way to lock in their carbon removal is to use carbonated timber to construct buildings. This method—where the wood is lightly charred before being used—seals it against water and mildew. Building with it displaces CO_2-

heavy cement, and locks a tree's carbon in for as long as the building is there.

Walker recommends other removal methods too. Low-level technologies such as biochar—created by burning wood in very low oxygen—alongside basal rocks, which absorb CO_2 over thousands of years, make good fertilizer that locks carbon in. And machines including Orca, a large plant in Iceland, will soon be sucking 4,000 metric tons of CO_2 from the air every year, mineralizing it and turning it to stone.

Walker finished with a chilling picture of a plaque in Iceland on the site of the first glacier to disappear. "A letter to the future," the inscription reads. "In the next 200 years, all other glaciers are expected to follow the same path. This monument is to acknowledge that we know what is happening and what needs to be done. Only you know if we did it."

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[Meghan O'Gieblyn](#)
[Business](#)
Feb 20, 2024 9:00 AM

Help, My Friend Got Me a Dumb AI-Generated Present

WIRED's advice columnist on the true purpose of gift giving. Illustration: Gustavo Pedrosa

"An artist friend of mine got me an AI-generated painting as a gift. I can see she tried to personalize the concept, and it's nicely framed, but part of me still feels a little cheated. Is that fair?"

—No Returns

[CLOUD SUPPORT](#)

Spiritual Troubleshooting for the Everyday User

*For timely guidance on encounters with technology, open a **support ticket** via email; or **register** and post a comment below.*

Dear No Returns,

There's something implicitly paradoxical about feeling "cheated" by a present. A gift is, by definition, something that comes into your possession at no cost or effort, an object that exists outside the economic concepts of debt and fair exchange. But the fact that these offerings do often leave us feeling shortchanged suggests that there is a shadowy economics of gift giving, one whose rules are tacit and loosely defined. While I won't pretend to know the nuanced history of obligations and credits that undergird your friendship, I think I can guess why the [AI-generated painting](#) disappointed you. First, the gift cost your friend nothing: The painting was presumably

generated by one of the free diffusion models that are available online, and so required zero monetary sacrifice. Second, the gift demanded no real creative effort, beyond the idea for the prompt. Your friend is an artist, someone endowed with creative talent, yet she seemingly refused to contribute to your gift a portion of that private reserve. The artwork that resulted feels to you generic and impersonal, lacking the singular imprint of your friend's creative mind.

Your question made me think of Lewis Hyde's *The Gift*, a 1983 book about the role of art in market economies. While the writers and artists who have sung its praises (Margaret Atwood, Zadie Smith, and David Foster Wallace among them) tend to regard the book as something akin to a volume of metaphysics, it bills itself, somewhat dryly, as a work of economic anthropology. Hyde begins with a lengthy discussion of gift economies, like those found on the South Sea islands or among Indigenous Americans. While modern markets are defined by exactitude and reciprocity—it's crucial that the seller receive compensation equal to the work they performed—gift economies, he argues, are not reciprocal but circular. The recipient of a gift isn't expected to repay their benefactor directly, though it is assumed that they will contribute in some way to the community—to pay it forward, so to speak. Rather than fixating on fairness, such communities maintain a kind of faith that whatever you give will come back, though not directly or on a determined schedule. "When the gift moves in a circle its motion is beyond the control of the personal ego," Hyde writes, "and so each bearer must be a part of the group and each donation is an act of social faith."

Hyde's larger point, which might be relevant to your question, is that artists tend to flourish in gift economies, where objects of art are regarded not as commodities with precise monetary values but as expressions of a communal energy, what Hyde calls "the commerce of the creative spirit." The act of artistic creation is already in the tides of giving and receiving, because inspiration itself is drawn osmotically from an array of outside sources. We call talented people "gifted" because it's understood that true creativity is unearned and unwilled—there are no private reserves. "We are lightened when our gifts rise from pools we cannot fathom," Hyde writes. "Then we know they are not a solitary egotism and they are inexhaustible."

This is why any genuine encounter with art completely obliterates the usual logic of fairness and economic value. When you stand in awe of a Hokusai painting, you are not thinking, typically, about the price you paid for admission to the museum, or wondering about whether it was a good deal. The gift of these encounters leaves the recipient inspired to create something herself, and so the generative energy continues to pass from one person to another.

You alluded to the generic quality of the AI art you were given, despite your friend's well-meaning attempts to personalize it. What's interesting is that impersonality is a quality that characterizes both the very best and the very worst art: The transcendence one feels when listening to the Bach cello suites, say, or reading Sappho's lyric poetry, perhaps stems from the feeling that the work's genius was not generated by an individual mind, but drawn from the well of the collective unconscious. (Recall the scores of artists who have referred to themselves as "conduits" or "instruments," insisting that they are merely the technological apparatus of some larger cosmic energy.)

There's a difference, though, between art that achieves a sublime universality and a product that is created to be benignly universal. The transpersonal quality of great art has its dark side in the vacuity of hotel paintings, Muzak, and formulaic paperback novels. I think it's fair to say that AI-generated art, in its current stage of development, belongs to the latter category. Although it is drawing from "pools we cannot fathom," to borrow Hyde's formulation (an apt description of the vast reservoir of training data that constitutes the model's unconscious), and although its stochastic logic is as opaque and mysterious as human creativity, its output still bears the stain of art that was created by committee and calculated to hit certain market objectives. If generative models were capable of creating something like an original van Gogh, then perhaps things would be different. As it stands, your friend gave you the digital equivalent of a *Starry Night* jigsaw puzzle.

It's possible that this will change as the technology develops. Perhaps a day will come when being presented with AI art will be akin to receiving manna from heaven or the golden apples from Gaia's enchanted tree—gifts of the

gods that are free, invaluable, and inexhaustible. It may also be true that we're still too early in the acclimation phase to see AI images as anything other than crude mechanics. Our experience of art is inseparable from its context—what Walter Benjamin called the "aura" of a work, which includes the location in which we experience it and our knowledge of its cultural value. Generative AI is still awaiting its Alfred Stieglitz—the photographer who transformed the camera from a novelty tool into an artistic medium—and without a recognizable canon with its own aesthetic standards, it's difficult to discern artistry from accident.

In the meantime, I think your feeling of being "cheated" is entirely rational—not because your friend necessarily owes you something, but because the gift, in its failure to inspire you in the manner of true art, has remained starkly within the realm of commodities, bringing to mind the crude economic logic of fairness and debt. It's obvious that you cannot return the gift you were given. But true gifts, as Hyde would point out, are never returned or reciprocated, only replenished. If the AI painting has not succeeded in inspiring you, take some time this week to revisit the art, music, literature, and film that you most love. Much of it can, miraculously, be experienced for free or is available to download for a list price far below its spiritual value. It might inspire you to create something of your own, but at the very least it will leave you changed in ways that are difficult to quantify.

Faithfully,

Cloud

Be advised that [CLOUD SUPPORT](#) is experiencing higher than normal wait times and appreciates your patience.

[Stephen Armstrong](#)
[Science](#)
Feb 20, 2024 4:00 AM

The Transport Companies Leaving Fossil Fuels Behind

Hydrogen-powered planes, more fuel-efficient aircraft designs, and all-electric parcel delivery services are just some of the ways in which the transport sector is looking to decarbonize.
Photograph: Getty Images

Cleaner, greener transport is on its way—from delivery to air travel—but government action on incentives and [infrastructure](#) is needed to make it work fast and at scale.

"It's a bit frustrating sometimes in the UK, with the government delaying targets and support," says Murvah Iqbal, co-CEO and founder of all-electric delivery network [Hived](#). Hived counts ASOS, Zara, Pip & Nut, and Minor Figures among its clients, and hopes to help decarbonize the 10 to 12 billion parcels delivered annually in the UK. But, Iqbal points out, [EV](#) infrastructure needs investment.

Igor Murakami, director of new services and open innovation at Jaguar Land Rover, agrees. "The market's very fragmented, so we need government support to consolidate everything," he explains. "It's a big investment to make sure that we have enough energy, charging points, and space to avoid congestion."

In air travel, markets are moving more efficiently than the government, says Tom O'Leary, CEO at [JetZero](#), which is on course to launch a zero-carbon-emissions, hydrogen-powered, blended-wing aircraft in 2030.

"The entrenched dynamics of a global market that's ruled by a duopoly didn't really have any interest in disrupting themselves," he says. "We found that a 50 percent reduction in fuel burn and emissions can be achieved using the exact same engines, prior to transitioning to future propulsion."

And that's just the start, says Katya Constant, chief investment officer at [ZeroAvia](). Fuel-cell technology needs a decade to improve—but her company is launching a hydrogen engine for 20-seat aircraft in 2025.

This article appears in the March/April 2024 issue of WIRED UK magazine.

[Stephen Armstrong](#)
[Science](#)
Feb 19, 2024 5:00 AM

Tech Still Isn't Doing Enough to Care for the Environment

Priscilla Chomba-Kinywa, CTO of Greenpeace, says technology firms must shape up—and consumers and business clients should walk away if they don't.
Photograph: Cole Burston/Bloomberg/Getty Images

We are in a climate crisis, and technology can be either a part of the problem or a force for good, says Greenpeace CTO Priscilla Chomba-Kinywa. According to the International Panel on Climate Change, she explains, we have "less than seven years before Earth becomes really difficult to live on." Last year alone, the world witnessed [wildfires in North America](#), floods in Southern Africa, and even the double tragedy of floods and fires in places like Greece, she says.

Social media allows people from across the world to communicate, but "we're seeing misinformation, disinformation, and a wanton disregard for sustainability by some of these platforms—and unfortunately, people don't have many other options."

Chomba-Kinywa says that VCs, startups, investors, and technologists should invest in alternative platforms "that are green, that are ethical, that are value-based, and that give us an alternative to what we have right now, being built by people so passionate about the environment that they will not sell out in the name of profits."

Even though conventional investment is supposed to maximize shareholder value, she argues, investing in these platforms is a price worth paying, as customers will soon be demanding action.

Chomba-Kinywa salutes companies already taking action—such as [Hyundai](#), which recently committed to stop supplying the heavy machinery used for illegal mining in the Amazon. This was possible, she says, through the use of satellite imagery and pressure from leaders in Indigenous communities, which led to a report that Hyundai couldn't ignore.

Good data, she explains, is vital—Greenpeace has been using it since 2009 to persuade some tech giants to switch to 100 percent [renewable energy](#). For those that refused, the campaigning NGO just walked away. Other organizations should do the same, she says.

"What if you could use your influence to apply pressure on these organizations to change?" she asks. "Say, 'We've looked at the data, we've looked at your plans. You're not doing enough, and we won't give you our money.' Then maybe we can make a little bit more of a change."

Finally, she says businesses need to work with communities from places like Senegal, Zambia, Nigeria, Bangladesh, and Mexico to understand and support their movements. "Sit with the elders in their communities, listen to the Indigenous knowledge that allowed them to coexist with nature, and start to reapply some of those principles," she suggests. "They are scrambling for their lives."

Chomba-Kinywa also says that conversations on AI need to focus on the planet. "We're talking about values, ethics, and putting guardrails in place—but we can't do that without talking about the environment," she argues. "We need to think through the environmental cost of AI. It has the potential to help us solve some of humanity's grand challenges, but that's only useful if humanity has a livable planet."

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Stephen Armstrong
Science
Feb 15, 2024 4:00 AM

Fake Caviar Invented in the 1930s Could Be the Solution to Plastic Pollution

An alternative to environmentally-harmful plastic is already within reach: seaweed.
Photograph: Andrew Merry/Getty Images

Imitation caviar invented in the 1930s could provide the solution to plastic pollution, claims Pierre Paslier, CEO of London-based packaging company Notpla. He discovered the cheap food alternative, invented by Unilever and made using seaweed, after quitting his job as a packaging engineer at L'Oréal.

With cofounder and co-CEO Rodrigo García González, Paslier and Notpla have extended the idea, taking a protein made from seaweed and creating packaging for soft drinks, fast food, laundry detergent, and cosmetics, among other things. They're also branching out into cutlery and paper.

"Seaweed grows quickly and needs no fresh water, land, or fertilizer," Paslier explains. "It captures carbon and makes the surrounding waters less acidic. Some species of seaweed can grow up to a meter a day." Best of all, he says, packaging made from seaweed is completely biodegradable because it's entirely nature-based.

Paslier noted an amazing coincidence—Alexander Parkes invented the first plastic in Hackney Wick, the same part of East London that, 100 years later, Notpla calls home. Since Parkes' first invention, waste plastic—especially tiny particles known as microplastics, which take hundreds or thousands of

years to break down into harmless molecules—has been wreaking havoc in ecosystems across the world.

Plastic pollution is proving [especially damaging in the marine environment](#), where tiny beads of plastic are deadly to the vital microorganisms that make up plankton and which sequester 30 percent of our carbon emissions, "without us having to build any new fancy technologies," Paslier says.

Notpla's plans to replace plastic began with a drink container for marathons. This is, in effect, a very large piece of fake caviar—a small pouch that contains juice or water that athletes can pop in their mouths and swallow when they need rehydration. "We wanted to create something that would feel more like fruit; packaging that you could feel comes more from picking something from a tree than off a production line," he says.

Paslier showed pictures of two postrace streets—one where refueling came in plastic containers and one where it came in edible Notpla. The first was littered with plastic bottles; the second completely waste-free.

The next step was takeout food containers. Even containers we think are cardboard contain plastic, he says, as grease from food would make plain cardboard too soggy. Working with delivery company Just Eat, Notpla has pioneered a replacement for the [per- and polyfluorinated substances](#) (PFAS), the so-called ["forever chemical"](#) plastics that currently line cardboard takeout containers. It has even found a way to retrofit its solution into the old PFAS plant, so there was no need to build new factories.

The company is developing soluble sachets for detergent pods, ice-cream scoops, and even paper packing for cosmetics. And there's plenty of seaweed to experiment with, Paslier points out. "You don't realize it's already available massively at scale," he says. "It's in our toothpaste, it's in our beer, it's in our reduced-fat products—so there's an existing infrastructure that we can work with without having to build any additional processes."

This article appears in the March/April 2024 issue of WIRED UK *magazine.*

[Stephen Armstrong](#)
[Science](#)
Feb 13, 2024 8:51 AM

Wild Animals Should Be Paid for the Benefits They Provide Humanity

Healthy ecosystems in developing countries sequester carbon, regulate the weather, and help plants grow thousands of miles away. Wealthier countries benefit from these services—and so should pay for them to be maintained. Photograph: Getty Images

We need to understand the value of nature if we want to protect it—and that should include paying ecosystems for keeping us alive, argues Ian Redmond, head of conservation for not-for-profit streaming platform [Ecoflix](#) and cofounder of [Rebalance Earth](#), a company that aims to build a sustainable, resilient, and equitable economy. He's trying to change the damaging equation where "if the minerals under the ground are worth more than the trees and the animals above the ground, then traditionally, the trees and the animals have to go."

Pricing nature's benefits would help protect it, he suggests. Wildlife tourism shows that people are prepared to pay up to $1,500 simply to spend an hour in the company of a gorilla in Rwanda, he points out—so tourists already know how valuable nature is. But what about local people? Filmmakers should share the profits of their wildlife films with those who protect or depend on the ecosystems they film.

"The irony is that people who live in the developing world, where many of these documentaries are made, don't get to see them because their national TV stations can't afford to buy them," he explains. "We should make people care about the wildlife in the countries where the wildlife lives."

And we should pay animals like elephants for their essential arboreal gardening, he argues. "Apes, elephants, and birds are seed-dispersal agents in tropical forests," he adds. "They swallow seeds and deposit them in their droppings miles away."

This has a hugely beneficial effect locally and globally, because trees do so much more than just store carbon. A study in the Congo Basin found that the amount of wood in a forest where elephants still lived was up to 14 percent greater than one where elephants had died out. That basin sets up weather systems that ultimately produce rain in Britain and Europe.

"Do you think any proportion of what you pay for your [electricity] goes to protect the elephants and the gorillas in the Congo Basin planting the trees that fill the hydro schemes in Scotland?" he says. "Not a penny. There is no valuation of that ecosystem's service that every one of us benefits from."

Ralph Chami, formerly assistant director of the International Monetary Fund, calculated that the value an elephant provides the world during its life is worth around $1.75 million dollars per animal. "That's roughly $30,000 a year, or $80 a day if the elephant were being paid for the service it's providing the world," he pointed out. "But, of course, no one's paying that."

So, it's time to pay the bill. "I want every gorilla, every orangutan, and every animal to be valued for what they do for the ecosystem, and for us clever humans to construct a system that allows that to happen," he says. "At the last count, that was estimated at about $700 billion a year. It's a lot of money. It's not going to come out of the government's coffers, it's not going to come out of philanthropy, but it could come out of the global economy if we construct it thus."

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Updated 2-22-2024 13:20 pm GMT: The story was corrected to state that tourists in Rwanda pay up to $1,500 to spend an hour in the presence of a gorilla, not an elephant.

[Stephen Armstrong](#)
[Science](#)
Feb 13, 2024 8:50 AM

Climate Finance Is Targeting the Wrong Industries

Roughly half of the world's emissions currently can't be reduced, yet green investment continues to avoid the sectors that need the most help—manufacturing, agriculture, and the built environment.
Photograph: Getty Images

To achieve net-zero carbon emissions by 2030, we have to increase the amount of capital invested in climate tech by 590 percent, says Daria Saharova, managing partner at VC World Fund, a European venture capital firm specializing in climate tech. While European funds, including the UK's, have €19.6 trillion ($21.1 trillion) under management—and invested €19.6 billion in 2022—that's not enough. We need to invest at least €1 trillion every year.

The good news? "Europe is leading the world in patent applications for climate technology," she says. "Twenty-eight percent of all patents in this field originate in Europe, so almost one-third of the technology needed is created here."

The problem, Saharova warns, is the misalignment between emissions and venture capital. Forty-eight percent of VC investment in 2022 was into mobility technology, such as e-scooters. Mobility accounts for only 15 percent of emissions, while more polluting industries like manufacturing, food and agriculture, and the built environment are underfunded. "Eighty-five percent of emissions receive only 52 percent of funding," according to Saharova.

This matters, she explains, because personal behavior change will reduce only 4.3 percent of emissions. Technologies already in the market will account for 49.8 percent—meaning technologies under development and in need of investment will need to fill in the rest. "Forty-six percent of emissions will be reduced by technology that's yet to be developed, and this is the tech we desperately need," she says. "And we need venture capital."

Venture capital has had its fingers burned in this area before, she points out. "Between 2008 and 2013 there was a lot of investment and a lot of failures. So right now, R&D accounts for 35 percent of investment, private equity 37 percent, and venture capital just 13 percent of climate tech funding."

There's a huge opportunity for VCs—as the fast rise of late-entrant private equity shows. The return on new investment in climate tech between 2015 and 2019 stands at almost 22 percent. But how do VCs pick the right investment areas when they often lack the skills?

"We need a crystal ball for a tech product's sales, the target market, the tech's influence on that market, its climate footprint, and interrelations with other solutions—in particular, some serious climate science," she explains. "That's a long list."

World Fund has developed a benchmarking system called the Climate Performance Potential, or CPP, which is gradually filtering through to academia. It's a blend of comparing the potential a startup has to avoid or reduce emissions, a willingness to ignore the startup's own predictions, and its ability to look at the Total Addressable Market (TAM), which World Fund calls the Total Avoidable Emissions. This pairs a team's ability to execute with an almost competitive product in a climate-effective technology bucket to understand the order of magnitude that your multiple can achieve.

"This model is focused on the technology rather than the company, so it can be applied to large organizations as well," she explains. "It allows us to measure the carbon market for a technology compared to others by 2040. We need more private capital and public capital, and this model makes it easier for them to predict success."

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[Amit Katwala](#)
[Science](#)
Feb 12, 2024 10:00 AM

Who Tests If Heat-Proof Clothing Actually Works? These Poor Sweating Mannequins

These mannequins undergo daily torture at the hands of textile scientists, but their suffering means we humans can have future-proofed clothing capable of handling our warming world.
Photograph: Meron Menghisthab

Meet ANDI, the world's sweatiest mannequin. Although he might look like a shop-floor stalwart from a distance, a closer glance reveals bundles of cabling and pipework concealed beneath his shell. He's wired up with sensors, plumbed into a liquid supply, and dotted with up to 150 individual pores that open when he gets warm.

It sounds gross, but it's all by design—ANDI is a highly sophisticated, walking, and yes, perspiring mannequin, part of a range of body-analog dummies developed by Seattle-based firm [Thermetrics](#). He made headlines recently—in mannequin circles, at least—because researchers at Arizona State University (ASU) are using an ANDI model to study how the human body reacts to [extreme heat](#).

An ANDI thermal mannequin being assembled.Photograph: Meron Menghisthab

The year 2023 was the [hottest since records began](#), and as the world gets warmer, clothing designers, car manufacturers, and militaries are among the groups scrambling to develop technology fit for purpose, whether it's more breathable textiles or [novel cooling solutions](#). "People are everywhere, and

there are billions of dollars in capital trying to figure out how to keep people safe, comfortable, and fashionable—and all those things have a link to the human thermal environment," says Rick Burke, president and engineering manager of Thermetrics, who has been with the company for 33 of its 35 years.

The easiest way to test that gear would be to put a human in it and ask them how they feel, but that also has its drawbacks. "Human test-subjects are super expensive and super subjective," says Burke. (And they tend not to like it when you set them on fire.)

So, from the 1940s onward, the US military began building the first thermal mannequins—human-shaped heaters to test garments for soldiers. Say the army is sending soldiers somewhere cold and they need to know how many layers to send with each soldier. "If clothing can be optimized for the specific deployment environment, lower costs and safer soldiers clearly justifies the testing investment," says Burke.

The technology evolved in the 1980s and 1990s as sportswear manufacturers began using it to put new products through their paces, while the addition of more individual heating zones to the mannequins added further realism. Recent developments include internal cooling and ANDI's modified sweating function, which can be paired with a computer simulation of human physiology to mimic the body's attempt to heat and cool itself. "Our mannequins are just a shell. They don't have meat," says Burke. "But we have a virtual simulation of the meat."
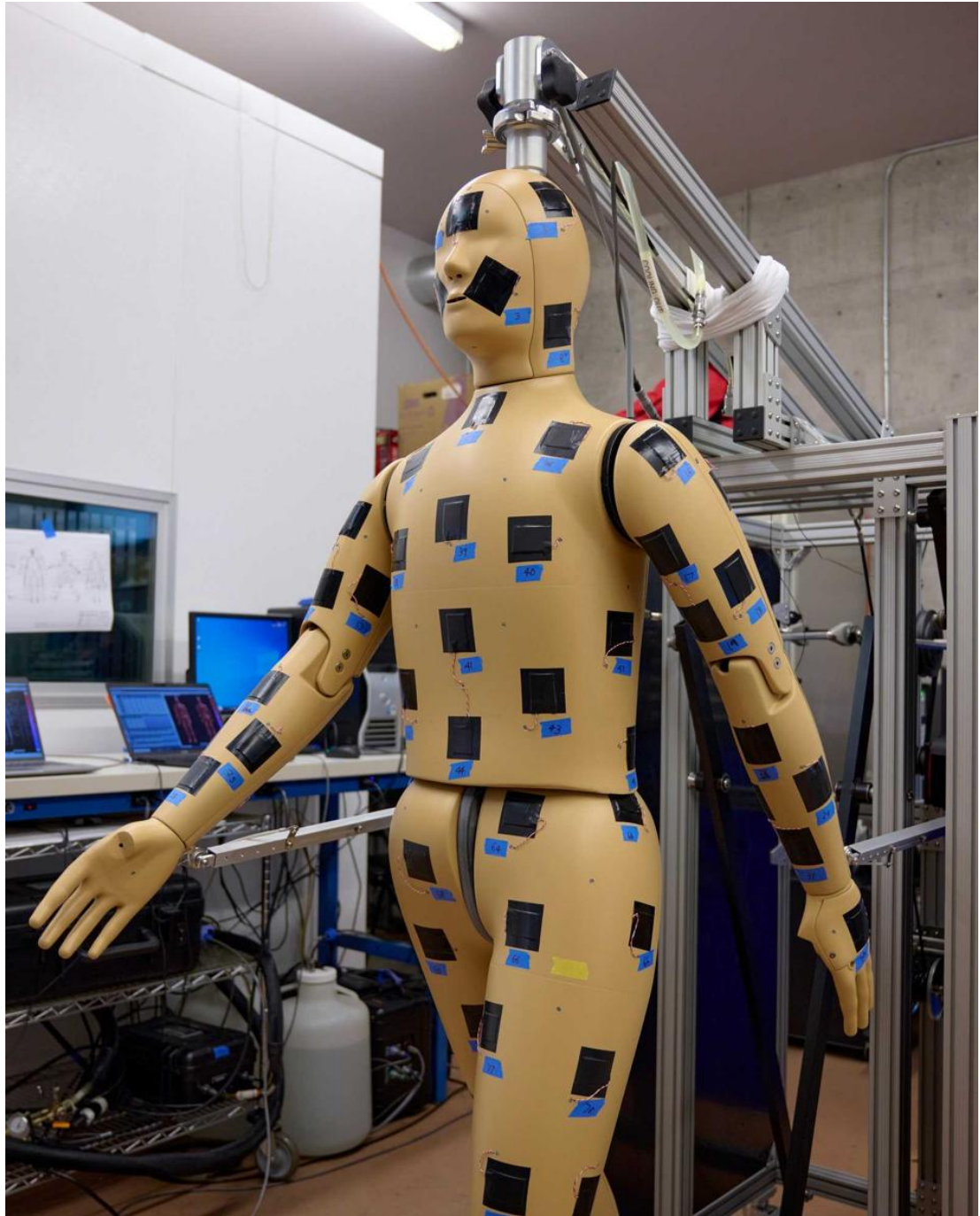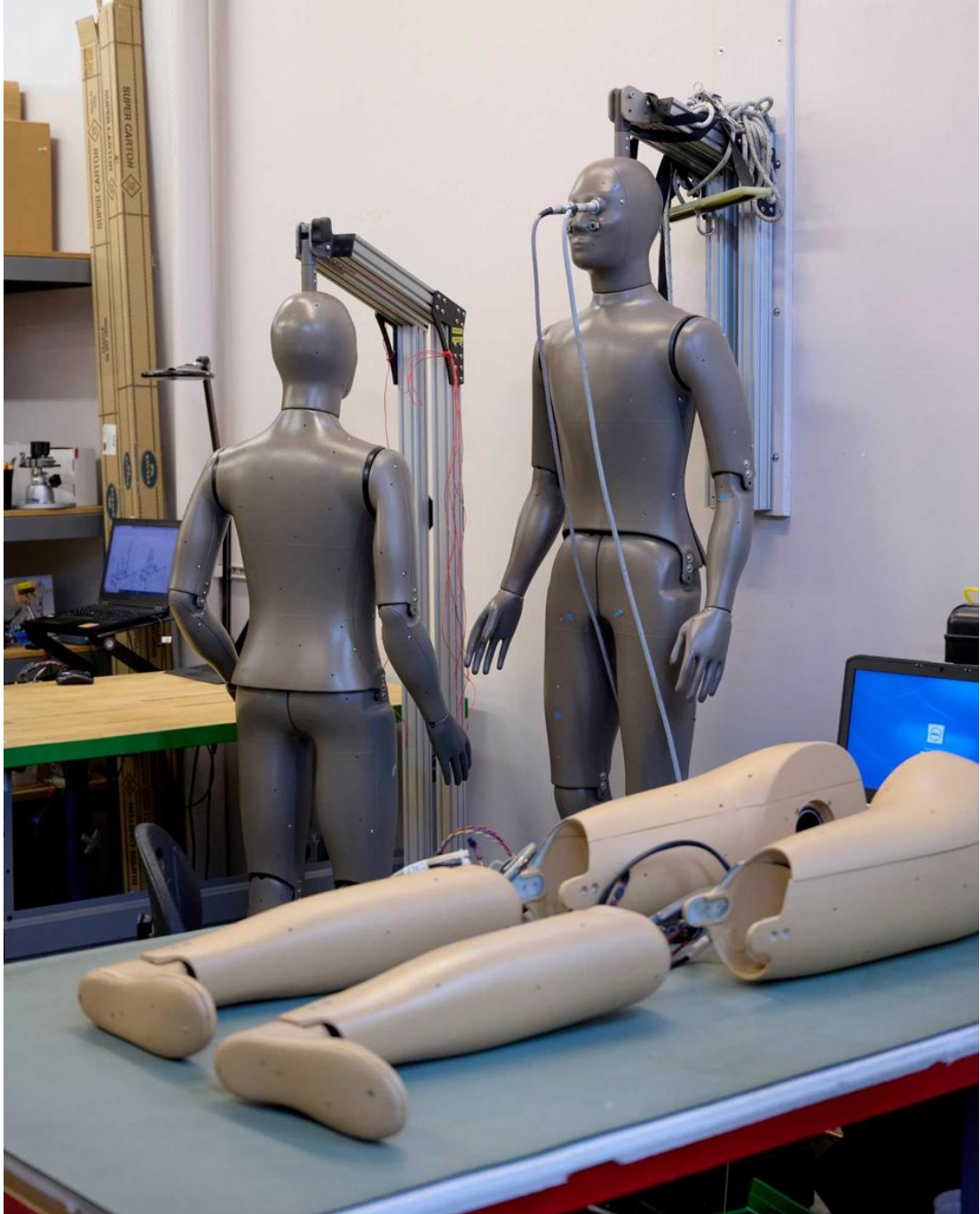
Photograph: Meron Menghisthab

The base model mannequin is often customized for specific tests. This one is covered in an array of sensors to measure radiant heat in firefighting environments.

In addition to ANDI, who is based on the average male body shape, Thermetrics makes dozens of other products, including a female thermal mannequin named LIZ, a baby thermal mannequin named RUTH (also one of the creepiest things you'll ever see), and STAN, a sweating simulacrum backside designed for automakers to test heated car seats. Roam around the Thermetrics lab, and you'll also see disembodied hands, feet, faces, and arms. Mannequins can also be dressed in protective clothing and then ignited in a fire chamber to see how well the garments perform.

In Arizona, researchers are using ANDI to understand the limits of the body. "We're able to push the mannequin to core temperatures that we wouldn't do with humans, or we can try to understand why somebody got heatstroke by replicating the scenario to see what happened," explains Konrad Rykaczewski, an associate professor at ASU, which is based in Phoenix, where daytime temperatures can exceed 43 degrees Celsius in the summer months.

Thermal mannequins can also be used to test cooling strategies—modeling more efficient methods by directing airflow to where it will have the biggest effect, for instance. In Phoenix, a recent "cool pavements" pilot program applied a reflective coating to street surfaces, so heat isn't absorbed by the dark asphalt. "We could put ANDI on one of these cool pavements and see what happens," says Ariane Middel, an associate professor at ASU. "Is he going to feel hotter? Is he going to feel cooler? Is he going to sweat more?" As the world heats up, those are questions we're all going to want the answers to.

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[Allyssia Alleyne](#)
[Culture](#)
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Nick Hornby's Brain-Bending Sculptures Twist History Into New Shapes

British sculptor Nick Hornby uses computer modeling to make mashups of famous artworks and historical figures that shift and change depending on your perspective.
Nick Hornby inspects *Power Over Others* during assembly at Benson Sedgwick in Dagenham.Photograph: Nick Hornby

You can get a crash course in Nick Hornby's work in the span of an hour-long London walk. The artist has three permanent sculptures installed across the city, metal silhouettes that start off familiar but transform depending on your vantage point. In St. James, his conquering equestrian, modeled on Richard I, becomes an amorphous squiggle as you circle; while in Kensington, his take on Caspar David Friedrich's *[Wanderer](#)* turns abstract; and a bust of Nefertiti doubles as the Albert Memorial.

Raising questions about power and the role of the monument, the trio are a clever combo of craft and concept. They're also feats of digital innovation. The equestrian, for example, started out as a digital model scripted in Python. It was then unrolled into individual components to be laser-cut from metal, then assembled by fabricators. "It was a lovely, seamless relationship between concept, digital processes, and mechanical fabrications —165 pieces manipulated into the six-and-a-half ton object," says Hornby from his studio in northwest London. "But when people look at it, they don't see that at all."

"I like to think that one of the distinctive features of my work is its ambition to capture the imagination of anyone, not limited to the art world; to try to address complicated ideas in plain English. Anyone will recognize the trope of the man on the horse and will have a reaction to how I have manipulated it."

Resting Leaf (Joe) is from a set of autobiographical works created using hydrographics—each resin sculpture is dipped into a wet medium containing an image transfer.

Photograph: Benjamin Westoby

This kind of technical-conceptual wizardry is Hornby's calling card. Favoring the screen over the sketchpad, he uses 3D modeling as the foundation for abstract sculptures that reference the art-historical canon and challenge notions of authorship—contorted mashups of works by Hepworth, Brancusi, Rodin, and more; the profile of Michelangelo's *David* extruded to a single point, legible only from above.

He started young, creating life-size terracotta figures in school while his classmates labored over simpler pots. "But then I went to art school, and it was like, I didn't want to do pastiche of Rodin. I wanted to be part of the future. I wanted to be innovative," he says. "So I jumped on technology."

At the Slade School of Fine Art in London, where he enrolled in the late 1990s, Hornby thrived in the new. There were forays into video; a semester at the Art Institute of Chicago, where he joined the artist-hacker collective Radical Software/Critical Artware; and musical experiments with MAX MSP, the object-oriented programming language employed by Radiohead in the early 2000s. But it was only after pursuing a master's in his thirties that his career took its current shape.

"I actually had quite a radical sea change in my relationship to tech," he says. "I got quite frustrated by people saying, 'Wow, that's really cool. How did you do it?' because I find that question really boring. I'm much more interested in the question, 'What does it mean?'" So, over the past decade Hornby has eliminated "any form of human subjectivity," he says. The

wires and screens were obscured, the rough edges erased with laser precision. All the better to invite questions of substance rather than process.

Face-on, *Do It All* presents as a realistic silhouette of the Albert Memorial, but step around 90 degrees to its left or right, and it transforms into a profile of the icnoic Nefertiti bust in Berlin's Neues Museum collection.

Photograph: Luca Piffaretti

But now Hornby feels his focus shifting again. "I thought that the reason I had been embracing this perfect digital realm was for rigorous conceptual questions around authorship. But when I turned 40, I came to realize that there was no visibility of me in my work at all. I'd eliminated myself," he says. It's something, on reflection, he ties in part to ambivalent feelings about his own queer identity. "I only realized 15 years later [after coming out] that I had been systematically erasing my subjectivity because I didn't feel that my opinion—and who I really was—was valid, legitimate, or something that I was willing to reveal."

After a decade reckoning with the canon, he's ready to insert himself into the work. A glimpse of this new stance comes through in a recent series of fiberglass sculptures wrapped in the liquefied photos of former lovers using a technique called water transfer-printing. (He started the work in 2020, in the month he turned 40 and broke up with a long-term partner). And, after three years largely spent coordinating the creation of three colossal monuments, Hornby is eager to level up his hands-on technical skills.

"I've been so enmeshed in production, making things, realizing projects, that I haven't had very much time to experiment and play," Hornby says. Now there's time to get his parametric design and 3D-modeling skills up to scratch, to find new ways to combine his established processes (water transfer-printing on bronze?) and to investigate the new tech on his radar. There have already been some experiments with generative AI, which Hornby finds "intoxicatingly exciting, exhilarating, and terrifying." "Watch this space," he says. "I'm just at the beginning of my career."

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[Amit Katwala](#)
[Science](#)
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This Small Wearable Device Reduces Parkinson's Symptoms

People with Parkinson's have fewer tremors when they receive rhythmic physical stimulation—so a UK startup has created a coin-sized vibrating device to help patients move more easily.
Photograph: Charco Neurotech

In 2015, Lucy Jung was a young industrial designer working on assistive devices for stroke victims, people with multiple sclerosis, and those with other conditions which meant they struggled with fine motor control. Her projects included a pen that used high-frequency vibrations to help Parkinson's patients write more clearly.

Then she was diagnosed with a brain tumor. "I really learned what it felt like to be a patient and that any kind of support or help can dramatically change the lives of people with long-term conditions," she says. Once she had recovered and returned to work in 2018, she picked up her research on Parkinson's, with the goal to improve the lives of those with the disease.

Parkinson's stems from a communication problem: Damage to neurons in the substantia nigra of the brain leads to decreased levels of dopamine and unusual electrical rhythms, making it harder for signals to move between neurons. The instructions the brain is trying to send to the body struggle to get through, resulting in the characteristic tremors, rigidity, and freezing of gait seen in sufferers.

But through her prior work on the pen, Jung had identified a potential solution. In the 19th century, French neurologist Jean-Martin Charcot noticed that Parkinson's symptoms seemed to be markedly better after

patients had been on long carriage or train rides, and subsequent research has revealed that rhythmic auditory, visual, or physical stimulation can help Parkinson's patients walk more fluidly through what's known as "cueing."

In 2019, Jung founded [Charco Neurotech](#), a Cambridge-based startup named after the French neurologist, which has developed a wearable device that promises to reduce the symptoms of Parkinson's disease. Charco's device, the CUE1, is a small plastic disc with an electric motor inside. It sits on the wearer's sternum, where it vibrates at a high frequency in a pattern that's been proven to reduce the symptoms of Parkinson's through cueing.

Unlike [deep-brain stimulation](#) implants, which [have also been used](#) to treat Parkinson's symptoms, the CUE1 is noninvasive—it attaches to the skin using medical adhesive—and inexpensive. The £295 ($371) device is being used by more than 2,000 people in the UK, with a waiting list of almost 20,000 across 120 countries. Charco has raised more than $10 million in funding and grants and now employs 38 people in the UK, South Korea, and the United States, including Parkinson's specialists, nurses, engineers, and data analysts. The goal is to get the device approved by regulators so that it can be prescribed by doctors through the National Health Service or Medicaid.

An app enables users to tailor the pattern of the vibration to one that works best for them. Jung is hoping to develop a feedback system so that the device automatically adjusts based on how well someone is moving—amping up or dialing down the pattern of cueing as needed. "What we're seeing is that people tend to use the device all day," she says. "Some people even use it when they're sleeping, and it helps with sleeping, too."

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