WIRED

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A CLASSIC ICON RETURNS

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OMEGA


20
22
2
4
TUDOR
GENEVE
28
GMT
CHRONOMETER
OFFICIALLY CERTIFIED
SWISS MADE
8
10
12

TUDOR

#BORN TODARE

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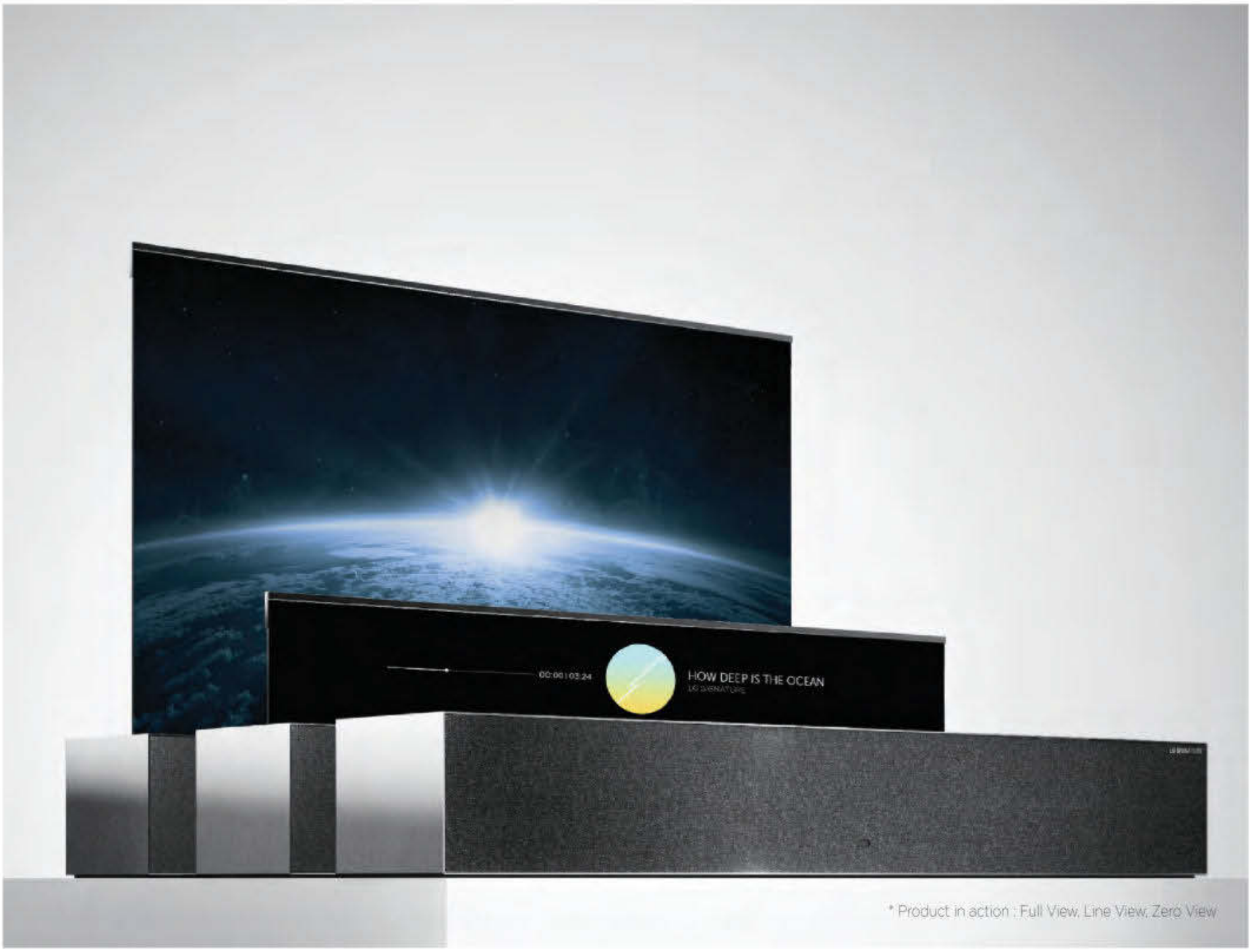

* Product in action : Full View, Line View, Zero View

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TECHNOLOGY COMPLETES ART

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revealing an unprecedented narrative about what a TV means today.
The LG SIGNATURE OLED R, rolling out a new perspective.

LG SIGNATURE has revolutionized the way we view TV through three modes of the OLED R.
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LG SIGNATURE
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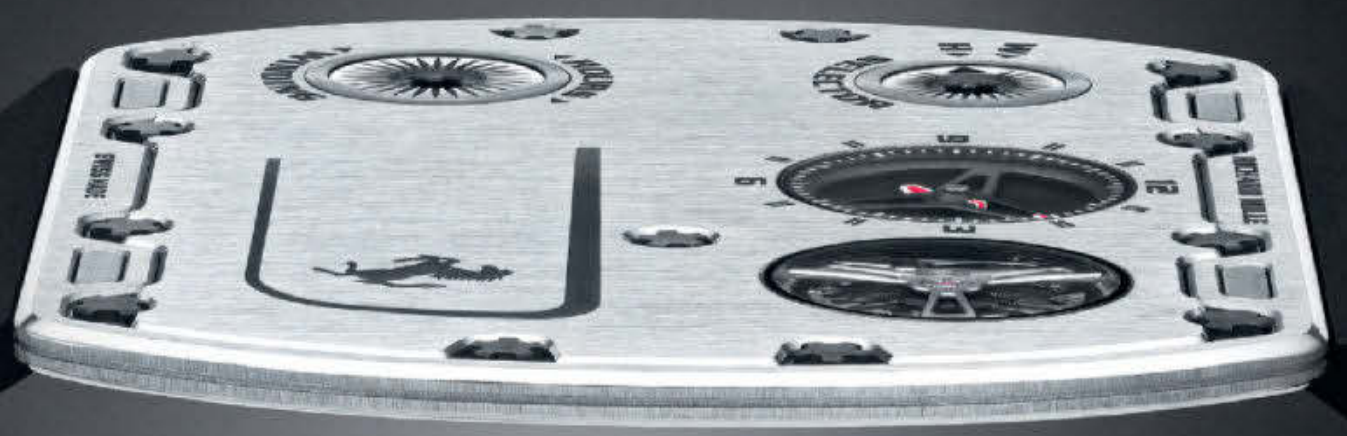
Find yours at **LGSIGNATURE.com**

RICHARD MILLE



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Ultra-flat manual winding calibre
1.75 millimetres thin
45-hour power reserve (± 10%)
Baseplate and bridges in grade 5 titanium
Patented ultra-flat escapement
Function selector
Limited edition of 150 pieces

RICHARD MILLE

A Racing Machine On The Wrist

PHOTOGRAPHY: DAVE IMMS

p. 40 Start
Fixing fashion’s waste-line

Josephine Philips wants to end the mass chuck-out of easily repairable clothing, by making tailoring and fixing items a commonplace, streamlined experience

- Manuel Marina Breysse, Cofounder, Idoven, **Spain**
- Google for Startups Residency alum

Diagnoses made earlier

Idoven's AI technology taps into existing health hardware to detect heart conditions sooner.

Find out more at goo.gle/3RqbJ9n

Google for Startups

Proud to help founders start, build, and grow

Saar Safra, CEO and cofounder of Beewise, in front of his robotic hives, which can monitor a colony's health, adjust the temperature, and detect pesticides.

PHOTOGRAPHY: JONATHAN BLOOM

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PICTET
1805
Building Responsible Partnerships

STAR OF THE SCREEN

Benedict Redgrove photographed Philip O'Ferrall, CEO of London's latest multimedia venue, The Outernet—and got his own work shown on its supersized screens: "I can't think of anywhere I've been where every wall and ceiling is a screen—and every single one displaying my images! I think this place is going to be such a great outlet for so many new creatives."

Creating WIRED

WORK, TEST, AND PLAY

"Shooting GEAR is always great, getting to see products that are new and interesting—and always unusual," says Mitch Payne, one of our regular photographers. "This time, I got to test an extremely clever folding boat, but my favorite was getting in some big-kid playtime building LEGO. What's not to like?"

THU-HUONG HA

Ha interviews Japanese author Sayaka Murata, whose work blends sci-fi, feminism and an uncompromisingly odd outlook: "Though her editors warn her not to say weird things in public, strange comments invariably flow out, like vomit."

JEFFREY BALL

Ball meets a scientist with a plan for the great flood of CO_2 entering the atmosphere: capture it and bury it. "By some estimates, there's enough suitable rock on Earth to lock away centuries' worth of carbon dioxide emissions, past and future."

AMELIA TAIT

Tait speaks to the creator of Craiyon, the AI art machine that can make anything you can think of. "Some fear that AI artists will replace human ones, but Craiyon's code relies on the user and their freaky, wonderful, beautiful humanity," she says.

PHOTOGRAPHY: BENEDICT REDGROVE; MITCH PAYNE

SeaQ

Dive into the Original

Glashütte
ORIGINAL

German Watchmaking Art since *1845*.

glashuette-original.com

LONDON Wempe, New Bond Street I Watches of Switzerland, Oxford Street I Watches of Switzerland, Knightsbridge
Watches of Switzerland, Regent Street I Harrods, Heathrow Airport, Terminal 2 **MANCHESTER** Ernest Jones, St Ann Street
YORK Berry's, Stonegate **EDINBURGH** Chisholm Hunter, Princes Street **GLASGOW** Chisholm Hunter, Buchanan Street

Carrots, sticks, and sci-fi thinking are what's needed to decarbonize our economies

One note of optimism in 2022's grim news cycle is that there is broad international agreement regarding the goal of decarbonization. This might seem like a troublingly low bar, but until relatively recently, it was still one that needed to be overcome.

There is also a clearer sense of the technologies that will need to be fast-tracked in order to make that happen, among them grid-scale electricity, green hydrogen, biofuels, carbon capture, geothermal energy, nuclear and large-scale battery storage.

What isn't so clear is how we ensure that these developments occur at pace and at scale, and how the public and private sector can work together. How can we effectively decarbonize economies?

Government has a vital role to play in this: they can set laws on emissions, rule on materials standards, regulate financial markets and price in the external impact of products that emit carbon. They can act to classify the risks of climate heating, leverage their vast power as procurers, and embrace their role as the largest investors in scientific research.

Fundamentally, legislators have two levers at their disposal when it comes to climate policy: incentives and disincentives. Carrots and sticks. Joe Biden's signature legislation, The Inflation Reduction Act, takes a carrot approach: broadly, it offers significant rewards to those who spend money on products and initiatives that will act to prevent further heating of the atmosphere—such as EVs, insulating homes or installing solar panels. A policy such as a carbon tax is essentially a stick.

The carrot and stick approach is the basis of a theory pioneered by Delton Chen, an Australian civil engineer and founder of the Global Carbon Reward (GCR) initiative. Chen's new economic theory for carbon markets uses carrots (carbon subsidies and rewards) and sticks (carbon taxes and cap and trade), and frames the climate crisis as an opportunity to create value while tackling carbon.

Central to this is the idea of the Carbon Currency (CC). Each unit of CC would represent one tonne of CO_2 emissions mitigated for 100 years, and would act as an asset, rather than a medium of exchange. It would be priced relative to a basket of other currencies and would have its floor price guaranteed by central banks. It would be overseen by a supernational authority that would certify the issuance of the currency to organizations based on their actions. As the GCR describes it, the currency would be a "proportional reward for climate mitigation services."

Think of it as a form of quantitative easing in the way that treasuries propped up the banking system in 2008-2009, and underwrote large parts of the economy during the Covid pandemic. But what's powerful about Chen's idea is the timeframe: these financial instruments will act as bonds over the long term; he proposes 100 years. We're solving for the future generations who will inherit the challenges from their ancestors. Unlike the financial and Covid crises, which used monetary policy as a way of returning to business-as-usual, CC could have the effect of altering significant realms of economic activity, although the grim truth is that a mechanism like a Carbon Coin would act as a means of compensating the private oil and gas companies and sovereign states that control vast carbon reserves for not destroying the biosphere.

If the idea of the Carbon Coin is familiar, you might have read Kim Stanley Robinson's *Ministry for the Future*, a bracing vision of humankind's looming, near-term prospects, which references Chen's work. We need our lawmakers to embrace these ideas, as much as science-fiction writers.

ILLUSTRATION: GREGORI SAAVEDRA

Greg Williams
Deputy global editorial director

THE NEW

i7

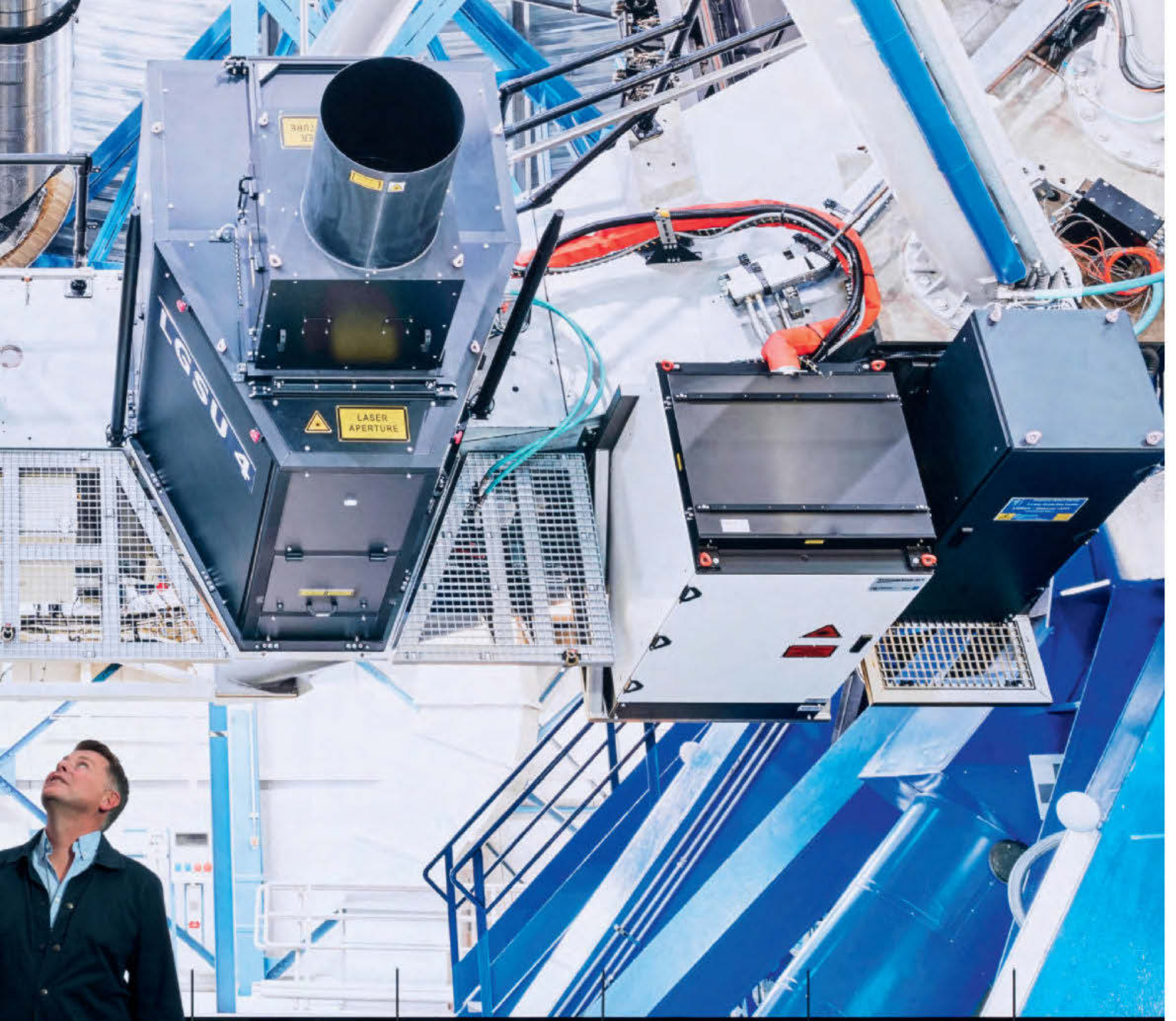
FORWARDISM

EVERY MOVEMENT
CREATES ITS OWN ICON.

#bornelectric

THE OUTE

Outernet CEO Phillip O'Ferrall stands in The Now Building, in front of the "hero wall"—a huge wraparound 16K resolution screen that can be used for advertising, videos, or in this case, to showcase the photography of regular WIRED snapper, Benedict Redgrove.



R N E T

Edited by
Amit Katwala & Gian Volpicelli

In 1752, humanity discovered electricity. In 2022, electricity discovered GTS.

From behind the wheel of the all-electric Taycan, the road offers almost unlimited thrills. The new Taycan GTS takes that experience and infuses it with decades of iconic GTS heritage. With more style, more passion and, naturally, more performance, the new Taycan GTS models show just how exciting electricity can really be.

The new Taycan GTS. Soul, electrified.

Porsche Taycan GTS official WLTP combined energy consumption 20.3 – 23.3 KWh/100km, combined CO_2 emissions 0 g/km. Figures shown are for comparability purposes only and may not reflect real life driving conditions, which will depend upon a number of factors including any accessories fitted, variations in weather, topography and road conditions, driving styles, vehicle load and condition, and state of battery charge.

PORSCHE

For decades, Denmark Street was the heart of London's music scene: lined with guitar shops and music publishers nestled below flats where the likes of the Sex Pistols and Elton John once lived and worked. Then Crossrail turned the area into a construction site for more than a decade.

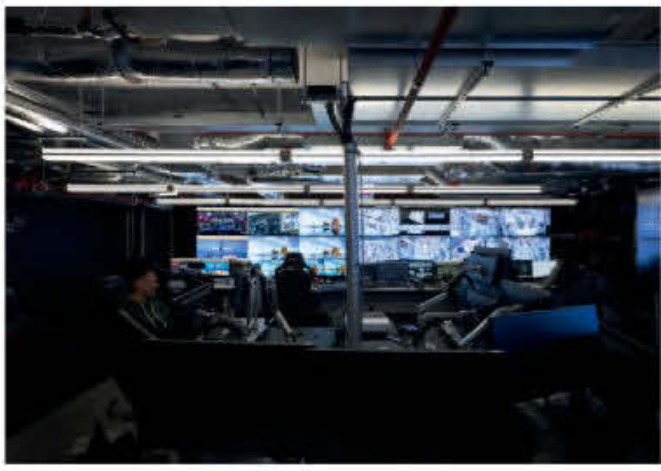
Now the dust and debris are gone, and in their place stands Outernet London, a combination music venue, events space, and digital advertising display that's the first venue of its kind, and one of many planned for cities around the globe.

Outernet is "the world's most advanced public building," says CEO Philip O'Ferrall. Its centerpiece is the enormous super hi-res wraparound screen of The Now Building, which will be seen by thousands of commuters and tourists each day.

It will be used for art, advertising and events, and includes new music venues for the capital, including a 2,000-capacity auditorium that's the biggest to be built in London since the 1940s (albeit one that merely replaces the 2,000-capacity Astoria, which stood on the same site until it was bulldozed to make way for Crossrail), and a hotel with rooms themed on the area's history of rock and pop music.

Since WIRED first visited the Outernet site in February 2020, the live events space has been battered by the pandemic, which delayed the opening, but also means the venue is now well-placed to take advantage of the strange trends

Outernet's master control room, where a team of four operators manage the content that appears on the venue's various digital displays. From here, security staff are also able to monitor 168 camera feeds.



The Outernet building's retractable screens as seen from the corner of Tottenham Court Road and Oxford Street, in London, with the new exit from the Tube station to the left. It sits in the shadow of the iconic, Brutalist, 34-storey Centre Point tower.

PHOTOGRAPHY: BENEDICT REDGROVE

Once a launderette, this is now a video and audio tunnel that leads people leaving the station into the complex. "It's programmed to draw people in and out," says O'Ferrall.

that have emerged since then. Outernet's unique selling point is the tech hidden behind its walls: hundreds of speakers, almost 200km of cabling, and racks of equipment running the latest computer graphics software from Unreal and Unity, serving screens with hundreds of millions of pixels. It's built for hybrid events.

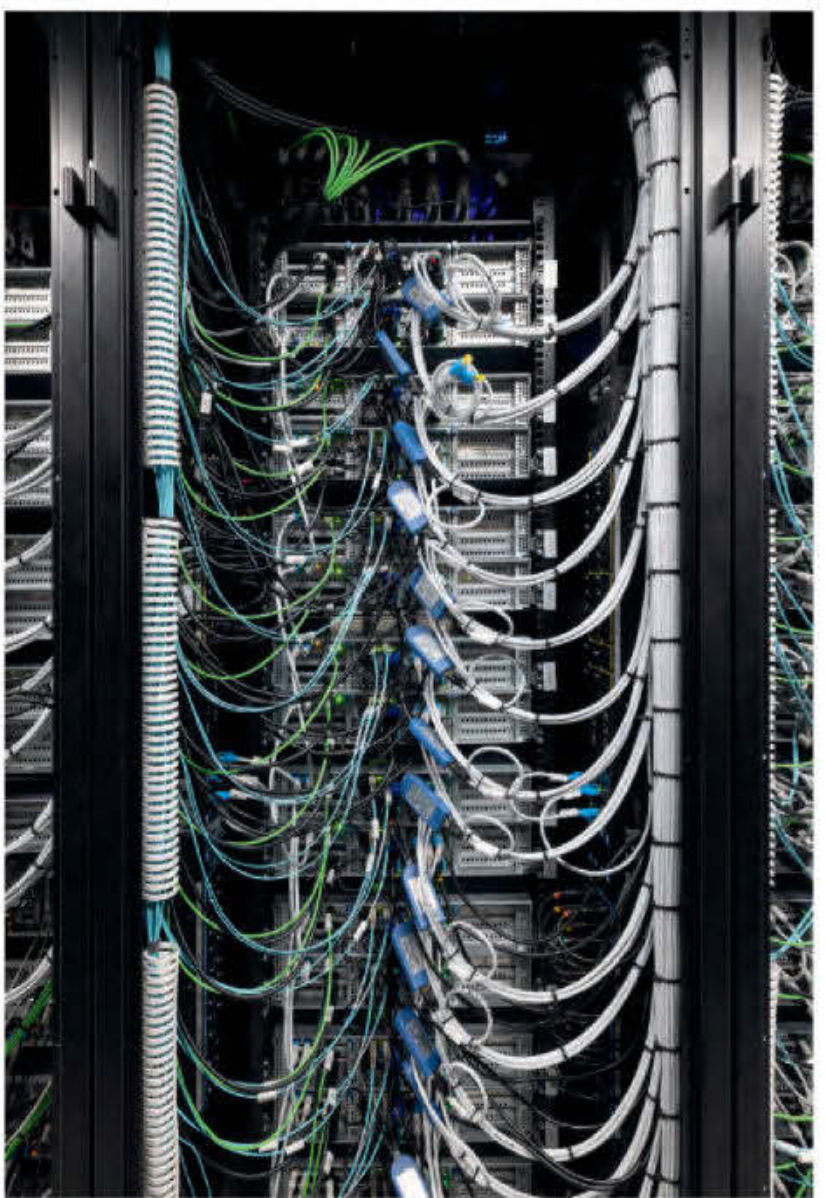
"What has evolved [since the pandemic] is audiences' propensity to interact," says O'Ferrall. "People are much more aware of how to interact with spaces through QR codes, through digital platforms." That could mean an awards show recorded in London and streamed live to other Outernets around the world, or onto people's phones, or perhaps showcasing a digital "drop" for a new NFT sneaker in association with Nike, plastered on giant screens, à la Times Square.

To some, Outernet represents a corporate monstrosity—a sanitization of the area that's anathema to the creative spirit that once ruled this part of London. But, O'Ferrall insists that the developers have gone out of their way to maintain continuity with what was here before, whether by retaining existing architectural features, or by ensuring that leases have been given to music shops, such as the new showroom for Roland synthesizers.

The building is "fully programmable," he says: it will constantly shift and change depending on the weather, or what events are being held there, or who's advertising—there are pop-up retail units and walls that slide open in the summer to reveal the screens behind. There have already been test events and promotions for Nike, Unicef, and Burberry.

There are further Outernet sites planned for locations in New York and Los Angeles, but when it fully opens to the public in November, Outernet London will offer a first look at a future where the boundaries between the inter- and outer-nets become blurred—"an extension of Web3, where audiences can become part of the metaverse," as O'Ferrall puts it. *outernetglobal.com*

AMIT KATWALA *is an editor at* WIRED.

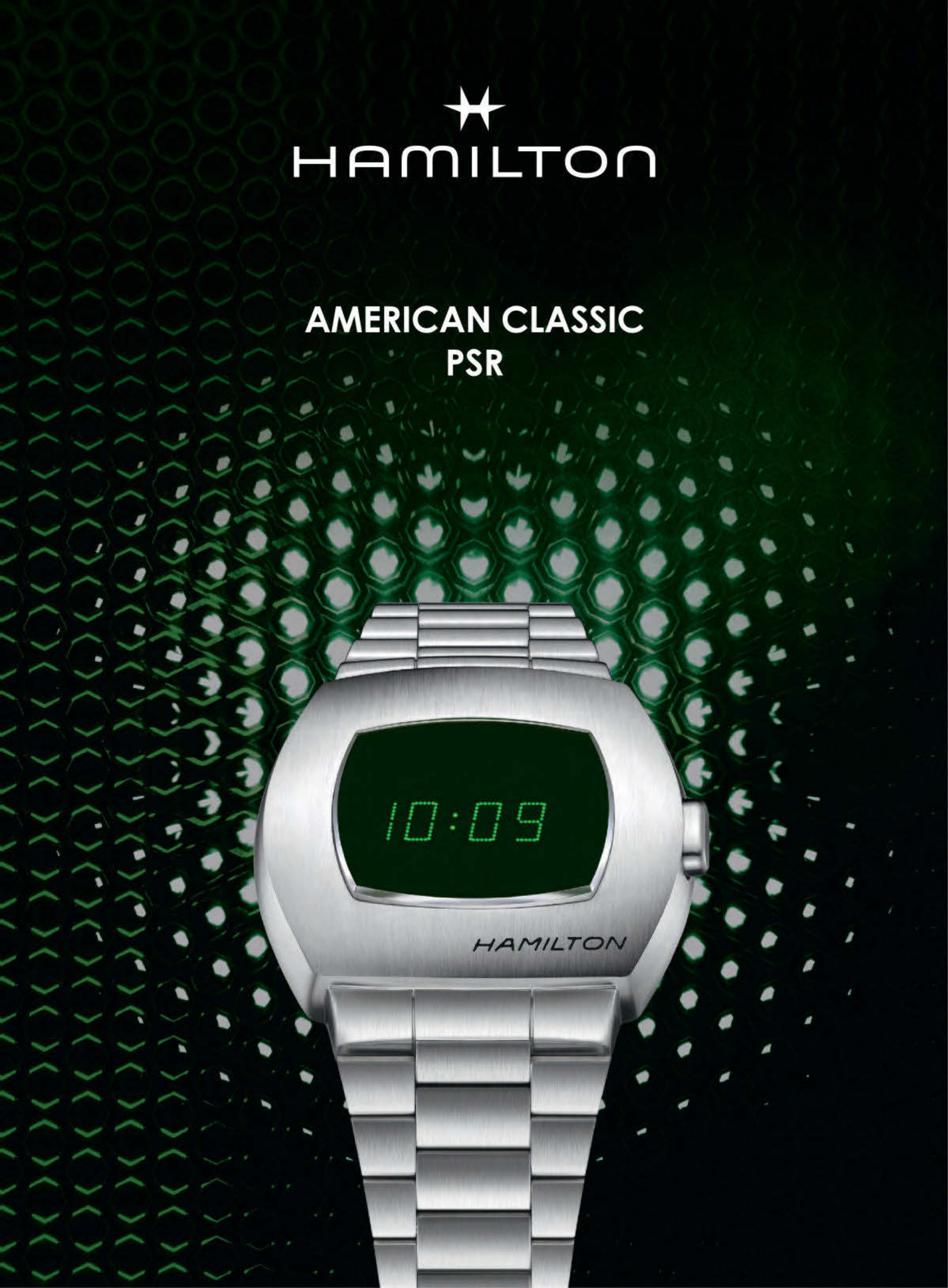


One of 26 fiber racks housing the tech that runs Outernet's screens and various interactive elements. "It really is very similar to a broadcast center, but more advanced and interactive with our app-based ecosystem," explains O'Ferrall.

PHOTOGRAPHY: BENEDICT REDGROVE

HAMILTON

AMERICAN CLASSIC
PSR



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PHOTOGRAPHY MARIUS KNIELING

Nils Frahm, in his studio in Funkhaus Berlin, a former Soviet-run DDR broadcasting facility.

THE SECRET SOUND OF NILS FRAHM

Flitting from orchestral to electronica via the spooky sounds of the glass armonica, the German audio artist is stretching music—and the instruments that make it—to its absolute limit

Nils Frahm has spent a lifetime turning the sounds inside his head into reality.

Inside the composer's studio in Funkhaus Berlin, a former radio broadcasting center once used by the East German state, you'll find the M450—the world's tallest piano, with 153-inch-long strings. In 2015, Frahm toured with three pipe organs so large they needed their own dressing room, and fitted the instruments with microcontrollers that turned them into wooden synthesizers.

He's performed the piano using toilet brushes, hitting the strings as if playing the marimba. In live shows, he navigates between electronic drum machines, synthesizers and self-built mixing desks. Right now, he's brainstorming an instrument inspired by the burr of air conditioning units, but he can't talk about that yet.

Frahm's music flits between classical and electronica—adored by fans of Beethoven and Berlin techno alike. His breakout record, 2013's *Spaces*, is a meditative experience. In 2015, he released *Solo*, recorded on the 3.7-meter-high Klavins M370 piano, the M450's older brother. Three years later came *All Melody*, exploring the extraterrestrial sound of dub music.

For his latest album, *Music for Animals*, Frahm turned to the glass armonica, a classical instrument with a strange history. Dating back to the mid-18th century, it's based on the noise a wine glass makes when you rub a wet finger around the rim, and consists of 37 glass bowls of different sizes, spinning horizontally.

The glass armonica was invented by US founding father Benjamin Franklin, and Mozart was one of a number of composers who wrote music for the instrument, which emits a ghostlike sound that can be both transcendental and unnerving.

Frahm believes the glass armonica fell out of favor as composers sought bigger, brasher sounds with greater volume. The instrument's obscurity is why it appeals to Frahm, whose pursuit of rare sound is driven by a need to offer listeners something they haven't heard before. "Some instruments have strong connotations [for the listener]," says Frahm. "I'm excited when I find a beautiful sound that doesn't have so many references, something which feels common, yet uncommon."

Music for Animals was largely improvised, during two years of German Covid lockdowns: When Frahm was bored, he played the same instrument for hours until something clicked. What was originally a ten-hour recording was edited to three, moving from complex, fleeting arrangements to slow-building melodies that bubble up to great crescendos.

Frahm says he wanted to create something that can't be experienced the same way twice. "You can listen to it now or tomorrow and certain things will sound different," he says. "I've listened to it hundreds of times, and sometimes I still don't know what'll happen in the next second."

JACK NEEDHAM *(@itsjackneedham) is a technology and culture writer from Yorkshire.*

If you can't prevent an illness, the next best thing is to detect it as early as possible, and to target the treatment where it will be most effective. But cancers are very good at evading even the most expert eyes, so medtech firm Earli is working on a way to make tumors announce themselves as they appear—and even provide directions

FORCING CANCER TO REVEAL ITS PRESENCE

In November 2016, German-American entrepreneur Cyriac Roeding read a magazine profile of Sam Gambhir, a physician and scientist at Stanford University School of Medicine. In the article, Gambhir described how he had devoted his career to early cancer detection, only to lose his teenage son Milan to a brain tumor in 2015.

Roeding, the cofounder and former CEO of mobile shopping app Shopkick, was struck by Gambhir's story, and sent him an email, asking to meet. Over the next few months, the pair became friends: Gambhir became Roeding's guide to the complex world of biology and engineering.

One day, Gambhir pitched his own idea—a poignant one. "Sam asked a simple but profound question," Roeding remembers. "He said, 'What if we stopped searching for cancer altogether; what if we didn't look anymore? What if, instead, we forced the cancer to reveal itself?'"

With cancer, time is of the essence—the quicker it's found, the longer the patient will live. Early cancer detection has become a key target in oncology—there are dozens of companies working on liquid biopsy technology, which scans blood samples for fragments of DNA shed by cancer cells. But this wasn't enough for Gambhir. His personal experience told him that waiting for the cancer to grow large enough to be detectable in the bloodstream was too slow, and it didn't tell you where to find the tumor. "We cannot rely on cancer signals that nature may simply not provide," he told Roeding. "But if we bioengineer the signal, then early tumors can become consistently visible."

That's the premise behind Earli Inc, which Roeding and Gambhir launched together in June 2018. The California-based startup has already raised $40m from Andreessen Horowitz, Marc Benioff, and Khosla Ventures.

Earli's approach essentially instructs the cancer to show itself. Bioengineered DNA is injected into the body; when it enters cancer cells, it makes them produce a synthetic biomarker not usually present in humans—say, limonene, a chemical found in the peel of citrus fruits. If subsequent breath or blood tests find traces of that biomarker, it could be a sign of cancer.

The next step is figuring out where exactly the cancer is in the body. An injected compound forces the cancer cells to produce an enzyme that then gobbles up a radioactive tracer, rendering it visible to the naked eye in a scan. Localizing the cancer makes it treatable—clinicians can use precision radiation or targeted surgery to then take it out. Earli is also planning to use the same approach to target and treat cancer—to kill the cells as well as finding them—although this idea is still in its early stages.

The plan is for Earli to be used at every stage of cancer's journey: for diagnostic monitoring in high-risk groups; for pre-treatment, to find out if there is cancer anywhere else in the body; during treatment, to make tumors easier to locate; and post-treatment, to detect recurring cancer.

Earli's technology "seems very exciting," says Shivan Sivakumar, a researcher in early cancer detection at the University of Oxford, who is not affiliated with the company—but adds that he wants to see the proper clinical trials done.

Those trials started in June 2021, in Melbourne, Australia, after successful test runs in mice and dogs. The first human participant was 84-year-old Ted Cunningham, an engineer with late-stage lung cancer—the goal of the trials is to show that the technology is safe, and that it can find cancer in patients already confirmed to have it. "I was diagnosed fairly late with cancer, and that to me was the biggest problem," Cunningham says. "If somebody would just get this very early, it would have to be an advantage."

Sam Gambhir never got to see his idea in action. Six months after the company was founded, he was diagnosed with cancer which had already spread to his bone marrow. He died sixteen months later, in July 2020. "For a guy who spent his entire career trying to prevent this from happening, the irony is not lost on us," says David Suhy, Earli's chief scientific officer. Roeding and Suhy feel the weight, and a pressure to make Earli's approach work. "We're here to carry Sam's torch," says Roeding. "And we've got to make this thing fly." *earli.com*

GRACE BROWNE *(@gracefbrowne) is staff writer at* WIRED*, covering health and tech.*

MAIN ILLUSTRATION: STEPHAN SCHMITZ. READOUT SOURCES: INTERNAL MESSAGES FROM WITHIN CRUISE; INTERNATIONAL TELECOMMUNICATION UNION; HUGGING FACE; BLOOMBERGNEF. ILLUSTRATION: ELENA LACEY

By instructing cancer cells to produce biomarkers, they can be detected earlier, as can their location.

Readout
The world, quantified.

60

Number of Cruise autonomous vehicles that were disabled in San Francisco over a 90-minute period on June 28, when they lost contact with a server and caused traffic jams.

2.9B

Estimated number of people worldwide who have never used the internet. That's 37 percent of Earth's population.

50K

Number of images a day that DALL·E Mini generated in June. The AI tool creates nine images at a time in response to any text prompt (e.g., "Demogorgon at the DMV").

80%

China's share of the market for lithium-ion batteries. Six of the 10 biggest producers of batteries for electric cars are based in the country.

One spring morning in 2015, Teemu Teeri was getting off a train in Helsinki when he spotted a chimera in the bushes. Few people would have looked twice at the petunia with blossoms in a vivid shade of orange. But Teeri, a botanist, recognized the plant as a survivor of an old moral panic.

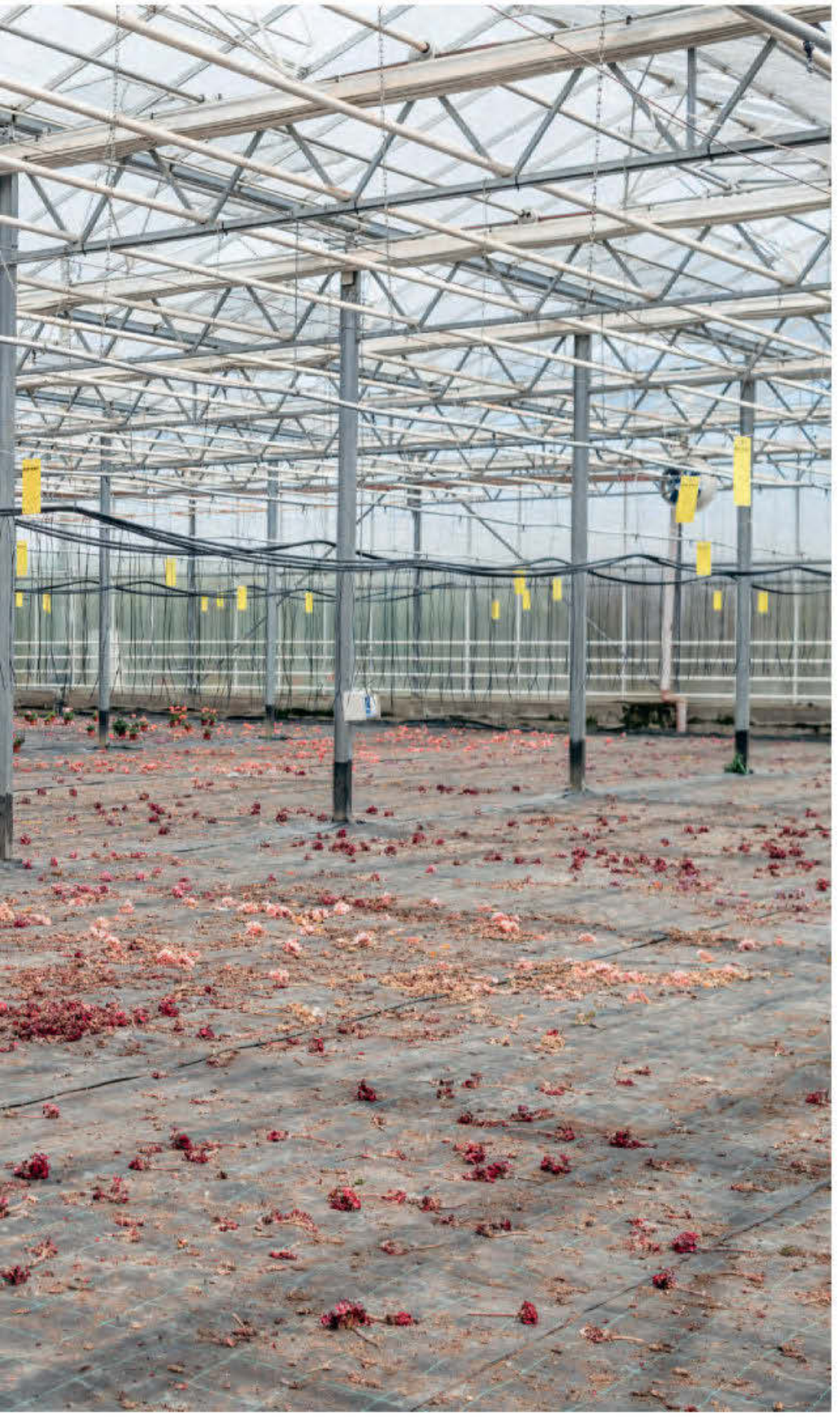
CRIMES AGAINST NATURE

This greenhouse in Vienna, Austria, used to produce orange petunias on an industrial scale, such was their popularity. The fate of these plants is unknown, but they were likely incinerated to ensure no further transgenic contamination of the “natural” varieties.

Blurring the line between reality and fiction, Klaus Pichler set up a *CSI*-style scene featuring an orange petunia treated like a murder victim.

He plucked a stem and took it back to his lab, where his hunch was confirmed: The petunia was orange because it contained a gene called A1-DFR, transplanted from maize by German researchers in the late 1980s in an early genetic engineering experiment. Somehow, it had escaped the lab.

Sure enough, soon after Teeri's discovery, regulators called for a global campaign to erase ill-begotten orange from the petunia's palette. Gardeners were free to choose their means of annihilation: Grind it up.



Bury it deep underground. Sterilize it with pressure and steam. Burn it.

Blind to its origins, horticulturists had previously embraced the petunia-in-orange. For decades, they had subjected the lab-born plants to their own manipulations, inducing stripes and softening the orange hue with prolific cross-breeding. They had given their new creations names like "Hell's Fury" and "Suntanned Butter". Now those plants shared a new label: GMO. And with that came the politics of what we grow and eat, and the line where human influence over nature crosses from ingenuity into crime. Local gardening columns soon celebrated the campaign to root out the deviants, citing potential harms to people and the environment.

But as the Austrian photographer Klaus Pichler asks in a series of mockumentary-style photos depicting what he calls the "Petunia Carnage" of 2017: Is the greater crime against nature to create a thing or to destroy it? Perhaps there was justice in the orange erasure; the mysterious lab escape meant society had been robbed of the chance to debate the introduction of the new petunia. Then again, the regulators decreeing the plants "illegal" never believed they were harmful. And after 25 years of crossbreeding, the genetic contraband had been so thoroughly scattered throughout the petunia population it was difficult at times to

identify which plants deserved destruction. The science of genetics was changing too, with powerful editing tools like Crispr, which in turn brought changing regulations. Sure enough, last year the US decided that orange petunias were fine to grow after all. As Pichler demonstrates with his surrealist photographs, the lines we draw between natural and unnatural are always subject to revision.

GREGORY BARBER *(@GregoryJBarber) is a staff writer at* WIRED.

Although not a genuine *Sun* front page, many real headlines from the purge of 2017 were as alarmist.

PHOTOGRAPHY: KLAUS PICHLER

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HOW TO TURN PLANT-BASED GOO INTO PLASTIC GOLD

It could get easy and cheap to swap oil-based plastics for ones made from protein and plants

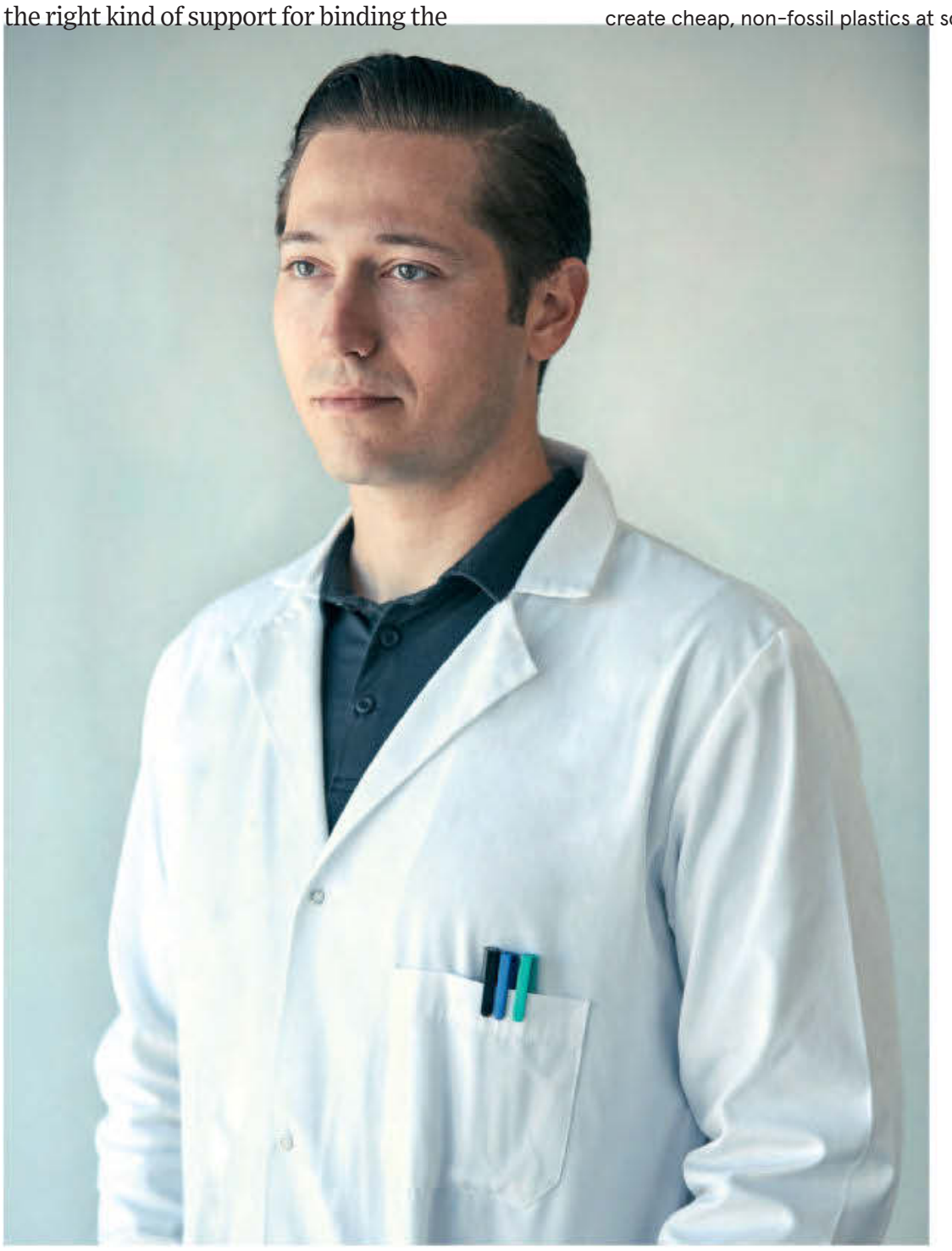
If you are wondering what the future of manufacturing looks like, visit the fourth floor of a brick building in the London borough of Camden. There, in a biosafety level 2 laboratory, FabricNano's chemists and biologists operate bulky machinery and parse the contents of reactors and vats filled with a thick yellow goo.

Born in 2018, courtesy of accelerator Entrepreneur First, the company has set its sights on changing the production of petrochemical-derived and fermented materials—aka plastic—by leveraging biological components. In other words, we could ditch oil and use proteins instead.

"Big chemical companies, some of which are our clients, want to make bio-based plastics at cost parity with things like PET plastic," explains Grant Aarons, the company's cofounder and CEO.

The process for creating products and materials by harnessing enzymes (proteins with the ability to accelerate chemical reactions) is well-known: High-fructose corn syrup is made by mixing cornstarch with a trio of proteins. "It looks like an assembly line: like, you're just taking your input chemical, your feedstock. You're putting it into the enzyme, handing it off to the next one, and making an ultimate product," says FabricNano vice president for operations Eliza Eddison.

But when it comes to producing more sophisticated materials such as plastic, biomanufacturing falls short. Most of the proteins used to trigger these reactions are destroyed or degraded in the process, making it too expensive to make stuff at scale. It is by addressing that issue that FabricNano hopes to jump-start the industry. The secret, Aarons says, was finding the right kind of support for binding the proteins to strands of lab-made DNA, a material that had never been seriously experimented with in the industry. What the team—which at the time still comprised cofounder Ferdinando Randisi, who had studied DNA theoretical biophysics at the University of Oxford—found was that, when bound to a DNA-based scaffolding, the proteins did not get damaged, allowing them to keep working for much longer, making biomanufacturing cheaper.



Grant Aarons, cofounder and CEO of FabricNano, which aims to replace plastic.

FabricNano's proprietary tech allows it to create cheap, non-fossil plastics at scale.

PHOTOGRAPHY: SAM LORT

Despite this success, they realized that DNA would always be too expensive for industrial-scale production.

"We were able to move away from DNA and still retain this benefit," Aarons says. "It's the same principle, but with a different support." How exactly this system works, FabricNano won't say, as the patent registrations have not been finalized yet. But chemical, pharmaceutical, and engineering companies—such as chemical giant Sumitomo Chemical America—have already started partnering with FabricNano. "We envision operating effectively at an industrial scale within three years," Eddison says. *fabricnano.com*

GIAN VOLPICELLI *(@Gmvolpi) is a senior writer focused on crypto, tech and society.*

DIGITIZING THE DAILY CATCH

Seafood is a truly global market, but how fish are caught and sold hasn't kept pace with the appetite for data—until now

The chaos begins at 5AM. The markets open, the traders arrive and the auction floor heaves. Over the next six hours, gambles are taken, hands are shaken and deals are made.

But this isn't a Wall Street trading floor, and the commodity isn't financial assets. This is how fishermen sell their catch to primary processors at auctions, who slice, dice and prepare seafood for wholesalers, the last-mile delivery companies who supply to restaurants, fishmongers and supermarkets.

Some 140,000 businesses make up the European seafood market, which trades more than €140 billion of fish every year. Despite those high numbers, it's an industry predominantly done offline and resilient to disruption; besides phone calls and emails, the grandest use of technology may be the occasional WhatsApp message to a close contact in a fish buyer's network.

Edinburgh-based Rooser is beginning to change that. Its B2B seafood trading platform connects buyers and sellers—the primary processors who supply the fish to the wholesalers that demand it—across 13 European countries. Following his frustrations opening a fish factory in Aberdeenshire, Joel Watt founded the business in 2019 alongside Nicolas Desormeaux, Erez Mathan, and Thomas Quiroga. "You have 35,000 types of seafood products moving on nothing but human emotion with no central price information," explains Watt. "It's professional gambling: Buying a pile of fish with the hope of quickly selling it—it easily goes wrong."

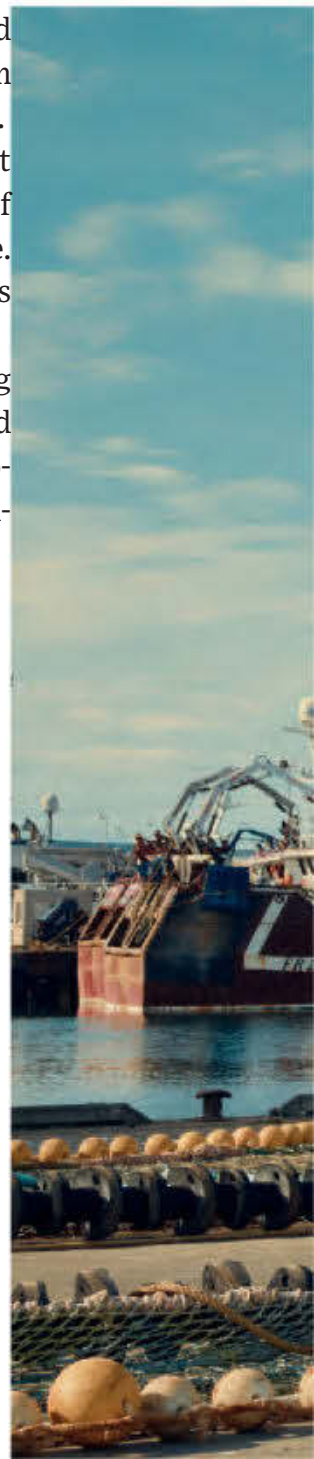
In the fishing frenzy that moves catches up the supply chain—from the ocean, on to the icy boxes at auction, on to the trucks transporting the goods around the country, and eventually on to the plate—a piece of fish may end up changing hands seven times. "You have three days to move the fish, or you're dead," says Desormeaux, a commercial fish buyer in the French port city of Saint-Malo, Brittany. "Once the truck leaves at midday, you have to wait for the next day."

Mistakes are inevitably made in the daily rush. Watt and Desormeaux aim for Rooser to take the guesswork away from seafood trading. "I remember one Saturday night sitting on a harbor wall looking through my contacts trying to sell ten tonnes of mackerel I'd accidentally bought," says Watt. "Without a communication channel connecting everyone in the chain, you might overpay for a species from the Scottish market, only for its price to plummet once the Danish catch comes in." Further complexity has been added to the supply chain by Brexit. "It's introduced layers and layers of paperwork, creating more friction in moving fish between the EU and UK," Watt says.

A centralized marketplace doesn't just benefit seafood traders. Watt says for every two pieces of fish consumed, another never makes it to the plate. By laying out all the information in real-time, sales are made faster, and less fish goes to waste.

Having secured £17.5 million in an April funding round, the next goal for Rooser is to scale globally and connect all the players in the worldwide seafood supply chain, even down to the individual boats and fish-

A fresh fish has three days at most to go from catching, processing, and shipping to consumers.



PHOTOGRAPHY: BEN QUINTON

Rooser's founders: Thomas Quiroga, Erez Mathan, Nicolas Desormeaux, and Joel Watt.

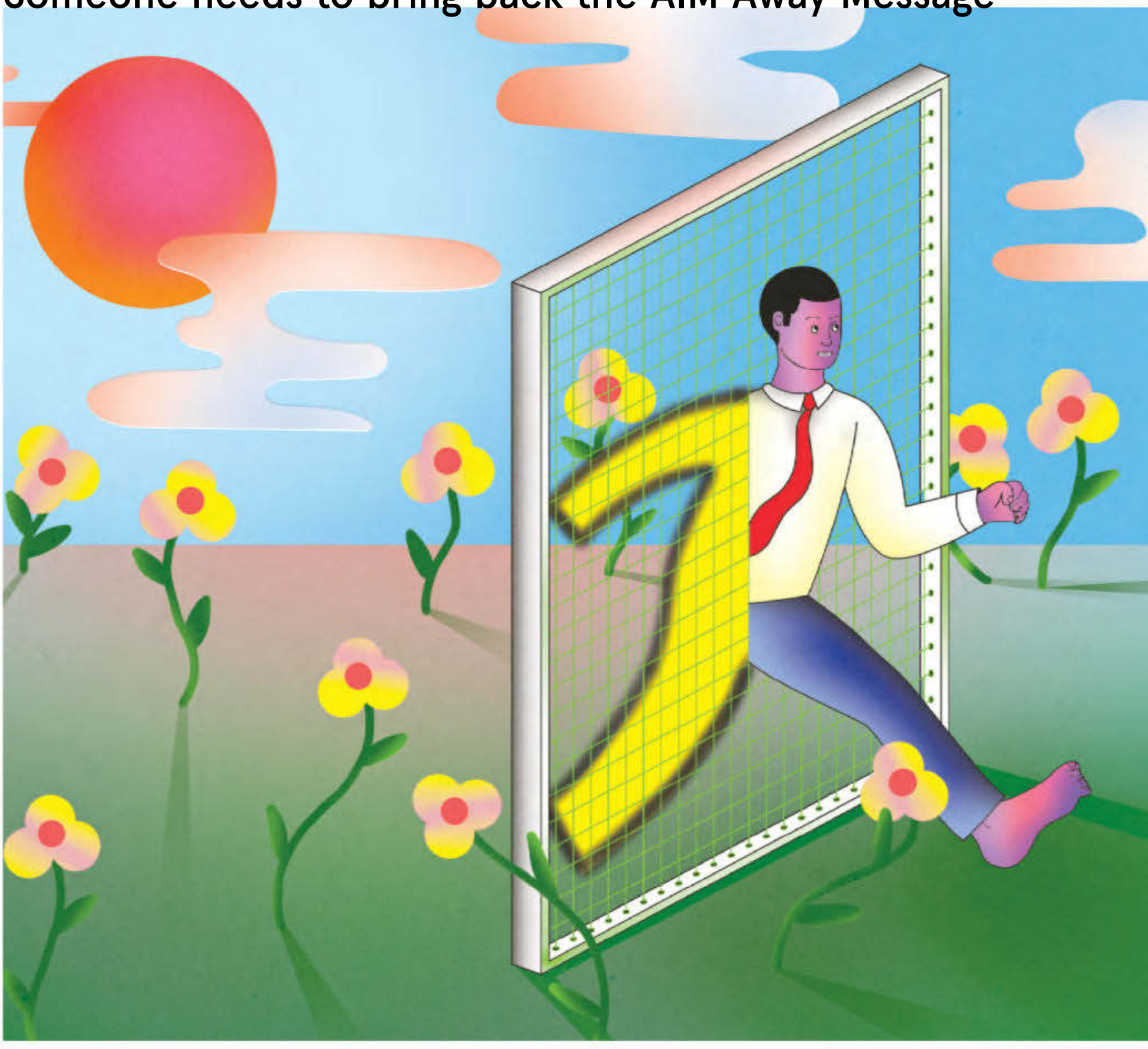
Rooser's plan is to digitally connect every boat and fishing trip, to build a live map of catches.

eries. The data harvested could then not only be used to accurately track the carbon footprint of a piece of fish and improve its traceability—Rooser could become a Google Maps for fishermen. "Every time a fishing net is taken out of the water, we'd be able to track where it's been, and map the ocean where the best fish are at different times of year," says Watt. "We could then provide that data to governments to better manage fish stocks in a data-driven way."

Seafood is a traditional business built on long-term connections, but the trade has been relatively quick to adopt Rooser. "An older contact of mine said he would never use technology: 'If you want to sell fish to me, you have to call me every day,'" says Desormeaux. "Now, he buys on our platform and tells me to stop calling—he's too busy using our system." *rooser.eu*

ALEX CHRISTIAN *(@alextchristian) is a culture, technology and business writer.*

The live chats of the AOL days are now in our pockets and are do-not-disturbingly inescapable, while the workplace-led culture of never really being OOO on Slack sets unhealthy expectations around availability. Someone needs to bring back the AIM Away Message



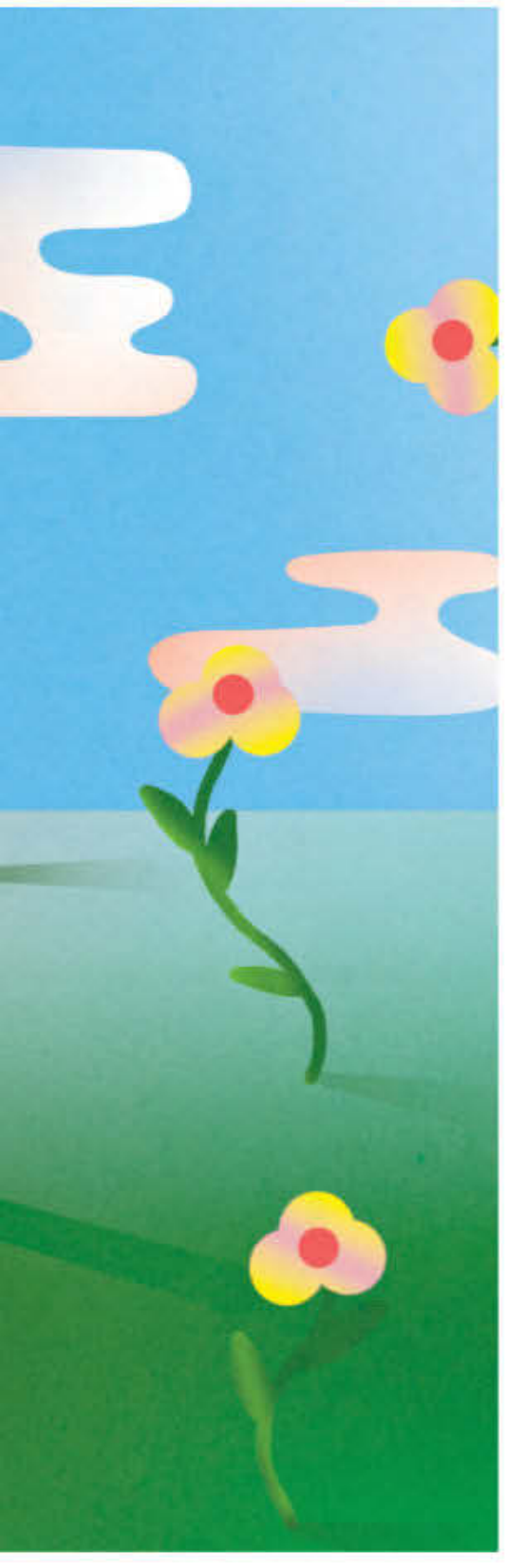
EMBRACE CHATTER BLOCKING

In the beginning, there was AOL Instant Messenger. OK, not really. Talkomatic, CompuServe's CB Simulator, and Internet Relay Chat all preceded it. But AIM was the beginning of *something*, and you didn't need to be a computer nerd to ride the AIM train. You popped the CD in the Gateway 2000, plugged your corded phone into a modem, and you were off—and very unaware at the time that you would never again live a wholly offline life.

AIM, which launched 25 years ago, propelled me into a universe of limitless pixels and endless distractions. It was also a live social network. And if you had to step away, you threw up an Away Message: I'm not here.

I miss Away Messages, those text boxes full of possibility. But they were more than that. They constructed a Maginot Line around our availability. An Away Message not only popped up after someone IM'd you, it was visible to that person *before* they did. Nothing like this exists today.

ILLUSTRATION: ABBR. PROJECTS



Oh fine: There's Do Not Disturb and Focus modes on iPhone and iPad. Do Not Disturb and Schedule Send for Android OS. Mute Notifications on WhatsApp. The workplace chat app Slack offers Update Your Status, the closest thing we have to Away Messages. You can warn folks that you're OOO or add a "sick" emoji. You can write "Writing, please DND." This, it turns out, is an invitation to be disturbed.

These are not guardrails. They're squishy orange cones that we all plow through like a 15-year-old in driver's ed. And the names—Focus, Schedule Send—are phrases born of a work-obsessed culture. Bring back the ennui, the poetry, the pink fonts. Bring back being *away*.

What I'm reminiscing about is, of course, an entirely different protocol. There's instant messaging, and there's text messaging. Today the two are practically indistinguishable, but 25 years ago they were disparate. AIM was a desktop client that pinged a server when you logged on, heralding your arrival to your Buddy List. Text messaging, on the other hand, mostly operated on cellular-connected mobile devices, and heralded nothing.

The social interactions around these messaging forms were also distinctive. Think of it as synchronous vs asynchronous messaging, says former Apple engineer Justin Santamaria. Back when he was working on iChat, a precursor to iMessage (now Messages) that supported live AIM chats, the mentality was that text messaging "was very much about asynchronous communication, a kind of 'fire and forget' model," he says. "I send it, you receive it, and then you respond on your time."

Now, "asynchronous" messaging is the dominant form of text-based remote communications, Santamaria says. We're all glued to Messages, WhatsApp, WeChat, Telegram, and Signal on our phones, and in many instances we receive the same messages on our laptops. With that evolution, social contracts have changed.

However, that synchronous/asynchronous distinction doesn't make sense now: Asynchronous messaging *is* real-time chat now. That corded phone that dialed up and signed me on has morphed into a pocket computer that also makes phone calls. We can be reached at nearly any time. The dreaded ellipsis—the *dot dot dot* as someone types a response—holds us captive. We are all walking live chats.

Of course, some people (not me) are just better at managing their messages. Not long ago I was horrified and fascinated by a screenshot that a prominent tech CEO shared on Twitter, in which he inadvertently revealed that he had well over a hundred unread text messages. I inquired about this via DM, no doubt interrupting him, and he told me he treats his text messages much like he treats email. He triages, which is a very CEO thing to say. "I just respond to the stuff I need and mark anything as unread I need to get back to … the numbers don't stress me out."

This seems smart—although author Sam George might diagnose him with a totally made-up condition called Dyscommunication Syndrome, the basis for his book *I'll Get Back to You*. (I haven't read the entire thing; I've been too distracted by messages.) George makes a case for responding to messages quickly to clear them from your queue, rather than letting them sit or breaking the feedback loop entirely. Some of his advice is sound—take the conversation offline when possible and channel empathy when someone doesn't respond right away. The book also includes such gems as "What you do with a dick pic is up to you."

Lest I'm perceived by others as a communications curmudgeon, I'll own up to it: I'm a communications curmudgeon. People (myself included) send too many messages. The first step in making amends is to admit that you, too, are an inconsiderate messaging maniac.

But I'll never stop, and neither will you. Quick messaging has become one of the most efficient and meaningful forms of communication. It's crucial for relationship building, for organizing, for supporting others through hard times. It can be joyful. It's an accidental social network. It's not even accidental: Meta, née Facebook, knew exactly what it was doing when it acquired WhatsApp.

Would something like the AIM Away Message, a relic from an era when we didn't message so darn much, actually put up the guardrails we need? Maybe not. But at this point I'm willing to try anything.

Senior writer **LAUREN GOODE** *(@LaurenGoode) covers consumer tech issues and trends.*

A FATHER'S QUEST FOR AN ACCESSIBLE GAME CONTROLLER

Andreas Karlsson finally found a hero in retro controller maker 8BitDo, to help his disabled son keep on playing

The Lite SE places the side-triggers on its face for flat use.

In June, game-controller company 8BitDo announced the Lite SE, created in collaboration with father and son team Andreas and Oskar Karlsson, and designed for physically disabled players with limited strength and mobility.

At a young age, Oskar was diagnosed with spinal muscular atrophy type II, a neuromuscular disorder that progressively weakens muscles over time. His father adapted standard controllers to meet his son's needs; as Oskar's disability progressed, so too did the designs.

"The GameCube controller was the first we adapted," Andreas says. "We mounted screws in the joysticks and buttons, and added polymorph around the screws. By doing that we could increase the length of the joysticks so it was easier to grip, and the increased length of the joysticks reduced the force required to maneuver it—but at the cost of range of movement. The screws and polymorph on the buttons meant increased weight on the buttons, making them easier for him to push down."

As games evolved without proper accessibility features and options, Karlsson struggled to discover tools that would allow his son to properly play. Furthermore, the substitutes never matched the designs of standard controllers, amplifying the sense of difference that can accompany gaming as a disabled player, leaving Oskar not wanting to game at all.

"That was when we geared up and started to modify existing controllers, and even built our own," Karlsson says. "Everything from low-force joysticks for power wheelchairs to the Xbox Adaptive Controller. As Oskar grew older we faced a new problem. Using a controller that didn't look like everyone else's was a factor we never thought about. But, it mattered."

After seeking outside assistance from charities and organizations, Karlsson finally found help through 8BitDo. "I have written more letters than I can remember to manufacturers of assistive aid, video-game manufacturers, and developers," he says. "Not even one time did I get the slightest interest from any of them—until last year I got in contact with 8BitDo."

The design resembles a trad Switch controller, but each button and joystick are also placed to purposefully suit Oskar and his needs. The joysticks and buttons have increased sensitivity and less resistance than standard controllers, while every button is on the face of the Lite SE.

Karlsson understands the unique and personal nature of physical disabilities, noting that this controller cannot help everyone. Rather, the Lite SE is just one solution that works for his son. "There seem to be so many people out there thinking that there is only one disability, asking questions like, 'Why haven't you placed the buttons like this or that, it would be smarter if you did it like this'," he says. "The point they are missing is that this isn't a controller to rule them all. This is one controller that was made especially for Oskar, that works well for him. It doesn't mean it will work for everyone, but hopefully it will for some."

GRANT STONER *writes on the video game industry from a disabled perspective*

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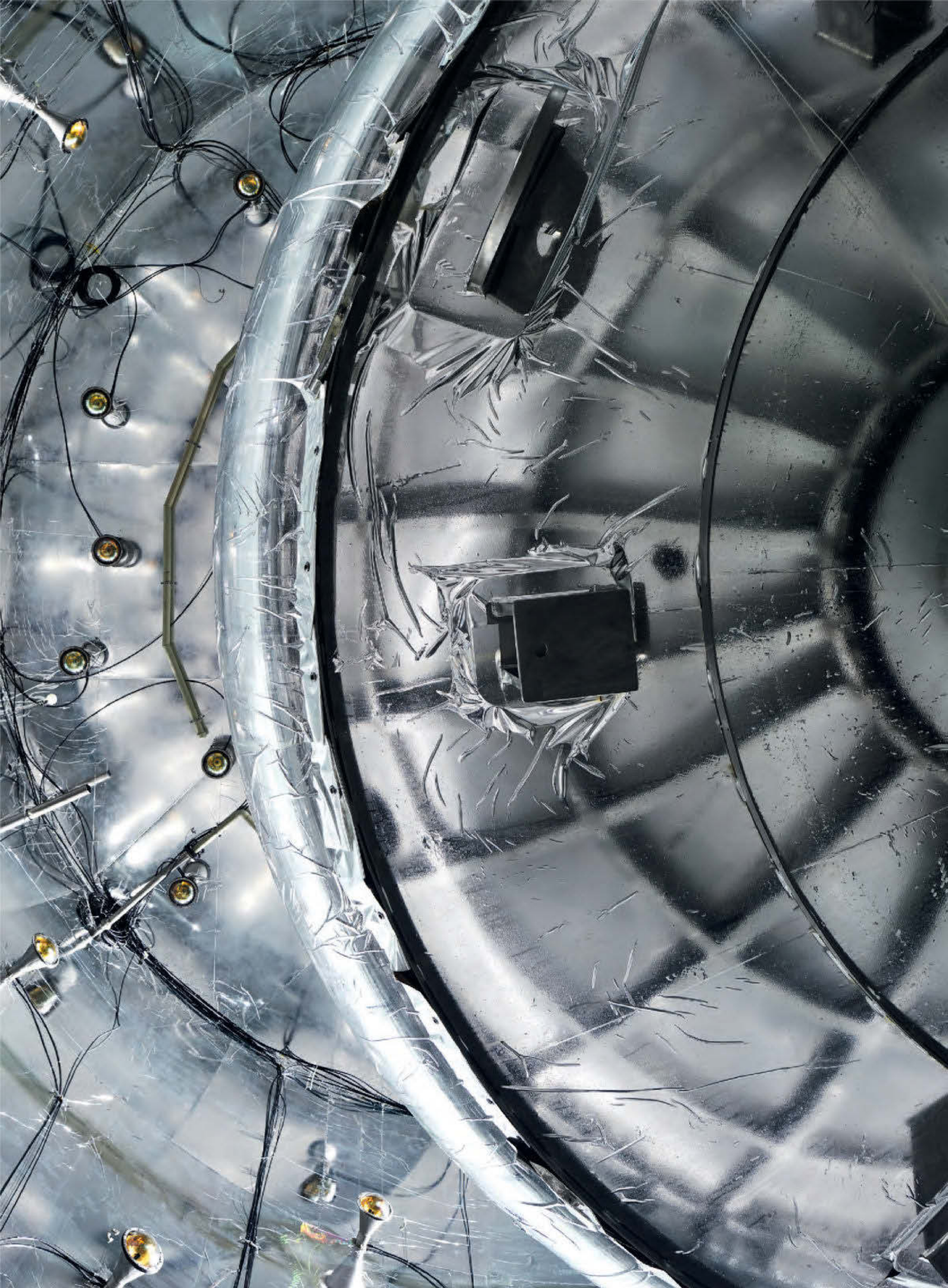


ESSENTIAL KIT FOR HUNTING AN ANTINEUTRINO

In Gran Sasso, the LEGEND-200 project is trying to explain why there is so much more matter than antimatter in the universe

After the Big Bang, the universe is thought to have contained equal amounts of matter—the atoms that make up everything we can see and feel—and antimatter, its oppositely charged equivalent. But why don't matter and antimatter annihilate each other, wiping away everything in the process? And why do we observe so much more matter than antimatter?

Deep below central Italy's Gran Sasso mountain, physicists at the underground research center Laboratori Nazionali del Gran Sasso (LNGS) are seeking an answer via a collaboration known as LEGEND-200.

"If we assume that the universe was born of equal amounts matter and antimatter, it should exist in that state now, which we do not observe," says Dr. Matthias Laubenstein from the National Institute of Nuclear Physics, one of the organizations working in the LNGS.

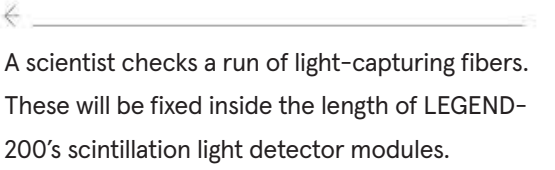
In the 1930s, physicist Ettore Majorana theorized why there is an imbalance between matter and antimatter—a hypothetical phenomenon called "neutrinoless double beta decay". Ordinary double beta decay is a naturally occurring process where protons transform into neutrons inside the nucleus of an unstable atom as it decays, emitting electrons, and either two neutrinos (zero-charge electrons) or two antineutrinos (their corresponding antimatter particles) as a byproduct.

Majorana posited the existence of a different type of double beta decay that produces no neutrinos or antineutrinos, and, as neutrinos and antineutrinos are essentially the same thing, sometimes identical particles end up annihilating each other. If Majorana was right, then some types of decay would only release electrons and no antineutrinos—more matter than antimatter—therefore tilting the cosmic scales in favor of matter.

The problem is, any neutrinoless double beta decay would be an extremely drawn-out process, and observing it in the wild could take tens of trillions of years. So, researchers are trying to trigger it in the LNGS, using germanium isotopes.

To maximize the chances of detecting the phenomenon, the labs must reduce background noise and cosmic radiation: from keeping the detector immersed in -188°C liquid argon, to enormous lead shields, to relying on an entire mountain as a radiation screen. This way, says Laubenstein, it may take between five and 10 years to see some result—if neutrinoless double beta decay actually exists. Detecting the phenomenon, however, would upend physics as we know it. "A new field of experimental challenges would be waiting to be explored," Laubenstein says.

Looking from above into LEGEND-200's mirror-film-coated water tank. The stalks on the walls with gold-toned lenses are photosensors.



A scientist checks a run of light-capturing fibers. These will be fixed inside the length of LEGEND-200's scintillation light detector modules.

One of the scintillation light detector modules, which will—assuming that they actually exist—spot antineutrinos as they annihilate each other.

ELENA GIULIANO *(@ElenaGiuliano5) is an Italian journalist based in London.*

PHOTOGRAPHY: ENRICO SACCHETTI

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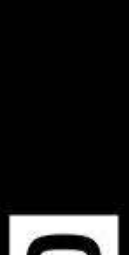

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IDLENESS AS AN EARNING STRATEGY

Getting paid for doing nothing? Seems like crypto has finally delivered a future we can all get behind. But yes, there's a catch

The popularity of "play-to-earn" video game *Axie Infinity* skyrocketed in the past couple of years, with estimated revenues of $4.17bn as of March 2022. In the game, the more you play using NFT-based characters, the more you amass tokens that can be traded on cryptocurrency markets.

The idea of earning money—albeit as crypto—just by playing a video game is far from the oddest proposition in crypto-land. Over the past few months there's been a new crop of ventures exploring ways for people to earn cryptocurrency while engaging in banal activities. Call it, if you like, the rise of the X-to-earn. Take Step, and its "walk-to-earn" application: The more you trudge along, the more cryptocurrency you pocket. Or SleeFi, whose business model hinges on having people earn tokens by, well, sleeping.

Some people think this is madness; others believe it is a smart way of nudging people towards better lifestyle choices. According to Alex Faliushin, CEO of crypto-lending platform CoinLoan.io, these initiatives have the potential to incentivize better habits, while also providing financial support. However, he also believes that these incentives are solely funded by an influx of new customers bringing in new money, which is then paid out to those who joined earlier. Once user growth slows, stagnation will set in. "As of now, the industry is built upon what could be considered a Ponzi scheme," Faliushin explains. "This will lead to collapse."

While Ponzi might be too strong a word, a similar dynamic is already apparent in *Axie Infinity*, which, as of June 2022, was grappling with a steep decline in both daily users (-60 percent year to date) and token price (-86 percent). According to an analysis from Product Hunt, the decline is due to fewer new players buying Axies, which is causing existing players to cash out.

ILLUSTRATION: JOE WALDRON

But SleeFi founder Megumi Hayashida feels optimistic. "It's not just an application used to make money," she says. "It can improve the user's sleep experience based on feedback." SleeFi measures users' sleep patterns via a smartphone app. The higher your sleep quality, the more tokens you get—but users have to purchase SleeFi's "Bed" NFTs first, of course. Ahead of the project's beta launch in August 2022, over 1,000 people a day were signing up.

Carlotta Tatti, Founder and CEO of walk-to-earn app Step, says that over 25,000 people are holding the Step token, and, as of July 2022, Step's iOS and Android app had been downloaded over 150,000 times.

"Thousands of people get rewarded for their physical activity," Tatti says. "As with every investment, there are ups and downs, but we have got lots of people that made great profits from the token alone."

Joseph James, a business advisor and founder of the Money, Mindset & Strategy podcast, is less impressed with X-to-earn firms. "They can be very attractive because they can give people a sense of control over their finances," James says. "But it's very important to make sure you research what you are investing in, get expert guidance and don't put all of your eggs in one basket or expect overnight results. You don't hear about the people who are losing money nearly as much as the people who got lucky."

ALESSANDRO MASCELLINO *(@a_mascellino) is a British-Italian journalist.*

X-to-earn firms promise crypto riches from everyday activities, but some doubt its model.

Josephine Philips, who founded Sojo after struggling to get a charity-shop suit tailored to fit

FIXING FASHION'S WASTE-LINE

Josephine Philips wants to stop the mass clothing chuck-out by making it easy to mend and tailor our old and new outfits

It started with a charity shop off London's Portobello Road, and the perfect pinstripe suit. Well, almost perfect. "I loved it, but it didn't fit. So I had the idea for building an app," explains Josephine Philips, the founder of Sojo, a startup that wants to bring tailoring "into the modern age".

Nicknamed "the Deliveroo of fashion repairs", Sojo was launched in January 2021, and connects users with nearby seamsters, while facilitating the pickup and return of clothes using a network of couriers. Independent seamsters register on the app and set their own price for their work, from fixing holes to altering sizes, with Sojo taking a 30 per cent fee. That very same pinstripe suit ended up being one of the app's first orders.

"I experienced going to a tailor, and it was really backward," says Philips. "It's not an activity that's common, and we want to make it common. We want every young person to be engaged with repairs and alterations." Indeed, two thirds of fixable clothes are thrown away.

Eighteen months after launch, Sojo is fresh from a $2.4m funding round, a partnership with Scandinavian fashion brand Ganni, and a hiring push that should see it reach 16 staff. It's also been a seismic change for Philips. The 24-year-old started working on Sojo full-time straight after graduating from university—her only previous jobs being as a waitress, and as a summer intern at Depop.

For those first few months, Sojo was a one-woman show, powered by overtime and youthful passion to change the "culture of waste" and "exploitation" that defines the fast fashion industry, from which Philips built up her initial, limited network of couriers and seamsters.

"I saw the way the system was working and was, like, 'I can actually change that' … That kind of outlook was definitely a superpower," says Philips. "But I was learning and doing simultaneously."

As a Black female founder, Philips found herself in an industry where women-led startups account for 2.8 per cent of VC funding. According to one report, between 2009-2019, only one Black female founder in the UK raised any Series A funding.

"Everyone knows what the venture capital space is like for under-represented founders," Philips says, explaining she would regularly get rejected by investors, only to see white male counterparts with little more than "a PowerPoint" getting "millions straight off the bat".

Eventually, Sojo was able to secure backers, initially through an angel round including Depop founder Simon Beckerman. The latest Series A round was led by female-directed VC firm CapitalT.

Outside funding has also prompted a change of focus. Instead of its direct-to-consumer operations, Sojo is increasingly focusing on business-to-business—making deals with fashion brands such as Ganni to provide alterations for its thousands of clientele. Those deals will allow customers to easily request clothing repairs and alterations, and go some way to changing the way they see tailoring.

"I realized that by shifting our business model into working with brands, we'd be able to actually reach scale and make an impact a lot faster," Philips explains. "One of our investors said you can either spend £10m trying to acquire ten million direct customers over a period of 10 years. Or you can have one B2B partner and you access ten million customers overnight."

Philips is also in the process of outsourcing Sojo's courier network, while hiring in-house seamsters. She has even explored expanding Sojo into providing its own "dark kitchen" equivalents; a network of industrial seamster workshops that would give it the scale to work on thousands of alterations locally, all at once.

Philips hopes Sojo will change consumer attitudes towards clothing, at a time when fast fashion is in the spotlight for its environmental impact. "Ultimately, we live in a culture of hyper-disposability," she says. "Clothing has not been considered something of value." *home.sojo.uk*

ANDREW KERSLEY *(@AndrewKersley) is a freelance writer based in London.*

PHOTOGRAPHY: DAVE IMMS

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In science fiction, when an AI spins out of its creator's control, it usually leads to death, dystopia, and destruction. When machine learning engineer Boris Dayma's AI model DALL·E mini took over the world this summer, the results were as disturbing as they were hilarious. Karl Marx was slimed at the *Nickelodeon Kids' Choice Awards*. Margaret Thatcher shook hands with Satan. Jesus turned water into wine on *America's Got Talent*. And Dayma's personal favorite: a CCTV camera caught teddy bears shoplifting from a store.

Don't panic: DALL·E mini didn't slide us into an alternate universe. The AI model—since rebranded as Craiyon—simply generates images from written prompts fed to it by users. The model was inspired by an open-source language model called BART that Dayma tweaked gradually over time, and it was trained on images from the internet (it doesn't, thankfully, learn from the images generated for its users).

Dayma created Craiyon in July 2021 because he wanted AI tools to be accessible to all. At the start of that year, AI research lab OpenAI released DALL·E (named after the artist Salvador Dalí and Pixar's WALL·E). Like Craiyon, it generates images from text, but unlike Craiyon, access is restricted. "I decided to try and build an open-source version," says 35-year-old Dayma, who lives in Texas.

ARTWORK: CRAIYON/WIRED

FOR AI ART, JUST ADD HUMANITY

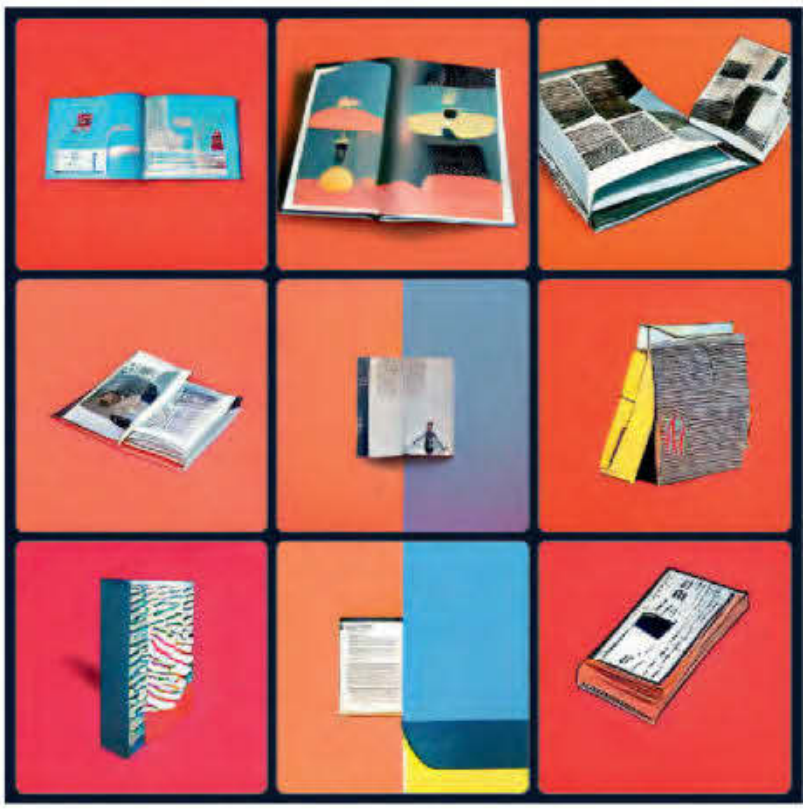
Craiyon's algorithms can bring your wildest imaginings to life

DALL·E is restricted because OpenAI wants to "develop and deploy AI responsibly". So, what happened when Craiyon started generating 50,000 images a day? One news site, NextShark, illustrated a (real) story about Mark Zuckerberg waving a katana sword in the Facebook office with a (fake) Craiyon image. Google Brain researcher Adam Roberts tweeted that this was, "paving the way for a very dangerous practice by media organizations."

"I consider it a one-off thing," says Ryan General, the millennial Philippines-based writer behind the Zuckerberg-sword image for the article. "I thought an AI-created image fitted such an unreal story." General adds he wouldn't have used the image if it was "not so obviously fake". At the start of the summer, the pictures made by Craiyon were haunting and ethereal; the AI blurred people's faces, so it was hard to mistake generated people for the real deal. By the end of the summer, however, Dayma and his team had fixed an issue in their image decoder which "immediately" improved the results. Faces are no longer blurred, although they are undeniably Picasso-esque. Dayma says the team will continually improve quality.

Dayma hopes that his AI will "give people a chance to develop a critical mind. This kind of model is coming, we need to be aware that when you see images, they may not be real." He also notes that it's better for the public that this happens openly, and not behind closed doors.

But what does Dayma's AI really reveal about us? Craiyon has illustrated not the depths of human depravity (partially because it can't—Dayma says the team filters out data from the images the model sees so it is "not aware of certain concepts", such as sex and some types of violence), but the limitless bounds of human imagination. Some fear that AI artists will replace human ones, but Craiyon's code relies on the user and their freaky, wonderful, beautiful humanity. It's no surprise that a subreddit celebrating the AI's strangest creations, r/weirddalle, gained 97,000 members in a month, while an accompanying Twitter account earned one million followers in the same time.



In case you were wondering what Craiyon thinks WIRED magazine looks like ...

"The sub grew insanely fast," says Charlie Edgson, an 18-year-old Florida waiter who moderates the subreddit. Edgson doesn't have a favorite post, but the 38th most-popular image immediately catches my eye—"Cucumber Connect Four".

The artwork known as Cucumber Connect Four is exactly that—how the game Connect Four would look if the grid and tokens were made out of cucumbers. You can't imagine a human would ever take the time to paint or Photoshop such a thing, and it is mesmerizing in its absurdity.

"It just popped into my head while staring at the site on my phone," says Hazel, a 35-year-old office admin from the UK who input the prompt into Craiyon.

Dayma is delighted by the ways people are using his tool. "I've been amazed to see the quality of the content people have been able to create," he says—one person reached out to Dayma because their mother couldn't afford a logo for her small business—and they solved the problem with Craiyon. Dayma hopes to improve Craiyon further, adding editing tools, and making it work with media such as videos and music. "If people can just have fun, that makes me happy," he says. "When you give access to everybody, you quickly learn what can be done." *craiyon.com*

AMELIA TAIT *(@ameliargh) is a freelance writer covering culture, trends and the internet.*

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How change is really made—and what it takes to make it

Lasting progress is built on hard truths, tough decisions and smart tech, but leaders in every sector know that however disruptive, it's an essential journey

Vision, determination, and a clear plan of action—not platitudes, social-media posts and wishful thinking—are what's required to bring about lasting positive change. And, increasingly, that change is advanced through the right technology, in the right places, for the right reasons.

Earlier this year, we set out to find and celebrate British change-makers who have leveraged technology for good across a range of industries and services—harnessing the power of AI to foster healthier finances and relationships; scaling up renewable energy sources; helping re-model healthcare; and providing the digital toolbox for a new generation of retail entrepreneurs.

We profiled Sam Seaton, CEO of MoneyHub, a kind of digital financial services go-between championing financial "wellness" and transparency; spoke to Sachin Raoul, whose Blueheart app provides affordable and accessible relationships therapy; and heard Shimona Mehta, managing director EMEA at Shopify, whose digital toolbox helps retail entrepreneurs to set up virtual shop.

Of course, Retail, finance and health weren't the only sectors affected by the pandemic—inevitably, healthcare also experienced a rapid and far-reaching digital transformation. From the mass adoption of NHS smartphone apps and virtual consultations, to the use of AI-driven modeling within health services, technology is now seen as central to future healthcare delivery—and Richard Corbridge, chief information officer for the pharmacy chain Boots, says that even greater change is already on its way.

Adoption and scaling of new technology has only grown in importance for the renewable energy sector—the UK already generates almost 30 percent of the world's offshore wind energy. SSE has the largest offshore wind development pipeline in the UK, and its director of engineering, John Downes, is helping develop a new generation of floating wind farms.

Corbridge and Downes both understand that lasting positive change is about scale and systems, proof and viability, attitudes and adoption, and making solid, undeniable sense on all levels. Change can seem inevitable, but only in the rear-view mirror. Profound change is fought for and thought through—it is made.

ILLUSTRATION: MARCOS MONTIEL

The digital future of health on the high street—and beyond

Boots is planning to make the community pharmacist a healthcare hub, but data will also bring health and wellbeing services to wherever patients are

We hear a lot about digital transformation, its promise and potential, and how it is bringing radical change. Richard Corbridge is chief information officer for the pharmacy chain Boots, and a cheerleader for tech-enabled healthcare—and he insists that such digital transformation is already advanced and embedded.

"The delivery of healthcare now has a reliance on technology—and that is a good thing," he says. Technology, argues Corbridge, can create "safer, more efficient and more patient-focused healthcare," but also hand power back to the patient.

Of course, the Covid-19 pandemic has supercharged this digitization, encouraging the mass adoption of NHS smartphone apps and remote consultations. Indeed, Accenture's most recent UK Patient Survey found that there was a five-fold increase in people using virtual consultations with their medical provider and in remote patient monitoring.

> 'The delivery of healthcare now has a reliance on technology—and that is a good thing'

"The pandemic taught everyone that digital is an intrinsic part of healthcare," Corbridge says. Boots was fully enlisted into the pandemic response, and its impact on the business brought innovation, experimentation, and a transformation of traditional roles. For Corbridge, it confirmed that the high street chemist has a central role in public health. "Community pharmacists are the lifeblood of the healthcare systems. Every one of our healthcare professionals, of which community pharmacists make up a high proportion, can be at the front of a healthcare journey."

Ashish Goel, Accenture's managing director, Europe, Health, agrees that an enhanced role for pharmacists could be a "win-win for patients and care providers".

The pandemic showcased the value of data—but how and where patient records are used and shared remains a challenge.

"With the investment that has been pledged to digitize medical records, the question of consent to share health data will become increasingly important," says Goel. "This flow of data could be critical to wider changes in healthcare, but Accenture's research suggests that any changes should involve people themselves. This should be seen as an opportunity to engage people more fully in managing their healthcare, and to collaborate with users in designing new services."

Richard Corbridge, the chief information officer for Boots

The next phase of healthcare's digital revolution will be built on data and devices, with a shift towards constant health-monitoring, early-warning systems, and prevention rather than cure.

"Connected devices could augment physical infrastructure to meet the demand for healthcare outside of traditional care environments," says Goel. "Advances in patient engagement could open the door to increased personalization. And greater data interoperability and connectivity could help improve healthcare operations and supply chains, enabling efficiency and effectiveness."

Offshore wind is proving the smart power-move

In the race to meet current and future demand for clean power, all eyes are on the UK's most abundant resource: wind energy. By harnessing the latest technology, SSE Renewables is able to head out to sea to catch the breeze

The UK is a wind-farming superpower, generating almost 30 per cent of the world's offshore wind-generated renewable energy. And the hope is there is much more where that came from.

A quadrupling of offshore wind-farm capacity to 40GW by the end of the decade is key to the UK government's net zero plan. By 2050, it is hoped that offshore turbines will produce 95GW and supply the bulk of the country's electricity needs. Energy company SSE is leading that charge. It is set on tripling its renewable energy generation by 2030, providing power for 20 million homes a year—and offshore wind will provide most of this.

"Offshore wind is crucial, because that is where you can get the really chunky numbers," says John Downes, director of engineering at SSE Renewables.

The price of UK offshore wind power has come down far more quickly than predicted. As Accenture's Sustainability Services lead, Toby Siddall says, commentators consistently overestimate how long it takes for new renewable energy technologies to become economically viable.

"Economists have typically put too much weight on inertia and failure to scale, and underestimated positive feedback loops," says Siddall. "As a market for a new technology grows, economies of scale and innovation hit manufacturing and supply chain costs, fast. It's a snowball effect."

'The UK has an opportunity to export innovation and knowhow globally'

John Downes, director of engineering at SSE Renewables

We are at the point where the transition to renewable energy makes sense not just in sustainability terms, but for brute economics. "Growing investment in renewable energy sources continues to accelerate the decline in costs in a way we typically no longer see with traditional fossil fuels," says Siddall. "And of course, once the capital is deployed, we don't have to continue paying for wind or sun."

And, adds Siddall, there are other positives generated by this transition. "The UK has an opportunity to export innovation and knowhow globally," he says. "It will bring sustainable careers to sustainable communities. But we need a just and fair transition, and this means investing in new skills and opportunities for workers in existing communities impacted by the energy transition."

Wind farms can go up relatively quickly—but the key will be ramping up the energy they produce, and getting to those really "chunky numbers". So, in a joint venture between SSE, the Norwegian energy company Equinor, and the Italian energy company Eni Plenitude, construction on the Dogger Bank Wind Farm in the North Sea, 130km off the coast of north-east England, has begun. When complete, Dogger Bank will be the world's largest offshore wind farm.

The pace of positive change has, Downes says, been remarkable. "There are technologies that I wouldn't have dreamed could be so far on in their deployment," he says. "The technology is there, you just need people who can stitch it all together."

ILLUSTRATIONS: MATTHEW GREEN

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*Based on internal test by GP of the fastest NiMH battery chargers by leading NiMH battery charger brands available in major global markets as of May 2021. Test conditions: Average time required during 5 simultaneous charges of 4pcs of new Charge 10 1700mAh AA batteries to 90%+ of capacity at 20°C followed by battery discharge according to IEC 61951-2.

THE ESSENTIAL GUIDE FOR CHRISTMAS 2022. EDITED BY JEREMY WHITE

Microlino 2.0 EV

From the company that made every six-year-old want a folding scooter, the Microlino 2.0 is an Isetta-style electric two-seater with up to 230 km range from 14kW power, and a top speed of 90 kph. In true bubble-car tradition, the EV's solitary door takes the steering wheel and dashboard with it as it hinges open. *From €14,990 microlino-car.com*

Bo M e-scooter

E-scooters are great for mobility, but for many people, zooming around at 25 kph on tiny 8-inch wheels is rightfully terrifying. Bo's "Safesteer" rider stabilization tech helps keep you upright and balanced when navigating potholes and speed bumps, while a 360° light "halo" and extra-wide footbed means you should be seen and stable throughout the ride. At 18kg, the M is on the heavier side, but its 50 km range (1,000W peak power) and built-in steel loop makes locking it up a safer prospect, while the loop also doubles as a bag carrier, capable of hauling 25kg. *£1,995 bo.world*

Kawasaki Electrode

Kawasaki's latest is sure to indoctrinate a new generation of mini-rippers. The Electrode is for ages 3 to 8 (1-1.4m tall), and its air-cooled, 250W brushless (36V battery) can hurtle kids around at 13 mph for up to 2.5 hours. The rubber-covered footpegs can be retracted while they learn the ropes, balance-bike-style, but flip out when they discover how much fun the twist-throttle can be. *$1,099 kawasaki.com*

VS

Turntable Tussles

Technics SL-1200M7L

Arguably the most recognizable piece of hi-fi kit in history, this 12,000-unit-edition, seventh-generation SL-1200 celebrates the turntable's 50th. Available in seven colors—black, red, blue, white, green, yellow, and, for some reason, beige—it features a golden anodized tonearm and an engraved serial number. There's a new digital motor control, ±8% / ±16% pitch control, and a reverse-play function. *£899 technics.com*

Cambridge Audio Alva TT V2

The original TT proved that Bluetooth streaming and vinyl playback could buddy up like Hall & Oates. Two years later, Cambridge Audio has revamped the original, adding, amongst other things, Bluetooth aptX HD audio codec, 24bit/48kHz hi-res playback,and a 2.2kg Polyoxymethylene platter atop the direct-drive system, all clad in cool, classy 6mm aluminum. *£1,699 cambridge-audio.com*

Nerf Pro Gelfire Mythic

This fully-automatic blaster vanquishes rivals with water-infused gel pellets. You can fit 800 of them into the hopper, and it comes with 10,000 extra shots in the box—a good thing, too, since it fires 10 rounds per second (and, yes, goggles are included). Powered by a 7.4V rechargeable battery, the polymer balls burst upon impact, leaving only a faint, non-toxic residue. *$79.99 nerf.hasbro.com*

Gibson Custom Made2Measure

Attention, wannabe Guitar Gods: Gibson has a drool-inducing made-to-measure division that's open to anyone with the pockets to spec their axe. Focusing on the icons (Les Paul, SG, Flying V, Explorer, ES335 to name a few), with the option of "relieving" weight from solid-bodied models for a more comfortable wear, you can choose from—deep breath—veneer, shape of neck, color and finish, as well as binding, choice of nut material (Corian boasts excellent tone and volume), fingerboard timber and inlay materials, plus 11 neck-pickup options, 13 on the bridge, 12 control knobs and 10 tuning pegs. And if Gibson still doesn't have what you're after, it can probably make it. *£poa gibson.com*

Pitch Perfect

Snow Peak Zekka Shelter

Zekka is a behemoth of a tent, made from 150D PU coated 3,000mm HH polyester that can house a small army. Sold as a six-person design, much in the way a suite at the Dorchester is technically a "twin", this expansive model can be opened out to let its occupants enjoy a panoramic view. Optional Inner Room compartments (£465 each) can be tucked into each corner for private sleeping, but still leave a huge communal area. *£2,800 snowpeak.com*

VS

Heimplanet Kirra Classic

Heimplanet pioneered the modern inflatable tent, and its sci-fi-style shelters are still a classic. Kirra is a 3.8kg, generous 5.2m² two-person design made from tough double-ripstop 40D polyester, with an awning that has capacity for loads of kit. Its improved geodesic Inflatable Diamond Grid frame structure makes it particularly stable in stormy conditions. Multi-chamber inflatable beams mean that even if one valve fails (or you get a puncture), the integrity of the structure will remain. *€849 heimplanet.com*

iPhone Alternatives

Nokia 5710 XpressAudio

It won't do 1/16th of the things you need a modern smartphone to do, but we applaud Nokia for having the vision to build true-wireless earbuds into the casing of this simple, quirky, retro-styled handset. Spotify devotees look away now—you'll be playing MP3 files via micro-usb card, or listening to the FM radio—but it's cheap, fun, and the battery will last all month. *£74.99 nokia.com*

Nothing Phone (01)

For a mid-level smartphone, the (01) caused quite a flap, but it is made from recycled materials, and the transparent rear panel's "Glyph" LED notifications are surprisingly practical. For less than a grand you get the Nothing OS, a 6.55-inch, 120Hz OLED screen, Snapdragon 778G+ chipset, up to 256GB storage, 12GB RAM, two rear 50 MP cameras, and reverse charging. *From £399 nothing.tech*

Spruce Vase

As most of the world's birch is grown in Russia, it's a material that's increasingly off the table, as stocks dwindle. Unto This Last has been digitally micromanufacturing furniture and accessories in London for years using birch plywood, but has now switched to Finnish Spruce. Besides making sensible, Scandi-style storage, its home range includes this watertight-lined, faceted spruce vase (30 x 18cm), which is designed to celebrate the texture of the edge-grained wood when polished and waxed. *£75 untothislast.co.uk*

Not Your Average Beverage

Morning

Improve your Nespresso—and any compatible pods—with Morning, which does away with push-button shots for a more nuanced brew. Using 20 bars of pressure, adjustable temp and an app, it squeezes the best from your capsules. *£349 drinkmorning.com*

PerfectDraft Pro

The original PerfectDraft machine offered pub-quality pints at home, chilled to 3°C—good for lager, but suboptimal for stouts or ales. This Pro model can run from 0°C to 12°C, while its app optimizes for the 40+ available kegs. *£385 beerhawk.co.uk*

Nutr

This milk-frother-cum-blender can turn a spoonful of almonds, oats, cashews, walnuts, soy, coconut, rice, hemp, flax or peanuts into a single serve of dairy-free. Add water to your ingredients, select the heat, and let the blending blades do the rest. *£142 thenutr.com*

Audio Technica ATH-SQ1TW

Yes, these earbuds are kind of basic, but the rounded-off squares and five considered colorways (Popsicle, seen above, is our pick) elevate them nicely. There's no ANC, and the battery is just 6.5hrs, but they're comfy, and the sound is surprisingly good. *£80 audio-technica.com*

Outdoor Essentials

Zoa PL1

Backcountry skiing—walking up a slope on adapted skis before enjoying the descent—opens up the mountains to the adventurous Alpinist. Zoa Engineering's PL1 is a portable 4.8kg rope tow that takes the effort out of those uphills. Yes, someone needs to trek up and secure a pull-rope first, but once anchored, users can attach the unit (and its rechargeable lithium-ion battery) to the rope, hit the throttle, and slide back up the mountain. *$1,430 zoaeng.com*

Leatherman x Topo Design

Pretty and practical, this classic Skeletool is 140g of made-in-America utility, blending all sorts of handy blades, pliers and cutters; Topo brings a splash of 80s color and a 1000D sleeve. *$99 topodesigns.com*

Opinel Picnic +

The classic No.08 knife is extremely sharp, versatile, and brilliantly affordable—and now, thanks to a neat hack from French industrial designer Franck Fontana, you can slot a fork or a spoon head into the shaft of the knife for even greater utility. And if you already own the knife, the other attachments can be bought for just €12. *€22 opinel.com*

Inov-8 Raceshell Pro FZ

Weighing no more than a medium tomato, but offering considerably more in the way of weather protection, this 106g (in size M) three-layer running jacket offers total waterproofing, impressive aeration, and packs down into a tiny pocket. Gore's similarly light R7 jacket is 117g, but with only two layers, lacks the durability of the Inov8 design. Sure, it's expensive, but you won't find anything lighter with a breathability rating of 70,000 B-1, fully-taped seams, and a waterproof rating of 20,000 HH. *£270 inov-8.com*

RUGD Battery

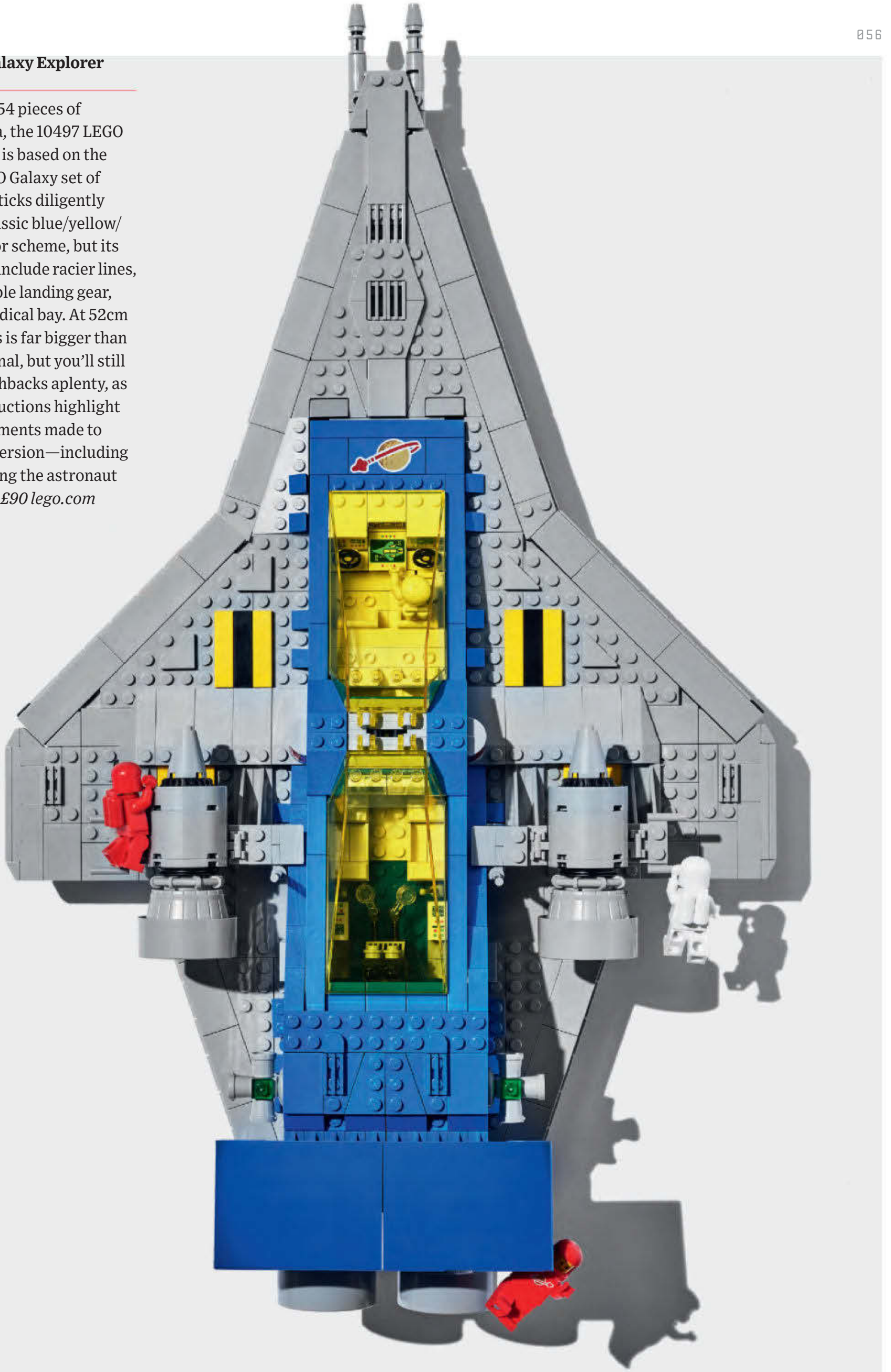
Battery life has improved, but if you're out on a multi-day adventure, you'll need a boost for your phone, GPS, bike computer or headphones. This suitably "RUGD" power bank is IP67 rated for dust and waterproofing, weighs 280g, has a carabiner for easy stowage, and a 10,050mAh capacity with 18W maximum total output. It's not huge, but can fast-charge compatible phones to 50 percent in just half an hour. There's also a 16-LED, 1,300-lumen torch built-in for camping convenience. *£69.99 rugdlife.com*

Oru Lake

Made from a single sheet of double-layered polypropylene, Oru's latest origami kayak is its most affordable and easy to use. With $2.25 million in Kickstarter funds to play with, its designers have done a brilliant job simplifying assembly, so once you've unfolded, slotted in the floorboard and clipped the fastenings, you're ready to paddle. The seat supports your back, and, with 18mm memory foam, keeps your cheeks happy, too. At 8.16kg, it's the lightest non-inflatable kayak on the market; once folded down (to 106 x 25 x 45cm), the handles are comfortable, and the paddle (sold separately) fits neatly inside. *$699 orukayak.com*

LEGO Galaxy Explorer

A full 1,254 pieces of nostalgia, the 10497 LEGO Explorer is based on the 497 LEGO Galaxy set of 1979. It sticks diligently to the classic blue/yellow/gray color scheme, but its updates include racier lines, retractable landing gear, and a medical bay. At 52cm long, this is far bigger than the original, but you'll still have flashbacks aplenty, as the instructions highlight improvements made to the 70s version—including reinforcing the astronaut helmets. *£90 lego.com*



Eco Warrior Garms
POC Myelin

Most old cycling helmets end up in landfill. This 340g EPS foam design is made from 50 percent recycled materials, a percentage POC will increase as the technology improves. By using clip-on and clip-in components, no glue is needed in its assembly—and despite the unusual construction, it's passed all relevant helmet safety standards, and still looks cool. *£100 pocsports.com*

adidas Terrex Xploric Rain.Rdy City Jacket

Reinventing the technical waterproof for city living, this 2.5-layer waterproof jacket features multiple stay-dry pockets, while its Primegreen Rain.Rdy material is made using recycled content, with durable ripstop added to heavy-wear areas. A 100 percent recycled polyester plain weave is used, and 60 percent of the total jacket comes from recycled items. *£230 adidas.co.uk*

Nike ISPA Link

The ISPA Link is a fully-recyclable, two-piece shoe with a booty-like knit upper, and separate bouncy sole. Without the usual gluing, cooling and drying on a conveyor-belt assembly, Nike says making a pair requires less energy and takes around eight minutes to create. *£202 nike.com*

Fab Folders
Brompton Electric P Line

Hand-built in London and Sheffield, the electric P Line, developed with Williams Advanced Engineering, has a 250kWh hub motor, effortless pedal-assist, a 25 kph top speed from three power levels, and a generous 70km range. The whole bike weighs in at 12.7kg (15.6kg with the detachable battery pack) *From £3,695 brompton.com*

VELLO Bike+ TITANIUM

This 12.9kg titanium electric bike from VELLO is a worthy Brompton competitor. Integrating the battery into the rear wheel-hub motor makes for a slender profile, albeit rather awkward for charging. This one has 50km range with a max speed of 25 kph—but an optional Schlumpf speed drive gear system bumps it to 40 kph assisted. *€4,490 vello.bike*

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On sale November 3 in print and digital

VS

Bags

Away F.A.R Duffle

Made from recycled, water- and abuse-proof materials, this 55 liter, 1.5kg design (40- and 70-liter options are also available) can hold a week's worth of kit, and comes in seven colors. And, thanks to the shoulder straps that convert the duffle into a backpack, you can carry it comfortably for hours. All the components feel robust, and even the mesh, zips and webbing are made from recycled materials. *£160 awaytravel.com*

Lululemon Hike

You're more likely to spot one of these bags on the way to pilates than wending up the Pennine Way, but Lululemon's new hiking apparel is full of such versatile gems. The bag's simple clip-fastening means you can compress or expand the capacity with ease (up to 21 liters), while the zipped pockets keep your clutter tidy. And, for the switch from hot yoga to hot desking, there's also a 16-inch laptop sleeve. *£128 lululemon.co.uk*

Panasonic MULTISHAPE

Based around the shower-proof MULTISHAPE motor (120g, 128 x 33 x 32mm), instead of getting every trimming attachment bundled together like usual, Panasonic lets you pick heads to suit, so beardies can avoid chucking that unwanted a foil-head shaver in the bin, and simply buy the multipurpose beard, head and body-hair trimmer they'll actually want to use. *From £69 panasonic.com*

Forust Vine Vessels

Turning wood chips and sawdust into new materials isn't new, as anyone who has ever bought flat-pack or MDF furniture will attest—but Forust's vision to unite 3D-print with wood waste brings a new dimension. Sawdust is sieved to get a consistent particle size, before mixing with a non-plant-based organic binder. Ingeniously, by injecting layered colored inks during the printing, Forust can also mimic a consistent wood grain throughout the finished item. Designer Yves Béhar has created a range of textured ornaments, including these bowls, trays and baskets, but anyone can upload a 3D design and have it printed. *$19.99-£79.99 forust.com*

Focal Bathys

The buy-in for a typical pair of Focal headphones starts around the £1,000 mark, and for that you get exquisitely made, gorgeous sounding, stay-at-home sensations. Now, for the first time, the French audiophiles are on the move, adding Bluetooth 5.1 technology, a 30-hour battery and adaptive Active Noise Cancellation, snuggled up with aluminum/magnesium “M”-shaped dome speaker-drivers. It’s a bold step, but with SBC, AAC and various Apt-X codecs offering the best possible wireless performance, and a built-in 24-bit USB DAC amplifier (Digital Analogue Converter), you can enjoy on-the-go convenience, but also get your audiophile fix by plugging into your laptop or USB streamer. By our reckoning, this makes the Bathy something of a bargain. *£699 focal.com*

RALPH LAUREN

PINK PONY

"When someone we love has cancer,
we are all affected—husbands, wives, mothers
and fathers, sisters, brothers, and friends.
This is our effort in the fight against cancer."

Ralph Lauren

Join us in the fight against cancer

Globally, 25% of the purchase price from the sale of each item in the Pink Pony collection is directed to an international network of cancer charities; within the UK, proceeds benefit The Royal Marsden Cancer Charity (Registered Charity No. 1095197).

- Ismail Jeilani, Cofounder, LiveLink, **UK**
- Google for Startups Black Founders Fund recipient

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TEL AVIV

Edited by
João Medeiros

In partnership with
Google for Startups

2022 saw much of the world emerge from Covid-19 lockdowns and embrace wholly new ways of working—when was the last time you met someone who was in their office five days a week? This changed landscape provided opportunities for many a resourceful entrepreneur—and a perceptible shift in what startups choose to focus on.

Solving the big challenges, blending profit with purpose, and being mission-driven is motivating many startups on this year's list, while advances in AI and machine learning have boosted medtech and healthcare. Startups founded by women, for women, have also seen a significant increase, as has the number of female founders securing funding—often from women-led funds. Our special report also features a hugely influential figure in the European startup scene: Niklas Zennström, who shares his hopes—and frustrations—on the state of European tech investment, and outlines how much-needed change, from building in diversity to tackling the climate crisis, is the biggest opportunity in decades.

BERLIN

Look out, London—Berlin is fast catching up in all areas, from sheer volume of funding raised by startups to its rapid transition into a center for deeptech, Web3, and AI firms

By **Megan Carnegie.**
Photography: **Wolfgang Stahr.**

Berlin remains one of Europe's starriest tech hubs, with Atomico's 2021 State of European Tech report ranking the city second only to London in capital investment, after its startups collectively raised $7.106 billion in 2021 alone. It's been a constant upwards trajectory too, with investment increasing 150 percent year-on-year since 2017. "We are finally reaping the fruits from an ecosystem that was slow in developing," says Bettine Schmitz, angel investor and founder of female-founder-focused VC fund Auxxo. "Now we have a solid base of angels, investors, and scaled startups that are churning out experienced future founders or C-Level."
With many major valuations, such as N26 and Contentful, and new investors on the scene, Berlin is more vibrant than ever. Julien Fredonie, head of strategic venture partnerships in Europe and Africa for Honda's Xcelerator program, notes Berlin's transition from an ecommerce and app powerhouse to a serious deeptech hub: think hardware, AI, Web3, space, new materials, energy, and biotech. "Berlin is becoming a leading climate-tech hub in Europe," he says. "It's attracting global talent, with a nice quality of living and international mindset."

Enpal
Becoming Germany's first "green unicorn" after securing €150 million from tech investor Softbank in October 2021, Enpal was established in 2017 and is now Germany's largest provider of solar solutions, with over 12,000 homeowners on its books. Founders Jochen Ziervogel, Mario Kohle, and Viktor Wingert are set on making renewable energy accessible to all. *enpal.de*

Moss
Less than two-and-a-half years after its early 2019 launch, Moss has been valued at over $500 million, with the latest funding led by Tiger Global Management and A-Star. It offers corporate credit cards that enable SMBs to track their spending. Founders Ante Spittler, Anton Rummel, Ferdinand Meyer and Stephan Haslebacher are now taking the Moss model to the UK. *getmoss.com*

Formo
The lab-grown cheese pioneer was founded by Raffael Wohlgensinger and Britta Winterberg in 2019, and became Europe's first cellular agriculture company by using milk proteins to produce animal-free dairy products. Lionheart Ventures, Happiness Capital and Albert Wenger pitched in to raise €42 million—the largest ever venture funding round in European foodtech. Now, Formo's focus is on scaling production at its microorganism dairies, bringing products to market by 2023, and, by 2030, replacing 10 percent of Europe's dairy consumption. "Precision fermentation is used to make highly specialized compounds, not bulk ingredients like milk, so we're investing in large facilities to brew milk on a big scale," says Wohlgensinger. *formo.bio*

FORMEL Skin
Sarah Bechstein launched FORMEL Skin in June 2020 with cofounders Florian Semler and Anton Kononov. A digital platform for dermatologists to deliver faster diagnoses for patients with chronic skin conditions, it was inspired by Bechstein's own experience of undergoing compounded treatments for acne. Through a questionnaire and photo submission, experts then formulate a personalized treatment plan which is adjusted through regular check-ins. It has offered 150,000 treatments across Germany and Switzerland, with plans to expand outside Europe soon. Rates start at around €50 for a monthly subscription and it's raised €36 million to date from Singular, Heal Capital and Vorwerk Ventures. *formelskin.de*

Mondu
The Buy Now, Pay Later model is fast infiltrating the B2B sector, and Mondu is Germany's star entrant into the space. Just seven months after its $14m seed round, Mondu raised $43m in a Series A led by Valar Ventures at the end of May. Next up: Building on its 100-strong team and expansion into Austria before the end of the summer, then more European markets. *mondu.ai*

Vay
Vay users can order a KIA Niro electric vehicle, remote-controlled by a human "teledriver", and have it driven directly to their location, then driven away when they're done. Founded by Thomas von der Ohe, Fabrizio Scelsi, and Bogdan Djukic in 2018, it raised $95m in Series B funding in late 2021. Vay will launch its fleet of remote-operated cars in Hamburg. *vay.io*

Above: Sarah Bechstein, cofounder of FORMEL Skin, a digital platform for dermatologists.

Stenon
Founded in 2018, Stenon is doing away with the time-suck of sending soil samples to labs for testing, helping farmers to make faster and more efficient decisions on crop cultivation. The startup makes the portable FarmLab soil-analysis tool, which uses sensors to instantly generate parameters including soil temperature, moisture, nutrient content, and pH value. “Soil data is a critical piece to drive better decisions, driving up productivity while working sustainably,” says founder Dominic Roth. Stenon is used by several hundred farmers in the German-speaking region, will launch in the UK and California next year, and has so far raised over $26.8 million. *stenon.io*

Apryl
The only Pan-European fertility benefits platform of its kind, Apryl enables companies to support employees on their path to parenthood. Employee benefits include subsidies for care navigation, consultations, access to clinics, and treatments such as egg/sperm freezing, IVF, adoption or surrogacy. It has raised $4.3 million so far. *apryl.co*

Pile
Pile’s simple API platform enables fintechs, neobanks and startups to integrate crypto through wallets or trading, dealing with the legal intricacies of smart contracts in the background. Founded in May 2022, it’s already raised €2.8m in a pre-seed funding round with investors including Anthemis’ Female Innovators Lab, Barclays, and Pitch founder Christian Reber. *pile.capital*

Alpas
Founded by Isabel Poppek and Nils Vollmer in 2020, Alpas’ procurement software helps mid to large manufacturing companies find, compare and manage suppliers. For the moment, it is focused on industrial companies that buy machine and electrical parts, making the sourcing at the start of the value chain more transparent. It has raised $2.2 million to date. *alpas.ai*

Left: Raffael Wohlgensinger, founder and CEO of Formo.

- Nina Julie Lepique, Cofounder, femtasy, **Germany**
- Google for Startups Founders Academy alum

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Google for Startups

AMSTERDAM

Amsterdam continues to punch well above its weight, combining tech powerhouse status with being one of the most livable cities on the continent

"Amsterdam is a global city—with a population of less than one million," says Ferdinand Goetzen, CEO of Amsterdam-based digital customer-insight business, Reveall. That, in a nutshell, is how Amsterdam has become a tech powerhouse, boasting unicorns such as Booking.com and Adyen, and an impressive crop of sustainability-focused startups. As part of a business cluster known as the Randstad—which also includes Utrecht, The Hague, and Rotterdam, and is Europe's third region by productivity—it is unsurprising that Amsterdam's startup scene is thriving; its tech companies are worth a total €227bn ($230bn) as of June 2022, reports Dealroom.

Above: Jorn Eiting van Liempt and Joost Kamermans, cofounders of recycling platform Seenons.

TestGorilla

TestGorilla thinks that CVs are dead, or at least they should be. Founded in 2019 by former Bain & Company consultants Wouter Durville and Otto Verhage, the company runs a platform providing businesses with skill-based tests designed to streamline hiring by surfacing the cream of job applicants. "We have a full test-development team in-house, and we also rely on subject matter experts," explains TestGorilla's head of international development Claudia Baijens. "But we think you don't need to only look at job-specific skills, but also test cognitive abilities—like logics and maths. In June, TestGorilla raised $70m in a Series A round led by Atomico and Balderton Capital, which, according to Crunchbase, brought its total funding to $81.2m. *testgorilla.com*

Seenons

Founded in 2019 by Joost Kamermans and Jorn Eiting van Liempt, Seenons is a platform that matches businesses who want to get rid of waste materials with people who can make use of them—aka, the circular economy—which, in these times of trade disruptions and climate crisis, is much better than landfills or incinerators. "Companies open our app and tell us, 'I have this type of waste'," Kamermans explains. "Depending on location, volume, and type of waste, we select the best solution for transport. Then we match them with whoever can use their waste as an input for their production process." Users pay Seenons a subscription fee, but for certain waste materials they can earn money back from buyers. *seenons.com*

Overstory

Funded in late 2018 by Indra den Bakker and Anniek Schouten, Overstory keeps a watchful eye on trees, blending satellite imagery and machine learning to monitor deforestation, prevent wildfires, and stave off the chance of damage from falling trees to infrastructures and power grids. The company has so far raised funding of $5.9 million. *overstory.com*

Crisp

An online grocery store focused on high-quality, seasonal fresh produce from local food producers, Crisp was launched in 2018 by Eric Klaassen, Michiel Roodenburg, and Tom Peeters. Available in the Netherlands and Belgium, to date the company has raised $46m in four funding rounds. It uses electric delivery vans and is aiming for zero food-waste. crisp.nl

By **Gian Volpicelli.**

The Fabricant
Launched in 2018 by Kerry Murphy, Amber Slooten, and Adriana Hoppenbrouwer-Pereira, The Fabricant was early to the metaverse party. The company styles itself as a fashion house designing "digital-only clothes" to be worn by avatars online. In 2021, the company made its meta-pivot clear with the launch of The Fabricant Studio, a platform where users can customize virtual garments and mint them as NFTs on the gaming blockchain Flow. The goal is to help people build their "wardrobe for the metaverse." The company has so far raised $14m in funding, most of it in a Series A round in April 2022, led by actor-turned-VC Ashton Kutcher. *thefabricant.com*

Hadrian
Launched in 2021 by Roger Fischer, Olivier Beg, Tijl Van Vliet, and Maurice Clin, Hadrian is a security company that has adopted a "hacker's eye" approach to help customers spot and fix IT vulnerabilities. The company raised a $2.6m pre-seed round from early-stage venture capital outfit Village Global in 2021, and a $10m seed round from German HV Capita in June 2022. *hadrian.io*

Terraform
Founded in 2021 by Salar al Khafaji and Sebastiaan Visser, both coming from stints at Palantir after it acquired their previous startup, Silk, Terraform aims to disrupt construction through robotics and software. The idea is to create smart machines able to fully automate on-site construction, thus bringing down overall costs. *terraform.ai*

Dott
Dott was founded in 2018 by French-born entrepreneurs Maxim Romain and Henri Moissinac, both previously of Chinese bike-sharing giant ofo. Today, Dott runs a fleet of 40,000 scooters and 10,000 electric bikes (all run on renewable energy) in 17 cities across Europe, and it has offices in 12 countries. It has also raised $210 million in funding so far. *ridedott.com*

Above: TestGorilla's Otto Verhage and Wouter Durville.

Fiberplane
Founder Micha Hernandez van Leuffen sold his previous startup to Oracle in 2017. Three years later, he launched a new company creating remote, collaborative work tools for IT professionals solving technical incidents. In September 2021, Fiberplane raised an $8.8 million seed round co-led by Crane Venture Partners and Notion Capital. *fiberplane.dev*

SingularityNET
SingularityNET wants to use crypto's decentralized structure to democratize AI and ensure that the AI singularity happens on a people-owned network, and not a tech giant's lab. Besides the funds raised in its ICO—$36m in ether—SingularityNET and its sister organization SingularityDAO also secured $25m from alt-investors LDA Capital in May 2022. *singularitynet.io*

LISBON

The reinvention of the Portuguese capital is picking up speed—it's still great for young, hungry, local entrepreneurs, but a slew of government incentives is making it an attractive base for new arrivals

Serial entrepreneurs Mila Suharev, Nils Henning and Mitya Moskalchuk had been involved in the German startup scene for more than 15 years—successfully exiting four companies with valuations above €100m—before deciding to launch their new startup in the Portuguese capital. "Lisbon has several ingredients making it a unique and efficient tech ecosystem," says Suharev, CEO of proptech company CASAFARI, listing factors such as quality of life, governmental programs designed to attract foreign entrepreneurs, and its Silicon Valley-like business mindset. Indeed, Lisbon is attracting many European entrepreneurs: of the 10 CEOs profiled here, half are expats.

Above: Mila Suharev, cofounder of Casafari, a centralized database for real-estate agents.

Remote

Remote's mission is to simplify how companies can hire global talent from anywhere. "It used to be extremely complex and expensive for a company to hire employees and contractors living in other countries," says CEO Job van der Voort. "The company would need to be equipped to handle international taxes and compliance, be able to offer benefits in the other country, and pay employees in their local currency." The startup, which was founded by van der Voort and Marcelo Lebre in 2019, simplifies the process with a platform that allows clients including DoorDash, GitLab, Hello Fresh, Loom, and Arduino to onboard, pay, and manage employees and contractors in more than 150 countries. Remote has now raised a total of $495 million. *remote.com*

Anchorage

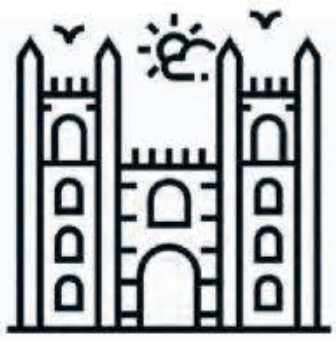
In December 2021, Anchorage Digital became the first Portuguese crypto unicorn, after raising a total of $487 million dollars from investors including KKR, Andreessen Horowitz, GIC (Singapore's sovereign wealth fund), Goldman Sachs, and Visa. Launched in 2017, the idea for Anchorage Digital came to cofounder Diogo Mónica when he helped an investor who had lost access to $15 million in bitcoin. The solution he devised with cofounder Nathan McCauley is Anchorage, a regulated crypto platform that allows institutions to offer crypto products, offering integrated financial services such as secure custody, regulatory compliance, and client service. Anchorage is the first federally chartered crypto bank in the US, and is valued at over $3bn. *anchorage.com*

Amplemarket

João Batalha, his brother Luís, and Micael Oliveira are former MIT computer scientists. Their startup, Amplemarket, uses AI-driven workflows to help sales teams find and engage with new customers. Founded in late 2019, Amplemarket has raised $12m from investors including Comcast Ventures and Armilar Venture Partners. *amplemarket.com*

Exclusible

Launched in July 2021 by Thibault Launay, Olivier Moingeon, Olivier Bureau, Artur Goulão and Pierre Guigourese, as an NFT marketplace for luxury brands and metaverse real-estate, this Web3 platform has also dropped its own NFT, the Exclusible Alpha Collection. It generated €2.4m in sales of 3,000 NFTs in less than 48 hours. Today, Exclusible has raised €2.2m. *exclusible.com*



By **João Medeiros.**
Photography: **Goncalo F Santos.**

Detech.ai
Detech.ai is a reliability intelligence platform that helps organizations decrease the number of outages and other reliability issues. "I'm obsessed about this space," says CEO José Velez. "My father is an IT Director at a large Portuguese company, and I grew up having conversations about reliability being one of the biggest challenges." His startup ingests monitoring and observability data from tools such as AWS, and turns it into insights and automations that ease the work of IT departments. "It lowers the barrier to adoption of industry-leading site reliability engineering practices, previously only accessible by FAANGs," he says. It has raised $620k. *detech.ai*

Coverflex
Coverflex gives companies a single operating system that allows them to manage their employees' compensation, including salaries, equity, bonuses and benefits—more than 1,500 Portuguese companies use the software. The company, founded in 2019 by Miguel Santo Amaro, Luis Rocha, Nuno Pinto and Rui Carvalho, is expanding to Italy and Spain this year. *coverflex.com*

Below: Cofounder of Artpool, Pauline Foessel.

Virtuleap
Virtuleap is building VR applications to improve your brain, with the help of USC psychologist Skip Rizzo and memory champion Nelson Dellis. According to CEO Amir Bozorgzadeh, its apps can train and test the cognitive abilities of its 43,000+ users. Four clinical studies are underway, with partners such as Roche, with whom a VR training tool for dementia is being tested. *virtuleap.com*

Casafari
Founded in 2017 by Mila Suharev, Nils Henning and Mitya Moskalchuk, CASAFARI is building a centralized database for real-estate agents. Using machine learning, it allows more than 30,000 professionals across Europe—including Sotheby's International Realty, Savills, Century21 and Keller Williams—to make deals and accelerate transactions. *casafari.com*

Artpool
Before launching Artpool, CEO Pauline Foessel had worked in the art world for over thirteen years, both as an artist and a curator. Launched in 2019 with cofounder Willy Bardiot, Artpool is an NFT marketplace and social network for the art world, where artists can sell their NFTs, curated by a community of more than 900 professional artwork curators. *artpool.xyz*

Soundparticles
Dune, *Game of Thrones*, *Star Wars*, *Frozen* and *Fortnite* were all produced using software developed by Sound Particles. Founded by Nuno Fonseca, it will soon launch its technology for headphones, in a bid to enter the VR and gaming market. In May 2022, it raised €2.5 million in a seed round, co-led by Indico Capital Partners and Iberis, and plans to open an office in LA. *soundparticles.com*

Fostering community, supporting founders, and scaling startups

Through establishing campuses, fostering community and ensuring founders get the support and resources they need, Google for Startups is helping entrepreneurs to create innovative and impactful businesses

A problem shared is a problem halved. That has been the guiding principle of Founders Standup, a community and support tool that's long been used by Google for Startups to foster community among entrepreneurs and unlock their collective knowledge to help solve problems they're each facing. Fostering such community is core to Google for Startups in supporting founders and the wider ecosystem. "There's this camaraderie with other people going through the same situation," says Abbie Morris, cofounder and CEO of compliance platform Compare Ethics, which were part of Google for Startups Residency in 2019. "You don't quite know how to solve it—but sometimes, there are other founders who do, because they had the same problem six months ago."

Google for Startups' underlying idea is that when startups succeed, the wider economy benefits, and therefore Google—and the tech sector at large—also benefits from that success. Today, Google for Startups is present in nine countries—the UK, US, Germany, Spain, Poland, Israel, Brazil, Japan, and South Korea—and is expanding quickly to other parts of the world. In some instances, it has established one of its iconic Campus coworking spaces, while in others it runs multi-month programs which provide mentorship, support, acceleration, and funding to promising tech companies.

More than anything, Google for Startups has sought to be a safe space for entrepreneurs who are just coming to grips with their startup journey. "While financial support is important, what we're hearing from founders the most is the importance of community, of how powerful it is for them to be able to come together, support each other," says Marta Krupinska, head of Google for Startups UK. "A bunch of them even started angel-investing in each other."

That sometimes boils down to tools such as the "Founders Standup"—a meeting where founders can meet up, share a high and low from the past week, and then a challenge they discuss with the group. They also receive help and emotional support from fellow founders and a Google-trained host. "What comes out of these sessions is a sense of perseverance, but also that many founders experience a sense of loneliness and lack of confidence at the top," Morris says. "But these sessions definitely help combat that loneliness."

"Being a founder is hard, it's even harder if you don't have access to networks. In lockdown we used Founder Standups as a tool to support our community because they were in a hard place balancing their startup, personal life and global pandemic."

Recent years, have been in many ways, even more challenging than an ordinary

Support and collaboration are key to helping young startups

decade would have normally been for an aspiring startup founder. In these circumstances, Google for Startups' focus on mental wellbeing became even more relevant. Morris recalls how, during the Covid lockdowns, Google for Startups' program alumni chat became a unique source of support and collaboration. "That was something that really stood out amongst every other program I've done," she says.

Krupinska recalls that as the pandemic escalated, Google for Startups' community became one team. "We were able to provide a sense of confidence, like, 'Follow this path and things are going to be fine'. And in that moment, there was no path. Nobody really knew what was going to happen," she says. "So emotional and mental support became much more important: We started including it in all of our programs."

Beyond dedicated support during Covid, the initiatives launched by Google for Startups, and the subsequent founder ecosystems in each community across Europe, are working to tackle other areas that have been holding startups back.

"It has been great to see that if we invest the time in fostering these communities these founders continue to pay it forward supporting each other and founders earlier in the journey" explains Marta.

"We now have Women's Health startups helping each other overcome Go-To-Market challenges and there are now founders from beyond London supporting each other's growth. And 70 startups from our Black Founders Fund in Europe actively supporting each other on partnerships and investor introductions."

In 2020, Google for Startups decided to ramp up Black founder initiatives, which had already been in running in the UK since 2018, and expanded it significantly. The initial $2 million fund in Europe in 2021—which challenged the pipeline myth.

Other steps and initiatives aimed at harnessing untapped or underrepresented tech and startup talents have followed. Google for Startups is increasingly setting its sights on Eastern Europe, using its Warsaw hub as a hub for supporting founders in countries including Romania, Latvia, Estonia, and Czechia. Programs vary, and include initiatives focused on startups leveraging a specific technology (e.g. machine learning), to conventional accelerators, to plans to help Eastern European companies expand to other parts of the continent. "We know that there is something interesting happening in those countries' tech scenes, and we know how to use Google's brand power to have people take notice," Krupinska says. "And maybe, when they start paying attention, there could be a little bit more investment, a little bit more engagement."

Besides crucial funding, Google for Startups Campus offers mentoring

Following Russia's invasion of Ukraine, another program was launched geared towards Ukrainian startups. "We're putting $5 million into Ukrainian startups," Krupinska says. "The goal is to try and provide cash to help these companies keep going, even if some of them have had their offices and warehouses bombed."

It's all what Krupinska describes as Google for Startups' core mission.

"It is to level the playing field for startups," she says. "It is to increase the amount of money raised by founders, increase monthly revenue, and increase jobs. When startups are doing these three things, our team is doing well— and the founders can go on to have a much bigger impact on the growth of the ecosystem, a positive impact on the community, and are helping each other develop."

BARCELONA

Barcelona is a global hub for investors, startups and larger companies seeking sunnier climes and a business-friendly atmosphere

"Barcelona has triumphed over Madrid as Spain's startup capital because of the deal flow and the talent," explains Miquel Martí, Tech Barcelona's CEO. "International talent is attracted by the lifestyle, the strength of the ecosystem and the presence of international companies." According to Barcelona & Catalonia Startup Hub—the region's startup directory—there are over 1,900 startups in Catalonia, mostly concentrated in Barcelona; since 2016, the number has grown by over 75 percent. The city has long had a strong tradition of healthtech startups fueled by university and regional government collaboration, but construction, mobility and sustainability firms are on the rise.

011h
Lucas Carné and José Manuel Villanueva sold Barcelona ecommerce site Privalia in 2016. In 2020, they both committed €2m to found this environmentally friendly "passive house" startup, raising an additional €8m in seed funding and, in July, €25m Series A funding with Redalpine, Aldea Ventures and A/O Proptech. 011h builds prefabricated homes in its factory using wood from managed forests to remain carbon neutral. "We're bringing the factory systems from automotive to construction to reduce costs and design buildings with low energy requirements," explains Carné. "Buildings are responsible for 40 percent of global CO_2 emissions." Expansion to more markets will follow next year. *011h.com*

acceXible
"We call it maths-based linguistic medicine," says Carla Zaldua, cofounder and CEO of acceXible. The company's automated speech analysis captures a patient's voice—anywhere from doctor's surgery to over a landline—and uses AI to analyze their speech patterns to detect the early signs of dementia, Parkinson's and even coronary disease from tone, pauses, repetition and sentiment analysis via so-called "vocal biomarkers". Founded in 2017, acceXible has raised €1.4 million, supported in the early stages by grants, plus $959k in seed funding in 2021. acceXible detects dementia with an accuracy of over 91 percent, has a new funding round at the end of 2022, and is expanding internationally. *accexible.com*

Doctomatic
Frederic Llordachs created Doctomatic last June with Carmen Rios, securing €415k seed funding from Encomenda Smart Capital and Ship2B Ventures. It's an AI-driven remote patient-monitoring app which, using any medical device, from heart-rate monitors to scales, allows doctors to check in on patients who have a chronic disease. *doctomatic.com*

VOTTUN
To help companies trace and certify data using the blockchain, VOTTUN offers "templates"—ready-to-use blockchain products that allow companies including Nestlé, Estrella Damm and the World Bank, to trace data, certify identity, manage crypto payments, and launch NFTs. VOTTUN has plans for a €20 million Initial Coin Offering at the end of 2022. *vottun.com*

By **Margaret Taylor.**
Photography: **Gregori Civera.**

Nuclia
"Nuclia makes the unsearchable searchable," says CEO Eudald Camprubí. With CTO Ramon Navarro Bosch he's built an AI-powered search engine that can index data from any document type, and transcribe videos in any language. Companies possess and store more unstructured data than they know what to do with. Nuclia's semantic search indexes everything online in a specially created database, so that when a user makes a search query, Nuclia offers relevant paragraphs, and specific moments from audio and video recordings, all based on keywords as well as semantic meaning. Founded in 2019, April 2022 saw a seed round of €5m, lead by Crane.vc and Elaia. *nuclia.com*

Lupa
Combining the second oldest human activity (running) with its newest (deeptech) Lupa combines audio coaching, wearables, GPS maps and sightseeing to take runners on new routes, explaining local landmarks as well as offering running tips and feedback on their physiology. There's also a social element to the app—Lupa hosts weekly run-clubs. *lupa.run*

HUBUC
HUBUC enables any company to embed financial services in their product—issuing payment cards, controlling FX rates and organizing customer payments. Hasan Nawaz, HUBUC CEO, and COO Ignacio Javierre launched HUBUC in May 2020; this February's seed round raised $10m from DreamWorks founder Jeffrey Katzenberg's WndrCo, and Runa Capital. *hubuc.com*

Last.app
Last.app is a B2B on-demand courier service for the restaurant industry. Founded in 2019 by two brothers, both former Glovo employees, it serves hospitality businesses, restaurants and ghost kitchens. January's €2.5m funding round, led by All Iron Ventures, a Spanish financier, with support from Bynd, is aimed at driving international expansion over 2022. *last.app*

Vitaance
Vitaance gamifies financial, social, mental and physical improvements for a company's employees, by offering rewards for individuals and teams that hit healthy physical, emotional and financial goals. The Catalan firm closed 2021 with a €3 million pre-seed funding round from SoftBank, Kindred Ventures, Astorya and others. *vitaance.com*

Payflow
Payflow shares Catalonia's respect for civil society. The startup sells a salary-advance service to employers, charging companies a commission if staff withdraw a portion of their salary early, rather than charging staff, as rival services do. "We're providing a true employee benefit for blue-collar workers and will never charge employees," says Benoît Menardo, who cofounded the company in 2020 with Avinash Sukhwani. Among users it has an average 40 percent download rate, peaking at 90 percent for some of its clients. Since its 2020 launch it has raised €12 million—with an €8 million round in January which included Spain's VC Seaya Ventures, Cathay Innovation, YCombinator, and Steve Huffman's Rebel Fund to transition to a neobank. *payflow.io*

Left: 011h's Lucas Carné and José Manuel Villanueva. *Right*: Doctomatic's Carmen Rios and Frederic Llordachs.

STOCKHOLM

A city famed for friendliness has an equally equitable startup scene—and that network of founders supporting founders has resulted in a slew of impactful and progressive firms taking the lead

Sweden often takes top billing in global rankings for altruism and business. For well over a decade, entrepreneurs with a progressive streak feel at home. Here, a city renowned for great ideas, design and innovation has become a tightly-packed startup haven overlooking the Baltic Sea. Local heroes Spotify and Klarna changed how we listen to music and shop. Now, a fresh crop of mission-focused disruptors want to reshape how we think, from our health and business, to conservation. "Stockholm is big enough not to create negative competition, but small enough that everyone knows everyone on the entrepreneurial and investor side," says Charlotte Ekelund, CEO of workplace collaboration tool Teemyco. "The ecosystem is based on friendship."

Above: Selah Rui Li and Marc van Almkerk, cofounders of Ellure.

Treyd

For Treyd cofounder Peter Beckman, the comparisons with Klarna are inevitable. But rather than consumers, his startup offers the Buy Now Pay Later model to businesses. "Thirty percent of world trade is paid by cash in advance," explains Beckman. "Banks can't give loans to companies whose entire assets are in a factory tens of thousands of miles away. So, we provide the capital." Treyd fulfills supplier invoices on behalf of businesses, which have up to 120 days to pay the loan back. In that time, direct-to-consumer brands can receive their goods, sell them and have cash flow. Founded in 2019 alongside Sameh El-Ansary, Treyd raised £8.4 million in a Series A round in May, ahead of expansion to the United Kingdom. *treyd.io*

LEIA

According to the World Health Organization, an estimated 140 million babies are born every year worldwide. And, says Astrid Gyllenkrok Kristensen, cofounder of femtech startup LEIA, ninety percent of mothers will experience some mental or physical difficulties within 12 months of giving birth. That was the experience of cofounder, Sandra Wirström, who suffered life-changing postpartum injuries following medical misdiagnosis. LEIA, founded in 2021, is a post-pregnancy health app and personalized digital tracker for new mothers. Since going live in February, 20 percent of users have been identified as being at risk of postpartum depression. LEIA has raised £560,000 in pre-seed funding. *meetleia.com*

Ellure

Ellure's cosmetic IoT-enabled 3D printers are able to design, formulate and manufacture lipstick on-demand in minutes. Besides 10,000+ shades to pick from, it also means waste and overproduction is reduced. Following a small-scale pilot in the US, and funding from the European Institute of Innovation and Technology, Ellure is moving towards its first product launch this year. *ellure.io*

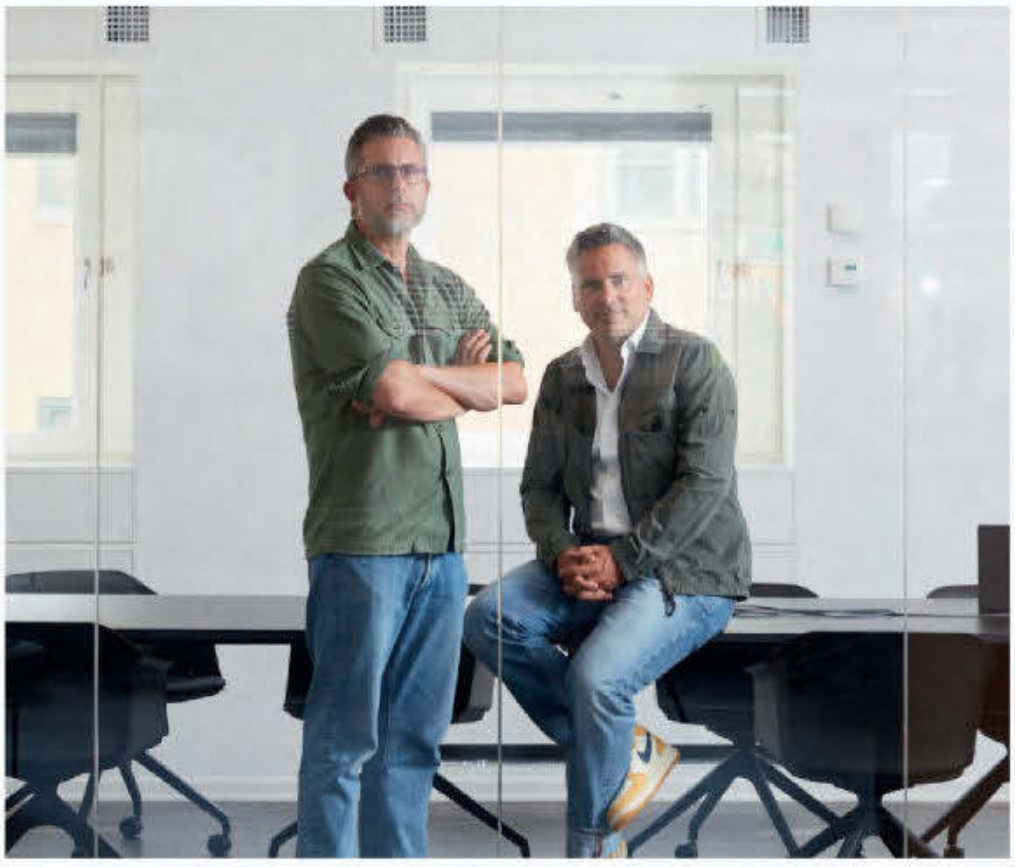
Cling Systems

Founded in 2020, Cling Systems ensures old batteries from EVs are reused, repurposed and recycled. In a January pre-seed funding round, it raised £1.7m to build a real-time map of used batteries to maximize environmental benefits. Its existing supply includes 2,500 batteries from more than 50 sellers in the Nordics and the Netherlands. *clingsystems.com*

By **Alex Christian.**
Photography: **Christopher Hunt.**

Mindler
This digital therapy service connects patients to mental health professionals with just a few taps of a screen. Since launching in 2018, Mindler has hosted more than 375,000 digital psychologist visits; video-call sessions are combined with in-app treatment plans. Its popularity surged through the Covid-19 lockdowns, with monthly active users having more than quadrupled to 13,000 since the start of the pandemic. Cofounded by physician Rickard Lagerqvist, and psychologists Rickard Färdig and Johannes Hatem, it's since expanded to four more markets—including the UK—and raised nearly £34 million in funding. *mindlercare.com*

ClimateView
From Malmö to Dundee, Cincinnati to Nottingham, ClimateView helps cities around the world reach net-zero through its ClimateOS platform. Local authorities manage, track, and then execute data-led climate action plans in the transition towards zero-carbon economies. It most recently raised a £8.6 million Series A round. *climateview.global*



Above: Johan Pihl and Mathias Wikstöm, cofounders of climate fintech Doconomy.

PocketLaw
Former M&A lawyer Kira Unger and ex-McKinsey consultant Olga Beck-Friis launched legal tech startup PocketLaw in 2018 to cut through the red tape that often ensnares small and medium-sized businesses. Its contract creation and management platform is now used by more than 6,000 companies. In May, it raised £8.5 million in Series A funding. *pocketlaw.com*

Dework
Touted as the LinkedIn for Web3, Dework is a decentralized job marketplace for crypto and blockchain gig workers. Founded by Lonis Hamaili and David Fant, the tool enables decentralized autonomous organizations to recruit, organize teams, manage projects and pay contributors with native tokens. It just secured £4m pre-seed. *dework.xyz*

Doconomy
Climate fintech Doconomy calculates the environmental cost of every purchase made on its DO credit card. Fed through its API, each transaction is presented in both krona and a carbon footprint rating, and offers customers carbon offsetting options. Founded by Mathias Wikström and Johan Pihl in 2018, it's totaled £15.5 million in funding. *doconomy.com*

Validio
Data engineering is typically a complex business. Validio helps strip that back: through machine learning, unknown data failures can be easily caught and data quality can be automatically validated. Founded by Patrik Tran, Urban Eriksson and Oliver Molander in 2019, it's now a Google Cloud build partner. In June, it raised £12.2m in seed funding led by Lakestar. *validio.io*

How AudioMob revolutionizes audio advertising

A chance discussion between friends turned into a $110 million business—and Google for Startups was there, offering support, every step of the way

Wilfred Obeng and his cofounder Christian Facey

Christian Facey and Wilfrid Obeng met in Dublin in late 2017. Facey was a strategist at Google, on its agency team, and later at Facebook, where he measured the value of ads and how people are influenced into buying products and services. Obeng was an engineer at Google, on its ads team.

Facey also had a sideline hobby that kept him busy: mobile games. "I started digitizing Japanese watercolor artwork, and streaming my own jazz music into those games," he says. "We were both very interested in being entrepreneurial," says Obeng. "We were bashing our heads together as to what we could do."

At the time, Obeng "Started seeing audio advertising booming, because of the likes of Spotify," he says. "People started to realize they could actually reach customers with audio."

In early 2020, the pair left their big tech jobs and built a minimum viable product to show how their idea—inserting audio adverts into games—could work. "It was very basic, very scrappy—and didn't work all the time, to be honest with you," says Obeng. But it showed the principle of what they believed would be a major business, and a new sector for the ad industry.

The pitch from AudioMob—the company the two launched in early 2020—was simple: Audio adverts in games were less intrusive for users, who could continue to play while they listened to an advert over the top of gameplay. In an attention economy, you were still grabbing their interest, while not interrupting them. "That's how we got our first pool of investment," says Obeng, who became chief technology officer to Facey's CEO.

"We received rejections from numerous VCs during our seed stage, but always asked for feedback, which we used to identify product development areas," says Obeng. "It was the tech stuff we've been building, and the IP of the patents, as well as the opportunities outside of gaming."

Following a £750,000 investment from a media and entertainment venture capital company, as well as $2 million from seed funders ("Including Supernode Global, one of the VCs firms who originally chose not to invest, due to the shortcomings of our original pitch," says Obeng), the company secured $14 million in Series A funding, valuing AudioMob at $110 million. "Attracting investors requires a great product, solid business case, strong storytelling, and, most importantly, perseverance," says Obeng.

AudioMob believes its audio ad technology could be used not only in games, but the whole app ecosystem. "You could put it into apps like Tinder or the Weather Channel," says Obeng. The company is developing new potential integrations and opportunities from their moonshot lab, based in Abu Dhabi. "We understand from our

times at Google and Meta that one of the most important things to do is not just rely on this ad ecosystem, but also to look at the loads of other opportunities that present themselves, otherwise you can soon find yourself displaced," says Obeng. AudioMob has since served up audio ads for high-profile clients, from Ed Sheeran to Intel and Jeep.

"I've had tremendous support from Google," says Obeng. After their successful review and interview process for Google for Startups' Black Founders Fund in Europe, Google helped connect wih mentor and product experts, and brought them into the Google support ecosystem. Google for Startups' Black Founders Fund in Europe provides cash awards to companies without asking for equity in return, alongside hands-on support to help Black entrepreneurs like Obeng and Facey build and grow their businesses.

It's one of a trio of high-touch programs from the tech giant that support home-grown innovation and job growth by igniting conversations about what success means for founders, and how to achieve it. Supporting young companies since 2012, Google for Startups builds community to share the realities of the journey as founders, changing the conversation about the task of setting up and running a business, and celebrating successes often overlooked in the narrative about startups.

Support from Google for Startups helped AudioMob as it grew from two people in 2020, to a team of 33 employees in London and Abu Dhabi, servicing clients worldwide in the space of eight months. "The benefits have been fantastic," says Obeng, who lists everything from Google Cloud credits, to help building and developing of the software, to conversations with Google Privacy teams to ensure best practices to keep users secure. "They were really helpful if there was anything we wanted," he says.

Google for Startups also helped AudioMob's founders navigate balancing work demands and life challenges. "As founders, this can be difficult to achieve, especially in the early stages of a company, as there were so many roles which needed to be assumed," says Obeng. "However, as we grew, this has improved with the exceptional talent we were able to hire."

Those hires also needed to be right, and for that, Obeng and Facey decided to shun the standard requirements most companies look for in favor of an alternative metric: How well they'd work in the company. "Always prioritize cultural fit over performance," says Obeng. "This is easier said than done—however, it is crucial to team morale and relationships. It is important to believe in your team's ability to execute." He adds that businesses grow in ways beyond the bottom line, and a healthy company culture is a key performance indicator to follow.

Not that AudioMob is lacking in traditional KPIs: "When it comes to commercial traction, we've got case studies in every single major vertical," says Facey. But that's not what he's most proud of. "I do feel the rigor behind our R&D efforts is really overlooked," he explains. "We had to not only create this industry in the most literal sense, but then validate it as well."

That validation includes plans for an IPO. "The reason our valuation is so high, and why we got investors like Google, Makers Fund and Lightspeed Venture Partners, is because we have a very specific plan through to IPO," says Facey. "We see AudioMob as being pretty much the ultimate audio content delivery platform."

Google for Startups helped AudioMob grow to achieve a $110m valuation

LONDON

The fallout from Brexit isn't quite in the rear-view mirror just yet, but the UK capital is forging ahead regardless, with best-in-Europe levels of investment and a diverse range of startup talent

By **João Medeiros.**
Photography: **Sam Lort & Kathryn Chapman.**

Despite the Covid-19 epidemic, Brexit disruption and Westminster's never-ending political drama, the success of London's tech scene continues unabated. According to a report by Startup Genome, London remains the second-best place in the world to launch a startup, after Silicon Valley. Last year, London attracted $11.3bn in tech investment—more than double that secured by Berlin and Paris combined. Underpinning this success is a welcoming and tight-knit community of founders and investors: "There's a broad, enthusiastic investor community," says Marcia Kilgore, the serial entrepreneur behind Beauty Pie, the online digital beauty brand. "Everybody knows everybody else, or knows someone who knows who you need to know. People are really supportive." Luca Schnettler, CEO of Qumata, agrees: "I came to the country as a student with no recognizable network, professional experience or money. Within a short time, I was able to meet our first clients and get exposure to one of the most developed, global and competitive VC markets. I owe this place much gratitude."

Daye

Valentina Milanova was just 9 years old when she first had her period. "I experienced painful periods and was placed on hormonal contraception when age 11, which later led to health complications, including ovarian cysts," she says. Solving the way women deal with their painful periods was her motivation to launch Daye in 2017. "The goal was to reinvent the menstrual tampon, so it serves for a lot more than just soaking up menstrual fluids," she says. Daye has already developed tampons to aid the 90 percent of women who suffer menstrual cramps; a tampon to detect STIs and HPV; and another to treat the vaginal infections which affect 7 in 10 women. More than 11,000 women buy Daye's tampons every month. *yourdaye.com*

Beauty Pie

Two moments in Marcia Kilgore's life led to the launch of Beauty Pie. "Leaving an elite third-party cosmetics lab in Italy, and walking into a train station where the Sephora product on the shelf cost fifteen times more than the fully manufactured ex-factory price," she says. Kilgore—a Canadian serial entrepreneur who's sold her previous startups to companies including LVMH and Walgreen Alliance Boots—defines Beauty Pie as a "buyer's club for people who love really high quality beauty and wellness products, but are tired of paying the crazy industry markups to get them." In September 2021, the startup raised $100m from investors including Index Ventures and Insight Partners—its investment now totals $170m. *beautypie.com*

Gaia

Nader AlSalim, the CEO and founder of Gaia, believes that parenthood is a fundamental right. "I founded Gaia after my wife and I experienced the frustrations and limitations of IVF firsthand," he says. He launched his startup in 2019, aiming to make fertility care affordable to all. Gaia provides personalized financing based on predictive modeling that forecasts the number of IVF rounds a couple might need—couples that fail to conceive only pay a fraction of the cost. The startup has raised $23m so far. "Designing the world's first IVF insurance product has been our biggest challenge." AlSalim says. "Underwriters were not willing nor prepared to spend the time and investment needed to design this complex proposition." *gaiafamily.com*

Hokodo

Hokodo offers a buy now, pay later solution to businesses, making it easier for them to buy and sell to each other. "Buyers get the freedom to delay payment, while merchants are paid upfront," says CEO Louis Carbonnier. More than 30,000 buyers have already used Hokodo to pay for purchases in countries across the EU. In June 2021, it raised $12.5 million. *hokodo.co*

Sylvera

Sylvera is a carbon-ratings platform that leverages data and machine learning to analyze the carbon performance of construction projects. It has partnered with researchers at UCLA, NASA and UCL, while Delta Airlines, Cargill, Bain & co, Equinor, Shell and Ecologi already use its service. In January 2022, Sylvera raised $32.6m in a series A round. sylvera.com

Above: Valentina Milanova, founder of Daye, a gynae health research and development company.

Hoxton Farms

Hoxton Farms grows animal fat—without involving any animals in the process. Instead, they use a combination of synthetic biology and mathematical optimization. "Starting with just a few cells, we grow cultivated animal fat to produce a cruelty-free, sustainable ingredient for the plant-based meat industry," says founder Ed Steele. In July 2020, Steele, who has mathematics master degrees from Oxford and Imperial College, launched the company with geneticist Max Jamilly. "We're both avid home chefs," Steele says. "We've been obsessed with the 'big fat problem' in plant-based meat for years, and both got excited by cultivated meat when Max was doing his PhD." *hoxtonfarms.com*

HumanForest

HumanForest's zero-emission, hireable e-bikes offer riders the first 10 minutes free—so long as they're served an advert at the start and end of their ride. Founded by former-Cabify lead, Agustin Guilisasti, and backed by Cabify founders Juan de Antonio and Vicente Pascual, in August 2021 it raised £2.3m pre-series A, and has a valuation of £32m. *humanforest.co.uk*

FabricNano

"I've always wanted to build something physical and impactful," says Grant Aarons, who launched FabricNano with a cofounder he met at Entrepreneur First. The startup makes a powder that can be used to mass-produce sustainable chemicals, such as bioplastics and biofuels. Its partners aim to be selling proprietary proteins by late 2022. *fabricnano.com*

Qumata

Launched in 2017 by Luca Schnettler and Etienne Bourdon, Qumata analyzes an insurance applicant's digital data to cutstom-price policies—say, calculating the risk of diagnosis for ICD-10 coded medical conditions without someone filling out a long questionnaire. It recently raised a $23m series A funding round, led by Tencent and MMC Ventures. *qumata.com*

Below: Vira Health's Rebecca Love and Andrea Berchowitz.

Vira Health

When Andrea Berchowitz and Rebecca Love first met, they bonded over a shared passion to tackle the gender data gap in healthcare. "Female-focused conditions receive less than 5 percent of healthcare R&D, women are often not included in clinical trials, and sex-disaggregation of data is not a legal requirement," she says. In 2020, they founded femtech startup Vira Health and, a year later, launched Stella, an app that currently offers lifestyle and behavior change advice for menopause, and will soon include telemedicine and access to regulated hormone replacement therapy. In March 2022, Vira Health raised $12m, in a round of funding led by Octopus Ventures. *vira.health*

PHOTOGRAPHY: (LEFT) KATHRYN CHAPMAN

Suvera alleviates pressure on GP clinics by providing routine care to long-term patients virtually.

Find out more at goo.gle/3RDrCtd

Proud to help founders start, build, and grow

Google for Startups

Showcasing Eastern Europe's major innovation engines

A string of tech hubs, from Tallinn to Prague, are breeding blessings of unicorns and pulling in new levels of international investment. Google for Startups is helping new entrepreneurs to build on that historic success

Cities across Central and Eastern Europe, from Warsaw to Tallinn to Kyiv, are fertile ground for tech startups.

Early success stories such as Skype, developed in Tallinn, LogMeIn (now GoTo), founded in Budapest, and UIPath (founded in Bucharest and launched on the NYSE last year at $30bn), have helped foster a dynamic ecosystem.

Google for Startups' Joanna Nagadowska says the region's tech sector is being driven by a "positive flywheel" as it matures, with savvy and seasoned local talent now launching their own startups.

"Central and Eastern Europe today is not an overnight success. It was built on a generation of entrepreneurs who know how to start and scale businesses."

We've highlighted five key Central and Eastern Europe cities, including Kyiv. The Ukrainian capital's tech sector has such momentum that it continues to grow, despite the Russian invasion. Warsaw remains the region's tech hub and a number of Ukrainian startups have satellite offices in the city. Tallinn births more startups per capita than anywhere in Europe, while Vilnius has leveraged its liveability to develop a vibrant tech ecosystem. Prague has global credentials in developing cybersecurity tech, but boasts a growing and quickly diversifying startup scene.

The old town area of Lithuania's capital city, Vilnius

Kyiv

Before the Russian invasion of Ukraine, Kyiv was the rising star of the European startup scene. It was the launch site for six unicorns, from GitLab to NFT pioneer Unstoppable Domains and workflow automation star, AirSlate—the latter two went unicorn this summer.

The IT sector is still growing in Ukraine, with many startups opening satellite offices in other countries, particularly Poland. Earlier this year, Google CEO Sundar Pichai announced the $5m Google for Startups Ukraine Support Fund, providing cash awards and mentoring support.

Elai.io was one of the first beneficiaries of the Ukraine Support Fund, and was launched in Kyiv last year by Vitalii Romanchenko, Alex Uspenskyi and Aleksey Pshenichniy, all relative veterans of the Kyiv tech scene.

Leveraging advanced AI, Elai.io's Software as a Service tool allows users to easily create videos using just text, putting words in the mouths of digital avatars. It offers a library of templates and animations, works in over 65 languages, and the avatars are based on a diverse range of real-life actors.

Warsaw

Google for Startups opened its Warsaw Campus back in 2015, since then almost 100,000 startups and community members have visited. The city has also become a satellite base for Ukrainian tech firms, with Google for Startups providing workspace for firms in temporary exile. "The Google for Startups Campus in Warsaw is our hub for Central and Eastern Europe. It was built on a strong commitment to support this incredibly diverse startup ecosystem with its almost 200 million people across over a dozen countries. Especially in Poland we see an emerging number of unicorns like Allegro or Docplanner, fueled by a solid pipeline of rising stars like Booksy, Brainly, ICEYE, Tylko or Packhelp. They are all testament to the strong momentum we see for Eastern European startups today." says Michal Kramarz, head of Google for Startups, Central Europe.

Prague's famous Charles Bridge and the Lesser Town Tower

Vilnius

Put simply, the Lithuanian government is extremely startup-friendly, and the capital, dotted with accelerators, has cultivated a close-knit business community. The pandemic has seen Lithuanians return to the capital from around Europe, and the city is also welcoming disgruntled tech talent from neighboring Belarus.

Fintech is a particular strength, but the city's startup ecosystem is deep and broad: take the mobility platform Trafi; Blockchain banking platform Bankera; and fashion resale marketplace Vinted—its first unicorn.

Vilnius-based Kamilė Jokubaitė is cofounder and CEO of Software as a Service platform Attention Insight, which uses eye-tracking and AI to create attention heatmaps, helping companies to make their landing pages, marketing and packaging as eye-catching as possible.

Jokubaitė, who is a Google for Startups alumni, explains that "we are forming a new niche in the market which perceives AI as our colleague—a way to do our work better, not as a threat taking over our jobs."

Talinn

Tallinn is a small but mighty tech-sector powerhouse, leading the rest of Europe in terms of startup creation and VC investment per capita. The customer relations management platform Pipedrive, and mobility app Bolt—both unicorns—are just two digital headliners launched in the Estonian capital. But it is Skype, developed in Tallinn in 2003, that established a model for the tech sector's development as well as creating a funding and talent ecosystem—known as the "Skype mafia"—that helped launch successive waves of startups in the city, including Transferwise (now known as Wise), Pipedrive, robot delivery specialist Starship Technologies, and the identity verification service, Veriff.

Launched in 2015, Veriff verifies customer identity using AI-powered factors including facial recognition, and behavioral and technological indicators, that show an individual is who they say they are. Its founder, Kaarel Kotkas, had previously worked in verification operations at Wise. Three years after launch, Estonian VCs named Veriff Startup of the Year 2018.

Prague

Prague is becoming one of the best places to startup or scale your business in Central and Eastern Europe. "Prague and other cities, such as Brno, are not only fantastic places to live in, but the overall startup ecosystem is picking up in terms of its overall maturity, access to smart angel, VC and PE capital along various verticals, meaningful connections to corporations and other actors of importance, an emerging community of founders and dedicated accelerators, and a quality pool of human capital," says Petr Vítek, the cofounder of Impact Hub Prague, which is a Google for Startups partner. "It is great to see these developments materialize not only in unicorns such as Rohlik or ProductBoard, but also other awesome startups—which we will hear a lot about soon!"

DUBLIN

The home of the Silicon Docks is celebrating more local talent than ever, as being the only English-speaking country in Europe drives outside investment, and tempts new founders to try their hand

Dublin has long been home to big tech's European outposts. Historically, however, this has negatively affected local startups: big salaries and cushy posts at major tech companies made it difficult for smaller companies to compete. That situation is finally changing: "Over the last few years, the culture has shifted away from big tech," says Nicola McClafferty, chair of the Irish Venture Capital Association, and a partner in Molten Ventures, a venture capital firm operating in Ireland. "We're seeing more and more people and talent wanting to come out of those companies, and really thinking about joining earlier-stage and high-growth startups."

Above: Bobby Healy, founder of autonomous drone delivery service, Manna.

Manna

Founded in 2018 by serial founder Bobby Healy, Manna has fast become one of Ireland's buzziest startups. The company was born out of frustration: "I live in a suburb of Dublin," says Healy. "It's impossible to get delivery from local restaurants to my house in a reliable, economical way, so I decided to build autonomous drones." Local businesses and brands that use Manna can reach customers within a 30 square mile radius, at a fraction of the cost of delivery by car or van. Average delivery time is currently two minutes and 40 seconds. "We charge about £3 for delivery, and, of course, you don't need to tip the drone," says Healy. The company's large white drones, roughly the size of a seagull, have completed more than 110,000 flights. Manna has so far raised $30m. *manna.aero*

Kinzen

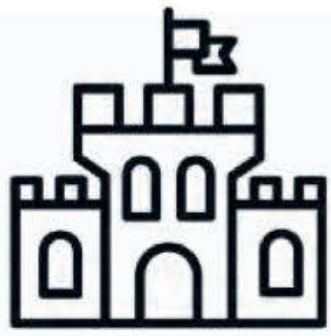
Kinzen cofounder Mark Little is well-known to Irish citizens as one of their best-known foreign correspondents and news anchors. Little left TV channel RTE in 2009, and with former political correspondent Áine Kerr, founded Kinzen in 2017. "Kinzen's initial mission was to help internet users improve the quality of their news feeds," says Little. It now uses a mix of machine learning for automatic speech recognition, and human moderation to further review controversial content and spot dis- and mis-information and hate speech—including providing podcast moderation services to Spotify. It's funded by partnerships with content platforms like Spotify, public health authorities in Ireland and content moderation companies. *kinzen.com*

Inferex

Founded in 2021 by 19-year-old Greg Tarr, Inferex automates the development of AI models, simplifying jobs that took weeks or months into a few lines of code. "We want to do for AI what Stripe did to payments," he says. "Engineers spend too much time on infrastructure." He leads a team of nine remote employees, and has raised €3.6m from Frontline and Seedcamp. *inferex.com*

Tines

Cofounders Eoin Hinchy and Thomas Kinsella left DocuSign to found cybersecurity firm Tines in 2018. Their platform allows people who don't know how to write code to automate repetitive, manual tasks. The company was valued at $300m in April 2021, when it raised $26m in Series B funding, and has raised $41m from the likes of Accel, CrowdStrike, and Blossom Capital. *tines.com*



By **Chris Stokel-Walker.**
Photography: **Laurence McMahon.**

Zipp Mobility
Founded in 2019 by Charlie Gleeson, dockless scooter startup Zipp Mobility is one of the few firms to be approved for a 2020 trial by the UK Department of Transport. It differentiates itself from competitors in the crowded scooter space through its sustainability credentials: it only uses electric vans and cargo bikes to replenish the fleet, so reducing its carbon footprint, and runs operations in-house, shunning outsourced workers. Operating in eight cities including in Poland and the UK, the company launched its ninth city in its home market in March 2022. Three months later, the company raised €6.1m, led by Fasanara Capital, to help it expand its team. *zippmobility.com*

Evervault
This encryption infrastructure startup has raised $19.4m from angel investors including Alex Stamos, former chief security officer at Facebook. Founder Shane Curran, an amateur cryptographer and software developer, was building software for his local school, and struggled to keep private information secure. In 2019, he set up Evervault. *evervault.com*

&Open
Gifting platform &Open solves the tricky issue of sending corporate presents, from finding the right gift to getting the address of the recipient. Launched in 2017, &Open is active in over 120 countries. Founders Jonathan Legge, his wife Ciara, and brother Mark run a team of more than 90 in Ireland, the UK and US, and landed a $7.2m funding round in May 2022. *andopen.co*

Oblivious
Founded in 2020 by Robert Pisarczyk and Jack Fitzsimmons, Oblivious supports the safe operation of Software as a Service. This means Cloud providers can offer "secure enclave" hosting, while Oblivious automates the process of applying for that secure hosting. The 10-strong company has raised $1m in pre-seed funding to grow further. *oblivious.ai*

PHOTOGRAPHY: (RIGHT) BRYAN MEADE

Above: Greg Tarr, founder of Inferex.

Vologrames
Founded by Rafael Pagés, Jan Ondřej, and Konstantinos Amplianitis in 2018, the company transforms regular videos captured on smartphones into "volumetric holograms"—vologrames—using AI-powered algorithms. The startup has attracted €2.4m in funding from Atlantic Bridge, Sure Valley Ventures, and Enterprise Ireland. *vologrames.com*

ApisProtect
Bee-tech startup ApisProtect has raised €3m to date. Fiona Edwards Murphy, CEO of the company, founded it in 2018 after studying the application of Internet of Things tech to beekeeping. ApisProtect takes real-time data from hives—temperature, humidity and sound within the hive—and analyzes it to provide insights that help beekeepers protect their hives. *apisprotect.com*

PARIS

The vast business incubator Station F has supercharged the Paris tech scene, but it's far from the only show in town, and local startups are attracting more investment than ever

Paris' largest startup campus is 300m long—the same size as the Eiffel Tower. Built in an old freight-train station, Station F is home to 1,000 early stage startups. Google, Apple and La French Tech, a government agency, all offer training and advice. Station F embodies the success of the support network France has built around its startups, which are now starting to attract significant funding. In the first three months of the year, France raised $5.4bn in VC funding, double that in the same period last year. There has always been tech talent in Paris, says Clara Chappaz, director of La French Tech. "The ecosystem is now really accelerating and we have the means to go much further," she says.

Above: Scott Gordon and Amine Bounjou, founders of fintech startup, Kard.

Commune

When Tara Heuzé-Sarmini was invited to a job interview at a co-living company targeting professionals in Germany, she had a realization. "I did not want to do co-living for yuppies working in tech in Berlin," she says. Instead Heuzé-Sarmini and her cofounder Ruben Petri launched Commune, a Paris startup applying the idea of communal living to single parents with young children. One-in-four French families live in single-parent households, yet the country's housing is still catered towards couples. Commune, which launched in 2021 and raised €1.1 million in seed funding the following year, plans to offer recently-separated parents the privacy of their own self-contained apartment combined with the community of a communal kitchen. *commune.house*

Kard

Paris is crammed with fintechs. But Amine Bounjou and Scott Gordon think they've found a gap in the market: France's unbanked under-18s. Their company, Kard, offers a bank account with two separate apps: one for kids and one for their parents. Children use their Kard account to spend pocket money or get paid for selling clothes online; parents set spending limits and track their offspring's shopping habits. So far, 85,000 teens and pre-teens have joined, but Kard don't want to be a kid's bank forever, and their route to retail banking hinges on a clever idea: "People don't leave their first bank," says Gordon. The startup has raised a total of €10m since its launch in 2019, with BlaBlaCar cofounder Francis Nappez among the investors. *kard.eu*

Offishall

Offishall is a hybrid-work planning tool which Audrey Barbier-Litvak launched in 2020 with cofounders Pierre Godret and Bruno Ronzani. Users tell Offishall when they will WFH and when they will travel to the office. That data can also help Offishall's clients, such as LVMH, understand their team's patterns. The company raised €1.2 million in August 2021. *offishall.io*

Omie & Cie

Christian Jorge was a cofounder of second-hand fashion site, Vestiaire Collective, valued at $1.7bn. His new venture, Omie & Cie, aims to revolutionize online grocery shopping using transparency. Every Omnie product is accompanied by a breakdown of where the ingredients come from, how the profits are split, and any packaging waste. It has raised €4 million. *omie.fr*

By **Morgan Meaker.**
Photography: **Julien Faure and Marina Zagortseva.**

Greenly
Greenly aims to make carbon accounting more accessible, says Alexis Normand, who cofounded the company with Matthieu Vegreville and Arnaud Delubac in 2019. Most of the startup's business stems from helping SMEs calculate how much carbon they could save by switching to greener data centers or buying more environmentally friendly laptops. Around 60,000 people have also downloaded the company's app, which analyzes a user's bank account to estimate the emissions associated with transactions at petrol stations or supermarkets. Greenly's technology has already been integrated into the banking app run by French banking group BNP Paribas, and, in April 2020, the company raised €21.5 million as part of its Series A. *greenly.earth*

Maki
In less than a year, Paris startup Maki has built a HR platform that aims to replace CVs with gamified online tests designed to make the hiring process fairer and more efficient. Maki's platform offers tests that assess candidates' personalities, cognitive abilities, use of tools such as Excel, and their soft skills. It has received €11 million in funding. *makipeople.com*

Kinetix Tech
Yassine Tahi and fellow gamer Henri Mirande cofounded Kinetix Tech in 2020, a platform enabling their user base of 25,000 people to turn videos of themselves dancing into animated avatars which can be imported into virtual worlds such as Roblox. The startup raised $11 million in seed funding in May, with virtual worlds The Sandbox and ZEPETO taking part. *kinetix.tech*

Homa Games
This games publisher gives independent developers free tools so they can quickly create and distribute their ideas fast enough to react to pop-culture moments. Developers can also see what's trending, and access the company's ad technology to monetize their games. It has raised $65m from investors including the founders of King. *homagames.com*

Jump
In exchange for a €79–€99 monthly fee, Jump offers security to freelancers and gig-workers in long-term contracts, providing a bank account, and managing their taxes and pension. If a client pays late, Jump can offer an advance, and will vouch for them if they want to apply for a mortgage. Jump raised €4m in a 2021 round led by Deliveroo and Index Ventures. *join-jump.com*

Pigment
Businesses can end up resorting to Excel because newer tools simply don't offer the same flexibility for data visualization and financial planning. So, founders Eléonore Crespo and Romain Niccoli created Pigment as a more intuitive, user-friendly tool which encourages collaboration. Deliveroo and BlaBlaCar are clients, and it has raised more than $100m. *gopigment.com*

Above: Heuzé-Sarmini and her Commune cofounder, Ruben Petri.

How Black European founders are busting the pipeline myth

Google for Startups' Black Founders Fund in Europe turbo-charges creative business ventures across the bloc, while addressing inequalities in the startups ecosystem when it comes to access to funding

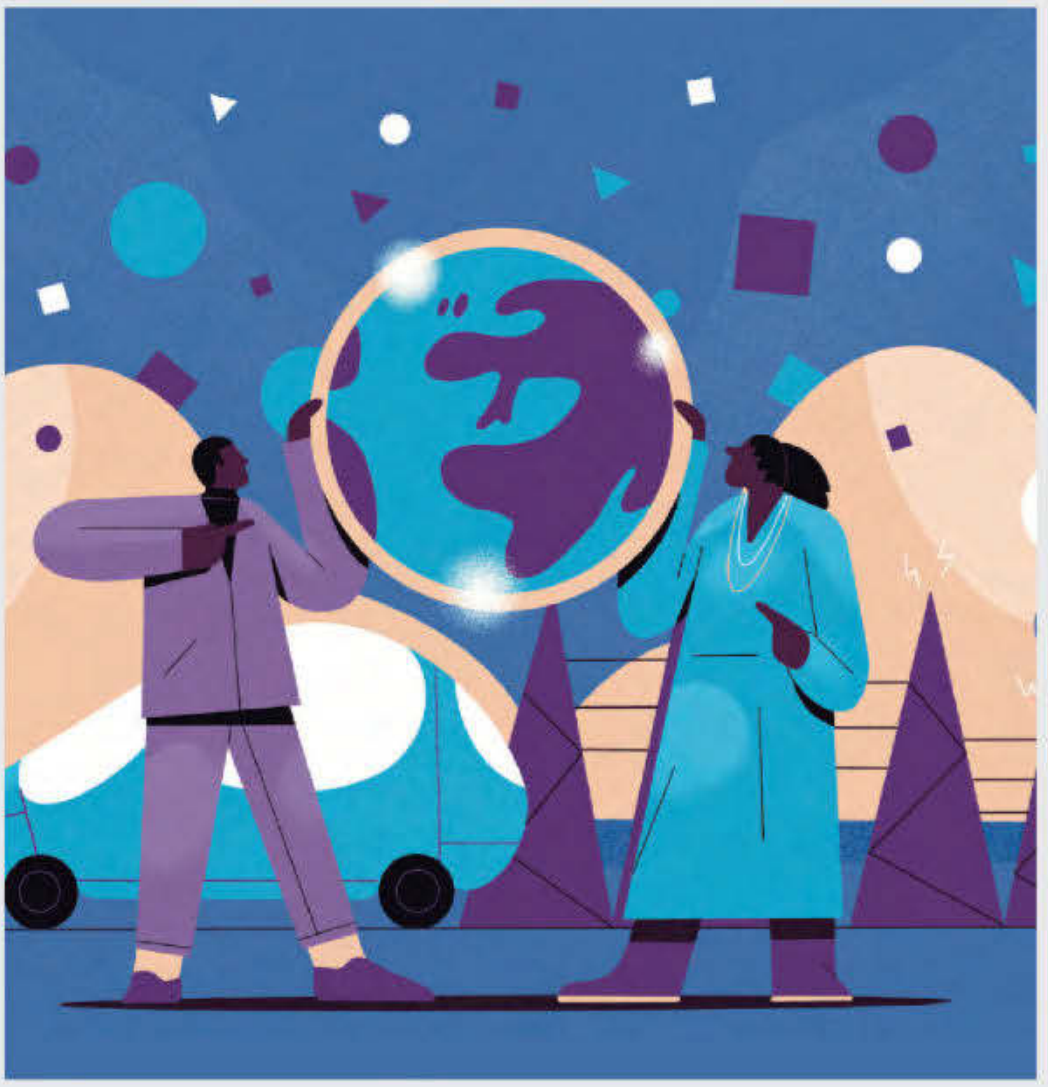


ILLUSTRATION: MICHAŁ BEDNARSKI

Like most entrepreneurs, Bruno Mendes Da Silva's path into business was winding. While studying in China, the air pollution he experienced in Shanghai led to the idea for his first startup: an electric vehicle rental company that he would go on to launch back in Paris. But local resistance to electric vehicles in his hometown pushed him onwards to San Francisco, where he became versed in the self-driving vehicle revolution.

It quickly became clear to him that the future of cars and mobility was not just electric, but autonomous.

Spotting a gap in a burgeoning market, this time when he returned to France he started a company called Heex that creates software solutions for self-driving vehicle engineers, helping them fast-track to autonomy with the aim of deploying vehicles at scale. Instead of "big data", Da Silva's second venture focuses on "smart data".

"It was not a service company like the first one," explains Da Silva. "It was a tech company."

Heex was one of the 30 startups which went on to claim a slice of Google for Startups' $2m Black Founders Fund in Europe, unlocking up to $100,00 in capital, up to an additional $200,000 in Google Cloud credits, and access to the best of Google resources—people, products, and best practices.

As soon as he came across the Black Founders Fund, Da Silva recognized the impact it could have. "I felt that underrepresented founders were not treated equally to other founders, because people like to [invest in] those who look like themselves," he says.

Unfortunately, Da Silva was right: the data shows that Black founders are at a disadvantage when it comes to accessing investment. Take the UK as an example: in 2020, less than 0.25 percent of venture capital (VC) funding went to Black-led startups, and only 38 Black founders received venture capital funding in the last 10 years.

Google for Startups brings funding and support for growth

This stifles the potential of Black entrepreneurs, and prevents innovative ideas from being transformed into thriving, potentially world-changing businesses.

Besides crucial funding, Heex received access to Google support and resources, including Google Cloud infrastructure and Google Ads. Being a software company, Heex's cloud expenses were growing; receiving $100,000 in Google Cloud credits was "a huge relief", Da Silva says.

The support provided by Google for Startups was overwhelming: "It was beyond what we expected, because they were offering us workshops with specialists from different fields every

week," says Da Silva. An additional incentive to partner with Google for Startups was, for Da Silva, that Google subsidiary Waymo is a leading autonomous driving company.

Like Heex, London-based startup Modularity Grid is focused on tackling a pressing, current day issue. Founded by Elizabeth Nyeko, its AI software tackles the complexities of deploying and managing fleets of microgrids, to bring down energy costs and emissions for homes, businesses and EV charging infrastructure.

Nyeko was working in this area before the onset of Europe's current energy challenges, but says that this is helping to hammer her company's value proposition home, as the centralized grid comes under increasing strain, and prices shoot up for consumers.

She draws a comparison to the onset of the Covid-19 pandemic. "You can talk about a potential pandemic happening, but until it happens ... no one really believes that it will happen," she says.

Modularity Grid has piloted technology that uses AI and machine learning to support mini-grid operators in monitoring and predicting energy consumption.

Nyeko was part of the first cohort funded by the Black Founders Fund in Europe. "Perhaps even more useful than getting the money was the hands-on support from Google employees on everything from user interface design, user experience and software," she says, "all the way through to the more practical things, such as supporting our recruitment efforts, and setting up the processes and systems to prepare us for growth."

'I felt underrepresented founders were not treated equally to others, because people like to invest in those who look like themselves.'

Da Silva and Nyeko are not outliers by any means. Contrary to the illusory "pipeline problem", which posits that there are not enough qualified Black entrepreneurs in line to set up startups, across 2021 and 2022, Google for Startups received in excess of 1,500 applications from aspiring entrepreneurs keen to join in its current round of funding. In fact, the sheer number of applicants it received since launching the Fund prompted Google for Startups to double the allotted funding to $4 million in 2022.

Nyeko says that one particularly invaluable experience provided by the initiative was being able to connect with a vibrant community of Black European founders. Events and meetups where Fund recipients were able to network helped facilitate the free-flowing exchange of experiences and ideas among the entrepreneurs.

"As a founder, it can be quite a tough journey," says Nyeko. "It always helps to be able to talk to other founders, share experiences, share tips—and even introductions to investors."

Black-led startups don't just create value for themselves—they contribute to the wider startup ecosystem and economy. Since 2021, Google for Startups-backed startups have gone on to raise $81m in follow-on funding, added over 100 new employees to their teams.

Working with the UK's National Farmers Union, Modularity Grid's immediate goal is to help farmers use micro-grids to bring down their energy costs, reducing the likelihood of energy-price hikes being passed on to consumers. Next, the company is eyeing how to use micro-grids to boost electric-vehicle charging connectivity across the UK. Heex has plans to continue refining its product, and is looking to more than double its staff in the next 12 months.

By working to help underrepresented founders to succeed in business, Google for Startups doesn't only create value for the Black startup community, but for Europe as a whole.

Google for Startups helped Heex, a self-driving-car software firm, get on the road

HELSINKI

It's a small city with a relatively low population, but investment in its startups is growing apace, thanks to an international mindset and a sturdy support system for local founders

Finland has produced many tech unicorns, from gaming giants Rovio and Supercell to database management system MySQL and food delivery service Wolt. And it's the home to one of the world's most renowned startup events, Slush, which is held every year at the city's Expo and Convention Center. Those who make their annual visit to Slush tend to treat the city as a stop-off point, but doing so misses out on engaging directly with Helsinki's vibrant startup sector. "The most important thing is the culture," says Mia-Stiina Heikkala, startup business advisor at NewCo Helsinki, the city's main business development service. "We have a very open and trustful mindset, so everyone is talking about their business ideas."

Gubbe
When Sandra Lounamaa's grandfather died, she faced a conundrum: who would help care for her widowed grandmother? So, in 2018, she founded a company that'd do it for her. She enlisted the help of cofounder Meri-Tuuli Laaksonen, a friend she met on a new mothers' Facebook group, and created Gubbe, named after a beloved dog. The firm brokers connections between student carers, who undergo a seven-step screening process, and those who need looking after—it's like Wolt, but for caring. More than 1,000 carers have signed up to the service in Sweden and Finland, with the company launching in the UK in August. The 45-strong company has raised €6.1m from investors—including Spintop Ventures, Nidoco AB, and Tesi. *gubbe.com*

Mjuk
Mjuk was founded in 2019 by Rickard Zilliacus, Max Heino and Casper von Pfaler, as a convenient way to buy quality second-hand furniture, with an app handling logistics, pickups and deliveries. In all, the company has sold 25,000 pieces of furniture since it was founded. A March 2022 funding round took the total amount from investors to €5.5m. *mjukhome.com*

GraphoGame
Mervi Palander and Jesper Ryynänenand's edtech startup gamifies literacy learning for four-to-nine-year-olds, supported by research output from the likes of the University of Cambridge and Yale University. The app is available in 15 countries and has 400,000 users per month, in languages including local Zambian tribal dialects. *graphogame.com*

Solar Foods
Throughout history, the food chain has been reliant on agriculture as its source—but Solar Foods CEO and cofounder Pasi Vainikka doesn't think that it needs to be that way. The firm, founded in 2017 after being spun out of VTT, produces a protein powder called Solein that can be used as a raw ingredient in other food items such as meatballs, noodles, and ice cream. The fermented powder, which is between 65 and 70 percent protein, 5 to 8 percent fat, 10 to 15 percent dietary fibers and 3 to 5 percent mineral nutrients, is created from microbes. Commercial production will take place at a factory in Vantaa, 20km north of Helsinki, funded with a February 2022 €10m investment from the Finnish Pharmacy Pension Fund, starting in the first half of 2023. *solarfoods.com*

Below: Rickard Zilliacus, one of the three cofounders of second-hand furniture platform, Mjuk.

By **Chris Stokel-Walker.**
Photography: **Jussi Puikkonen.**

Above: Tuure Parviainen, cofounder of Volare.

Volare
Tuure Parviainen and Matti Tähtinen, cofounders of Volare, think the black soldier fly might be the solution to two major problems in the global food chain: the demand for protein, and food waste. The two worked together at VTT, the Technical Research Centre of Finland, to develop a way to farm the fly, and in spring 2021, they spun out of VTT to scale up the idea to an industrial level. Black soldier fly larvae are fed food waste—collected within a 50km radius of their HQ—to grow into insects that can be used in pet food and animal feed. €700,000 of pre-seed funding from Maki.vc has helped build the team of nine, and will fund the construction of an industrial plant capable of producing 5,000 tons of protein a year in Hyvinkää, about 50km north of Helsinki, in 2023. *volare.fi*

Flowrite
Flowrite's main product is an AI-powered writing assistant that turns short instructions such as "cal invite?" into ready-to-send emails and messages. Currently in beta, the Google Chrome browser extension is used by more than 50,000 people, but should see wider release in late 2022. Flowrite has $5m in funding, and an 18-strong team, all of whom work fully remotely. *flowrite.com*

Pixieray
Founded in 2021 by Niko Eiden, Rebecca Xu, Klaus Melakari and Ville Miettinen, Pixieray's adaptive glasses work like a phone camera's lens, constantly readjusting focus and zooming in and out every 100 milliseconds. The company raised $4.4m in June 2021 from the likes of Maki.vc and the Amazon Alexa Fund, with plans to ship its first glasses in 2023. *pixieray.com*

IQM
The brainchild of Jan Goetz, Kuan Yen Tan, Mikko Möttönen and Juha Vartiainen, IQM builds quantum computers using superconducting qubits. Its 180 employees in offices in Espoo, Munich, Paris, and Madrid, work to develop processors for specific tasks, such as nanoscale nuclear magnetic resonance imagery. It secured a €128m round in July 2022. *meetiqm.com*

Helppy
Finland has one of the five fastest-aging populations, so the elderly care sector is growing. Helppy enables continuity of care between nurses, giving them data about the patients' needs. It's attracted 5,000 nurses, who the app connects to those needing care. In May 2022, Helppy landed €3m in funding from Wolt cofounder Elias Aalto and others, including Alliance Venture. *helppy.com*

Mainframe Industries
Massively multiplayer online games are a $43bn industry—but they're ill-equipped for the cloud. The cloud-native gaming Mainframe is developing will allow players to pick up and play in a device-agnostic way. The company has 60 employees and raised nearly €30m from investors including the cofounders of Twitch and King. *themainframe.com*

TEL AVIV

Home to Silicon Wadi and a long-running streak of mega-money exits, the Tel Aviv tech scene continues to lead with innovative applications of robotics, AI, and medtech

By **Stephen Armstrong.**
Photography: **Jonathan Bloom.**

Tel Aviv's startup scene underwent a transformation around 2019, moving from a system of "Holy Grail exits," as Eli David, CEO of StartUp Link puts it, to "building companies not looking to sell to Google right away." As has always been the case, the military is still the main source of founders—not least because almost everyone passes through it, but also for its emphasis on problem-solving and a focus on cybersecurity, AI and robotics. There's also growth in Web3, gaming and productivity startups, while countries such as India are coming online as customers. "We have a brain-drain problem," admits Michel Abadi, managing partner at Maverick Ventures Israel. "But we have a lot of patience."

Immunai

"We're mapping the immune system and all its different pieces, from cell types and cell states, to provide researchers with a complete map and comprehensive understanding of the immune system," explains Luis Voloch, who cofounded Immunai with Noam Solomon in 2018. The platform blends single-cell multi-omics, machine learning, and functional genomics with high-quality patient data to identify and validate novel drug targets, lowering the cost and increasing the success rate of drug development. Total raised to date is $295 million in three rounds from Viola Ventures, Dexcel Pharma and Koch Disruptive Technologies. Immunai has 25 academic collaborations with institutions including Harvard, Stanford, and Memorial Sloan Kettering, and 30 partnerships with Fortune 100 pharmaceutical companies. The company, with offices around the world, achieved unicorn status in October 2021, less than three years after founding. *immunai.com*

Beewise

"We have the clearest KPIs of any company I've launched," says cofounder Saar Safra. "For every dollar we make, we save two bees." According to Safra, 75 percent of all fruit and vegetables are pollinated by bees, while a worrying 35 percent of bee colonies are disappearing every year. Beewise, launched in 2018 by serial entrepreneur Safra and beekeeper Eliyah Radzyner, is on a mission to prevent colony collapse disorder. How? A robot that can shutter a hive if it detects pesticides, provide food if a colony runs short, and control the temperature to keep the bees alive. The company has raised $120 million over four rounds, which have included local VCs lool Ventures and Fortissimo Capital, as well as US funders Corner Ventures and Insight Partners. It's opening new factories near large bee populations, and claims to have reduced collapse from 35 percent to 8 percent where deployed. *beewise.ag*

Trigo

For a startup founded in 2018, Trigo has picked a tough target to beat—Amazon, which already has numerous checkout-free stores. "We are the only company which can convert existing stores into autonomous stores," Michael Gabay, CEO and cofounder—with brother, Daniel—explains. The company's computer vision system includes camera hardware and encrypted "grab and go" software that allows customers to pick up items and get billed before they leave the store. Trigo has secured $104m from the likes of 83North, Vertex Ventures, Red Dot Capital Partners, and Tesco, which opened its first London checkout-less Trigo store in October 2021. Trigo is deploying in Germany, Netherlands and the UK across 2022. *trigoretail.com*

Run:AI

Run:AI has created what it calls a special virtualization layer for deep learning that can train AI models running on graphics processing units much faster than is normally possible—and while using fewer resources. The company has raised $118 Million in three financing rounds, backed by Insight Partners, Tiger Global, TLV Partners, and S-Capital VC. *run.ai*

Empathy

Empathy combines technology and human support to help grieving family members through the logistical tasks and emotional trauma following the death of a loved one. The app can help arrange a funeral and validate a will, while care managers offer emotional assistance. Founded in 2020, the company has raised $43 million in two rounds. *empathy.com*

Above: Saar Safra, CEO and cofounder of Beewise, on top of a robotic beehive.

NeuraLight
Most neurodegenerative diseases—such as Parkinson's or Alzheimer's—have highly subjective, non-sensitive examination and diagnosis of symptoms, hindering timely diagnosis, drug development and precision care. Cofounded by CEO Micha Breakstone and CTO Edmund Benami in 2021, NeuraLight is building the world's largest database of symptoms, measuring over 1,000 volunteers to date. It has recently secured its first commercial contract with a publicly-traded pharma company to help therapeutic discovery for amyotrophic lateral sclerosis (ALS). The company has raised $30.5 million in two rounds from Koch Disruptive Technologies, Samsung Next, Operator Partners, and VSC Ventures. *neuralight.ai*

LUSIX
In its solar powered lab, LUSIX produces lab-grown diamonds for the gemstone market and industrial applications. The company has raised $135m, with LVMH Luxury Ventures leading the company's recent $90m round, intended to fund production capacity expansion in Israel, with a second 100 percent solar-powered facility. *lusix.com*

Tevel
"Farmers all over the world are struggling to recruit fruit-pickers, a situation that puts the whole industry at risk," says Tevel founder Yaniv Maor. The company has raised $32.1 million, most recently from agriculture equipment manufacturers, including Japan's Kubota and China's Forbon, for its fleet of drones for performing picking, thinning, and pruning tasks in orchards. A single unit consists of a wheeled vehicle with four quadcopter drones electrically tethered to the vehicle, and equipped with a meter-long mechanical claw and AI-powered eyes, which can differentiate between fruits, and assess their size and ripeness. The company plans a commercial roll-out in southern Europe in late 2022. *tevel-tech.com*

Above: Yanib Maor, founder of Tevel.

AiVF
AiVF use AI-based computer vision and a database of previous studies to identify IVF embryos most likely to be successfully implanted, without needing invasive tests. Founded in 2018, the company has raised $35m from investors including Insight Partners and Adam Neumann's Family Office. After receiving a European CE Mark in 2021, the US is next. *aivf.co*

Better Juice
Better Juice uses enzymes from microorganisms to convert sugar in fruit juice into non-digestible fiber, claiming to reduce up to 80 percent of all sugars in juice, but not affecting its smell or taste. Founded in 2018 by Eran Blachinsky at the Hebrew University, Jerusalem, it has received $8m led by iAngels with Food Tech Lab and The Kitchen Hub. *better-juice.com*

- Miri Berger, Cofounder, 6Degrees, **Israel**
- Google for Startups Growth Academy alum

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IT'S THE AGE OF THE INVESTOR-ENTREPRENEUR

According to Taavet Hinrikus and his Plural 'peers', if you want your early-stage VC fund to pick up the true hidden gems of the startup scene, you first need to set a founder to catch a founder

By **Stephen Armstrong**.
Illustration by **Matthew Green**.

"We want to create the kind of investor we needed when we set out to build our own companies," Taavet Hinrikus, cofounder of early-stage investment fund Plural explains.

Plural's founders—who have raised €250 million with the aim of leading early stage rounds between €1 million and €10 million—are something of an overachieving lot, bringing with them a wealth of experience in the art of the startup. They comprise Hinrikus, cofounder and CEO of Wise; Songkick founder Ian Hogarth; angel investor Khaled Helioui; and Teleport founder Sten Tamkivi. With their track records in leading such notable successes (the group has also played significant roles in Skype, Bigpoint, and Topia), they now intend to offer their entrepreneurial expertise—as well as capital—to their portfolio of companies.

"In Europe, only eight percent of investors have worked in a fast-growing tech company." Hinrikus explains. "We are decades behind the US. Founders have a brain configured for what life for entrepreneurs is like. There are too many investors asking why legal costs are higher this quarter than last quarter. That [sort of thing] doesn't make or break a company—but ex-founders can zoom in on the things that matter."

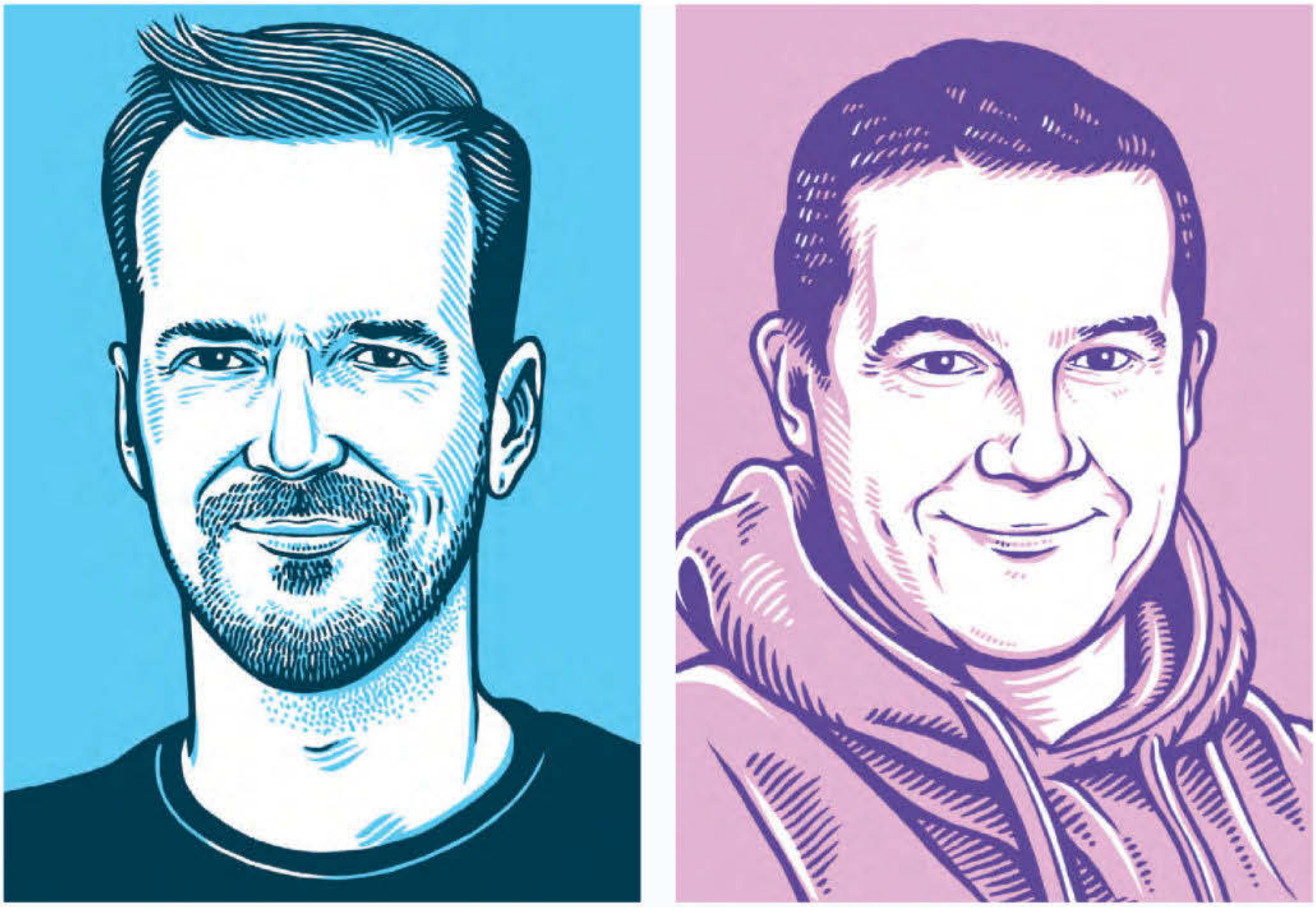
Plural plans to expand the team rapidly—looking to add a total of 10 entrepreneurs as investors by the end of the year, another 20 the year after, and thereafter maintain an ambitious rate of growth. "We have identified a bunch of possible new investors and are working to identify the entrepreneurs ready to make that journey," Hinrikus explains. "People prepared to become a partner you can trust over the long-term. There is too much short-termism in investing. We're looking for brains that know being a company builder means not looking at one line in a spreadsheet, but sitting next to you, and being on the wavelength."

So far, Plural has invested in Certific, a company that offers guided home testing for conditions such as urinary tract infections or Covid-19; Field, a renewable infrastructure startup working on battery storage; insurance disruptor Feather; blockchain-based legal, tax, and accounting support platform Koos; metaverse fintech and avatar platform Ready Player Me; and student banking challenger MOS. "We're completely agnostic on sectors—but we all gravitate to harder things to resolve," he explains. "Khaled is fascinated by AI, Sten is keen on Web3, and I'm climate curious. In terms of diversity, our portfolio has 29 per cent female founders and 36 per cent minority founders. We're fully aware that the world needs a lot more diversity, but there's nothing in our term sheets yet. That sounds more like PR than a business decision."

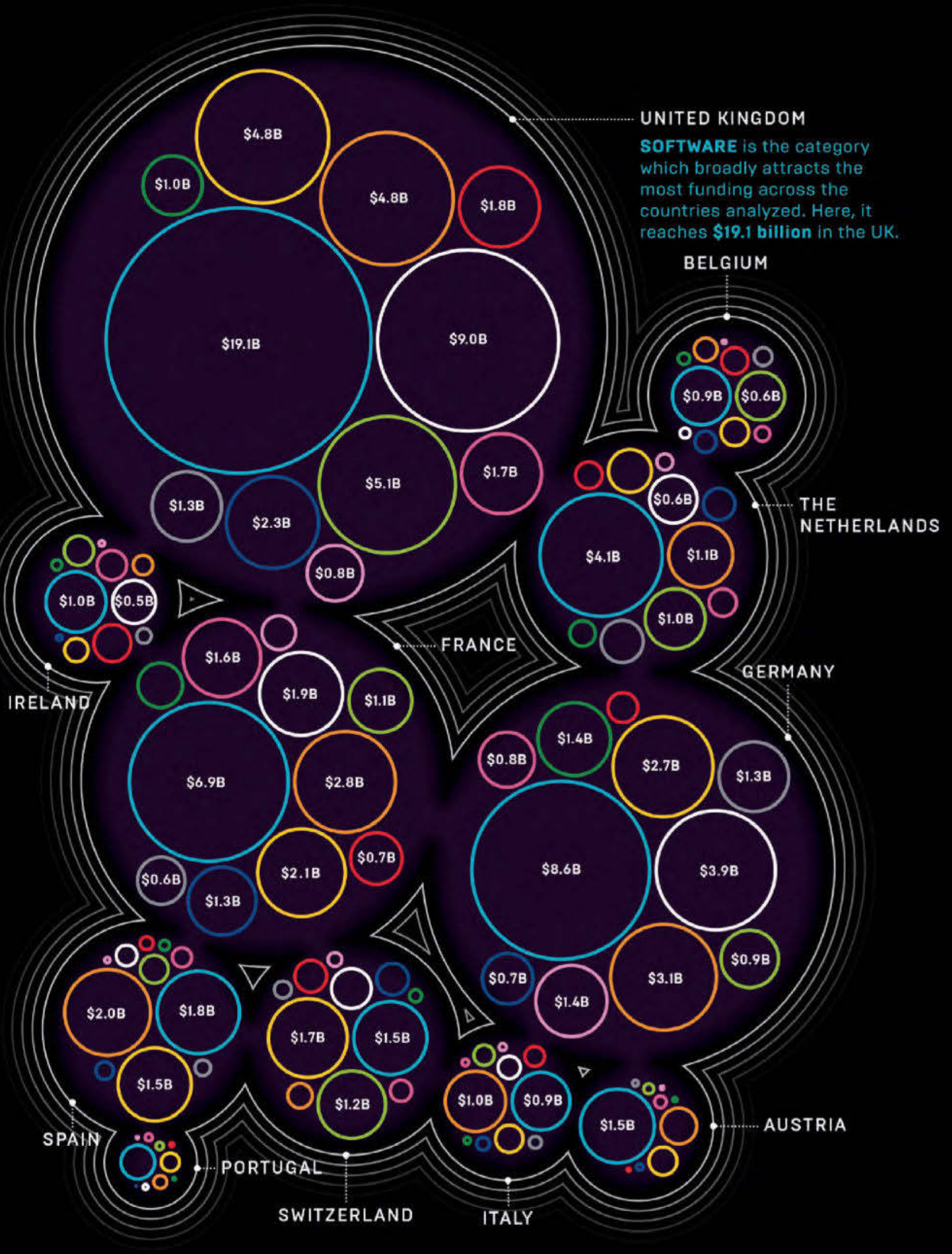
'In Europe, only eight percent of investors have worked in a fast-growing tech company.'

The difficult financial headwinds have made fundraising tougher, although there's plenty of capital looking for deployment. According to Crunchbase data, investment in European startups dropped from €29 billion in the first quarter of 2022 to €14 billion in the second quarter—although VC funds are still raising money at the same rate, with the UK and Germany leading the major players.

"Thinking in national terms isn't enough," Hinrikus insists. "We're looking to help Europe as a whole accelerate its ecosystem development. Estonia got really lucky, thanks to Skype founders staying in the game. Now Estonia has 10 unicorns for a 1.3 million population. I don't love the word unicorn, but I would love to accelerate Europe in the same way."



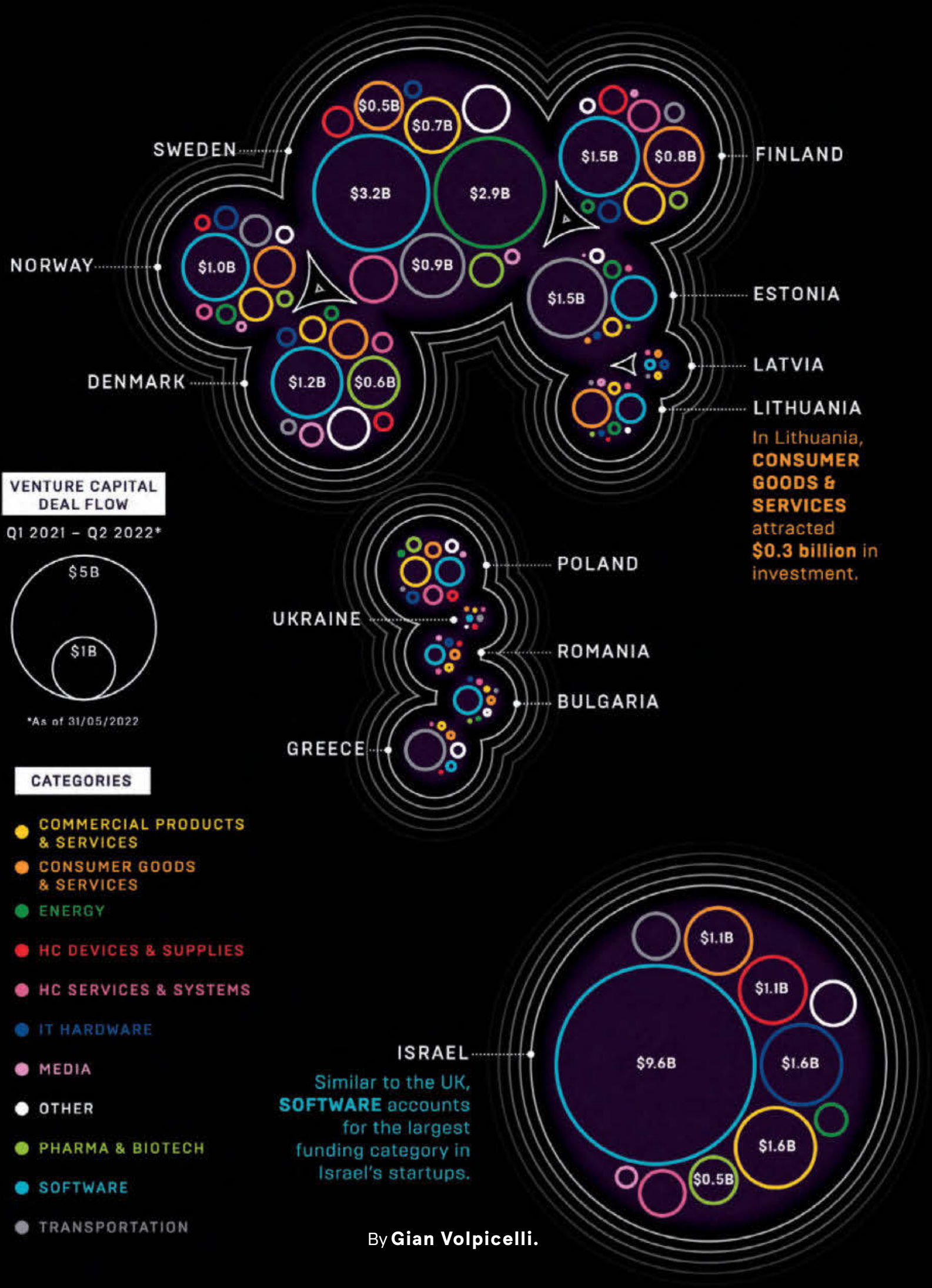
Plural’s ‘peers’, clockwise from top-left: Taavet Hinrikus; Sten Tamkivi; Ian Hogarth; and Khaled Helioui.



THE HEATMAP

Plotting the tech sectors drawing in the investors, and where they are

By **Gian Volpicelli.**



By **Gian Volpicelli.**

It's been another challenging 12 months in Europe—but the investment wagon kept trundling on, seeking out new opportunities across the continent and beyond. We asked companies database PitchBook to crunch the numbers and plot whether particular countries had developed specialisms that were attracting funding—and the results were surprising.

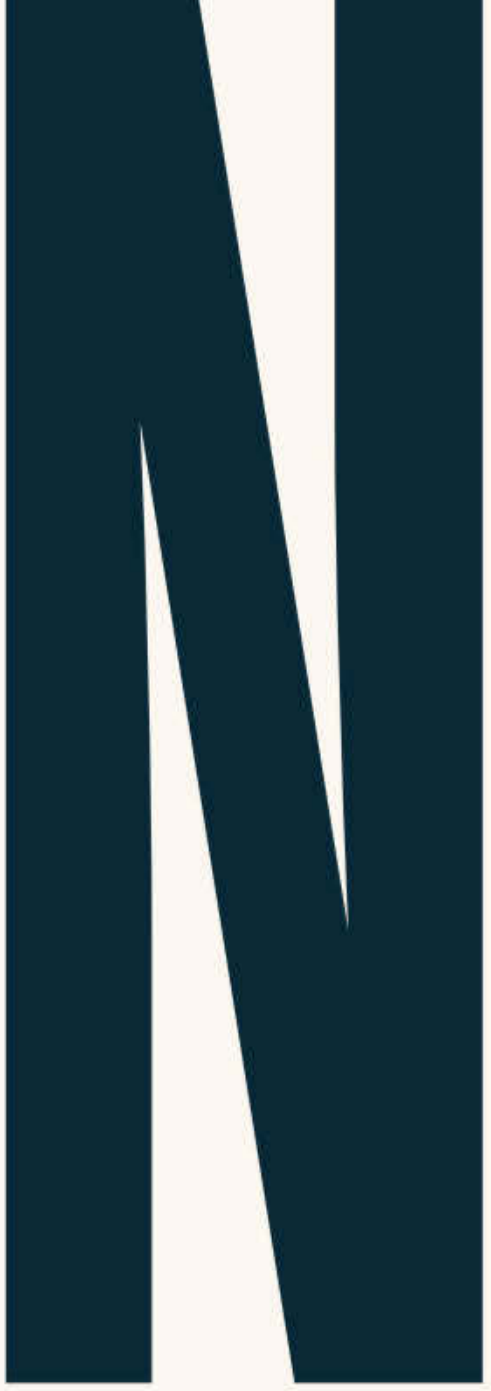
Software, of course, leads the investment pack for most nations, but that's where the similarities end; in Sweden, energy firms attracted almost as much money; Belgian investors poured nearly the same into pharma; while in Spain and Italy, firms supplying consumer goods and services came out on top.

Above: Niklas Zennström, founding partner of Atomico, photographed in Sweden.

NIKLAS ZENNSTRÖM

By **Stephen Armstrong**.
Photography **Christopher Hunt**.

Skype was arguably the first breakout European tech company. Nearly two decades on from its creation, cofounder Niklas Zennström reflects on the growth of the European ecosystem, posits that combining profit and purpose is critical—and explains why Europe is set to beat Silicon Valley at its own game.



iklas Zennström is so calm when describing moments of intense upheaval that you suspect the "Zen" in his surname is there for a reason. WIRED meets the founder of venture capital firm Atomico in its brand-new HQ in Fitzrovia—offices that Zennström designed himself. It's the first in the UK to achieve net zero certification; the boardroom is climate-controlled with temperatures designed around the different needs of the individuals that make up the company's workforce. With solid oak floors, Moroccan tiles, vintage furniture and carefully placed wool rugs, it's a space designed to soothe and inspire.

Zennström recalls a situation when, one morning in 2003, he and his wife Catherine left their London apartment, and six people showed up on his doorstep, one on a motorcycle. They were lawyers from the music industry pursuing him for lawsuits against his peer-to-peer file sharing startup Kazaa. "I tried to run," he says mildly, as if describing catching a bus, "but sadly, was not in the same shape I am now, so they served me." He shares similar adventures with a wry smile and slight shrug of his shoulders: like when his parents sheltered US soldiers fleeing the Vietnam draft during his childhood; or when he had a back door built into his office to escape unwanted visitors while at Skype, the pioneering VOIP startup he'd founded with Janus Friis in 2003.

During our conversation, it becomes clear that one topic in particular irks him: people—who ought to know better—wildly underestimating the European startup scene.

He's still annoyed about an extract from a book by the journalist Sebastian Mallaby published in the *Financial Times* in February 2022. The article claimed that Europe "has been slow to develop tech unicorns. Can Silicon Valley's creativity and cash spark a winning streak?" It cited a San-Francisco based VC making "an especially contrarian wager" in 2019 when he bet that Europe, "the perpetual continent of yesterday, was on the verge of a technology take-off."

'Young talent today wants to make money, but also wants to have a purpose.'

"It's like they think we're a weird, primitive people," he sighs, frustrated. "When we look at the early-stage funding rounds last year, the US had 35 percent of the global share and Europe had 33 percent," he says. "There was a time when there were accelerators in Europe just copying US companies, but that's long gone. There's real innovation all over the continent."

And he's got the data to back his argument. According to Atomico's annual State of European Tech report in 2021, Europe recorded a mighty $100B of capital invested and 98 new unicorns, bringing the total to 321. At the end of 2020, Europe had 115 VC-backed unicorn companies. Less than one year later, that number grew to 202. As of March 31, 2022, PitchBook records 607 active unicorns in the US—with the growth rate roughly equal. Zennström, the OG of European founders turned investors, is responsible—directly and indirectly—for a significant chunk of this growth. In fact, that's precisely why he founded Atomico. He hopes to convene the continent to fund and support founders that can lead the new era of tech, and return to the old internet dream of making the world a better place. "Where Europe is leading compared to the US is in ESG (Environmental, Social and Governance) and climate strategy," he explains. "Young talent today wants to make money, but also wants to have a purpose. Europe has a competitive advantage here, because the ecosystem is younger, and the whole ecosystem is fundable. The US ecosystem has so many

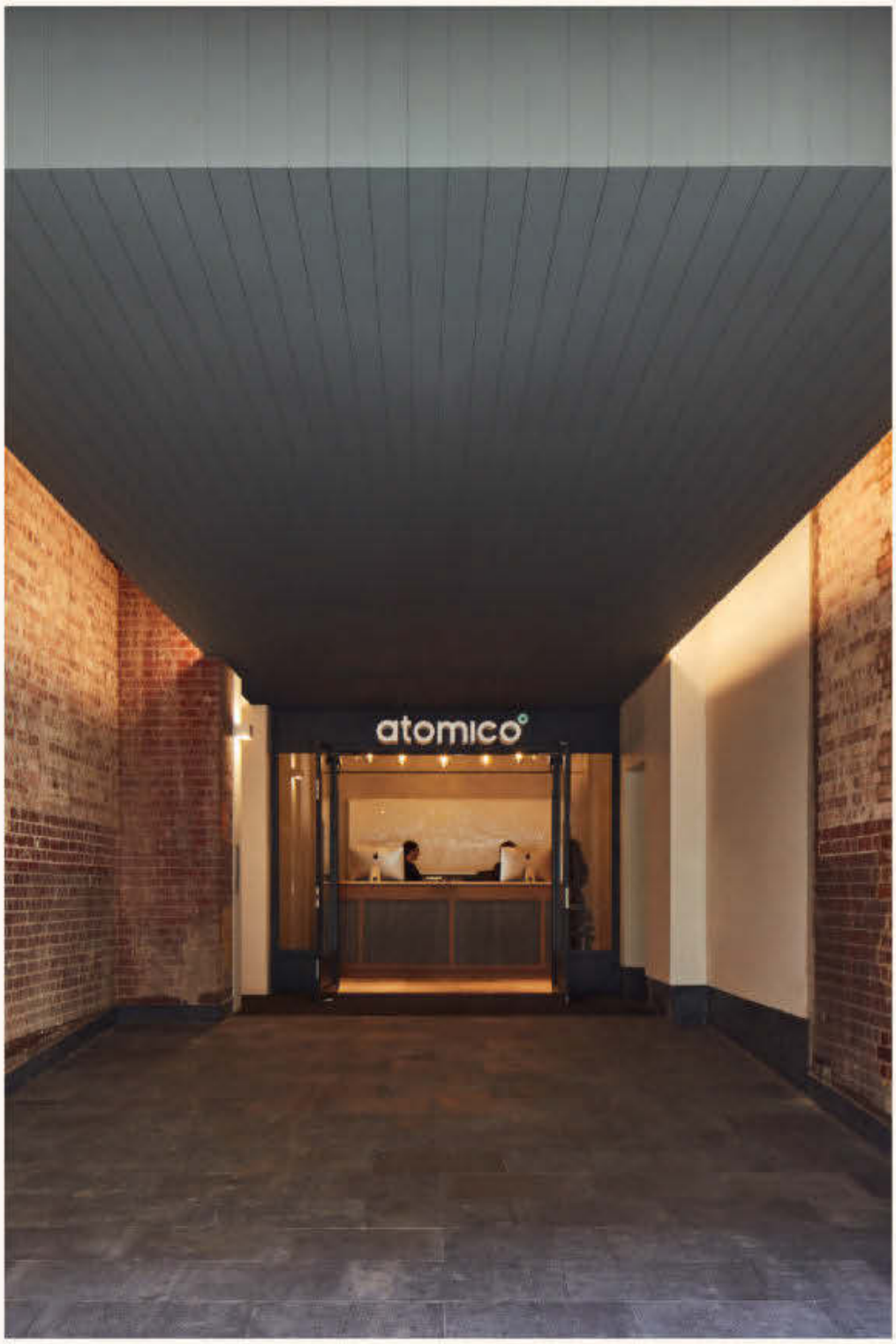
entrenched players and so much capital it is harder for them to reinvent themselves. Sixteen percent of capital invested in European tech in 2021 went to purpose-driven companies, compared to around 10 percent in North America. I believe European founders are uniquely positioned to lead this technological revolution."

It's tempting to see Zennström's success and open-minded attitude as rooted in his Swedish DNA. The country still boasts the highest tech investment per capita in Europe and Stockholm, Zennström's hometown, reports the highest number of unicorns per capita of any European city.

"Sweden punches above its weight for a few reasons, but social mobility is a really, really important one," he says. "Companies are started by founders, individuals who have talent, drive, and ambition. The environment either helps them to be successful or pushes them down. When I was going to school, everyone went to the same schools, the state schools, so we all mixed and knew each other regardless of wealth. There were no private schools. It has changed, but the private schools are limited as to how much they can charge, so they are still accessible. University education is free, so people who are talented and coming from different social backgrounds can all go. If you're ambitious and are hungry, you can do it."

His own family were almost hippies—his grandfather was a successful industrialist, while his father was a painter who ended up an art teacher, and his mother taught in the textiles department at the University of Uppsala. Some of Zennström's earliest memories were of political demonstrations. His parents wanted him and his sister to do well, but he found his friends' parents in their suits, ties and Volvos too well groomed. "I felt I was different," he smiles. "So, I always wanted to beat the system and show them I was better—but on my own terms and in a different way." Which he did—but almost by accident. He worked his way through university where he fell in love with computers. After graduating, he started working for Swedish telecoms pioneer Tele2, where he set up dial-up internet services in Denmark and the Netherlands. By then, however, the dotcom boom was making millionaires left, right and center, and he felt trapped. He began to worry he'd missed his chance.

"At the end of '99 I decided to fly with Janus Friis, who was much younger and more daring," he nods carefully. "We were excited by what Napster was doing—because it was decentralized—so we thought we'd focus on people sharing digital



Atomicio's new London HQ is in The Gaslight, a 15,000sqft Art Deco building, which was refitted and modernized by Bluebottle Architecture and Design.

OFFICE PHOTOGRAPHY: ATOMICO

media. We started to raise money in Amsterdam, but it wasn't successful. Although there were a few angel investors, the venture capital environment was not developed."

This was the first, but not the last time, that Europe's weak funding structure would slow his plans. With Friis, financed by their own money and supported by Zennström's wife Catherine—to whom, he notes regularly, he owes so much of his career—they recruited a bunch of Estonian programmers, who they constantly struggled to pay. Finally, in late summer 2000, they launched Kazaa, insisting users not deploy it to exchange music, while they negotiated with record labels to operate legally. Discussions in Europe started positively, but then they headed to the US, and hit trouble fast.

In 2001, the company legal team had arranged a meeting with RIAA and MPAA—big teams of lawyers flying in from the East Coast to meet in their lawyer's office in Beverly Hills on a Friday. On the Wednesday, they found an internal memo leaked from the organizations they were meant to be meeting, stating they were "Public Enemy No 1 operating offshore and that it was imperative to make an example of us," he recalls with a slight smile.

"Instead of going to the meeting, we were driving around and around, while the lawyers were doing their thing. Later in the evening, when we went to our lawyer's office, we switched clothes with two lawyers on their team to avoid being served. After that we moved from one shady motel to another, night by night, paying in cash until we bought tickets at the airport an hour before we departed, as we were sure they were tracking our credit cards."

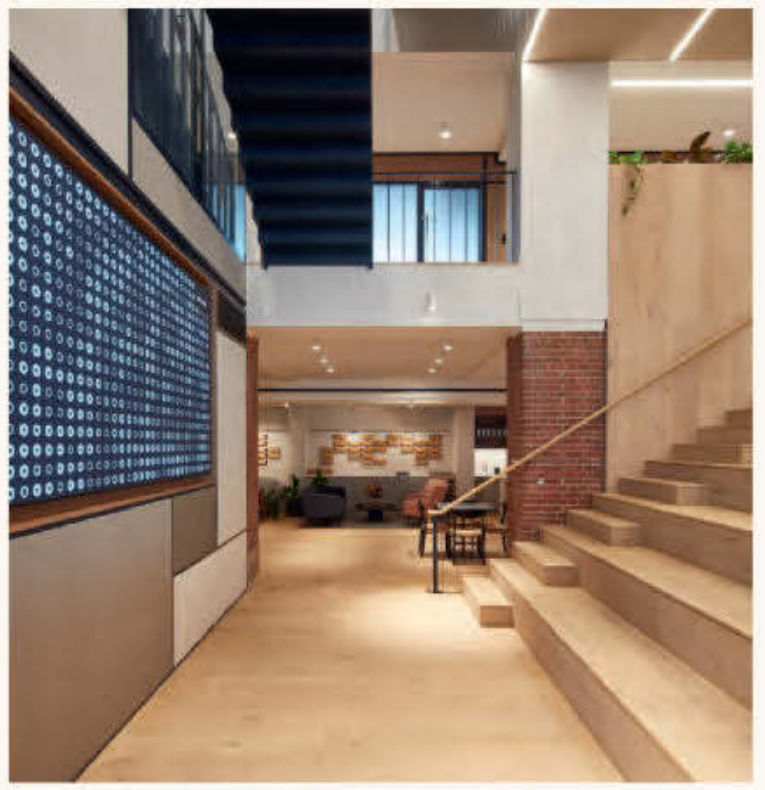
Zennström and Friis sold Kazaa for a loan note of €600,000 at the end of 2001. Then, in 2003, using Kazaa's P2P backend, they founded Skype, an app which allowed users to make a call by directly connecting with each other. But founding Skype revealed something unexpected—that European VCs were not interested in innovation.

"We got turned down by everyone," he says simply. "We wanted to disrupt the global telephone network with this peer-to-peer technology, and that's a big ask. A lot of them had been burnt by the dot com crash. The model they preferred was to take something that worked in the US, and do it in a local market." He pauses and smiles. "Of course, we were also involved in a massive, billion-dollar litigation ..."

Nevertheless, Skype would soon become one of the first European startups to challenge the hegemony of American internet giants in the early 2000s. This led to Zennström facing a crucial decision when, in 2004, one of the big Sandhill Road VCs offered to fund the company, but only if they moved to the US. "At that point we had already built up a world-class team in Tallinn, London and Stockholm, and I did not want to 'leave my team'." he explains. "We knew then that we were committed to building Skype as a globally successful technology company based out of Europe." He declined the offer.

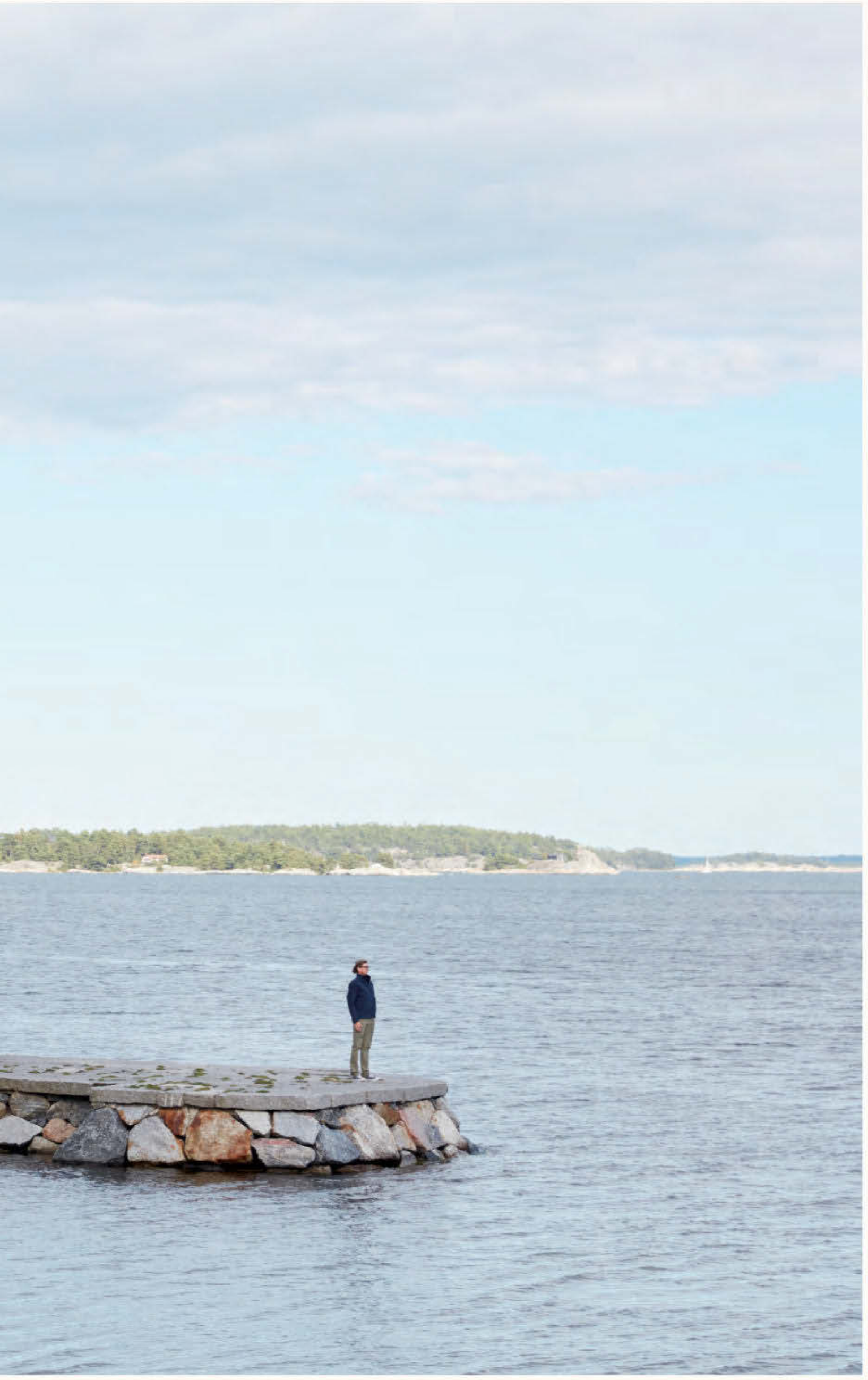
One year later, Skype went on to become a unicorn—eight years before venture capitalist Aileen Lee coined the term—after being sold to eBay for $2.6 billion. It was the world's largest tech M&A since the dot com crash, and dwarfed eBay's $1.5 billion acquisition of PayPal in 2002. All of which lead to his next move—to disrupt venture capital with the launch of Atomico in 2006. European VCs weren't taking risks. Founders were coming to him and asking for advice. VC funds were inviting him onto their boards to make themselves look good. "Meanwhile, the only place in the world that had a functioning tech ecosystem was Silicon Valley—and I like being contrary and breaking monopolies, so we set out to break the US VC tech monopoly with Atomico," he says.

'I like being contrary and breaking monopolies, so we set out to break the US VC tech monopoly.'



Atomico's new offices in Fitzrovia, London, were designed by Niklas Zennström himself. It's net-zero-certified, and the boardroom (top) can tailor its climate to each individual.

OFFICE PHOTOGRAPHY: ATOMICO



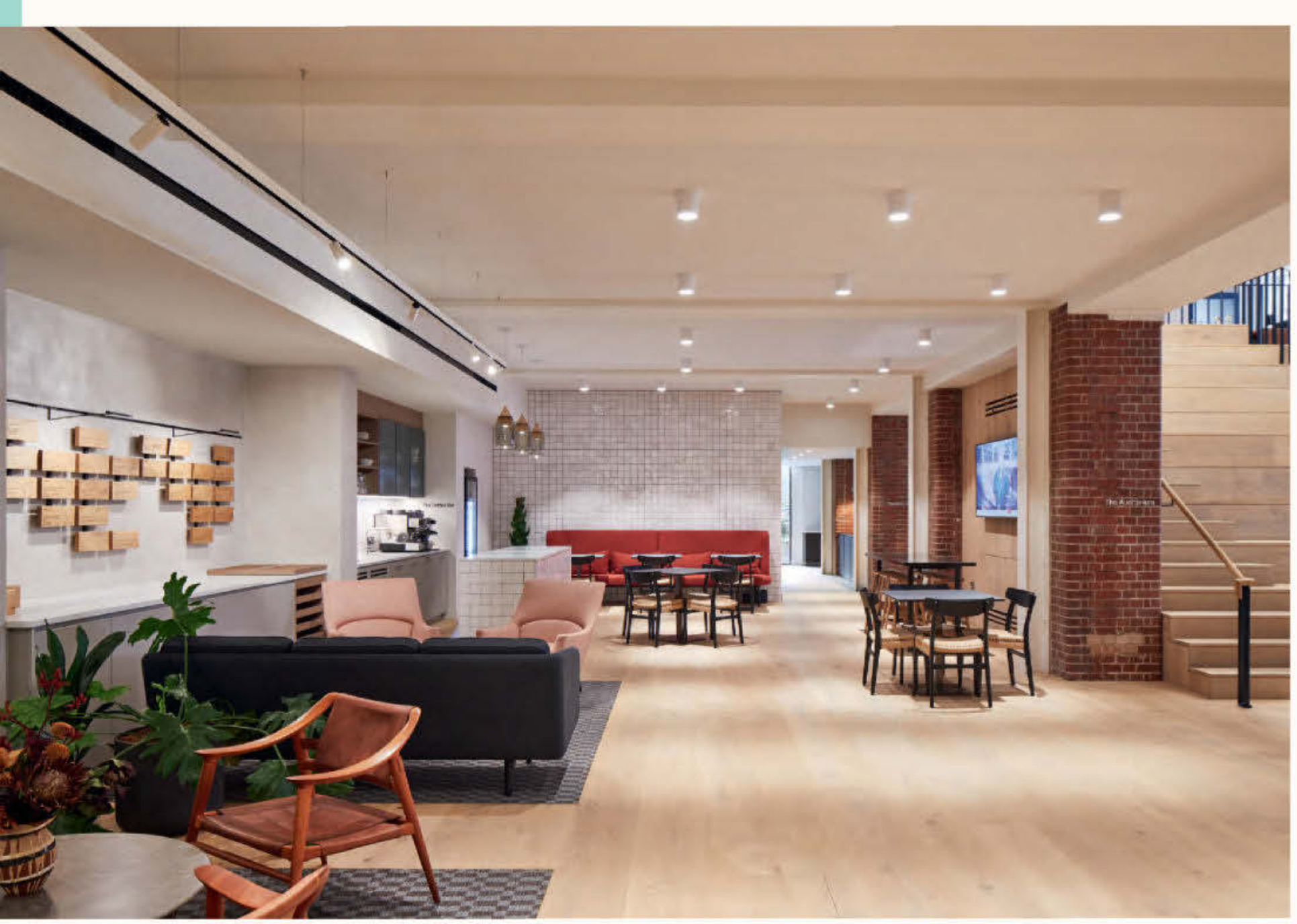
Niklas Zennström: ‘Profit and purpose are mutually reinforcing, not mutually exclusive.’

For a time, no one was interested in investing in funds raised by European VCs, "because they all thought if you are in venture, you need to be in the US." But it's all underpinned by his philosophy, picked up from a famous quote by Albert Einstein: "Those who have the privilege to know have the duty to act, and in that action are the seeds of new knowledge." Once again, he was right. Today, Atomico has invested in 23 European unicorns including Klarna, MessageBird, Supercell and Lilium. "Atomico works more in line with the US way of VCs offering a lot of operational support, not just checks," explains Robert Vis, founder and CEO, MessageBird. "They helped with PR, with hiring—there were times when they were in my office three times a week when we were scaling. Niklas brought that philosophy to Europe, and it had a remarkable impact for me as founder. He's focused on driving the business forward, staying independent, and is a supportive investor in that sense. He's been through it, so even though he's not on our board, I still consult him on founder-type stuff."

Daniel Wiegand, cofounder of Lilium, the unicorn eVTOL jet company, recalls the initial pitch, where Zennström asked expert witnesses from companies like Tesla to join the meeting, followed by a weekend away where the two got to know each other and their respective companies in greater depth before the initial investment. Atomico was the company's second investor in 2016 and has reinvested in every round, while Zennström remained on the board after the firm achieved unicorn status in 2020, and its September 2021 IPO.

"He wants to be sure the companies are aligned," explains Wiegand. "He focuses a lot on diversity, ESG, and company culture in general. He's not loud, he watches and analyzes—but once he speaks, he's always spot

The materials, finishes and furnishings added to the building were all selected for their high Circular Economy value.



‘In the next decade, we will be facing bigger challenges than ever. We can’t waste time.’

on. His founding of Atomico was an incredible moment for the European scene. We would not be where we are without him.”

Interestingly, many of Zennström’s former team at Skype have followed similar paths: Friis and Ahti Heinla are now behind robot firm Starship Technologies; Taavet Hinrikus, Skype’s first ever employee and founder of TransferWise (now Wise), has just launched a new fund for tech founders called Plural; Eileen Burbidge, Skype’s former director of product, launched early-stage London VC firm Passion Capital; and Saul Klein founded early stage and seed VC LocalGlobe.

Zennström’s troupe have proved so influential that, in 2019, *Forbes* dubbed them the Skype Mafia and—in a head-to-head with the PayPal Mafia of Peter Thiel, Elon Musk, Max Levchin, Ken Howery and co—decided the Skype Mafia were “interested in building a thriving European tech ecosystem,” whereas the PayPal Mafia were “merely interested in making each other rich in a small, exclusive club.”

Zennström enjoys this comparison and sums up his approach: “I’m from Europe; this is where I live, and we can do better than this.”

According to Zennström, the history of European technology can be broken down into three themed decades—Foundation, Monetization and the forthcoming Mobilization.

“Skype showed what was possible for Europe, and the continent had its first globally successful entrepreneurial role models, paving the way for more in the future, as success breeds success,” he explains. “Between 2003 and 2013, 153 European unicorn companies were founded, creating thousands of jobs.”

The monetization decade that followed “saw VCs, once the fuel for funding breakthrough innovations, become focused on supporting software companies, some of which has made our lives vastly cheaper and easier. In the process, we also built some problematic tech with a much less positive impact on the world, like big tech and social media.”

Globally, VCs and technology companies became addicted to wealth creation, he believes, at the expense of innovation and purpose. “More VC money, more technology companies, more well-paid jobs, and more experienced operators—but governments, finance, and corporations have failed to solve the problems that really matter,” he argues.

This heralds, if Atomico has anything to do with it, Europe’s forthcoming mobilization decade—where technology should be a positive force and play a role in fixing the problems of climate, inequality, food production, health, energy, transportation, and sustainable manufacturing through innovation. “Venture capital was founded on funding breakthrough innovations that moved humanity forward from semiconductors to vaccination,” Zennström explains. “In the next decade, we will be facing bigger challenges than ever before. In Europe, there is hope. Governments are too slow, technology has to regain its central role in improving society. We can’t afford to waste time.”

And when it comes to his personal belief that “profit and purpose are mutually reinforcing, not mutually exclusive,” he believes Europe, rather than the US, is where the vanguard of the mobilization decade is to be found. He’s already backed Vay and Lilium in clean transportation, Infarm and Upside Foods in sustainable food production, PsiQuantum in Quantum Computing, and is searching out a new generation of companies looking at health, micro reactors, and hydrogen fusion.

“Sectors like transportation, aviation, food production, and construction materials are starting to be transformed by technology,” he points out. “But equally important is that to take advantage of this, you need more and more talent from more diverse backgrounds.”

Atomico’s approach to diversity—from the company’s hiring strategy to baking-in diversity into term sheets—didn’t arrive overnight. “We had such a blind spot to that for many years,” he admits. “We had these pictures with our founders, and my wife pointed out that most of them were white men. So, we set some objectives both for our own team and our portfolio to invest in diverse founders.”

Carolina Brochado, partner at private equity firm EQT, worked at Atomico in 2012, and says although the company didn’t offer maternity leave until she actually had to take it herself, she sensed a huge shift as that happened. Reshma Sohoni—managing partner at Seedcamp—also credits Zennström with housing her and Seedcamp when they had no money and no office. “I was an Indian American woman starting a fund, and in the US I would have been met with a clubby tech-bro culture, but Niklas—and to be fair, the UK—has always been more cosmopolitan.”

OFFICE PHOTOGRAPHY: ATOMICO

Niklas Zennström: 'We need founders who want to solve the problems that matter.'

'Just think how many startups were founded by first- or second-generation immigrants.'

Today, Atomico's investment team and partners are split in a 45/55 female to male ratio. For the past four years, Atomico has run an angels program, recruiting 12 individuals, mainly founders, from eight countries in the first year, and giving them $100k each to write early-stage checks. By 2022, these angels—a mix of new recruits and old hands, were 50 percent female and 50 percent non-white.

Laura Connell, the company's newest partner, joined from Marcho Partners because of this new approach. "Atomico is putting its money where its mouth is," she explains. "Attracting and keeping better people makes them more appealing to the best founders who come from anywhere. Companies that have greater diversity do better—there's cognitive diversity, not just physical. We are in the midst of a basic generational transition—younger people do fundamentally care about diversity and being mission-driven."

"If you want proof of the value of diversity, think how many startups were founded by first- or second-generation immigrants," Zennström points out. "It's important that we have a lot of female investors, because it happens more organically that female investors find female founders, and female founders are more comfortable speaking to female investors. It's really hard when a company gets bigger—over 200 people—to fix the diversity problem. If the first 50 people are men, it's intimidating for the first female engineer. We need to front-load this much earlier."

European tech's future, he argues, is in tracking down the outliers, encouraging new role models from diverse backgrounds to prosper, reinvesting in Europe and inspiring the next generation—and the next, and the next ...

"Unicorn companies are coming from all over Europe, rather than having US-style tech capitals," he points out. "You want to have diverse locations, diverse people, and make sure that the value is coming back to the European economy. We need to encourage entrepreneurs from the north of England who don't think they stand a chance. That's how you build companies with purpose, not just profit—we need to ensure the two are mutually reinforcing."

"We need founders who want to solve the problems that matter, VCs to fund things that matter, and LPs to challenge those laggard VCs to step up," he argues. "VCs should dedicate a portion of our funds to breakthrough innovations solving world problems at scale, and remember that we are funding the creation of the jobs your children and grandchildren will do. I have never been as hopeful as I am now about the potential of technology, and I have never been as motivated by the urgency we all face to find and fund it."

STEPHEN ARMSTRONG *is an author and regular* WIRED *contributor.*

- Anton Kononov, Dr. Sarah Bechstein, and Florian Semler, Cofounders, FORMEL Skin, **Germany**
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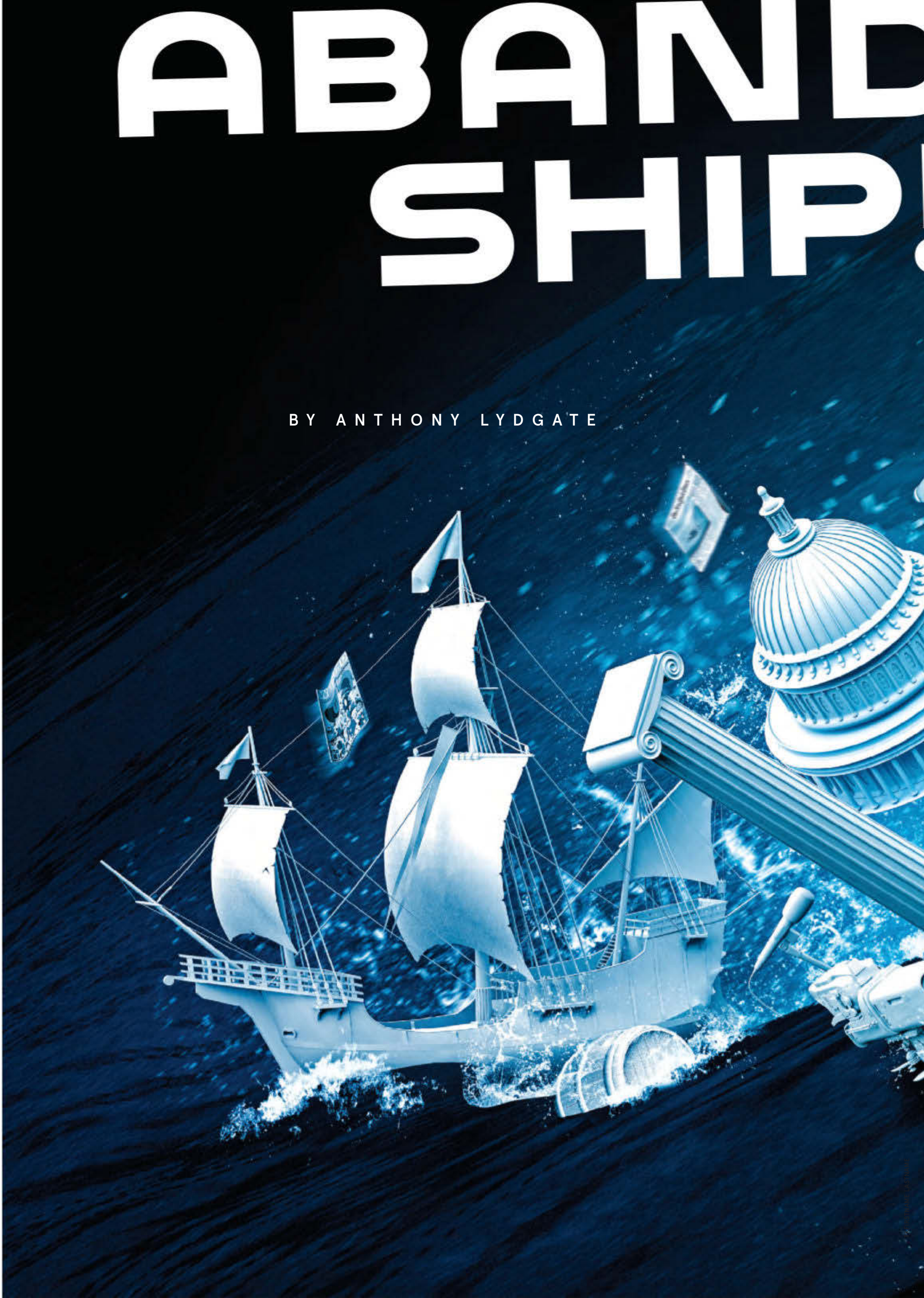


CIVILIZATIONS **FALL APART.** THE SOCIAL CONTRACT **CANNOT HOLD.**
BUT **BALAJI SRINIVASAN** IS HERE TO LIFT YOU SAFELY OUT
OF THE **MAELSTROM** TO A COUNTRY IN **THE CLOUD.**
(WELL, MAYBE NOT ALL OF YOU.)

ILLUSTRATIONS BY EDDIE GUY

YOU, THE PROTAGONIST, are on a small fishing schooner off the coast of Norway. This is an Edgar Allan Poe story, so things aren't going well. Your ship is trapped in a mile-wide whirlpool that grinds whales into pesto. Your younger brother just drowned in a perfunctory half-sentence. Your elder brother is clinging to a ringbolt near the bow. You're astern, hanging on to a lashed-down empty water cask. The ship rides the maelstrom like it's in the Indy 500, keel centripetally pinned to the black lane of water. Up to one side is the whirl's edge, open sky, a brilliant moon. Down to the other is a rainbow, which smiles across the roiling mist of the abyss. ¶ Fear has driven your brother mad. You, however, take this chance to reflect on the romantic hopelessness of your situation. Turning and turning in the narrowing gyre, you begin to feel that you could get *excited* about dying this way, about being consumed by this great vortex of violent energy. It's pretty fucking tremendous, right? Aren't you and your brother lucky, in a way, to be finding out what's down there? ¶ But the run-me-over moment passes. You start contemplating the other debris that got sucked into the vortex along with your ship—home furnishings, construction materials, the snapped-off trunks of trees. Some stuff plunges quickly down into the funnel. Some stuff holds its place. Smallish cylindrical things, you notice, hardly descend at all. And look, here you are atop one of Poe's favorite cylindrical literary devices, a cask. ¶ You signal your brother to join you, waving an arm as if to semaphore: *Hop on! I found us a ride!* He refuses to let go of the ringbolt. Grief-stricken but stoic, you lash yourself to the cask and wait for your moment. When it comes, you cut loose into the unknown alone. ¶ You watch the ship spiral down and disappear below you. The maelstrom subsides. Hair gone prematurely white, you live to tell your tale to a reporter.

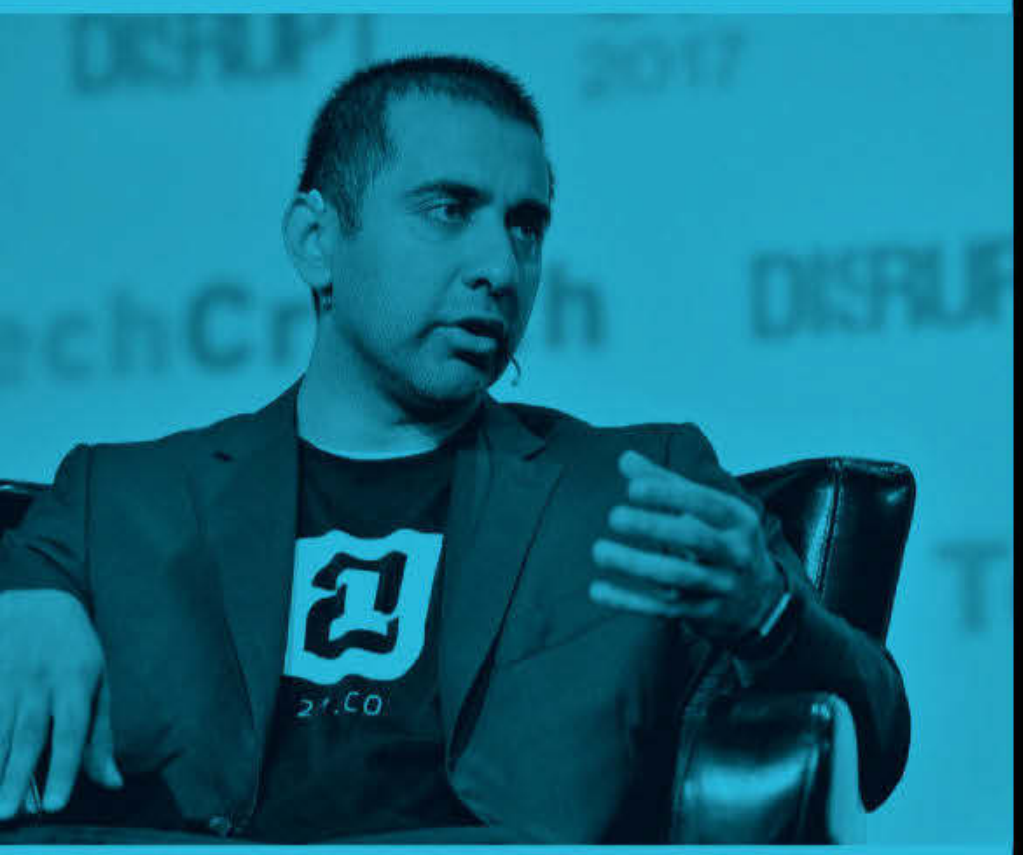
GETTY IMAGES

MARSHALL MCLUHAN, the adopted seer of Silicon Valley—and at one time WIRED's official patron saint—loved this story of Poe's. Employed as a professor of English in Canada, he understood his job as awakening the masses to the "vortices of energy" exerted by different communication technologies (TV and film, radio, the printed word) and helping people "program a strategy of evasion and survival." He preached that participants in "the electric age" must be like Poe's fisherman. "Pattern recognition in the midst of a huge, overwhelming, destructive force is the way out of the maelstrom," McLuhan once told a roomful of students. They had two choices: Learn to make the leap, or die paralyzed by the whirl.

It's a shame that Saint Marshall didn't live to tweet. What would he have said as he watched the electric age become the networked age, the age of a dirt-cheap, globe-spanning communication technology riding around in people's pockets? What patterns would he have spotted as the great human network—with its political enmities, racial hatreds, economic uncertainties, climate fears, wars, pandemics—drove the walls of the maelstrom higher? What buoyant objects might he have pointed out on deck? When would he have said to jump?

The story you're reading now is not about McLuhan or his obsession with vortices. This story is mostly about Balaji Srinivasan, a technologist and investor in his early forties, who does tweet, prodigiously.

Srinivasan has worn many identities in public—biomedical entrepreneur, Stanford professor, venture capitalist, crypto exec, potential head of Donald Trump's Food and Drug Administration, Covid sage, gadfly up the nose of *The New York Times*. But I'd say his true calling is that of an ideological cooper. He develops flotation devices for escaping the maelstrom. In this too he is prodigious. When he first appeared on the *Tim Ferriss Show*, a podcast hosted by the author of *The 4-Hour Workweek*, he spotted patterns and prophesied the future almost uninterrupted for nearly four hours. This is typical, a former coworker of his told me; it's called "getting Balaji'd." Earlier this year, Srinivasan synthesized his thoughts into a book called *The Network State*, which is meant to provide some of the equipment and coaching you need to cut loose from this doomed schooner.



Of course, Srinivasan isn't the only one in this business. You, the consumer, have an Ikean abundance of casks to choose from these days. And like a lot of people, you may be questioning whether the traditional manufacturers (media corporations, major political parties, institutions generally) are really putting out the most watertight stuff. Maybe you've furtively checked out a few competing models over the years. Could this reclaimed-wood Occupy cask be your ride out? Or this splintery democratic-socialist one? Or this polyethylene drum that says TRUMP in gilt letters on the side? Should you consider the communal living cask, the digital nomadism cask, the prepper cask? Is a Bitcoin key more buoyant than a bank account?

At first glance, Srinivasan's barrel may not stand out from the pile on deck. It seems to be made of a fairly typical techno-libertarian composite material—some mix of disdain for institutions, fear of wokeism, zeal for engineering, and lots of "personal runway" (i.e., enough money to buy an actual runway).

But look closer. Like a Dr. Bronner's soap bottle, the cask is covered with curious utterings. *Transcendence requires self-defense … The more mobile we are, the more cheaply we can change our law … A fractal polity is nuke-resistant …* As you trace the words with your fingers, you begin to understand why Srinivasan is known—among his nearly 700,000 Twitter followers, among founders and VCs from Singapore to Sand Hill Road, among the kings and queens of crypto—as something of a mystic.

But what kind of reality is this cask made for? Where McLuhan looked out from the deck of the schooner and saw a "huge, overwhelming, destructive" spiral, Srinivasan sees something far more tidy—a corkscrew. "I have this concept that all progress actually happens on the *z*-axis," he has said. (That's the imaginary axis that comes out at you from the page of the math textbook.) What does he mean? That what feels to many people like the punishing cyclicality of capitalist technological life—industries disrupted, lives upended, societies undermined—is just a series of twists toward a grand goal. Humanity makes headway by going in circles. Srinivasan calls this his "helical theory of history."

To puny mortal brains, the grand helical motion is visible as "unbundling and bundling" or "decentralization and centralization." Srinivasan likes to quote a dot-com executive who said this is the only way to make money: Either you take something whole, dismantle it, and sell the parts, or you take some parts, put them together, and sell a whole. Srinivasan sometimes cites the example of the CD, which got unbundled into the MP3, which got rebundled into the Spotify playlist. "That's the cycle that happens in computing," he says. "That happens in history. It happens in technology. And I think it's also happening here with nations and with states and so on."

Yes, my fellow cask shoppers, the nation-state is unbundling. The weary giants of flesh and steel came down with what Srinivasan calls "civilizational diabetes," and Covid has delivered the coup de grâce. The end won't be pretty, he predicts. The gerontocracy will hoard power. The dreams of the masses for a happier, safer future will be frustrated. Crises will go unsolved. Potential will curdle into despair. But in the face of it all, Srinivasan tells Ferriss, he is here to teach us how to be "square-jawed Chads." (We'll get to who "we" are later.) He's here to work toward "the great acceleration as opposed to the great stagnation." He's here to deliver a message to all followers of Saint Marshall: The time to jump is now.

Balaji Srinivasan: "We want to be able to peacefully start a new state for the same reason we want a bare plot of earth, a blank sheet of paper, an empty text buffer, a fresh startup."

What awaits us beyond the maelstrom, far along the *z*-axis, at the corkscrew's end? Government by the internet, for the internet, and of the internet—a new birth of freedom in the cloud. Srinivasan's book, published on the anniversary of the US Declaration of Independence, is a how-to guide for building startups, where the thing being started up is a new society. His own cloud country, if he were to found one (which may be more of a "when"), would be based on three ideals: "infinite

frontier, immutable money, eternal life." He has called this his "bumper sticker that expands into a PhD thesis." It's also his Twitter bio.

Is this the cask for you? Perhaps not. Maybe you'd sooner go down with the ship. But some of the squarest-jawed Chads on deck say the cask has qualities worth considering. And if you've paid any attention to Srinivasan during the last few gut-wrenching turns around the vortex, you have to admit: The guy careens, but he sure doesn't sink; if anything he's been ascending. So hop on for a turn. See what you like about this cask and what you hate. Maybe you can jot down some ideas for building your own one day.

BEFORE WE GET to the lab-grown meat of this thing, a disclaimer: You're best off not trusting a word I write about Srinivasan. The one time I spoke with him, in a refereed conversation he insisted take place on Clubhouse, he compared my profession to that of the East German secret police.

I am what Srinivasan calls a "corporate journalist." I am an editor at WIRED, which is owned by a media company called Condé Nast, which is owned by a media company called Advance Publications, which is hereditarily owned by the Newhouse family (may they live forever and ever, amen). Srinivasan believes that media companies have "set out to compete with tech companies," jealous that their (our) old-guard influence is waning at a time when Silicon Valley is attracting "all these users" and "all this money." And because Srinivasan has founded and funded a number of tech companies, much of what a journalist writes about him—or anyone in the industry—should be understood as emerging from a sense of "wounded amour propre."

How do a bunch of beta English majors expect to win a fair fight with Silicon Valley alphas? We don't, of course. So we sit up here on the parapets of the First Amendment, this château we inherited along with every other goddamn thing, and take potshots at the hardworking civilization-builders down below. As Srinivasan has said, "Necessity is the mother of defamation."

Srinivasan seems to respect our craft in the same way an exorcist respects Satan's. We are quite good at what he calls "surveillance journalism." We know how to "befriend and betray" our subjects, he says, how to sweet-talk them into embarrassing sound bites. We use the word "subjects" because we consider them—as we consider *you*—to be beneath us. And what do we do, finally, when we have gathered enough *kompromat* on you? We deploy it like malicious code. We "install software into the brains of your social network and make them turn on you," Srinivasan says. Which is why it's important to find out which periodicals your friends care about.

Reader, the Subject is right about us. We will stop at nothing. We'll spam your acquaintances with interview requests. When almost none of them respond, and most of the ones who do say no, and most of the ones who say yes don't want to be quoted by name, we'll turn the weapons of Big Tech on itself. We'll have an AI transcribe days' worth of your podcast interviews. We'll learn enough Python, kind of, to scrape your tweets, though we won't be able to figure out what to do with the resulting JSON file, and our wounded amour propre will prevent us from asking for help. We'll search doggedly through your old Hacker News comments. We'll take up residence in the Internet Archive. We'll mercilessly consider comments you've made in their historical and social context. We'll come into possession of some emails you wrote and waffle over whether to quote from them, not wishing to be the subject (there's that word again!) of a retaliatory lawsuit.

Point is, don't trust me. Don't trust any of the dozen other Newhouse flacks who worked on this surveillance file. We're the Stasi, and we monetize the lives of others.

Let's begin the operation.

IT IS A SATURDAY MORNING in October 2013. A crowd is gathering at the Flint Center in Cupertino, California. They're here to attend a lecture series and networking event called Startup School, put on every year by the VC firm Y Combinator. For a technologist of a certain age, the venue is akin to Mount Sinai: From the stage here in 1984, Steve Jobs handed down the original Macintosh.

Of the people on today's list of speakers, Srinivasan has one of the lower-wattage names. Jack Dorsey, the Twitter cofounder, is here. He'll talk about how to build a product that "strikes a chord with everyone on the planet," which he'll illustrate by standing at the podium in a half-zipped track jacket for two and a half minutes while the audience listens to a French jazz tune called "Anguish." Paul Graham, a cofounder of Y Combinator, will interview Mark Zuckerberg onstage, and when Zuck describes Facebook's drive to connect the whole world "because it's the right thing to do," Graham will say, "so it's a *movement*."

In other words, Silicon Valley is twisting the corkscrew like there's no tomorrow and generally expecting applause for it. The technocratic liberalism of the Obama era and the platform economies of Big Tech have been enjoying a nerdish cross-country romance for several years. Even jaundiced corporate journalists have occasionally caught feelings for all the talk of hackathons and network effects and health care economics.

But signs of an eventual, acrimonious unbundling have also been swirling for some time. Lehman Brothers went overboard in 2008, and then the global economy went grasping after ringbolts. Six weeks later Satoshi Nakamoto introduced Bitcoin and the idea, both threatening and beguiling, of a trustless decentralized financial system unencumbered by big banks and regulators alike. In *The Wall Street Journal*, Marc Andreessen issued his famous dictum that "software is eating the world." (Other verbs he used to describe what tech was doing to the existing order included "take over," "invade," "eviscerate," and "crush.") Occupy Wall

Street happened. Peter Thiel, after publishing an essay that questioned whether "freedom and democracy are compatible," began making donations to Ted Cruz, a Tea Party insurgent running for Texas senator. Steve Jobs died. The writer Rebecca Solnit referred to Google's private buses as "the spaceships on which our alien overlords have landed to rule over us."

The romance really began to unravel in the month leading up to Startup School. In Washington, Cruz and other Republicans maneuvered the Democrats into a standoff over Obamacare funding, causing the US federal government to shut down for more than two weeks. Simultaneously, the botched rollout of Healthcare.gov—a would-be Kayak.com for comparing insurance plans—revealed the Obama team to be a hopeless JV squad when it came to building platforms. When the government's 16-day hiatus barely budged the stock market, a prominent venture capitalist said it was "becoming excruciatingly, obviously clear" that "where value is created is no longer in New York; it's no longer in Washington; it's no longer in LA; it's in San Francisco and the Bay Area." In Valleywag, Sam Biddle wrote, "This Asshole Misses the Shutdown." In *New York* magazine Kevin Roose noted that the shutdown cut off essential services for low-income Americans and accused Silicon Valley of having a "dysfunction fetish."

It is in this charged atmosphere that Srinivasan steps up to the podium. He is dressed sort of like Steve Jobs at an Apple event, which could be a coincidence. When he looks out, he sees a friendly crowd. His mouth seems dry, but he looks confident.

For the past five years, Srinivasan has been living a Silicon Valley bildungsroman. With a group of other young Stanford alums, he founded a startup called Counsyl, funded by Thiel, among others. It sells genetic tests for expectant parents to help them avoid passing on heritable conditions such as spinal muscular atrophy, sickle cell anemia, and Tay-Sachs disease. Returning to Stanford a triumphant entrepreneur, Srinivasan co-taught a big MOOC called Startup Engineering. (Course description: "Spiritual sequel to Peter Thiel's CS 183 course on startups.")

THE TECH INDUSTRY "AROSE OUT OF NOWHERE," SRINIVASAN SAID, "AND BY ACCIDENT WE'RE PUTTING A HORSE HEAD IN ALL OF THEIR BEDS."

MIT Technology Review has named him to its "Innovators Under 35" list. He cofounded another company, which is busily, buzzily working on a dedicated chip for bitcoin mining. He's about to become a general partner at the VC firm Andreessen Horowitz.

As Srinivasan's business profile has grown, his political ideas have undergone a few twists of the corkscrew. In the years to come, he'll talk especially about a book called *The Sovereign Individual*, recommended to him by Thiel. He appreciates its "strength-to-weight ratio," how each line rewards exegesis. The authors—James Dale Davidson, an American investor, and William Rees-Mogg, a British baron, longtime editor of *The Times* of London, and father of Jacob Rees-Mogg the notoriously anachronistic UK Conservative Party MP, and Minister of State for Brexit Opportunities and Government Efficiency—argue that as digital technology makes wealth increasingly hard to tax, the nation-state will dissolve. Governments and industries will topple. Millions of "losers" and "neo-Luddites" and "left-behinds" will find themselves unemployed, or worse. But in the end, a tiny "cognitive elite" will escape the "tyranny of place" and build a global meritocracy in cyberspace. They will live wherever they please, associate with whomever they please, and keep every tax-sheltered cent they earn. Davidson and Rees-Mogg call this new realm of opportunity "Bermuda in the sky with diamonds." (Thiel wrote the preface to the 2020 edition.)

Srinivasan introduces himself to the Startup Schoolers as one of a dozen people with his name in the Bay Area. "I left Stanford in early 2008, scandalizing the department, to found a genomics company, which has become very successful," he says. But he isn't here to talk about that. He brings up his slide deck. "What I want to talk about today," he says, "is something I'm calling 'Silicon Valley's Ultimate Exit.'"

Next slide: "Is the USA the Microsoft of Nations? Let's consider the evidence." Srinivasan gets a few jokes in: The Constitution is an ancient code base in an "obfuscated language." There's "systematic FUD" (Bitcoinese for "fear, uncertainty, and doubt") about security issues. The software maker treats its suppliers terribly (thumbnails of Saddam and Gaddhafi). The audience laughs.

Next slide: "What displaced Microsoft?" Answer: Larry Page and Sergey Brin, the founders of Google. The force that incumbents fear most, Srinivasan says, is "some guys in a garage."

Srinivasan is en route to the first statement of his big thesis, but he must take a detour through what he calls "a fundamental concept in political science." He brings up the cover of a book by the late social scientist Albert O. Hirschman called *Exit, Voice, and Loyalty.*

Exit, Srinivasan explains, is taking your business elsewhere. It's emigrating, unbundling, hitting the Back button on your browser. "Voice" is staying and speaking up. It's citizens voting in elections, customers writing letters to the CEO. Voice and Exit are "modulated" by Loyalty, meaning that if you're more loyal to something you're less likely to eye the door.

The United States, Srinivasan explains, has been powerfully shaped by Exit. It's "not just a nation of immigrants." It's also "a nation of emigrants." The Puritans fled religious persecution;

the revolutionaries fled a tyrant king; the Western pioneers fled the "East Coast bureaucracy"; the huddled masses fled pogroms, Nazism, Communism, the American embassy in Saigon. Exit is about "alternatives," Srinivasan says. It's about reducing "the influence of bad policies" over people's lives without "getting involved in politics," without "lobbying or sloganeering."

IN THE WINTER OF 2017 SRINIVASAN FINDS HIMSELF IN NEW YORK, RIDING AN ELEVATOR UP TRUMP TOWER FOR A JOB INTERVIEW TO RUN THE FOOD AND DRUG ADMINISTRATION.

And what other choice is there? The problem, Srinivasan explains, is that Silicon Valley is mired in a battle with what he calls the Paper Belt, "after the Rust Belt of yore." The Paper Belt includes the entertainment industry (represented by LA), higher education (Boston), finance and media (New York), and government (DC). Against these incumbents, Silicon Valley has been the ultimate garage guy. The tech industry "arose out of nowhere," Srinivasan says, "and by accident we're putting a horse head in all of their beds. Right? We are becoming stronger than all of them combined."

Naturally, Srinivasan continues, the Paper Belt is experiencing a "Paper Jam" and is pointing its finger at the IT department. "They are basically going to try to blame the economy on Silicon Valley—to say that it was the iPhone and Google that done did it, not the bailouts, the bankruptcies, and the bombings." It's important to correct the record, Srinivasan says, but no good will come from too much fighting: "They have aircraft carriers; we don't." What he's describing instead, and will keep describing for the next nine years, is an "opt-in society, ultimately outside the US, run by technology."

The Valley is already moving this way, Srinivasan goes on. Larry Page has talked about a special zone being set aside for unregulated experimentation. Andreessen has predicted that the world will see "an explosion" in the number of countries. Thiel has proposed colonizing the ocean; Elon Musk, colonizing Mars. To partake in the "Ultimate Exit," Srinivasan says, you could buy a private island or even just telecommute. His final tip to the Startup Schoolers is that if they want to think big, they should build technology "for what the next society looks like."

Here in Cupertino, the talk seems well (or at least politely) received. People post their notes from Startup School, weaving Srinivasan's speech in among all the other helpful tips for founders. But in the media, it sets off a klaxon. In Valleywag, Nitasha Tiku (later a WIRED staffer) writes, "This is the Tea Party with better gadgets." In *New York*, Roose writes that Srinivasan shows signs of a political personality type unique to Silicon Valley. His diagnosis: a "persecution complex" with "undertones of class hostility," driven by a "secessionist instinct."

Srinivasan, in an email to the journalist Tim Carmody (also a former WIRED writer), says there has been a misunderstanding. "I'm not a libertarian, don't believe in secession, am a registered Democrat, etcetera etcetera," he writes. "There's nothing wrong with thinking about leaving the country of your birth in search of a better life." But the damage control doesn't seem to work. "Silicon Valley Dreams of Secession" reads a headline in Salon. "Silicon Valley Roused by Secession Call" reads one in *The New York Times*. "Silicon Valley Has an Arrogance Problem" reads one in *The Wall Street Journal.*

"Sheesh," Srinivasan writes on a lively Hacker News thread the next day. "Clearly this touched a nerve." He feels a need to clarify his position to a wider audience: "The motivating emotion here isn't arrogance," he writes. "It's one part apprehension," given what typically happens to talented would-be emigrants when the right of Exit is denied (he cites "the Jews in Europe"), and "one part hope, thinking that we can build something better with a clean slate." Over the next two weeks, as *The Economist* warns of "a coming tech-lash," he drafts thousands more words about Exit. And he starts working with an editor at WIRED to condense his ideas into an essay.

AT THIS POINT, according to my tattered copy of the Stasi employee handbook, I am supposed to sit down at my sad little socialist typewriter and punch out my assessment of how the Subject came to hold his views.

Srinivasan's childhood isn't something he spends "too many cycles on"—that is, cogitates a lot about. He grew up on Long Island in the 1980s, the son of physicians who emigrated from India, and showed an early impatience with institutions. When the libertarian economist Tyler Cowen asked him about his upbringing, he said, "I have this one-liner which says: Life in the United States begins with a 12-year mandatory minimum—the Schoolag Archipelago."

In class, the suburban Solzhenitsyn "was kind of a smartass at times." Once, when a physics teacher tried to explain centrifugal force by saying it was like "when you wash clothes in the drying machine," Srinivasan says he raised his hand and asked, "Don't you *dry* clothes in the drying machine?" He recalls this moment as life-changing. "I was trolling him," he says. "I was a kid, but I was also technically correct, which is the best kind of correct." The comment set off a liberating chain of events: It got him kicked out of class, which pushed him into the orbit of a kindly public-school administrator, who let Srinivasan do independent studies in science and math. That taught him "how to self-bootstrap," he says.

Srinivasan's father had always urged him and his brother

Ramji not to go into medicine, but into tech instead. As his mother once noted, Hindu scripture distinguishes between *janmabhoomi*, the land you're born in, and *karmabhoomi*, the land of action. Srinivasan went west, to Stanford. He majored in electrical engineering, dove straight into a master's in the same field, then one in chemical engineering and a PhD; he taught classes in statistics, data mining, and genomic analysis. (According to his brother, he saw the human genome as "the next internet.") All signs pointed to his being a Stanford lifer, clicking through slide decks until his hair and beard took on a Socratic quality.

But what kind of bildungsroman would that have been? In 2007, Srinivasan picked another track: the dorm-room-to-boardroom startup. With his brother and a handful of friends (including another guy named Balaji Srinivasan), he founded Counsyl. A few years later, he had his first appearance in *The New York Times*, which quoted him as saying, "Nothing is more relevant than making sure your child doesn't die from a preventable disease."

SRINIVASAN'S WIRED ESSAY is published on a Friday morning in November 2013. It runs under the headline "Software Is Reorganizing the World," a friendlier restatement of Andreessen's famous dictum. Where the "Ultimate Exit" talk was like a stump speech, all sharp-elbowed appeals to the base, the essay makes a softer case to the general voter.

"For the first time in memory, adults in the United States under age forty are now expected to be poorer than their parents," Srinivasan begins. "This is the kind of grim reality that in other times and places spurred young people to look abroad for opportunity." Emigrants often used to leave "out of sadness and melancholy," he writes, and remained "homesick for the rest of their lives." His idea of Exit isn't about "going Galt." It's about making a new start and seeking communities of a kind only software makes possible.

Srinivasan describes his vision as the logical culmination of a world where two people can meet on Match.com and then make a life together, or a handful can meet on Quora and form a housing co-op. "There is no scientific law that prevents 100 people who find each other on the internet from coming together for a month, or 1,000 such people from coming together for a year," he writes. And as those trends continue, "we may begin to see cloud towns, then cloud cities, and ultimately cloud countries materialize out of thin air." In the long run, these new polities will also coalesce in physical space—a "reverse diaspora," in which the far-flung citizens of a cloud nation come together at some *x,y* coordinate on Earth. The exodus will be frictionless, because software has nullified the tyranny of place. "Nothing today binds technologists to the soil besides other people," Srinivasan writes.

What, you might wonder, will happen to your current neighborhood, your current town, your current country as people increasingly abandon ship for their own Cloudworlds? What will become of the people who can't or won't make the switch? The authors of *The Sovereign Individual* are forthright about the violence and disorder that will attend the rise of Bermuda in the Sky With Diamonds. Srinivasan, in WIRED, doesn't get into it.

But if he hopes that the essay will calm the furor over the "Ultimate Exit" talk, he is quickly disappointed. Less than a day passes before it's upstaged by the Paper Belt's latest provocation, an article in TechCrunch called "Geeks for Monarchy." The writer, Klint Finley (a longtime contributor to WIRED), mentions Srinivasan, but his story is mostly about the neo-reactionaries, a more stridently antidemocratic tribe of bloggers who are popular on certain fringes of Silicon Valley.

Their lead thinker—their most charismatic writer, anyway—goes by the pen name Mencius Moldbug. He was once described to me as "the Machiavelli to Thiel's Cesare Borgia." The first post on his blog, *Unqualified Reservations*, in 2007, begins: "The other day I was tinkering around in my garage and I decided to build a new ideology." Moldbug stands against what he calls the Cathedral, an oligarchic ruling class shrouded in a fig leaf of representative democracy, which includes swaths of traditional media, academia, and government (for all intents and purposes, the Paper Belt). In his vision of the future, called Patchwork, "sovereign corporations" take the place of nation-states, and CEOs are territorial monarchs with absolute power over everything save their subjects' right to exit. The world becomes a shopping mall of polities.

Moldbug gives a bit more attention than Srinivasan does to the transition from our decrepit political order to the next. It is to be accomplished via RAGE, which stands for "Retire All Government Employees." As for dealing with unproductive members of society, he suggests finding a "humane alternative to genocide"—something that "achieves the same result as mass murder (the removal of undesirable elements from society) but without any of the moral stigma." He imagines imprisoning them in a pleasant VR world, "waxed like a bee larva into a cell."

Finley is careful to avoid unduly implicating anyone in these ideas. "I don't know Srinivasan," he writes, "but it sounds like he'd find neoreactionary views repulsive." This turns out not to be quite true. Within hours of the story going live, Srinivasan is on an email thread about it. Here are some of the people CC'd:

Curtis Yarvin, aka Moldbug, is a programmer. When he isn't on Blogspot toying with birtherism and writing things like "but maybe I've been reading too much Hitler," he works on a software project called Urbit, described as a "clean-slate OS and network for the 21st century." (Thiel and Andreessen Horowitz are early investors.) The point of Urbit is to strip off the cruft and rebuild modern computing from first principles. Usually when you're versioning software, you count up: Version 1.0, 1.1, 1.2. With Urbit, the numbers count down to 0.

Patri Friedman, son of the anarcho-capitalist thinker David Friedman, grandson of the legendary economist Milton Friedman, is the cofounder of the Thiel-funded Seasteading Institute. He sometimes blogs on a site called Let a Thousand Nations Bloom, which is devoted to "a Cambrian explosion in government." He has been talking about Hirschman's Exit/Voice paradigm for years and has called exit "the only Universal Human Right."

Michael Gibson, an apostate academic who works at the Thiel Foundation, is another Hirschman stan. He will shortly cofound the 1517 Fund, named for the year in which Martin Luther, the original Garage Guy, is said to have posted his 95 Theses on the Cathedral's door. He describes himself as a "conservative anarchist."

Blake Masters is a Stanford Law grad who took Thiel's course when he was a student. His notes on it will soon become the basis for *Zero to One*, a best-selling book on how to run startups and "build the future." (The original notes include an entry about Srinivasan's visit to class in 2012, when he talked about the futons-in-the-office stage of creating a successful company.)

Though Srinivasan has gotten off easy in Finley's article, his sense of threat is palpable in the email chain. He calls the story "extraordinarily dangerous." He tells the others that they should "unite the clans"—the audiences of various edgelord bloggers—and retaliate against journalists who "dox" them. He seems to imply that this is what Finley's article did to Yarvin, whose name had been quietly linked with Moldbug's online for years but not paraded in the press. (Usually, "doxing" also includes publicizing a street address or a phone number or other private information that might enable serious real-world harm, which Finley's article doesn't do.) Srinivasan thinks an attack-back strategy could work. "It might mean moving to Singapore though as endgame," he writes.

Yarvin counsels calm. "Dude, control the frame," he replies. "If you make a big thing of it, you prove their point." He tells Srinivasan, "You and I have different vulnerabilities, you because you're in the closet and I because I'm out of it. Our mission over the next few years is to drag sanity into the mainstream from opposite directions. It's a long game which rewards patience ..."

Friedman agrees that inaction is best for now.

Gibson agrees too. (He's at a wedding in Tahoe.)

Masters doesn't reply.

Five days later, Moldbug writes a 6,000-word blog post that says, among other things, "No one should ever respond to a journalist. (Or a Stasi-Mann.)"

IN DECEMBER 2013, SRINIVASAN joins Andreessen Horowitz. The VC firm hires him mainly for his crypto savvy, but he also uses his new perch to follow his own advice to the Startup Schoolers—to build the technology stack that the next society will run on. He handles the firm's first investment in civic tech, a company called OpenGov, whose goal is to make the complex workings of local government as simple to understand as an analytics dashboard. He moonlights as the cofounder of a company called Teleport, which is building a geographic search engine for digital nomads. He spends his time "evangelizing" the view that the biggest risk for many tech companies is government regulation.

Srinivasan has to step back from Andreessen Horowitz in 2015 to tend to his bitcoin-mining-chip company, which is in dire straits. (Long story short: The price of the cryptocurrency crashed.) While he is doing so, Thiel becomes a member of Donald Trump's presidential transition team.

So in the winter of 2017, Srinivasan finds himself in New York, riding an elevator up Trump Tower for a job interview to run the FDA. Srinivasan has recently deleted all of his tweets, including one in which he said that a doctor-run "Yelp for drugs" would work "vastly better than FDA" and another in which he said Trump's shtick was "amusing" but that the man was "no fan of technology." All that's left on Srinivasan's timeline is a single message for his audience—or is it a mantra for himself? "Don't argue on Twitter. Build the future."

I don't know what Srinivasan and Trump discussed. I asked him about it in our one interview, and he said: "What I think is realistic is to exit the FDA, like we exited the Fed with crypto." He also said: "Ultimately, the reason that I've never joined a government agency is that many of these roles are like white elephants. People are chasing brass rings that have long since been tarnished. And they find themselves in the cockpit of a dysfunctional robot that actually doesn't do anything. In fact, the only thing it does do is take lots of bullets through the windshield, to mix metaphors. And the thing about that is, I prefer to build things myself."

Though he does not join the president's inner circle, the Trump years are nonetheless good to Srinivasan. Counsyl, the genomics company, sells for $375 million, a figure he is not shy about quoting. Even his bitcoin venture turns around: Many eyebrow-raising shifts in strategy (and two name changes) later, he sells the company to Coinbase for $120 million—and gets himself "acquihired" as chief technical officer of the country's biggest crypto exchange. After barely a year there, during which time he seems to strike many executives as brilliant and some employees as disruptive (the polite way to put it), he leaves. Eventually, he changes his LinkedIn bio to say that he is "angel investing and taking some time off."

There is a special term for the state of capitalist transcendence that Srinivasan has now attained. Tim Ferriss will use it in their podcast interview. "You've sold multiple companies, you've had multiple exits," he says. "You are post-economic, I assume."

YOU'RE BACK ON that fishing schooner. It's late 2019. The maelstrom is churning with the flotsam of several years' worth of America under Trump—and, let's be honest, several hundred years' worth of America under various other influences. It's probably best that you didn't bring your quadcopter drone with you on board, because if you could look over the lip of the funnel right now, you'd see further trouble on the horizon.

Srinivasan senses it. On January 30, 2020, he tweets out to his roughly 130,000 followers: "What if this coronavirus is the pandemic that public health people have been warning about for years? It would accelerate many preexisting trends."

Those include "border closures, nationalism, social isolation, preppers, remote work, face masks, distrust in governments." He elaborates in a long thread.

Srinivasan has latched onto his latest, possibly greatest identity: Covid oracle. At a time when the maelstrom seems like a chaotic horror to most people, when media outlets and government officials seem to be putting out more heat than light, he is the confident pattern-spotter. Thanks to his collection of Stanford degrees and his experience setting up a biomedicine company, his analysis is well informed, and it begins attracting him new readers. Most of them are technologists—if not in the US then abroad, where he has many fans—but even some journalists are climbing down from the château wall to listen to what he has to say.

As he accrues hundreds of thousands more Twitter followers, Srinivasan dispenses short-term advice (work from home, cancel group events, ramp up testing capacity, stop making comparisons with the flu) and long-term gospel, painting the pandemic as a moving sidewalk to the future that he has been talking about since Startup School in 2013. "The virus breaks centralized states," he says in a talk in the summer of 2020. The world is unbundling into "green zones" and "red zones." This moment represents the true dawn of the internet age, civilization's ascension to the cloud.

For Srinivasan, it is also a moment to escalate his war with the journalists of the Paper Belt. He takes to task a reporter at Recode, offering a $1,000 bitcoin bounty to anyone who can get her Covid article retracted. He offers the same bounty to anyone who can make the best meme about a scrap he recently had with Taylor Lorenz, then a reporter at *The New York Times*. (When I ask him about this during our Stasi interrogation, he says that against the forces of corporate journalism, "a little bit of crypto on the internet is like a gorilla against a tank.") In early 2021, when another *Times* reporter gets into hot water with the fans of Slate Star Codex, a rationalist blog whose audience has some overlap with Moldbug's, Srinivasan again rushes to his tribe's defense. When Slate Star Codex reboots under a new name, Astral Codex Ten, its author writes: "I got an email from Balaji Srinivasan, a man whose anti-corporate-media crusade straddles a previously unrecognized border between endearing and terrifying. He had some very creative suggestions for how to deal with journalists. I'm not sure any of them were especially actionable, at least not while the Geneva Convention remains in effect."

By that spring, Srinivasan has fulfilled his own prophecy and moved part-time to Singapore.

IN A RECENT review of Srinivasan's new book, *The Network State*, his friend Michael Gibson calls it "a provocation, an assault, an outcry, a handbook, and a gospel that cannot be ignored." Srinivasan released it in digital form only, so you can have it as either a traditional ebook ($9.99) or as a continuously updated website (free).

Besides being published on the Fourth of July, *The Network State* shares something else with the US Declaration of Independence. While some of the text is a high-minded defense of inalienable rights, much of it is a recitation of historic grievances. Srinivasan describes how a new trifecta of political forces—"crypto capital," "woke capital," and "Communist capital," represented by the initials BTC, NYT, and CCP (for the Chinese Communist Party)—is shaping the world order. He name-checks *The Sovereign Individual* several times, including in a chapter titled "If the News Is Fake, Imagine History." And he expounds on his helical theories at typical length.

But if, for a moment, you tune out the rants, you may find more to appreciate in Srinivasan's vision of the future than many did when he first aired it. Where his "Ultimate Exit" talk was an exclusive invitation for technologists to take their toys elsewhere, and his WIRED essay was a sanitized description of a world gently reshaped by new ways of connecting, *The Network State* attempts to address a broad audience, and it acknowledges that the shit is, very ungently, hitting the fan.

So what does Srinivasan's future look like now? Sort of like a world gradually re-created in the image of Reddit. You'll start out—you probably already have—by spending more and more of your time communing with like-minded people around the planet, forming your own virtual tribe. Maybe you all want to ban guns; maybe you all want your aging parents to be able to try experimental therapies for Alzheimer's; maybe you all want abortion to be politically off the table, one way or the other. Soon you may find that your friends on the infinite frontier matter more to you than the nameless, sometimes menacing hominids who co-occupy your meatspace. You'll become part of what Srinivasan calls a "sovereign collective" or a "network union." *E pluribus unum*, a new bundle born of the great unbundling.

Eventually, whether it's under duress or in a state of fervor, you and your tribe may move toward founding yourselves a country—not a nation-state but a network state. You'll code a social smart contract, the terms of which will guarantee law, order, and whatever freedoms matter to you. If you like, you can crowdfund social goods, like child care or cyberdefense. You can make it possible to interact with your fellow citizens from behind the safety of a pseudonym, maybe with your social reputation stored in the form of karma points on a blockchain. You could make firearm ownership a capital offense, or you could issue every toddler a Glock. When the collective gets strong enough, you might crowdfund a constellation of territories—a "networked archipelago." At some point, you'll achieve diplomatic recognition from other states.

You see the future, right? You want to have a kid, so you go enroll in a network state with Nordic-style social benefits in its territories. You want to Crispr human gametes, so

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you move your lab to a locality without bioethics panels. You want to live in a sugarless society, so you join a state called Keto Kosher. The life you live is constrained only by the people you choose to associate with. And those people, because they have self-bundled with you, will be more eager to reach a political consensus you like than the nameless hominids ever were. If they can't, you—or they—will simply seek another network state. This kind of polity, Srinivasan writes, "prizes Exit above Voice."

Albert O. Hirschman, the original coiner of those concepts, didn't care for prophesiers. He looked down on what he saw as their Warhol-esque desire for airtime. A European Jewish refugee from Nazism, he was similarly wary of the possibility of an Exit-based, Patchwork-style future. "It is possible to visualize a state system," he wrote in 1978, in which "each country would supply its citizens with a different assortment of public goods." They could "'specialize' in power, wealth, growth, equity, peacefulness, the observance of human rights, and so on." Hirschman found this vision inspiringly "polyphonic," but "perhaps too beautiful to be real." For one thing, what if a rival power invades? When you think about it, this new polity of ours is vulnerable to a lot of the same risks as our old polity. Our leader could turn out to be a megalomaniac we can't fire. We might prefer to leave but lack the resources. Maybe no other place we want to live will take us in.

Speaking of which, who are "we"? As I read Srinivasan's book, my editor brain kept getting hung up on how often he reaches for that pronoun. In the opening essay, for instance, he writes: "We want to be able to peacefully start a new state for the same reason we want a bare plot of earth, a blank sheet of paper, an empty text buffer, a fresh startup, or a clean slate." Later: "History is the closest thing we have to a physics of humanity." And: "In the fullness of time, with truly open data sets, we may even be able to develop Asimovian psychohistory."

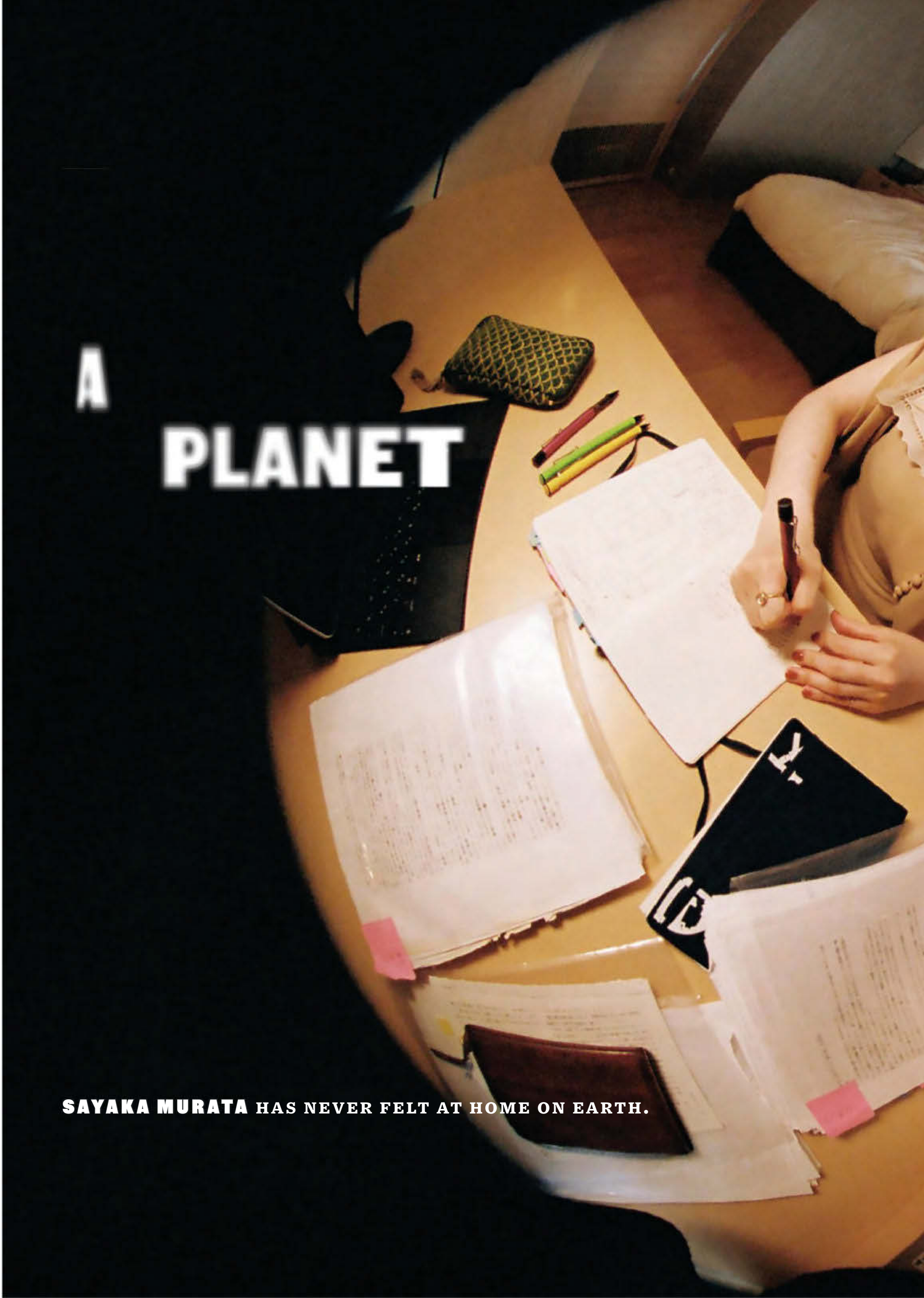
Does "we" refer to people like Srinivasan, the technologists, the self-bootstrappers, the seekers of *karmabhoomi?* Is it a weird-fun Dr. Bronner's "we," a freaky Borg "we"? Does it include the fellow travelers he CC'd on that email back in 2013—the other lovers of Exit? They too have only risen with the maelstrom. After laying relatively low for a few years, Curtis Yarvin has resurfaced with a newsletter on Substack, and his influence on prominent Republicans was recently explored at length by *Vanity Fair*. Blake Masters is the Thiel-funded, Trump-endorsed Republican nominee for US Senate in Arizona and jokes about RAGE on the stump. Patri Friedman runs a venture fund that invests in charter cities. Gibson has a book coming out later this year called *Paper Belt on Fire: How Renegade Investors Sparked a Revolt Against the University*.

All those people, I suspect, would quickly find their notes in the polyphonic world that Srinivasan imagines. And it's likely that anyone else who lives according to roughly his values would too, from the 19-year-old coding wiz in Mumbai to the grad-school dropout crypto-nomadding in Costa Rica to the billionaire investor in his New Zealand bunker. But when you strip off the techno-cruft—the promises of a new civilization engineered on a new stack, one that privileges decentralization, devolution of power, and the sovereignty of every individual and/or central processing unit—you see that the essential political philosophy here is pretty antiquated. I don't know what to call it. Cosmopolitan feudalism? Enlightened tribalism? Corkscrew cliquism? It reflects a belief that the main failure of contemporary society is that the *wrong people* hold the power. It addresses the problem by unbundling society and then rebundling it to ensure that none of those people ever bother you again. And OK, as long as no nukes get loose, maybe that turns out fine. Maybe you go to your Bermuda in the Sky and I go to my DigiSweden and we're both happy in the telepresence of the people we've chosen. But maybe we find that the imbalance of power, spread out across the overlapping constellations of the physical world we still see outside our windows, feels just as bad as always. And maybe we find that, most of all, we desperately miss home.

YOU SEE THE FUTURE, RIGHT? YOU WANT TO HAVE A KID, SO YOU GO ENROLL IN A NETWORK STATE WITH NORDIC-STYLE SOCIAL BENEFITS.

IF I COULD SLIP through the quantum foam at the bottom of the maelstrom, I think I might eventually arrive in an alternate universe in which Srinivasan gives a talk called "Silicon Valley's Ultimate Voice." He might start it just the same way—poke a little fun at the government, praise the garage-guy ethos, lay some Hirschman on the Startup Schoolers. And then he might say: "Silicon Valley is a place where a certain ideal of American progress finds its purest expression. That makes it our job to offer not just solutioneering oratory and different repackagings of rare earth minerals but also the tools of a better, fairer future for all. So Startup Schoolers, let's figure out how to update the crappy code base! Help me clear the FUD! Whatever we may all believe, however we may disagree, let's use our Voice!"

No point wondering what's down there, though. We have our own maelstrom to escape. Exit is up to us. We are the protagonist.



SAYAKA MURATA HAS NEVER FELT AT HOME ON EARTH.

PHOTOGRAPHS BY
MONIKA MOGI

OF HER OWN

IN HER NOVELS, SHE DEVISES WORLDS WHERE WOMEN REINVENT SEX, MARRIAGE, CHILDBIRTH—AND THE BOUNDARIES OF HUMAN EXISTENCE.

BY **THU-HUONG HA**

BY THE TIME I MEET SAYAKA Murata, on a recent afternoon in June, the back of my linen dress is damp. It's an oppressively humid summer day in Tokyo, the sun hidden by a thick blanket of gray, and we're taking a stroll at the Shinjuku Gyoen National Garden, a 116-year-old park that becomes dense with crowds during the sakura blossom. Today, visitors are sparse; it seems we're the only ones foolish enough to be out at noon. Looking at Murata's long, collared black dress and black tights, I feel even hotter, but she seems unaffected, apart from a gentle glisten across her forehead. Maybe the subtle sheen is a source of pride for Murata, I think. After all, she's not sure her body works like those of other humans.

"In high school, no matter how hard I tried, I couldn't sweat," she says. "Even now I feel like my body and I don't understand each other." Murata, the author of more than a dozen novels and story collections, writes often from this place of alienation. Many of her female characters feel distant from their bodies, both in mechanics and in purpose. In 2016, Murata published *Convenience Store Woman*, a novel narrated by a contentedly unambitious Smile Mart worker who achieves greater fulfillment performing her rote duties as an employee than aspiring to marriage or motherhood. *Convenience Store Woman* was a national bestseller that year—winning Japan's prestigious Akutagawa Prize—and nearly every year since, and it has sold 1.5 million copies worldwide. *Earthlings*, Murata's second novel to be translated into English, is about a woman whose alienation is literal; she believes she's an extraterrestrial disguised as a human. In July, Murata published *Life Ceremony*, a new story collection in which she concocts grotesque social rituals (in the title story, funerals are occasions to eat the dead) to expose the absurdity of the corporeal norms we've all become desensitized to.

SINCE CHILDHOOD, MURATA HAS BEEN TROUBLED

Though she is unlikely to use either term, Murata's fiction might best be described as speculative-feminist. The worlds she invents are future-looking without adhering to the tropes of science fiction; her scenarios horrify without leaving the daylit quotidian spaces of home and office. She devises bizarre social experiments that unfold in seemingly familiar worlds and implants unhinged fantasies inside otherwise unrebellious women. Her characters navigate domestic arrangements that distort the smooth image of marriage, childbirth, and family life like a funhouse mirror. As in a fun house, her tricks amuse and delight. Reading her books, I often find myself scream-laughing out loud, then doing a double take: *Did I really just read that?* While she is sometimes outrageously gross, she's rarely merely so. Rather, her speculations act as a provocative form of scientific inquiry, probing incredulously at the conventions of her species. Why, she asks, do humans live this way?

Meeting Murata, I experience a bit of cognitive dissonance, knowing the sweet-voiced 43-year-old woman in front of me is the author of several scenes of sensual cannibalism. She is small and delicate, with neatly curled, chin-length hair. She giggles often. The way her eyes shine makes me think of Piyyut, the stuffed alien-hedgehog talisman in *Earthlings*: cute but distant, as if belonging to a far-off world.

In the Japanese media, Murata is sometimes called "Crazy Sayaka"—a nickname first bestowed on her affectionately by friends but one that she fears borders on caricature. Though her editors warn her not to say weird things in public, strange comments invariably flow out, like vomit. A few times during our conversation, Murata starts to say something and then catches herself. She glances sideways as if checking with someone; then a bashful grin flashes across her face as she goes ahead and says it anyway. This happens when she talks about looking for her own clitoris and about being in love with one of her imaginary friends. Listening to Murata, I feel an odd sense of relief wash over me. Her literary worlds offer little comfort, and yet I feel my body relax in her presence, as if it has found a momentary refuge from the crush of humankind's collective delusions.

SINCE CHILDHOOD, MURATA HAS been troubled by an intense—sometimes painful—effort to, as she put it in a 2020 essay, be an "ordinary earthling." Growing up in a small city in Chiba, a prefecture east of Tokyo, she was lonely and sensitive, frequently interrupting her kindergarten class with inconsolable crying fits. Her father, a judge, was often away at work, and her mother, occupied with caring for her and her older brother, worried over her timid appetite and weak constitution. "I just wanted to hurry up and become a good human," Murata says.

writing stories in the style of the *shōjo* mystery and fantasy books that were popular for young girls at the time. Her mother helped her buy a word processor; Murata thought it was a magic machine through which the god of novels would transform her writing into books. "In elementary school, I went to the bookstore to look for my own stories," she says. "But I couldn't find them. Obviously." She releases a giggle.

Murata's struggles at school continued through junior high. She was rejected by her classmates, who told her to go and die. She started keeping a calendar that counted down to her "death day," which she marked for after graduation. As the days ticked down—120, 119—she felt, alongside the thoughts of suicide, an intense desire to live. During

as "Prez," a diligent go-getter, then becomes the emoji-loving airhead "Princess" in college while working at a diner as "Haruo," a rough-talking tomboy. The story is a gross exaggeration of *kūki wo yomu*, the ability to read the room and intuit the right response, which is considered an essential skill in Japan. From the outside, it might have seemed that Murata's newfound social fluency meant she'd at last grown up; another way to tell it, though, is that she was learning to act the part of being human.

She'd stopped writing stories by the time she entered college, at Tamagawa University, but in her second year she met novelist Akio Miyahara, and, moved by the precision of his psychological works, she started again. One of the stories she wrote in Miyahara's class, about

EFFORT TO BE AN **"ORDINARY EARTHLING."**

BY AN INTENSE AND SOMETIMES PAINFUL

Aware that her frailty made her stand out, she studied the earthling manual carefully. But pressure to keep up the daily pretense felt like "little cuts" to her heart. She would frequently hide in the bathroom of her elementary school and cry until she threw up. When Murata was 8, she writes, an alien came through her bedroom window. It whisked her away to a place where she didn't have to perform, where she felt accepted. She would make more imaginary friends over the years and now counts 30 of them. "Thirty?" I repeat. "I couldn't just keep one or two," she says. "That's how sentimental I was." These beings have kept watch over her since childhood, playing games with her and holding her hand while she falls asleep.

When she was 10, Murata started

that time, Murata says, writing became "a kind of church." On graduation day, Murata ran home, ripped off her school uniform, and threw out the calendar. "It was an important realization: that by my own desperate devices, I could control my own mind and survive," she says.

When she was in high school, Murata's family moved to Tokyo. In her new environment, she was able to make human friends, and she started looking forward to school. But this newly sociable Sayaka, while a relief, was another of what would be many guises. Murata has long felt that she doesn't have a single, identifiable personality. Like the narrator Haruka in her story "Hatchling," she sees herself as a rotating cast of personae that shift to match the social context around her. Haruka starts grade school

a schoolgirl who breastfeeds her private tutor, would become the title piece in her debut collection.

During college, Murata started working at a convenience store. At the *conbini*, for the first time, she felt "released from being a woman," she tells me. Men and women wore the same uniforms, and she easily formed platonic relationships with male colleagues. This simple, rule-bound world, in which every task was outlined in the company handbook, provided instructions she knew how to follow. After five or six years, the store closed, but Murata continued working at five other conbinis over the next 18 years.

During this time, she wrote *Convenience Store Woman*, a story of feminist rebellion with her singular spin. The book is told from the perspective

of Keiko, a 36-year-old woman who has never had sex or held a real job and has no particular interest in either. The romance between Keiko and her place of employment is oddly moving, as is her quiet bewilderment over purpose and personhood. Keiko is happy and content, but her family worries about her. To get them off her back, she starts a sham relationship with a misogynistic coworker with whom she shares a mutual loathing. Though the reality is horrible, the setup appears conventional. Her family is thrilled.

Keiko, as a prototypical Murata hero, is not a preachy, angry agent of change who rails against the patriarchy. She's more like an alien quietly trapped inside a woman's body. Her antagonists are not government leaders or laws; they're her own family members, who seek to preserve something called "normal."

Convenience Store Woman, Murata's most widely read novel, is also the most subdued of her works. *Earthlings* takes the same themes to a far more outlandish dimension, treating incest, cannibalism, and cult indoctrination as strategies of subversion. In the book, a woman named Natsuki harbors a deep paranoia that society is a front for something she calls the Factory, which sucks in adult conscripts and churns out babies. The pressure to procreate and become a component in the system is "a never-ending jail sentence" that Natsuki tries to escape by, like Keiko, entering a sham marriage. In one scene, Natsuki's sister confronts her:

"You won't be allowed to carry on running away. You have to get intimate, have a baby, and live a decent life."

"Who? Who won't allow me?"

"Everyone. The whole planet."

Murata's characters can't reject society entirely, so they live uncomfortably within it. They operate as if they missed the social contract in the mail, or forgot to sign it. Reading Murata, you might begin to scrutinize all of the clauses in the human Terms and Conditions you'd previously skipped over. *Hey, I don't remember signing up for this baby thing.*

Murata's work tends to offer imperfect alternatives, rather than solutions, to the problem of having a uterus. Her stories contain artificial wombs, no-

"FROM A YOUNG AGE I WAS MADE AWARE THAT I HAD **A UTERUS** AND WAS A MEMBER OF THE **BIRTHING SEX.**"

contact insemination, and male pregnancies. But her visions for a better world often bend back toward the monstrous. In one of her popular untranslated books, called *The Birth Murder* in Japanese, the government has instituted a bizarre incentive to urge its shrinking populace to procreate: Anyone who has 10 babies is allowed to kill one person of their choosing. The system ends up becoming a grotesque cycle of corporeal sacrifice. In a novel Murata is currently writing, other living creatures are forced to give birth on behalf of humans. "I thought it would provide a great relief to women," she says of the conceit, laughing. "But it just got more and more hellish. I didn't solve anything."

OF ALL HUMANKIND'S ARTIFICIAL constructs, those that most urgently disturb Murata involve social systems of procreation. When describing sex, she often uses sterile, clinical phrases: Sex is "insemination," while orgasming is "discharging fluid." Her female characters seek a way out of the biological fatalism that draws a straight line from having a womb to becoming a mother. "From a young age I was made aware that I had a uterus and was a member of the birthing sex," she says, recalling that she was assessed by her elders on the sturdiness of her hips. "More than thinking about whether I wanted to have a child or not, I felt I was being regarded as a birthing machine, a machine of flesh."

Perhaps in resistance, Murata's first story to be translated into English, "A Clean Marriage," imagines a different sort of reproductive machine. The story chronicles the attempt of a husband and wife to have their first child. They're perfectly satisfied as partners, except they've never had sex, and don't plan to. They aren't asexual—they have partners outside of their marriage—but they are disgusted by the prospect of having sex with their *spouse*. Happily,

their society has devised a solution for their needs. The couple visits a fertility clinic that offers a "graceful, non-erotic experience" via a contraption called the Clean Breeder so that insemination can occur without the nasty business of actually having intercourse.

Many of Murata's stories resist the expectation that love, sex, and reproduction come easily and naturally in a single relationship. In her early romantic life, she found sex excruciating. "So I had to make myself numb in order to love," she tells me. When she was around 20, she says in a 2020 *Guardian* interview, she had a painful relationship with a man—a convenience store manager 15 years older than her—who demanded that she cook for him and do his laundry. It didn't suit her. "I have a rice cooker," she says. "But I just heat up rice in the microwave."

Murata declines to speak in detail about her relationship history. She confides that, these days, she's intimate with one of the 30 imaginary friends she lives with, the same ones she made as a young child. "If that can be considered love too, then maybe romantic love isn't so bad," she speculates. She mentions a married friend who feels no attraction to her husband and fantasizes instead about having a big white dog as a lover. ("Oh no, I said something weird," she says with a resigned laugh.) Still, she's open to love with humans. Her sexuality fluctuates, and she's reluctant to close herself off completely to any possibility or to declare any one sexual orientation. I imagine her filling out a dating app profile: *Gender identity: alien. Sexuality: imaginary.*

Sex-free, businesslike marriages and partnerships recur throughout Murata's stories, so it's not surprising that readers might find in them a disinterest in sex, or even outright rejection. It's also tempting to read asexuality into her characters. But Murata's work evades such easy categorization. Her fiction, rather than circumscribing the pleasures of intimacy, widens its possibilities. *Life Ceremony*, Murata's new collection, includes a few short, sweet stories about platonic friendships and relationships with nonhuman forms. In one, two elderly women, one a virgin and one promiscuous, platonically raise a family together; in another, a teenage girl has a romance with the billowing curtain in her bedroom.

Life Ceremony uncovers Murata's preoccupation with our species' norms writ large, beyond gender, sex, and reproduction. Several stories imagine near-future worlds in which bodies find new uses after death. In one story, recently deceased humans are repurposed to make tables, sweaters, and shimmering veils. The effect is strangely tender; the narrator feels it's "marvelous and noble" that her corpse should be of practical use. "I would always feel that I too was a material," she says. In another story, funerals have morphed into loving, sexy, generative dinner parties called "life ceremonies," for which the body of the recently deceased is served as a multicourse meal. The ceremony guests, energized by a collective duty to solve an imminent population crisis, then pair off in the night to have sex and get pregnant.

In offering such exaggerated scenarios, Murata exposes the lunacy of the norms we so blithely follow. What if human bodies were used as material, like those of other animals? What if children kept adults as pets? In another hundred years, what will be forbidden and what will be sanctioned? "Normal," says one of Murata's characters, "is a type of madness, isn't it?" Murata's lifelong feeling of being a stranger has given her a perspective from which to create her worlds. "This has enabled me to see clearly the repulsiveness of humans, to dissect their grossness," she says.

In an untranslated essay published in *Shinchō* magazine earlier this year, titled "The Commonplace Urge to Kill," Murata describes how she became fixated on killing an editor she calls Z-san. An established editor, Z tries to recruit Murata to become a "novel machine" and produce whatever he wants her to write; when she resists, he tells her to stop writing altogether. In an intensely personal and uncharacteristically sober style, Murata confesses that she becomes convinced she has to kill him or die herself.

After a year of torment, prayer, and medication, the urge eventually leaves her body. Finally at peace, she embarks on the self-soothing ritual of her typical routine: She goes to a chain café, writes, drinks a coffee, opens a door, goes for a walk. What's truly weird, Murata concludes, is not that people sometimes have murderous intentions, it's that the urge can just dissipate. How strange it is, she marvels, to walk around in the light and forget that we wanted to kill—how strange, and perfectly normal.

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THEN MAYBE ROMANTIC LOVE ISN’T SO BAD.”

MURATA IS A REGULAR AT SHINJUKU Gyoen, where she sometimes takes walks at the end of the workday. She lives nearby, in the same area she has been since college. The rhythm of life from her convenience store days was comforting in its regularity: wake up at 2 am, write, go to work at the conbini, go to a café to write, go to bed by 8 or 9. Now she keeps a strict schedule of working at three or four neighborhood cafés. In the vast garden and city and universe, it’s as if her world can be reduced to a single route confined to a 1-mile radius. This monotonously regulated lifestyle keeps her tethered to the ground. “If I stay in my house,” she tells me, “I’ll get sucked into my dreamworld.”

At times, she still feels like she has to study the manual of human behavior. At literary events she has attended in Europe, she observed that her straight-as-a-cane posture stuck out next to the other speakers, who sat slack and slouchy. Overall, though, Murata no longer sees herself as a freak. “I’m a completely ordinary human,” she says, using an adjective that in Japanese can mean both “commonplace” and “mediocre.” In college, she recalls, she opened a psychology book and saw all her worries—about her family, about her own mind—outlined from the very first page. It was a clue that her deep anxieties about not being human enough were, indeed, very normal. The world was full of people just like her, people desperate to understand the rules that everyone else follows, who endeavor to pass as members of the human species. She looks down at the two tight fists in her lap, her elbows straight and her torso rigid. “If you dissect it and analyze it, it’s classic human,” she declares, with supreme conviction. “I’m extremely ordinary.”

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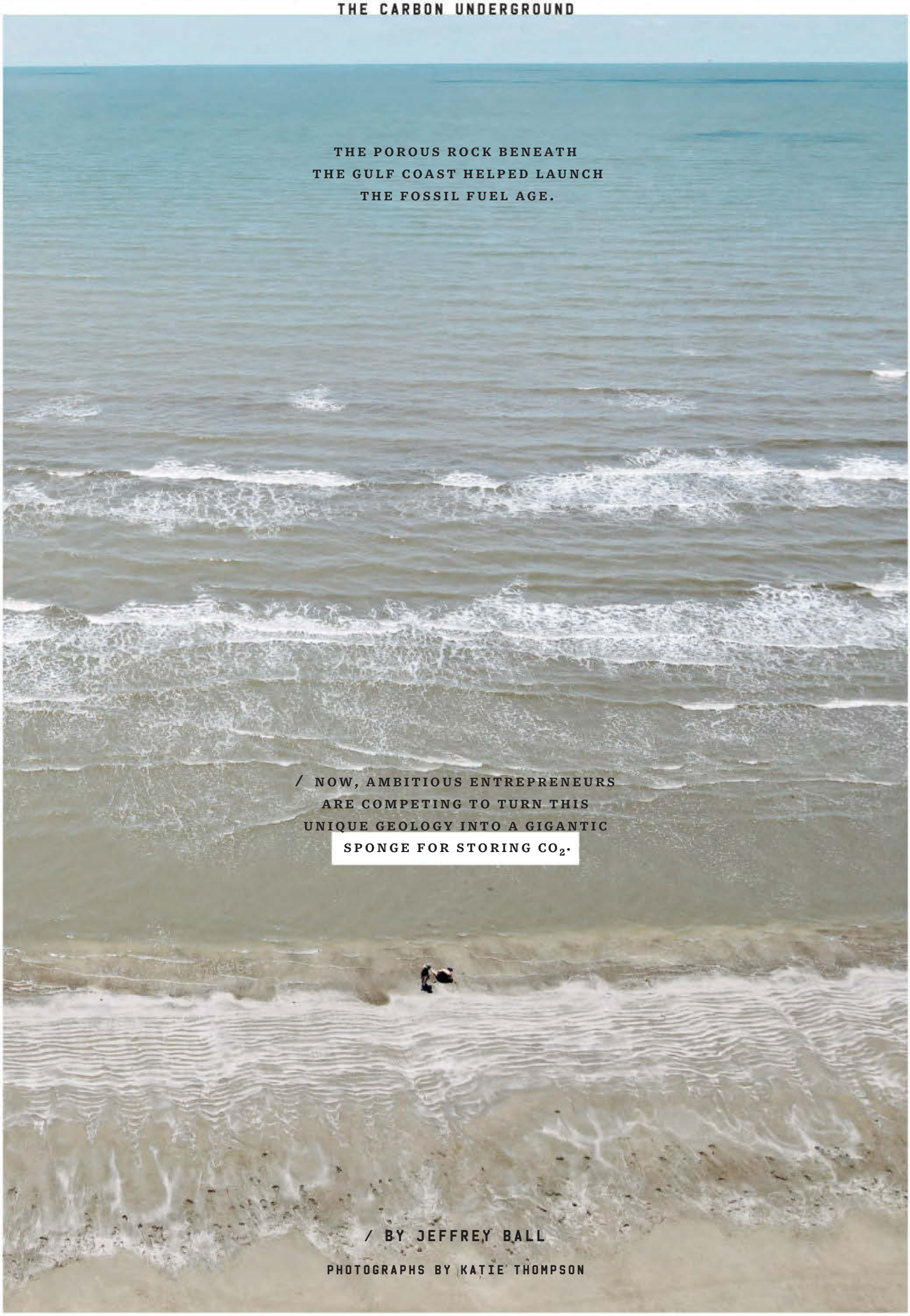

THE POROUS ROCK BENEATH THE GULF COAST HELPED LAUNCH THE FOSSIL FUEL AGE.

/ NOW, AMBITIOUS ENTREPRENEURS ARE COMPETING TO TURN THIS UNIQUE GEOLOGY INTO A GIGANTIC SPONGE FOR STORING CO_2.

/ BY JEFFREY BALL

PHOTOGRAPHS BY KATIE THOMPSON

THE CARBON UNDERGROUND

SOMETIME AFTER the dinosaurs died, sediment started pouring into the Gulf of Mexico. Hour after hour the rivers brought it in—sand from the infant Rockies, the mucky stuff of ecosystems. Year after year the layers of sand hardened into strata of sandstone, pushed down ever deeper into the terrestrial pressure cooker. Slowly, over ages, the fossil matter inside the rock simmered into fossil fuels.

And then, one day in early 1901, an oil well in East Texas pierced a layer of rock more than 1,000 feet below Spindletop Hill, and the well let forth a gooey black Jurassic gusher, and the gusher began the bonanza that triggered the land rush that launched the age of petroleum.

One of the products of the economy that black gold built is the city of Port Arthur, Texas. Perched on the muggy shores of Sabine Lake, just across the border from Louisiana, it's among the global oil-and-gas industry's crucial nodes. Port Arthur is home to the largest petroleum refinery in North America, opened the year after the Spindletop gusher and now owned by the state oil company of Saudi Arabia. The area emits more carbon dioxide from large facilities every year than metropolitan Los Angeles but has a population 3 percent the size. Smokestacks are its tallest structures; nothing else comes close. Around town, pipeline pumping stations jut up from shopping-center parking lots, steam from petrochemical plants hisses along highways, and refineries flank both sides of main roads, their ductwork forming tunnels over traffic. Janis Joplin, who grew up here, described it in a 1970 ballad called "Ego Rock" as "the worst place that I've ever found."

Tip Meckel has a more hopeful view of the place, maybe because he spends so much time looking down. A lanky research scientist at the University of Texas' Bureau of Economic Geology, Meckel has worked for most of the past decade and a half to map a roughly 300-mile-wide arc of the Gulf Coast from Corpus Christi, Texas, through Port Arthur to Lake Charles, Louisiana. Though he's the grandson of a refinery worker and the son of an oil consultant, his interest isn't in extracting more petroleum from this rock. Instead, he has devoted most of his career to figuring out how to turn it into a commercial dump for CO_2.

The idea is that major emitters will hoover up their own carbon waste, then pay to have it compressed into liquid and injected back down, safely and permanently, into the same sorts of rocks it came from—carbon capture and sequestration on a scale unprecedented around the globe, large enough to put a real dent in climate change. Suddenly, amid surging global concern about the climate

Tip Meckel holds a sandstone sample.


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"We're talking about a whole area the size of Texas that you can develop for storage. Who's not going to think that's a good idea?"

crisis, some of the biggest names in the petroleum industry are jumping in.

On the rainy morning I meet Meckel in Port Arthur, the brown-haired geologist is dressed in a blue Patagonia fishing shirt, black jeans, and running shoes, with sunglasses dangling from a leash around his neck. We pile into his gray Toyota 4Runner and head south, through the petro-sprawl, toward the Gulf. We're off to see a patch of ocean that Meckel thinks could be key to the drive for decarbonization.

"You don't throw trash out of your car, do you?" he says as we cruise down a coastal highway, the city receding into the rearview mirror. "Well, we don't want to dump our CO_2 into the atmosphere either." Maybe the problem, Meckel says, is that the gas is invisible. "If it was purple, and the skies had turned purple by now, everyone would be like, 'Shit. We really screwed up.' Maybe they should just dye the CO_2 that's coming out of the stacks and let people see where it goes."

By some estimates, there's enough suitable rock on Earth to lock away centuries' worth of CO_2 emissions, past and future. The Intergovernmental Panel on Climate Change, the world's preeminent climate-science body, has repeatedly affirmed that extensive long-term carbon storage is likely necessary to meet any of its targets to seriously mitigate the overheating of the planet. Globally, in 2021, a paltry 37 million metric tons were sequestered—roughly what the Port Arthur metropolitan area emits in a year. Meckel and his colleagues have worked hard, with millions of dollars in funding from the petroleum industry, the state of Texas, and the federal government, to prove that the Gulf is the best place in the country, if not on Earth, to get this new industry truly ramped up.

The work has focused on mapping the region's underground rock, a process that combines physical evidence, computerized extrapolation, and intuition. Meckel's university lab in Austin holds a gigantic collection of well logs—long paper strips, rather like the printouts from a heart monitor, that reveal instant-by-instant, centimeter-by-centimeter measurements of myriad features of the underworld, typically from sensors that have been carefully lowered thousands of feet into a borehole. (The folded strips are stored in narrow manila envelopes in row upon row of metal shelves in the basement.) Meckel and his colleagues augmented the logs with 3D seismic data, which they got at a discount; the data company selling it had seen a drop-off in interest in the Gulf from oil-and-gas drillers. Armed with that data, Meckel says, they began to "mow the ground" along the coast, methodically assessing it.

The search drew their attention to a layer of sandstone from the Miocene epoch, ranging in age from 5 million to 23 million years old, which lies partly under waters controlled by the state of Texas and stretches into Louisiana. The layer is porous (lots of holes to hold liquid) and sits close to many big polluters (lower piping or shipping costs for the waste CO_2). The sandstone is also covered by a less porous layer of rock that can act as a carbon-tight seal. Meckel and his team built new computer models, then ran simulations of how injected carbon dioxide might flow through the rock. By 2017, they had published an atlas of the Gulf Miocene layer, 74 pages of intricate maps and tiny print.

The year after that, events in Washington transformed the atlas from an academic treatise to an economic playbook. Amid rising climate concern, Congress fattened a federal tax credit for carbon capture and sequestration that until then hadn't attracted much commercial interest. The new subsidy, modeled broadly on ones for renewable energy, gave developers a credit topping out at $50 for every ton of waste carbon dioxide they captured and geologically stored. That $50-per-ton prize coincided with a surge in warming-related natural disasters, which catapulted climate change to the top of many corporate agendas. It also launched the US carbon-storage race. Meckel's atlas, available to anyone, became the racers' guide to the best route.

The result today is that, more than a century after opportunists first swarmed the Gulf to profit from its hydrocarbons, a new swarm has descended, this time to profit from mitigating the damage those hydrocarbons have wrought. A quest that just a few years ago was a science project has become a high-stakes contest to lock up good rock. Within about a 75-mile circle around Port Arthur, more than half a dozen industrial-scale projects are in various stages of preparation.

Their backers include oil giants such as ExxonMobil, ConocoPhillips, BP, and TotalEnergies, which have announced the possibility of more than $100 billion in investments; major pipeline operators, which see human-generated CO_2 as a huge new market; renewable-energy developers who once lambasted fossil fuels but now want to decarbonize them for profit; and landowners who sense a new way to monetize their dirt. A stampede for capital, land rights, and regulatory approval is underway.

Meckel pulls his Toyota into Sea Rim State Park, a beach on the Gulf. The parking lot is open, but much of it is flooded. Roseate spoonbills wade through puddles on the asphalt.

We wander onto the sand. Looking seaward, Meckel points to a line of oil platforms squatting on the horizon. He envisions dozens of new wells drilled in the coming decades, this time to inject CO_2. "We're talking about a whole area the size of Texas that you can develop for storage," he muses. "Who's not going to think that's a good idea?"

Meckel concedes that carbon storage is a "blunt" and "dumb" approach to curbing climate change. "You're basically just landfilling," he says, not decoupling the economy from the production of heat-trapping gases. But with it, he adds, "you buy the time to use the scalpel to do all the cool stuff," by which he means renewables at a scale big enough to power the planet.

Just off this coast sits what may be Texas' most promising site for a CO_2 landfill, a spot to which Meckel is directing my gaze. It includes a well-mapped block of underwater acreage that oil-and-gas insiders call High Island 24L. In Meckel's color-coded atlas, the rock that will likely accept the most injected carbon is rendered in shades of orange and red. The area encompassing this block is crimson. He and his colleagues have studied it intensely and found it to be especially capacious. As the land spreads east, toward Louisiana, the color holds—and the rock does too.

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LAST YEAR, the Texas General Land Office, which leases out state waters for economic activity, held its first auction for carbon-injection rights. On the block was a 360-square-mile patch of Gulf that includes High Island 24L. The winning bid, for a portion of the big patch, came from a joint venture launched by a startup called Carbonvert, which is run by Alex Tiller, an entrepreneur, and Jan Sherman, a veteran of the oil industry. When I meet them one morning in Port Arthur, Tiller is sporting a version of the standard founder uniform—untucked dress shirt, dark jeans, Panerai watch, Tumi briefcase, baseball cap advertising his startup. Sherman is in jeans and an athletic shirt bearing the maroon logo of her alma mater, Texas A&M University. We head outside and pile into the leather-lined cab of a hulking black F350. The license plates read "88GIGEM." That's as in 1988, the year Sherman's husband graduated from college, and "Gig 'em," the Texas A&M motto. Sherman usually drives her BMW SUV, whose plates read "89GIGEM." Tiller drives an electric Audi.

Carbonvert's story dates to 2018. At the time, Tiller, based in Denver, was running a renewable-energy investment fund for a San Francisco financial firm. His specialty was the trade in so-called tax equity. He would find solar developers whose projects qualified for tax credits but whose tax bills were too small to take advantage of them. Then he would arrange deals in which the developers sold their credits—and pledged revenue from five years of electricity sales—to Tiller's investors in exchange for an influx of cash. Tiller knew the game well. He had learned the tax-equity ropes helping build a solar company in Hawaii, whose sale in 2014 brought him a small fortune. When

→ *Meckel interprets a well log.*

→ *Port Arthur's Motiva oil refinery.*

Congress passed the $50 carbon incentive, Tiller says, he pounced on it as an "opportunity to ride a wave that I'd seen before." But he had "zero idea" about burying carbon. So he hit the conference circuit, where he got wind of Texas' coming auction. He heard of Sherman through a friend and reached out to her—a lot.

Sherman fairly bleeds oil. During college, she spent summers fixing leaks on wells. She worked her entire career at Shell, most recently as head of the company's US carbon-storage business. The month before Tiller contacted her, she had retired, having concluded that a new corporate reorganization made it likely many of her team's projects would slow down. Sherman decided she wanted to either go big with the carbon-storage knowledge she had amassed or go home. At first, she didn't answer Tiller's entreaties. "He kind of stalked me," she says. By February 2021, after a few months of nudging, she signed on.

Sherman was skeptical that the state would entrust a big project to an unproven startup. "I didn't think Carbonvert could do it," she says. "I even said, 'I don't think that the world is going to let us do that.'" But Meckel and his colleagues had revealed "a ginormous storage opportunity in the Miocene formation," she says, so the foundational geologic work was done. Sherman and Tiller struck up a partnership with Talos Energy, a Houston-based firm with offshore experience and its own valuable trove of local seismic data. Then they set about figuring out where, in the area that Texas was expected to offer for lease, they thought they could bury carbon in a way that would please both investors and regulators.

The Carbonvert-Talos team focused on areas pierced by comparatively few existing wells, because those can be paths for carbon dioxide leaks. And because each new injection well would cost between $20 million and $30 million to drill, the team avoided geologic features such as synclines—areas where the rock layer dips, as if forming a bowl, effectively cleaving the injectable acreage. Carbonvert and Talos submitted their bid in May 2021. The list of bidders, according to the Texas General Land Office, included much bigger players, among them Marathon Petroleum, an oil company; Denbury Resources, a major pipeline operator; and Air Products, a chemical company. Three months later, Carbonvert and Talos won a 63-square-mile lease. This will be the future home of Bayou Bend CCS (short for "carbon capture and sequestration"). Earlier this year, Chevron threw its weight behind the project, announcing that it would invest $50 million for half of Bayou Bend.

One of the biggest hurdles now for Tiller and Sherman is to sign up enough polluters to make the project economically viable. The business model envisions that polluters will collect the carbon—and the tax credit—and then pay Bayou Bend a transport-and-disposal fee that Tiller says is likely to be $20 to $25 per ton. (That fee could fluctuate.) Scoring clients is a scrappy, dog-eat-dog process. I get a taste of it as Sherman, with Tiller in the back seat, drives me around Port Arthur in the monster truck.

On paper, grabbing carbon emissions in and around this town should be like shooting fish in a barrel. They're not only plentiful but also localized: A small handful of super-emitters accounts for a large part of the output, and a free and easily downloadable federal database reports each facility's emissions. But a refinery, petrochemical plant, or liquefied-natural-gas terminal is a dizzyingly complex collection of industrial processes, each of which produces CO_2 in different concentrations, ranging from near purity to nearly nil. The less concentrated the carbon in a waste stream is, the costlier it is to capture. According to the National Petroleum Council, the $50 tax credit is enough to incentivize sopping up less than 5 percent of US emissions (mostly from ethanol and natural gas processing plants, whose CO_2 emission streams are highly concentrated). But carbon from, say, a coal-fired power plant or a diesel refinery doesn't currently pay to clean up.

Tiller, Sherman, and their partners ultimately hope to inject at least 10 million tons of CO_2 a year to make the profit on which they and their investors have penciled out the project. To get the financing to break ground, the bar is lower—they will need to have inked contracts with polluters to inject 4 million tons a year. By then, however, Bayou Bend will have spent tens of millions of dollars preparing and designing the project. "There is a bit of a build-it-and-they-will-come philosophy," Sherman says.

The crux of the dilemma is that only about 2 million of the 35 million tons of industrial CO_2 emitted annually by large facilities in the Port Arthur area, which includes neighboring Beaumont, is, as Tiller puts it, "low-hanging fruit"—meaning that the tax credit of $50 a ton can cover the cost of capturing, transporting, and burying it.

Back in the truck, which is stocked with 2-pound tubs of honey-roasted peanuts and cheddar Goldfish for long days of sleuthing, Sherman drives us by the oil refinery that opened just after Spindletop. Today it occupies 2 square miles and

← *Jan Sherman and Alex Tiller in front of an oil rig.*

"I DIDN'T THINK CARBONVERT COULD DO IT. I EVEN SAID, 'I DON'T THINK THAT THE WORLD IS GOING TO LET US DO THAT.'"

emits millions of tons of CO_2 every year. "Most of this is all $50 or higher," she says, her right hand on the steering wheel as her left hand sweeps across a windshield filled with the facility.

The next morning, Sherman, Tiller, and I take a boat ride from Port Arthur to the area of the Gulf that they have leased. Over the engine roar, Tiller explains to me that he gave our charter captain only the vague location of the lease area. "He's under NDA"—a nondisclosure agreement—Tiller yells.

When we reach the prospective carbon-injection area, the captain idles the boat. We're in about 40 feet of water; the rock into which the Carbonvert group hopes to inject greenhouse gas is more than a mile and a half below that. I check my phone; it still gets service, because we're only about 5 miles off the coast. To the east, hulking tankers, many of them carrying liquefied natural gas, head out to sea. To the west, every now and then we see a shrimping boat. It's a beautiful morning on the water. And everything in view is belching carbon.

Toward the end of the trip we motor up the Gulf Intracoastal Waterway, a constructed canal that serves as a long driveway in which ships park and take on product from Port Arthur before ferrying it to the world. We pass a biodiesel plant, one of the biggest in Texas, and the boat captain mentions that he used to work there. Sherman plies him for details about the places in the plant that emit carbon. "Where would it come from?" she asks.

Even if the Carbonvert consortium signed up every pound of carbon dioxide it needed, it would still face another hurdle: The US Environmental Protection Agency has yet to issue its first permit for large-scale commercial carbon injection. Permit reviews are widely expected to take years, and the outcome isn't assured. The proposed Bayou Bend project will eventually need as many as 10 injection wells, each of which must win an EPA permit. The timing of that, Tiller says, is "an enormous risk."

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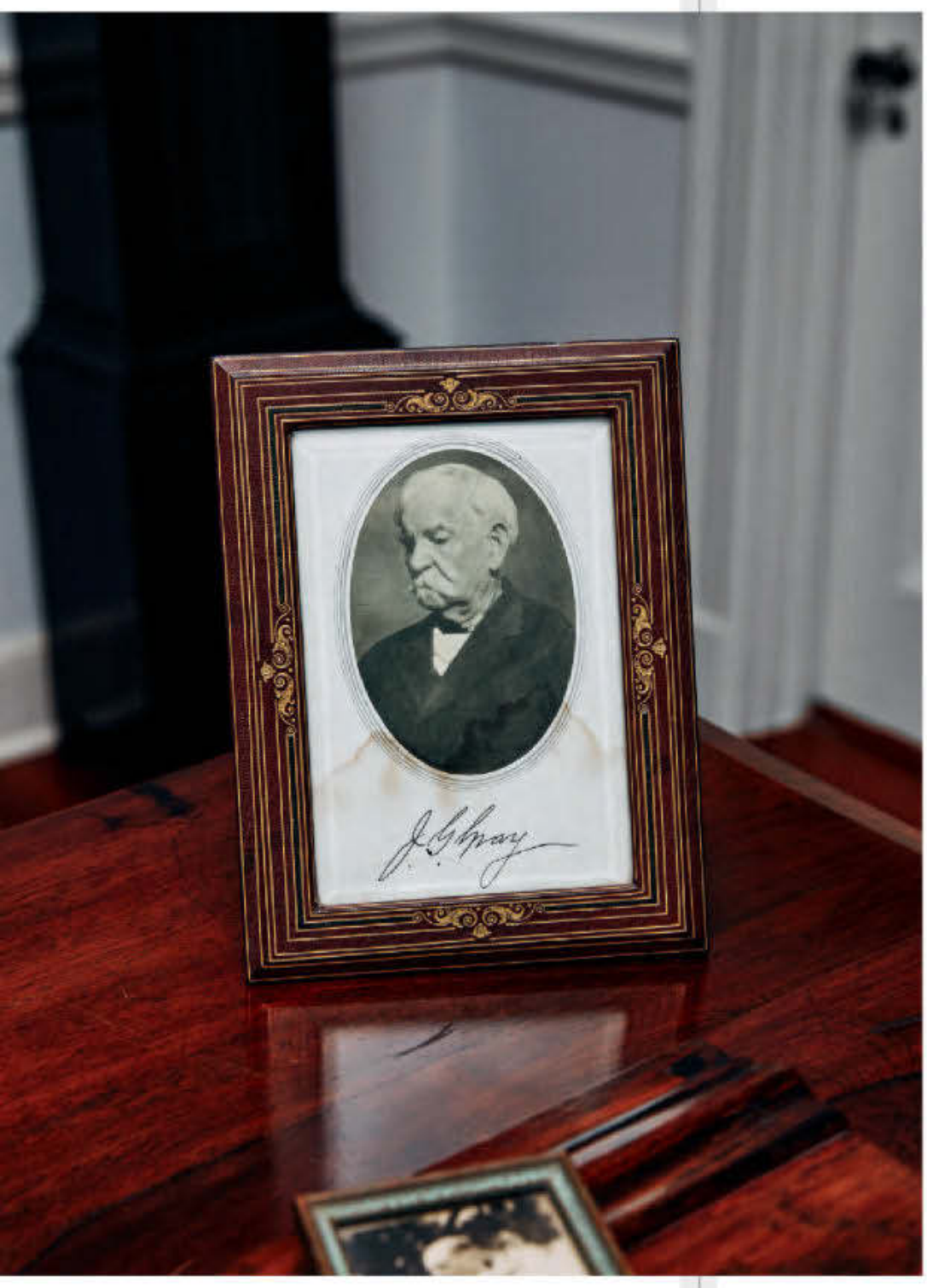
IF ANYONE IS at the front of the line of the EPA approval process, it's a man named Gray Stream, the steward of a roughly 100,000-acre patchwork of southwest Louisiana that Meckel's atlas suggests is at least as red as High Island 24L. Stream is a scion of the Louisiana dynasty that owns Gray Ranch, and he's betting that his chunk of Gulf Coast rock gives him pole position in the carbon-storage race. "Mine goes to 11," he tells me, smiling wryly as he evokes a line from *This Is Spinal Tap*, the 1984 mockumentary about a British rock band with extra-loud amplifiers. He hopes the EPA, in particular, will like his ranch's carbon-carrying capacity.

Stream grew up in Nashville and went to college at Vanderbilt, then did a stint as a legislative aide on Capitol Hill. He hoped to become a Navy SEAL officer, but when that didn't pan out he dove into managing the family business. His office is in a former bedroom in the family's business headquarters—a grand, colonnaded red-brick house in the city of Lake Charles built in 1923 by Stream's great-great-aunt, a noted collector of Fabergé eggs. The office is decorated today with intricately carved walking sticks and antique sabers. It overlooks the backyard, which boasts a Japanese tea garden and, as if out of a Faulkner novel, a two-story, octagonal pigeonnier.

Stream assumed his filial responsibilities in 2004, at a time when diversifying beyond oil and gas was becoming increasingly important to the family and the region. That was partly because fields deplete over time, and those beneath Gray Ranch had been pumped for a century. But it was also because momentum in the oil-and-gas industry was starting to shift to so-called unconventional plays—the shale that fracking had unlocked—and Gray Ranch was conventional rock. The surge in shale production was spurring an industrial boom in and around Lake Charles. But on Gray Ranch, as on much of the land along the Gulf Coast, production was in a long decline.



← *Portrait of John Geddings Gray.*

In 2018, when Congress increased the carbon-storage tax credit, Stream started having ideas. He and some colleagues consulted the work of Meckel and others—not only their assessments of the Miocene layer under the Gulf but also an earlier experiment involving a layer of rock called the Frio.

The Frio sits below the Miocene layer. One of its chief allures is that, beneath Gray Ranch, it's particularly thick—and therefore, at least theoretically, able to hold a lot of CO_2. It's also far below sources of drinking water and is topped by the Anahuac shale, which appears to be a carbon-tight caprock. After extensive study, Stream and a team of technical experts he hired decided to bet their bid on the Frio. He says he hopes the EPA will see its combined characteristics as a "belt-and-suspender" approach—a level of safety that will give the agency confidence that his company, Gulf Coast Sequestration, deserves to become the country's first commercial collector of other people's carbon trash.

Applicants for EPA carbon-storage permits must persuade the agency that they can contain both the plume of injected carbon dioxide and a secondary plume of saltwater that the CO_2 displaces from the rock—what drilling engineers call the pressure pulse. The EPA requires evidence that neither plume will contaminate drinking water while a project is operating and for a default period of 50 years after CO_2 injection stops—but the agency can decide to shorten or lengthen that for a particular project.

Stream employs a well-heeled team, including oil industry veterans and a former top EPA official, to shepherd the permit application, which was submitted in October 2020 and which remains, nearly two years later, under agency review. Inside his company, Stream dubbed the carbon-storage play Project Minerva, after the Roman goddess of wisdom (and sometimes of war).

Heading up the technical work is a British petroleum geologist named Peter Jackson, who used to work at BP. His team planned for Project Minerva in much the way Meckel's UT group had mapped the Gulf Coast. Using well-log and 3D seismic data, the scientists modeled the Frio under several tens of thousands of acres on and around Gray Ranch. Then they simulated how the carbon dioxide plume and the pressure pulse would behave, depending on where they drilled wells and how they operated them.

In their computer models, the resulting plume movements appeared as multicolored blobs against rocky backgrounds of blue. The best blobs were round, a cohesive shape that suggests the plume will be easier to control. In other spots, the CO_2 wouldn't behave: Sometimes it escaped upward; other times it spread out like a pancake or, Jackson recalls, "like a spider." Either shape, the team fretted, might degrade project safety and set off alarms at the EPA. The simulations led the Stream team to choose two general locations on the ranch where they intend to drill wells.

The Stream family offices in Lake Charles.

Stream agrees to show them to me one morning. He picks me up in Lake Charles in his decked-out black Chevy Tahoe, and we head west, toward Texas, until we're several miles shy of the state line. We exit the highway at the town of Vinton, Louisiana, and arrive at Gray Ranch. We turn right onto Gray Road. We turn left onto Ged Road. Then, beside cowboy-boot-shaped Ged Lake, we mount a subtle rise known as the Vinton Dome.

These are iconic names in Stream fam-

"The risks of CO_2 going into the atmosphere are more fundamental than the risks of CO_2 going into the ground."

Gray Stream visits with the horses at Gray Ranch.

ily lore. As early as the 1880s, a local surveyor named John Geddings Gray—"Ged"—started assembling this acreage to profit from timber and cattle. Four years after the gusher at Spindletop, Ged saw in the Vinton Dome a topographically similar prospect, and he bought it too. He opened the area for drilling, and his hunch paid off.

Today, the top of Vinton Dome offers a panorama of part of the Stream empire. To the right stand barns bearing the family's cattle brand and quarter-horse brand. All around, rusty pump jacks rise and fall, pulling up oil and gas. Stream, Ged Gray's great-great-grandson, likens the ranch to the cuts of beef he grills for his three young children, who think he's the best steak cooker around. "It's only because I just buy the prime fillet," he says. There's one rule: "Don't screw it up."

We stop at one of the expected well sites. The area around it is resplendent with wire grass, bluestem, and fennel. It's frequented by three kinds of egret: cattle, great, and snowy. This being Louisiana, it's also stamped with a line of yellow poles; they mark the underground route of the Williams Transco Pipeline, which whooshes natural gas from offshore platforms in the Gulf to the interstate gas-distribution system. If it seems strange that this ranch, which for a century has served up fossil fuels, may play an influential part in curbing greenhouse gas emissions, it's also instructive—a measure of how economic signals are changing in a part of the world that has long adapted the way it exploits its natural resources to meet shifting market demand. "People are ultimately going to have to put up" to tackle climate change, Stream says. "They can't just talk about it."

Stream is right: Humanity must choose. As he talks, I'm reminded of Meckel's reaction when, as we stood on the beach, looking out at the waves over High Island 24L, I asked the geologist about the dangers associated with storing carbon dioxide underground. I brought up a bizarre disaster that struck Cameroon in 1986, when a massive, naturally occurring cloud of carbon dioxide suddenly burped up from the depths of Lake Nyos and fell onto nearby villages, crowding out ambient air and asphyxiating to death an estimated 1,800 people. "Now that we know that shit happens, put a sensor down there," Meckel told me, pointing to the Gulf. (At the Cameroon lake, a vent was added.) Meckel doesn't deny there are dangers. But, as he told me in another of our conversations, people "have to decide that the risks of CO_2 going into the atmosphere are more fundamental than the risks of CO_2 going into the ground."

Meckel, of course, was arguing his pocketbook—and that of the fossil fuel industry, which helps fund his work, and of Carbonvert, and of Stream, and of each of the companies now gunning to make a buck from carbon burial. Yet his point stands: Every potential climate fix carries risks.

Storing carbon at a scale large enough to materially help the climate is now, many scientists say, a must. But it would require facing devilishly difficult dilemmas that extend beyond the technical to the philosophical. What level of confidence should regulators demand before blessing a proposed carbon-storage project as unlikely to leak? Who should be held legally responsible for monitoring the safety of injected carbon, and for how long, and with what penalty for failure? Fights between environmentalists and industry over such questions are growing more intense. And yet, as always in the battle over what to do about the climate, if anything significant is to happen, someone will have to budge, and something is almost certain to go wrong.

Along the road from Beaumont to Port Arthur is a museum dedicated to the Spindletop gusher. It houses a life-size replica of part of a turn-of-the-century boomtown—a vision of the good life, lubricated by oil. The museum stages free gusher reenactments, using water. A long wooden boardwalk guides visitors to a pink granite obelisk, where an engraving on the base says petroleum "has altered man's way of life throughout the world."

When the prospectors at Spindletop sold their first barrels of crude, they didn't know the trade-off they were making on behalf of all humanity. They didn't know that the price of cheap energy and better living through petrochemicals would be environmental degradation at planetary scale. We have been playing with fire, and it has warmed us and burned us. This suggests a broader lesson worth remembering as we advance, however slowly, from the age of hydrocarbons through the age of decarbonization to the age of renewables. Maybe, when we encounter energy's next big threat to the environment, we can resist the urge to stick our heads in the sand—and so avoid the last-ditch, multitrillion-dollar, existential slog to bury the problem.

JEFFREY BALL *(@jeff_ball), formerly* The Wall Street Journal*'s environment editor, writes about energy and the environment and teaches at Stanford.*

SHOOTING IS CHILDSPLAY

"I wanted to capture the symbol of youth and innovation represented by Kard, an online bank for teenagers," says photographer Julien Faure of his encounter with Scott Gordon and Amine Bounjou, founders of the fintech-for-kids startup. "The playground we shot in matched their branding perfectly—and it turned out some of the kids playing basketball there were card-carrying Kard customers. It was all really harmonious."

Colophon

CATCHING HIS EYE

Ben Quinton took a trip to Fraserburgh in Scotland to visit Rooser, a firm digitizing the fishing industry: "Seeing the huge variety of fish coming through the factory was an eye-opener—so many vibrant colours. I had no idea we had such things around our coasts."

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Royal Way was founded by the Young Portuguese entrepreneur Luisa Ferreira dos Santos in 2019, deciding to create and design her own brand with the beauty of elegant jewellery made of waterproof material (stainless steel) as well as portable personalised leather jewellery boxes. The brand also offers an elegant clothing line. Visit **royal-way.pt** and follow on IG: **@royalway_lfs**

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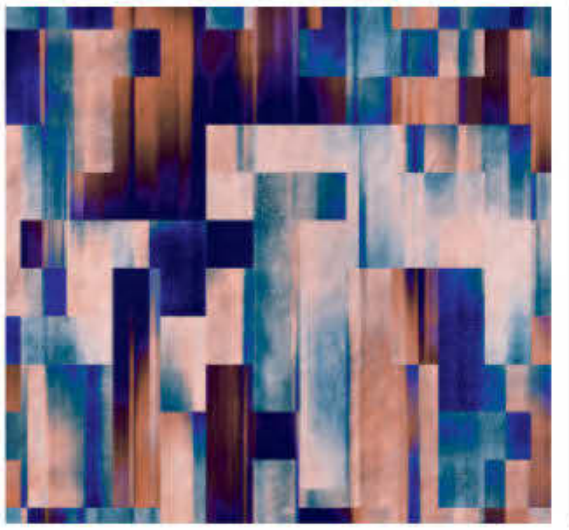
Enriching surfaces with artful conceptions, rhythms of infinity, and design for integrity are the heart of brand mk allure, founded by Slovenian designer Mojca Kosir. Featured: artwork snippet SOURCE from EXPANSION ZONE collection designed for Fabric Bank. Available as customisable wallpaper or upholstery fabric at **mk-allure.com** and follow on IG: **@mkallurepatterns**



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WOLKOV

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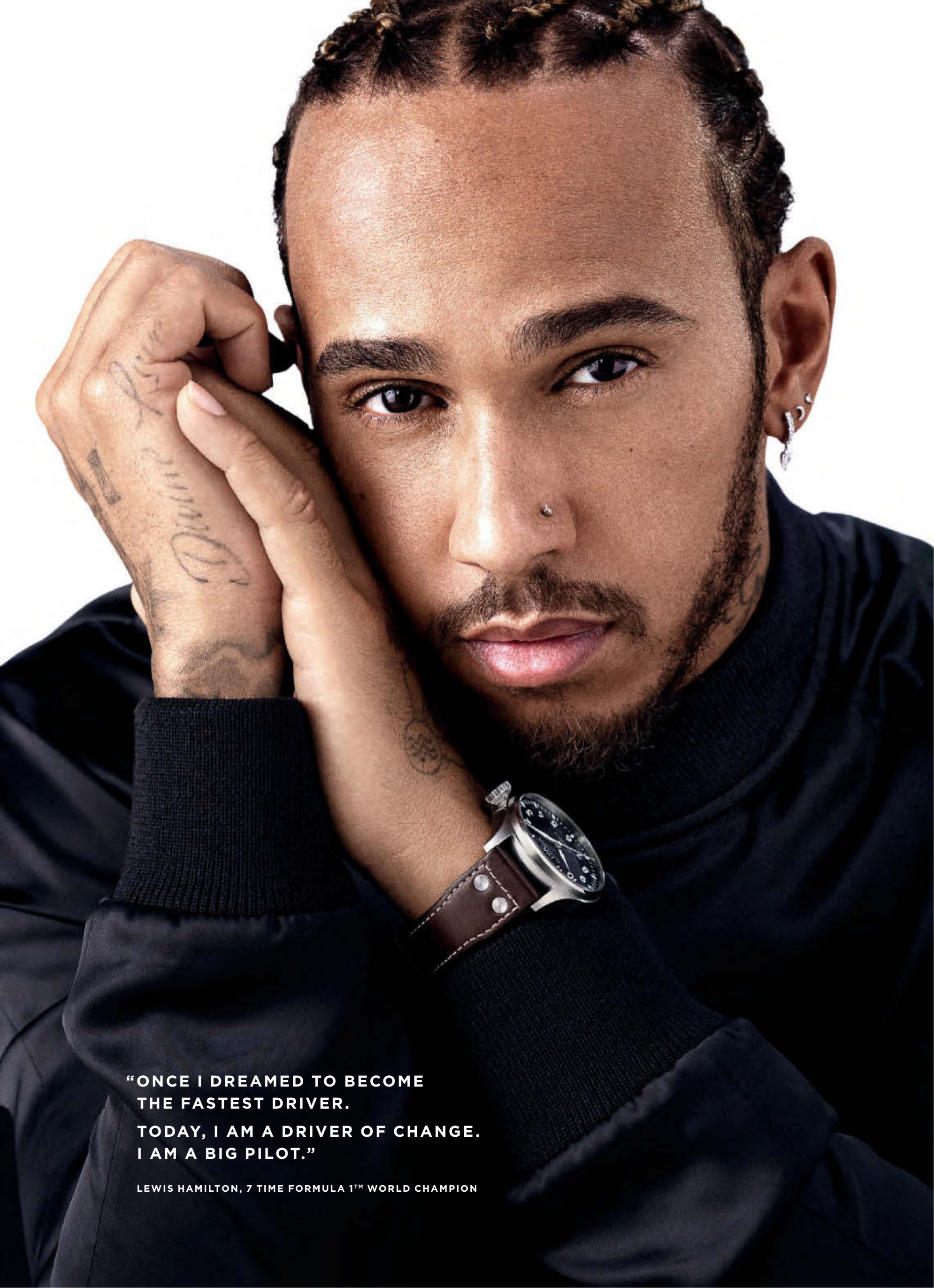
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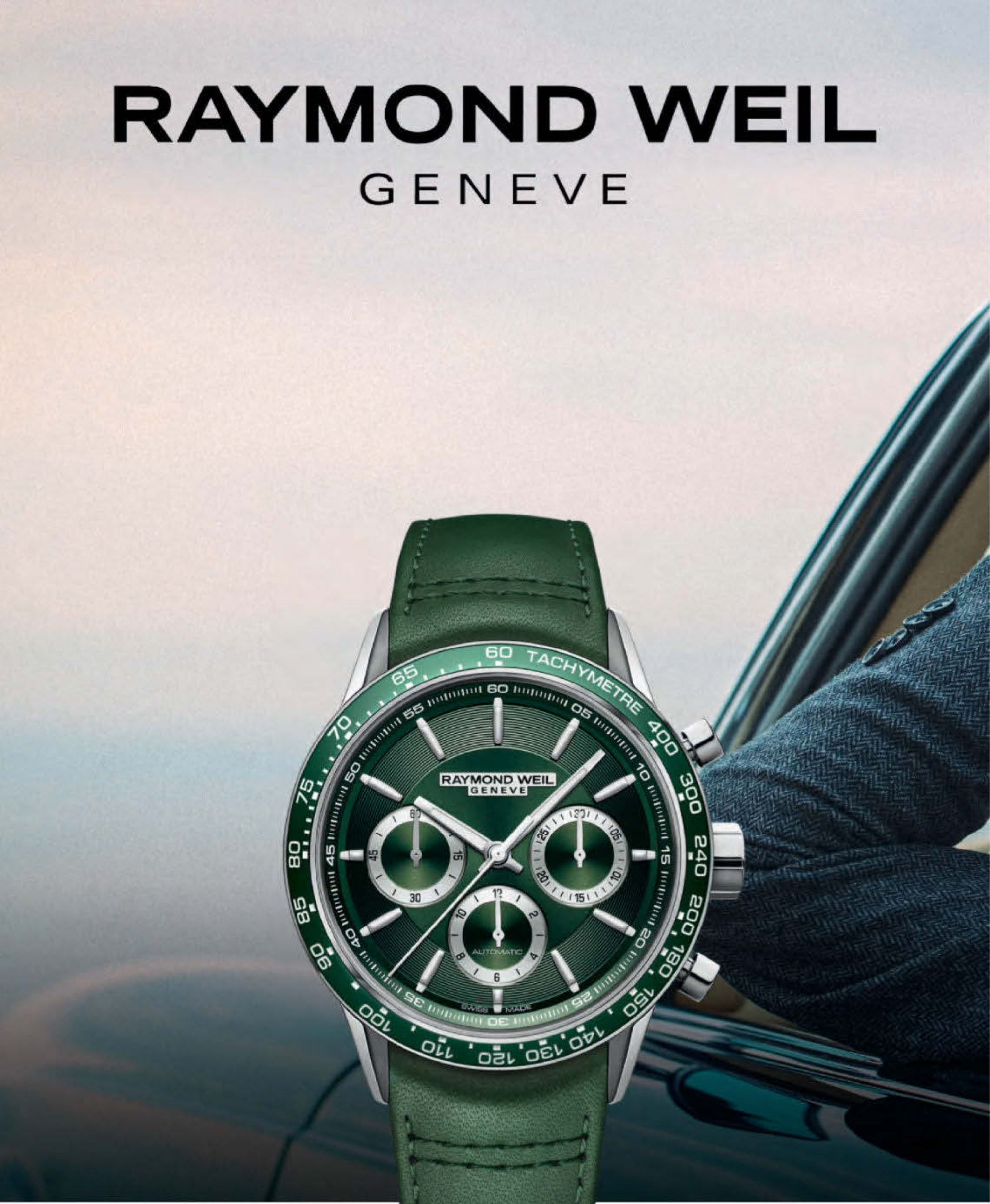

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SEIKO 5 SPORTS GMT SKX RE-INTERPRETATION

WIRED has long been a fan of Seiko's 5 Sports collection, and its new 42mm Black Grape GMT brings serious secret-agent vibes to the line. Of course, when we say "new", the SKX watches are really a reworking of models first launched in the 90s, themselves updates of 1960s originals. Refreshingly, Seiko's tinkering has not dulled the design, and even stays true to the classic "beads of rice" bracelet. Although a GMT, and oh-so handy for travel with the ability to show a second time zone, it will also serve as a capable diver, thanks to its 100m water resistance, grippy bezel, and legible dial (but go for the Mikan Orange version if you're getting it wet). Inside, there's the calibre 4R34 automatic movement, and a 41-hour power reserve. *£400 seikoboutique.co.uk. See p42 for our stealthy-watch picks*

PHOTOGRAPHY (COVER): LISA SHEEHAN. WORDS: JEREMY WHITE

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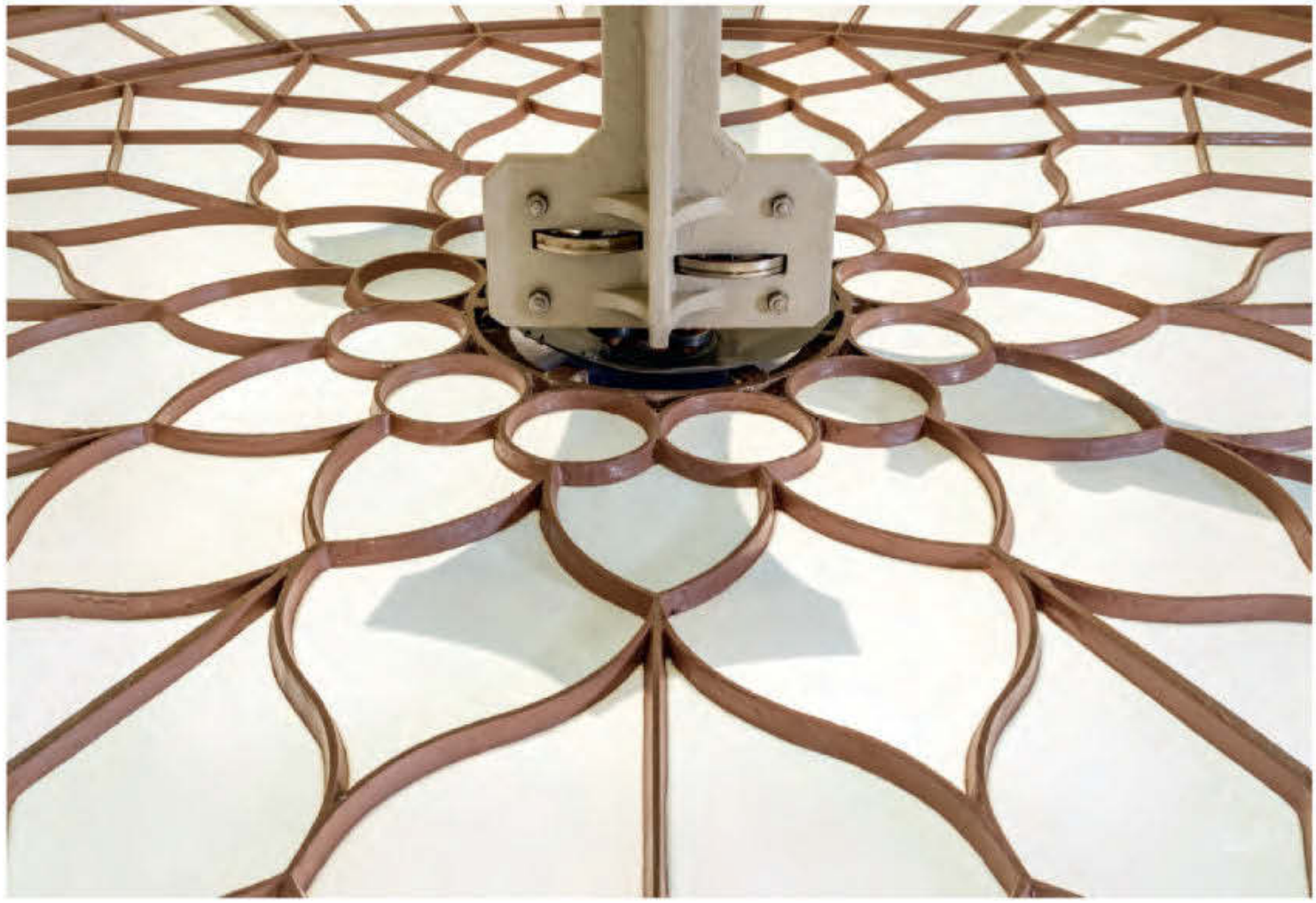
BIG BANG INTEGRATED TIME ONLY

Titanium case with integrated bracelet.
Self-winding movement.

A Gothic Revival

London's beloved Big Ben is emerging from an £80 million overhaul that used digital ingenuity to future-proof 'the smartphone of 1859'.

By Alex Doak. Photography: Alastair Philip Wiper.



Previous, left: The famous Big Ben bell (centre), with a quarter-bell in the foreground. Above: Behind one of the Elizabeth Tower's iconic dials, which were also refurbished.

Visitors to London's Westminster are forgiven for having been confused lately. Ever since scaffolding started peeling from the Houses of Parliament's Elizabeth Tower—or Big Ben to most—it's been acting rather erratically. Surely, after its £80 million and six years of conservation work, the world's most accurate public, or "turret" clock, should be ticking better than ever?

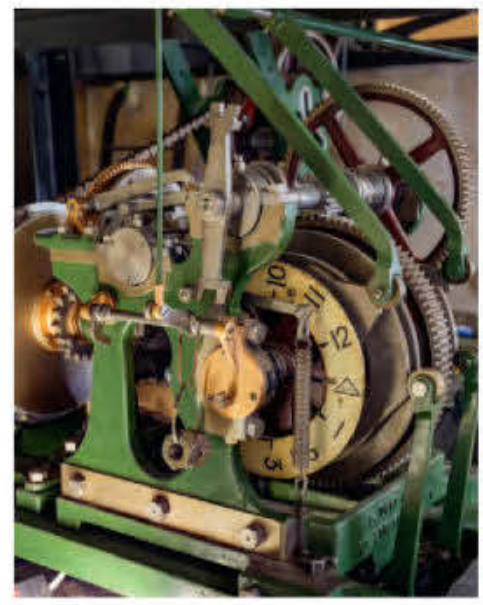
It will be. But not before 13.5 tonnes of iron and brass mechanics, including their drive weights, ropes, and a 170kg pendulum, as well as eight hours- and minutes-hands, have been reinstated.

Repair work on Westminster's Victorian, neo-Gothic icon started in 2017. Hundreds of specialists, from gilders to masons and glaziers, undertook the most complex conservation project in the tower's history, after decades of stone-crumbling pollution and weather, previously undiscovered asbestos, and visitor groups traipsing those famous 334 steps (UK citizens can write to their local parliamentary representative to request a free tour). But for the clock itself, all 1,000 components took a holiday to Dacre, Penrith, some 270 miles north of London.

'We transplanted the ticking heart of the UK up to Cumbria. It became like part of the family, and its return was like a child leaving home.'

"We transplanted the ticking heart of the UK up to Cumbria," says Keith Scobie-Youngs, director of the Cumbria Clock Company. "We were able to assemble the timekeeping core, and put that on test in our workshop, so for two years we had that heartbeat ticking away. It became part of the family, and its return to Parliament was like a child leaving home."

Below: The restored auto-winder mechanism from 1908.



He and his team at the Cumbria Clock Company's workshops, deep in the Lake District National Park, were charged with the task of not only painstakingly cleaning, repairing and restoring the clock (all under the strictest secrecy, for fear of theft), but making detailed photos, notes and drawings, as neither the designer Edmund Beckett Denison nor manufacturer Edward John Dent did so back in 1859. The result is the first-ever user manual and set of engineering diagrams for "Big Ben".

"The work went well," says Ian Westworth, who heads up the Palace of Westminster's three-strong team of clock keepers, "because CCC are great, but also because the clockworks were incredibly well made in the first place. It's Victorian engineering on steroids."

As well as documenting the assembly itself, a large part of the work in Cumbria has been to adjust design flaws and retro-engineer features for easier servicing. Lubrication points have proven pivotal, shoring-up bearings that were hard to access in the past, such as those of the clock hammers. "We also invested in making lots of tools for easy ongoing maintenance," Westworth reveals. "Milling-out

'The clockworks were also incredibly well made in the first place. It's basically Victorian engineering on steroids.'

new spanners to fit obscure nuts, for example. Or, on a bigger scale, a set of gear pullers to ease those 300- and 100-kilo hands from each of the four dials' axial shafts. We fabricated a frame that sits behind the hands, mounted by two protruding arms on a thread that, when turned, gradually 'pinch' off the hands from their arbors."

Big Ben's mechanism was revolutionary for it being fitted with a "double three-legged gravity escapement", which regulates the speed of the mechanism's "tick" more steadily than anything before it. It "detaches" the impulse of the pendulum—its swing fine-tuned, famously, using old English pennies placed on top—from the escape wheel connected to the clock hands' precisely ratio-ed geartrain. Thus, the pendulum is kept in motion by an utterly consistent pulse (powered by weights hanging the length of the tower), unaffected by wind, rain or snow swirling about outside.

"It's been a huge privilege to follow in the footsteps of the greats and become part of its story," says Scobie-Youngs, who established the UK's leading turret-clock maintenance firm in 1990, and counts the country's oldest (that of Salisbury Cathedral) among its wards. "All clocks absorb their makers, they say. Not least John Vernon, the chap who first ventured up the Elizabeth Tower in 1976, when metal fatigue had caused the tightly loaded mechanism to literally explode, taking chunks out of the interior masonry. In fact, without John, we wouldn't be doing what we're doing, thanks to his singlehanded repair work. We even discovered his name scratched on the weights."

Scobie-Youngs, Westworth *et al*. found that getting into the head of Dent and Grimthorpe proved as important as the metalwork. Besides Vernon's 1976 notes, they had an 1860 edition of *A Rudimentary Treatise on Clocks, Watches and Bells for Public Purposes*, which Grimthorpe had updated with an 18-page chapter on "The Westminster clock", just one year young.

"Sitting and reading it up in the Tower," Scobie-Youngs recalls, "I realized Vernon only had a front elevation of the geartrain [the meshed cogs forming the core clockwork] to go on, illustrated for the frontispiece. Before turret clocks were industrialized with the advent of standardized GMT, clockmakers just did the gear ratios, then built the mechanism as they went along. As a result of disassembling the entire mechanism for the very first time, we've taken the opportunity to create a full suite of 3D CAD drawings, working with my brother Rob, whose company Tempus Consulting is usually in the business of robotics and motor drives. Thanks to him, there'll be no doubt whatsoever for the next generation of palace clock-keepers."

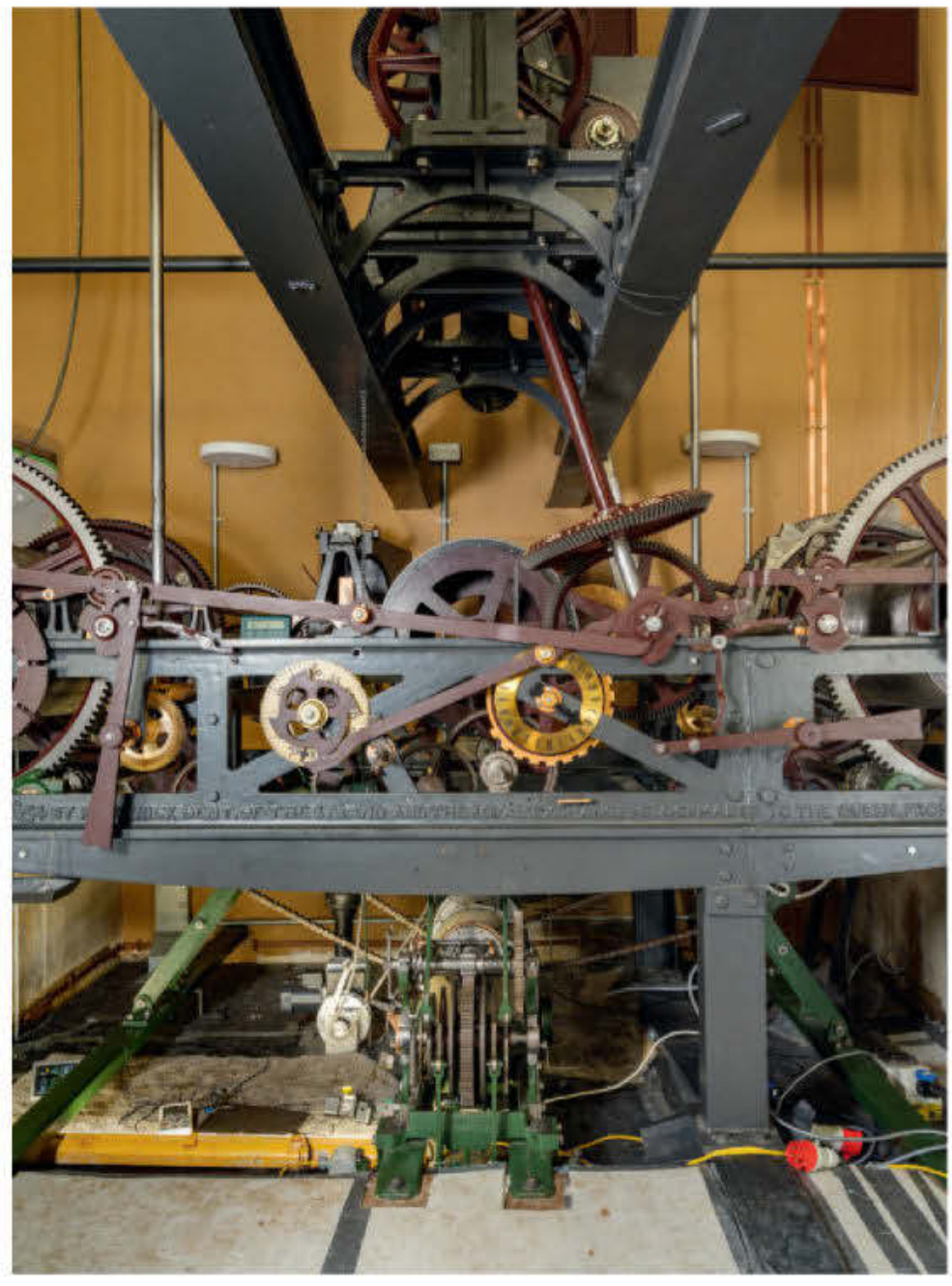
Naturally, this 3D modeling proved to be a whole new world to a certain breed of artisan more used to an anachronistic approach. But now, every elevation of every major component has been drawn up on a traditional drawing board, then entered into a CAD program (Tempus uses Autodesk's Inventor), and rendered as 3D files.

Above: A fully rotatable 3D render of the mechanism.

"It's afforded us a fresh perspective on the mechanics buried deep inside. The ability to rotate in all angles means any faults occurring in the future will be easier to diagnose," says Scobie-Youngs.

So, if you're planning on visiting Westminster from October 2022, rest assured: you'll be able trust all four dials to set your watch, more than ever.

Below: The Elizabeth Tower's Mechanism Room holds the beating heart of the clock, now restored to its home.



Weighing up your options

That heavyweight mainstay of the wristwatch—the metal bracelet—is exploring its lighter side.
By Tim Barber.

The stainless-steel bracelet wristwatch has become, arguably, the definitive trend in modern watches—such models today comfortably outsell those on straps (a significant reversal on the situation a decade ago), while aftermarket versions of the most famous, sports-luxe bracelet watches go for eye-watering premiums. But the re-rise of the bracelet watch, and in particular the weight it adds to the wrist, has also spurred interest in materials other than stainless steel or precious metals. In 2022, titanium—durable, non-corrosive, and far lighter than steel—has come of age in the luxury watch world, across price points and styles.

A. Lange & Sohne Odysseus in titanium, £48,600

Oris, for instance, is known for the significant value, both in technical specs and aesthetic quality, that it offers in watches largely in the sub-£3,500 range. Its ProPilot X Calibre 400 is ostensibly an extension of its tech-forward aviation watch range. But in streamlined, matte-finished titanium set off by a minimalist dial in coral pink, it turns into something else entirely. Powered by Oris's impressive automatic movement, which includes a five-day power reserve, elevated anti-magnetism, and a 10-year warranty, it becomes a svelte, unisex upgrade of the classic integrated bracelet watch: sculptural and eye-catching, combining both significant technical content and the smooth, lightweight feel of a smartwatch. It finds its *haute horlogerie* equivalent in a new titanium iteration of A. Lange & Sohne's sports-luxe entrant, the Odysseus. Previously, it was impossible to imagine the achingly conservative German firm creating anything as casual as the Odysseus (which was introduced in 2019), let alone doing so in a material as ignoble as titanium. But turning its attention to a metal more associated with aircraft manufacturing than super-deluxe watchmaking has not prevented A. Lange & Sohne applying its renowned handcraft and attention to obsessively perfect finishing, right down to the mirror-polished edges of every link in the bracelet. The weightlessness of the material is matched inversely by the heavyweight sense of craft and detail in a watch that is robust—the apotheosis of sports-luxe, in fact.

Oris ProPilot X Calibre 400, £3,200

A more decorative take comes from Hublot, and its collaboration with French artist Richard Orlinski. For some years, Hublot has been transposing the angular, faceted surfaces of Orlinski's Pop Art sculptures into watches, hitherto in ceramic and precious metal pieces on straps. In the new titanium version, the aesthetic extends across the dial and case into the complex geometry of a brand new bracelet, all in Grade 5 (aeronautical quality) titanium. Each center-link alone bears six facets, a significant challenge in machining and finishing, and makes a striking background for diamond-set versions.

Hublot Classic Fusion Orlinski titanium, (diamond-set £37,000)

SEIKO

SINCE 1881

It’s all in the next-level timing

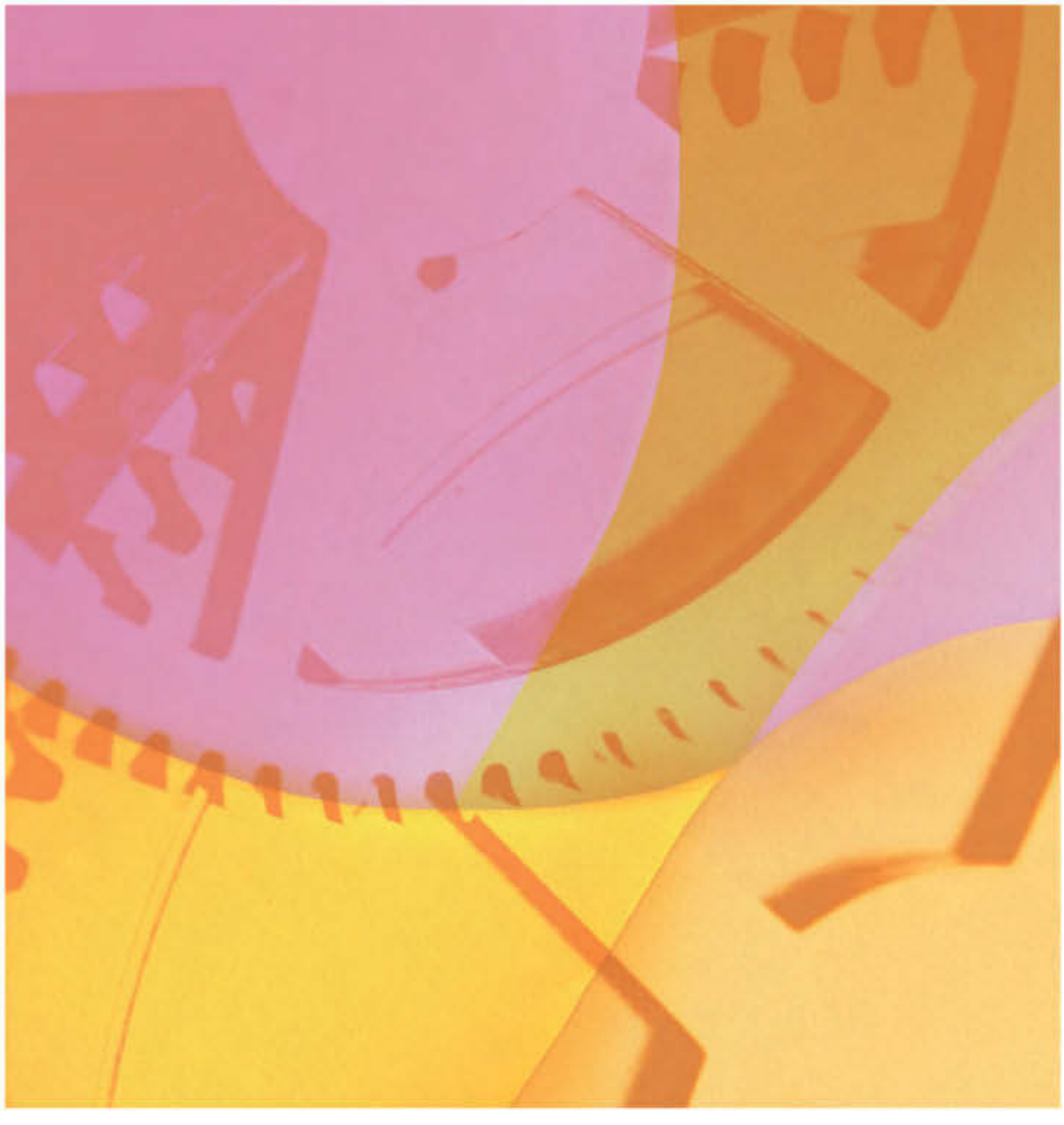
Chronographs are a long-established complication for many brands, but a rare few still push the boundaries. By Chris Hall.

Patek Philippe 5470P-001, £poa *patek.com*

Perpetual calendars or tourbillons might command a higher price, but the chronograph is unique in the engineering challenges it poses. Interrupting the flow of time at a whim, starting and stopping a fragile mechanism thousands of times over, requires precise mechanics. It took the finest minds of the 1960s nearly a decade just to combine a chronograph with an automatic winding mechanism, and the vast majority of mainstream chronographs today still run on the descendants of these middle-aged calibers. So, it’s all the more impressive when watchmakers design not just new chronographs, but exceptionally advanced ones—and of late, we have had several examples enter the fray. The most loudly heralded (and visually striking) of the bunch is the MB&F LM Sequential Evo. Followers of the high-end Genevan brand will remember fondly the LM Perpetual Evo of 2015, which dramatically reinvented the perpetual calendar, and this model does the same for the chronograph. It actually packs a movement with two chronographs side-by-side, allowing for simple, split, sequential or cumulative (think chess clocks) timing, a dazzlingly complex array of functions that’s showcased by the watch’s openworked design. All of which is doubly impressive when you consider that it’s the brand’s first chronograph of any kind. Founder Max Büsser was determined only to enter the game if he could bring something new. Not a month later came news of another much-loved independent watchmaker producing its first chrono: the Grönefeld 1941 Grönograaf (yes, the pun is intentional). Netherlands-born brothers Bart and Tim Grönefeld announced their latest with less fanfare, and it breaks fewer technical boundaries, yet is still a sensational take on chronograph watchmaking that fuses classical and contemporary influences. Notably, it tackles one of the recurring problems in chronograph engineering—that of the sudden slamming to a halt experienced by the hands when stopped—by incorporating a “governor”, which is a flywheel-like system that dispels the hands’ inertia for a more mechanically-sympathetic “soft reset”. Making top-grade chronographs requires top-grade budgets, as well as technical genius, so it’s no surprise to find Patek Philippe here. Announced in April, the 5470P-001 is the brand’s latest technical masterpiece. Packing 31 separate patents, seven of them newly filed for this movement, the watch is a high-frequency chronograph capable of timing to intervals of 1/10th of a second. It’s a goal already achieved by others, but Patek Philippe has developed a movement with so many improvements in efficiency, resilience and conceptual simplicity that the whole thing amounts to a masterclass in problem-solving. Because, as all three of these watches attest, it’s not just about the end result, but how you got there.

Grönefeld 1941 Grönograaf, €155,000

MB&F Sequential Evo, CHF 172,000



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This 12-position machine makes adjustments to mainplates that form the base of each movement.

Machine learning

Serial disruptors Ulysse Nardin and Girard-Perregaux are keeping each other at the vanguard of horological technology, combining automation and experimentation under a shared roof that's theirs alone. By Alex Doak.

Late January this year, Parisian luxury giant Kering made a shock announcement: it was offloading both of its luxury-watch brands, Girard-Perregaux and Ulysse Nardin, wholesale, and for far less than the €1–1.2 billion that industry analysts believe Kering has invested since 2011. The transaction was still ongoing at the time of writing, but management, led by a former Apple executive who started his watch career at TAG Heuer, appears to have bought back full, 100 percent ownership.

It was certainly a surprise to me, fresh from a pre-Christmas visit to the Kering Watch Manufacture in Switzerland: Ulysse Nardin's purpose-built facility of 2003, in which it has bunked-up with Girard-Perregaux since 2020. The cross-fertilization of more than 400 years of horological innovation is undeniably potent, but given a combined output of a little over 20,000 watches a year, the clout of Kering, with all its cash-cow stablemates (Gucci, Bottega Veneta, Alexander McQueen) still seemed crucial to the medium-term upkeep of this impressive multi-storey hive of micro-tech.

Morgan Stanley reckoned Kering's sale was a positive move, saying the French group "is now in a position of having no real 'problem child' in its portfolio of brands … the first time it has been in this position in over 20 years."

Nevertheless, Sowind, as the holding group is known, remains stoic about its prospects, citing "more of the same".

"We were already autonomous when we were part of the Kering group," says Ulysse Nardin's chief marketing officer, Françoise Bezzola, during WIRED's visit. "This is how we implemented our current strategy: streamlined collections and distribution networks; a common integrated manufacture offering different movements to the two brands. We will continue our journey in the same direction."

"That's the beauty of a management buyout with the same team," adds chief of industrial ops and supply chain, Lucas Humair. "We believe what we're doing is right, and our production facilities are sized to match our ambitions and future prospects."

Nevertheless, Morgan Stanley doesn't wield phrases like "problem child" lightly, and sure enough, industry insiders are scratching their heads over the wisdom of Sowind sticking to "more of the same", with so much still at stake.

"The management buyout deal was probably that the acquiring party had to commit to invest the amount needed to cover the losses after that, and guarantee an ongoing business," says Oliver R. Müller, founder of LuxeConsult, who worked with Morgan Stanley on its annual Swiss watch industry report. "Most of the goodwill paid for the acquisition of Girard-Perregaux and Ulysse Nardin has already been written off in previous fiscal and financial years by Kering."

Both brands are loss-making. Sales of around €75 million in 2021, versus an operating loss of around €30 million was admittedly a good recovery from the previous year, when the pandemic saw (according to Morgan Stanley) a €50 million turnover with similar losses—but you then need to consider Ulysse Nardin's singular turnover of circa-€190m when Kering purchased.

With just south of €140m forming a notional value of accounts for both, it doesn't seem like good fiscal sense, our luxury-industry analyst reckons.

"To summarize the estimated cash-burn of Kering of €1.2bn … it is the perfect example of a financial investment with no branding strategy," Müller states bluntly. "Kering went into a new market segment without the management capacities needed, and not understanding that a roadmap was key to re-boost two brands which had massively lost momentum. Both Ulysse Nardin and Girard-Perregaux are still wonderful brands, but they need to rebuild their image. They have enough potential to blossom again."

That former, and hopefully future, glory is born on the outskirts of watchmaking's own "Silicon Valley", La Chaux-de-Fonds, high in the Francophone Jura: the location of Sowind's prosaically renamed "The Watch Manufacture". Behind these doors, you'll find technology that represents the cutting edge of fine mechanical watchmaking—technology that Sowind believes will most likely turn around the company's fortunes, at long last.

Ulysse Nardin's historic, 19th-century HQ is still down the road in Le Locle, now home to a new museum whose display of marine chronometers charts, through the prism of a single marque, everything you need to know about naval navigation through the 20th century. Girard-Perregaux' own art-nouveau homestead on the north edge of town now serves as a kind of *haute horlogerie* skunkworks—microscopic multi-axis gyroscopes, tweezered painstakingly over the course of months, to the distant soundtrack of cowbells.

However, the Watch Manufacture, at 138 Rue des Crêtets, has a distinctly unhistoric lack of kerb appeal, complete with bolted-on roof extension and neighboring black-clad annexe accessed via an umbilical corridor.

PHOTOGRAPHY: FABIEN NISSELS

‘We believe what we are doing is right, and our production facilities are sized to match our ambitions—and our future prospects.’

Despite all impressions, this is a fertile hothouse for two niche innovators, now more symbiotic than ever.

They even share a captain, in the form of Patrick Pruniaux—the ex-Cupertino exec who launched the Apple Watch in the UK, and who represents the next generation of that dynamic CEO duo, Rolf Schnyder and Luigi “Gino” Macaluso. These late watch-industry legends each took on the ailing husks of Ulysse Nardin and Girard-Perregaux in 1983 and 1990 respectively, producing in parallel a brace of phoenixes from the ashes of the 1970’s so-called “Quartz Crisis”. Macaluso masterminded the revival of Girard-Perregaux’s virtuoso “Tourbillon With Three Bridges” of 1880, in wrist-worn form, while Schnyder took on a genius in the form of Ludwig Oechslin, scouted from the back-room of a Lucerne jeweler.

It was Oechslin’s triptych of astronomical complications in 1985, ’89 and ’92 that heralded the modern era of mechanical watchmaking as art, before bringing us the FREAK in 2001: an otherworldly “carousel” movement that drove its own rotation, and formed the hours hand in its entirety. More crucially, FREAK introduced silicon components for the very first time in a watch; materials-science ingenuity that’s already trickled down to £675 Tissots. (Ulysse Nardin’s secretive “Sigatec” laboratory, deep in the Alps, counts more than 30 clients, ahead of CSEM’s Rolex/Patek Philippe/Swatch Group-owned facility in Neuchatel.)

Both Macaluso and Schnyder’s deaths led to their heirs selling the respective companies to Kering, in 2011 and 2014. But now, Patrick Pruniaux, his leadership team, and a consortium of investors, have custody of two very distinct, widely revered maisons, whose differences must be, in his own words, “nurtured”. In a Hodinkee interview back in February, Pruniaux stated his investors have a long-term view, and stated that growth will be kept steady after that difficult 2020.

Pruniaux has started rehiring some of the 100 employees laid off that year—a smart move, given the expertise that’s evident as WIRED walks the factory floors of Sowind’s Watch Manufacture.

“We were among the first to provide a five-year warranty on our products,” Lucas Humair tells us, “because [the Watch Manufacture’s] development, characterization, assembly and control processes allow us to do so. We estimate that productivity on the line is 2 to 3 times more efficient, depending on the product. The principle is not that we work faster, but the organization of work is such that we optimize efficiency by drastically reducing wasted time and doing a maximum of operations in parallel, so that operators and watchmakers are 100 percent concentrated on assembly and adjustment.”

It all begins with floor 1’s battery of CNC milling machines, transforming bars of brass and steel into baseplates and bridges. Multi-axis robotic drilling bits whirr day and night, cooled by trickles of oil whose warm petrolic fug fills the air. Even before “deburring” and decorative hand-finish, the rough parts boast tolerances of less than a tenth of a hair’s width.

So far, so Swiss. But where things get truly cutting-edge is upstairs, in the assembly and quality-control department. Here, the traditional rows of watchmakers, sporting lab coats and loupe eye lenses, are interwoven by a fully automated Scalextric-like conveyor system. Each part-complete movement assembly arrives at its next workstation via rolling tracks, fed by stacked magazines of color-coded cassettes.

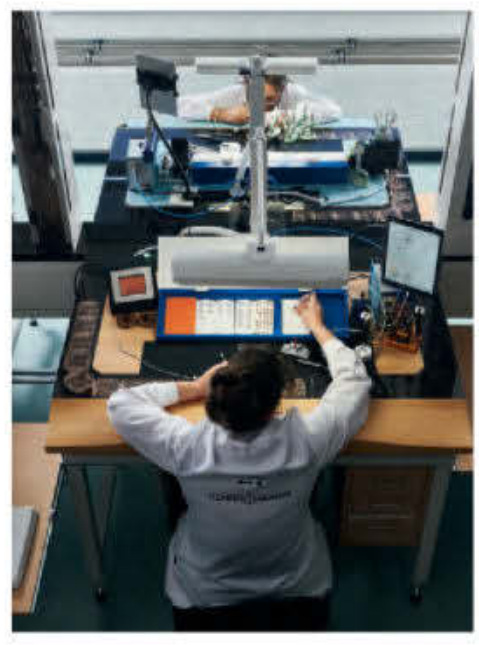
Given the seeming sentience of these “cars”, navigating a waist-height Spaghetti Junction in constant ebb and flow, this is man and machine in eerie concert. The machine itself derives from blood-sample analysis labs. Made by Clinical Laboratory Automation SA (CLA) in the northeast reaches of the Jura, radio-frequency identification (RFID) on each unit ensures traceability.

CLA also provides Ulysse Nardin and Girard-Perregaux with total chronometric peace of mind, through the workshop’s jewel in the (winding) crown: the CLAchronométrie.

A perspex-clad unit about the size of a city car, this is the nerve center that assesses everything that comes off the end of the Scalextric track. The fact its cylindrical bank of white-plastic cassettes looks like the “Power Plant” of human cells in *The Matrix* only adds to the man/machine metaphor.

A fully articulated robot arm on a monorail works back and forth in a mesmeric dance. It picks up the parts to be checked, and then prepares them for the first operation, generally the winding. This can be done via the movement’s crown (a rod coupling and turning it clockwise), or self-winding rotor (the movement being loaded onto a miniature ferris wheel for a minute or two). Once wound, the robot moves the cassette onto a unit that measures for “rate deviation” over the course of 24 hours. Like Willy Wonka’s squirrels in *Charlie and the Chocolate Factory*, if a bad nut is found (i.e. losing or gaining more than 4 to 6 seconds a day) the out-of-tolerance movement is isolated and sent back to manned correction workbenches, via the conveyor network.

Below: The assembly line unites handworking, RFID chips—and instructions on an iPad.



Away from the manufacture, Girard-Perregaux will continue to plow its furrow of hardy Laureato sports numbers, as well as tourbillon-spiked masterpieces of trad horology. Ulysse Nardin, meanwhile, under its own distinct brand remit, will further its legacy of maritime chronometry and silicon innovation. It’s in this automated factory where their streams cross, and, for the newly independent Sowind Group, things at least seem more well-equipped for the road ahead.

PHOTOGRAPHY FABIEN NISSELS

Above left: Movement components are dropped into the assembly train, ready for the next step. Above right: The assembly line automatically adds tiny drops of lubricant to precise locations.

Above: Assembled watches are quality-checked by the CLAchronométrie. Its robot arm scoops up each cartridge and tests its contents on amplitude, winding, and pusher operation.

Adventure time

The great outdoors is calling, so try a classic watch that's tailor-made to handle extreme in-the-field action.
By Tim Barber.

IWC Pilot's Watch Chronograph Top Gun Edition "Woodland", £9,450

In an age defined by versatility, the military-influenced field watch—robust, clear, classic, capable—might be the ultimate all-things-to-all-people wristwatch. The traditional field watch carries forward the blueprint laid down by mid-20th century military watches: these were designed to be read easily (generally via black dials with white markings) and to perform reliably under harsh conditions. The essential military look has been around since the earliest days of wristwatches; but today's inheritors of that style aren't just about retro. Tudor's new Ranger, for instance, certainly bears a close resemblance to the 1965 Ranger, with its high-contrast dial, mixture of Arabic numerals and hour markers, and its quirky spear-head hour hand. But it carries the refinements of modern watchmaking, not least in Tudor's exceptional automatic movement—chronometer-certified, and packing in a 70-hour power reserve—while a brand new steel bracelet uses a micro-adjustment fitting system. This being Tudor, the fabric strap option is equally desirable, bringing an appealingly tweedy practicality.

Tudor Ranger, £2,1700

Bremont's crisp Airco Mach 1 Jet gives a clean spin on the kinds of watches that were supplied to thousands of Allied soldiers and airmen during World War II. Bremont was only founded in 2007, but it has taken rich inspiration from the past, not least in the watches it produces for modern military units. For a brand known for the muscularity of its watches, the Airco is one of its more compact, with an elegantly sculpted 40mm case, here given an action-ready coating in matte-black DLC. Its intrepid nature is only heightened by an olive sailcloth strap, while the chronometer-certified automatic movement will perform reliably in whatever field of adventure you happen to encounter. IWC produces many models in the field-watch vein under its Pilot's Watch lines, descended from those it made for pilots in World War II and subsequently. But in its experiments with colored ceramic case materials, particularly in what it describes as "woodland green"—a dark shade it has registered with the Pantone organization—it takes the idea of an outward-bound watch in a high-tech new direction. Powered by IWC's in-house chronograph movement, Calibre 69380, the all-green Pilot's Watch Chronograph Top Gun Edition "Woodland" is a thoroughly modern beast for adventurers of all stripes. And for snow- or desert-bound escapades, it comes in white (Tahoe) and beige (Mojave) options.

Bremont Airco Mach 1 Jet, £3,295

MAURICE LACROIX

Manufacture Horlogère Suisse

PONTOS S
CHRONOGRAPH

Down, down, deeper and down ...

Most dive watches won't ever see the true depths, but the tech they're based on is always looking deeper.
By Chris Hall.

Omega Ocean Seamaster Ultra Deep Pro, £10,350

Very few people will ever have strapped on an Omega Seamaster Planet Ocean (43.5mm across, and depth-rated to 600m) and rated it "inadequate". Its stainless-steel case, ceramic bezel and helium-release valve equip it for prolonged submersion at a depth usually only experienced by military submarines. Yet, this year, Omega decided to release a range of Planet Ocean "Ultra Deep" watches rated to a mighty 6,000m: yes, 10 times that of its stablemate. The increase in pressure-resistance comes with a slight increase in size, to 45.5mm, but otherwise the emphatic new design looks and feels like any other large watch. Extreme performance for a dive watch once necessitated extreme characteristics—Rolex's Deepsea Challenge, which was the first watch to descend to the foot of the Mariana Trench, had a fully hemispherical sapphire glass bulb atop its dial. But engineering and material science advances mean a piece of exploration-spec tech is now wearable in everyday life. Omega has released this new collection three years after it produced a watch for Texan businessman and amateur adventurer Victor Vescovo, who descended the Mariana Trench and recorded a marginally deeper rating than James Cameron and his Rolex. That watch, the Ultra Deep Professional, was a 55mm device never intended for sale—and it was tested to 15,000m, meaning it can survive pressures the Earth's oceans are incapable of providing. There has been some trickle-down to allow Omega to commercialize an Ultra Deep range, even if its max depth has been reduced by 60 per cent. It is not alone in maintaining a watchmaking range of such superhuman abilities: Rolex's Deepsea Sea-Dweller (3,900m) was updated this year with a bevy of minuscule tweaks (like an increase in dial size of *eight percent*) that passed unnoticed by all but the most faithful. Practically, it means little, but symbolically, it reminds us that to be a serious maker of dive watches—even the 100m or 300m variety that comprise the mainstream (and are quite sufficient for *actual* diving)—one also has to cultivate some truly deep-sea chops. Besides the R&D that comes from creating such overqualified timepieces, it's about the reputation. This was reportedly a factor in TAG Heuer's recent re-entry into the super-deep chasm: CEO Frédéric Arnault was eager to pep up the brand's aquatic credentials, and what better than a new flagship Aquaracer, the Professional 1000 Superdiver. As the name implies, it is rated to a depth of 1km; it also boasts a retracting-extending crown guard that moves as you screw the crown in or out. Thwacking the crown of a watch underwater is one of the easiest ways to render your diver useless (and somewhat permeable), and this is one of the most robust, foolproof crown defenders yet developed.

Rolex Deepsea Sea-Dweller, £11,350
rolex.com

Tag Heuer Aquaracer Professional 1000 Superdiver, £5,500

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Mech vs Tech

For watch brands, is getting involved in the metaverse madness?

By Laura McCreddie-Doak.

Watchmaking moves at its own pace. Back in 1980, when renowned British watchmaker, George Daniels, patented his co-axial escapement—his version of the device that controls the transfer of energy in a watch from the power source to the counting mechanism—it was hailed as the greatest leap in mechanical timekeeping for 200 years. Daniels' invention reduced friction—and therefore the need for lubrication—making his escapement more accurate and less in need of servicing.

Since then, major innovations have been sporadic. The likes of Swatch Group, Patek Philippe, and Rolex all supported the Centre Suisse d'Electronique et de Microtechnique (CSEM) and its experimentation with silicon, arguably one of the most transformative materials to be engineered into a movement due to its improved stability, accuracy, lack of need for lubrication, and resistance to magnetic interferences and thermal fluctuations. Then there was Guy Semon's tenure at TAG Heuer in the late 1990s and early 2000s where, as director general, he was allowed to apply his PhD in physics to watchmaking; a combination that spawned the Mikrograph, the first mechanical chronograph with a 1/100th display; the Mikrotimer, which displayed and measured the 1/1,000th of a second; and the Mikrogirder, measuring the 5/10,000th of a second. This was on top of creating an escapement that had adjusting organs, and which used magnetic fields and lab-grown carbon nanotubes, in an experiment to find new ways of making hairsprings. Recently, however, material science has taken over with carbon composites, EcoTitanium (made from scrap titanium from aircraft manufacturers), Carbonium (carbon fiber offcuts also from the aeronautical industry), Carbotech (a polymer and carbon-fiber composite), and straps made using ocean plastic taking precedence over any real movement invention. Is it that we've reached peak accuracy? Thanks to its discovery that two terminal curves on a Spiromax balance spring could dramatically improve a watch's accuracy, Patek's 2019 Aquanaut boasted a mean rate of -1 to +2 seconds per 24 hours. Is that the pinnacle? Or are brands uninterested in reinventing the wheels, simply because it doesn't garner the kind of flashy, splashy PR new materials do?

"We had reached an asymptotic limit," says Antoine Pin, managing director of the Bulgari watch division, when asked why he thinks innovation, in general, has stalled in the watch industry—though not, conversely at Bulgari. "In the 1970s, quartz appeared, letting the world think that mechanical was behind us. Today, micro mechanics, used in biotech for instance, lead the way to major innovations, new ways to conceive gears, to reach new limits. We just have to believe that physical limits are there to be beaten."

Bulgari's quest to whittle a watch case down to its slimmest possible has led to mechanical innovations including a patented oscillator module in its latest Finissimo, with a case just 1.8mm thin. However, this was a by-product of a separate goal, not the aim in itself. The same is true at Frederique Constant, which last year launched its Monolithic movement featuring an oscillator—rather than a balance spring, balance, and lever, and a smaller version of the one seen in Zenith's Defy Lab and Defy Inventor—that beats at 40Hz, or 10 times faster than a typical escapement.

Frederique Constant is combining NFTs with its 10th anniversary Worldtimer

Again though, the improvement to timekeeping wasn't the goal. "This launch was not focused on precision, as the innovation of this timepiece was that we were able to replace the 26 components of a standard regulator [or escapement] with a single component fitted with two regulation weights," explains Niels Eggerding, managing director of Frederique Constant.

Increasingly, watch brands, including Hublot, TAG Heuer, and Panerai, like to show they are keeping up to date with the 21st century, not through material innovation, but via dabbling in the metaverse, despite the fact that many watch companies aren't even Web 2.0-savvy, let alone capable of experimental mixing of the physical with the virtual in the nebulous world of Web3.

"If there is anything positive which came from Covid, it is certainly the acceleration of ecommerce in the luxury watch industry," says Oliver Müller, founder of Geneva-based luxury consultancy firm LuxeConsult. "For example, Omega's UK ecommerce was launched in the midst of the shop closures in 2020, and it took six weeks to go live. This would normally have taken six months, if not years."

TAG Heuer has a similar story, where, with the help of IBM, it developed a new purchasing online journey in just three weeks, which delivered a more personal service and saw growth triple. "We went through tough months, including the shutdown of production—you can't make watches from home—and to be completely honest, thanks to ecommerce, it was not that bad," says Béatrice Goasglas, vice president for digital and consumer experience at TAG, in IBM's report.

Zenith, too, had to rush implementation of ecommerce. Already, online purchases account for 7-8 percent of sales—two thirds of which are new customers. "Had I known it would be so successful, I'd have done it four years ago," says Julien Tornare, Zenith's CEO.

That said, Rolex, Patek Philippe, and Audemars Piguet do not sell a single watch online, "because they strongly believe in the 'temple experience' when a client visits a boutique," says Müller. "Which, in my opinion, is losing relevance with the younger generation."

Which is where brands' engagement with the metaverse comes in. Despite

'If there is anything positive which came from Covid, it is certainly the acceleration of ecommerce in the luxury watch industry.'

a shaky grasp of Web 2.0, venerable houses are piling into Web3 with surprising enthusiasm. Purchase one of Panerai's limited edition Radiomir Eilean Experience watches and you'll also receive a unique NFT artwork "as well as priority access to future Web3 initiatives" (though examples of such exciting fare are yet to given), along with other services and events held by the brand.

"We wanted to use an NFT to augment and digitize the Panerai experience for lovers of our brand. It is an added value—but it doesn't replace the joy of owning and wearing a Panerai," says CEO Jean-Marc Pontroué.

Bulgari stuck an artwork-unlocking QR code front and center on its new

Hublot Takashi Murakami Sapphire Rainbow, £88,000

Octo Finissimo, and unveiled its private metaverse platform, which apparently honors the magnificence of "future Rome", at the annual technology conference VivaTech 2022 in Paris.

Also taking owners on a virtual trip to other countries is Frederique Constant, which, for the 10th anniversary of its Classic Worldtimer, collaborated with 3D NFT agency Rarecubes to produce 888 Time to Travel NFTs that supposedly evoke the architectural and aesthetic characteristics of one of the locations around the timepiece's 24-hour ring.

However, this all feels like brands dabbling in the metaverse without truly understanding it. By his own admission, Bulgari's Pin says that it is "taking our chance to test and try our crazy ideas" without any real certainty that this is something Bulgari will pursue. But one brand with an idea of what the metaverse can really do is Hublot, which is experimenting with art, in collaborative works with Japanese artist Takashi Murakami, and crypto, in the Big Bang Unico Ledger, a 50-piece special edition that includes access to a metaverse-enabled crypto-wallet from Ledger.

In July, Nike announced a hoodie in collaboration with RTFKT (pronounced "artifact"), a Web3 creator-led organization now owned by the sportswear brand. This hoodie has a Near Field Communication (NFC) chip embedded in it, so it is trackable using augmented reality, and features a QR-code inspired graphic that allows you to add virtual effects (currently wings) to your Clone X avatar on RTFKT's digital platform. *Vogue Business* described it as the first proper example of a Web 2.0 brand successfully entering the Web3 space.

"When we think about sports, specifically merchandise, the ability for fans to wear their favorite team or athlete's jersey is age-old, but powerful and important in connecting fanbases," says Petrit Berisha in his Sporting Crypto newsletter on LinkedIn. "We're seeing the starting point of the next step for sports brands and franchises. RTFKT are creating the building blocks for a gateway between physical and digital that hasn't been seen before."

Besides art and crypto, Hublot also plans to add sports to its involvement in the metaverse. CEO Ricardo Guadalupe says Hublot got involved early in the world of NFTs, specifically so the brand "could better understand Web3 and the challenges and opportunities. At Hublot, with the choice of our partnerships in football, golf, art, we go where our clients are, and so NFTs and the metaverse are another outlet for us to reach and join them in an exciting arena."

None of which really has anything to do with making the watch on your wrist more accurate or reliable. But at least your avatar will have some decent wrist candy, even if your IRL version is still languishing at the service center.

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Behind the rise of the MoonSwatch

Omega and Swatch's timepiece isn't just a hype juggernaut—this collaboration has revolutionized materials, manufacturing, and more.

By Tim Barber.

In April, the president of the Swiss Confederation, Ignazio Cassis, visited Japan to hold talks with the country's prime minister, Kishida Fumio. As is customary, gifts were to be exchanged, and Cassis' office requested what had just become the hottest Swiss watch to launch in years, if not decades: the MoonSwatch, a $260 Swatch-produced version of Omega's Speedmaster Moonwatch. The Swiss president, however, was out of luck. "We were pleased, but we told them that the only way that he can get the watch is if he sends someone from his office to queue up in the hope that the Swatch shop in Bern has it," says Nick Hayek Jr., chief executive of Swatch Group, the world's largest watch producer, which owns both the Swatch and Omega brands.

Hayek, a 67-year-old billionaire who drives himself to work in a Mini and flies a pirate's flag outside his office, prides himself on the fact that privileged access—a feature of the luxury watch world—is entirely absent with the MoonSwatch, despite the demand. "It doesn't help if you have deep pockets. The Patek Philippe and Rolex client, the Breguet client, the Richard Mille client, they all rang. They all want one. But even if you give us $10,000, it makes no difference. You have to wait, you have to buy it in the store. That's the game changer."

But finding the MoonSwatch at any Swatch shop anywhere has been a question of luck, timing, and sheer endurance. News had been dripped out gradually in the week before launch. On March 17, cryptic ads appeared, with blank pages bearing the legend: "It's time to change your Omega ... Swatch" and "It's time to change your Swatch ... Omega." Social media feeds hinted at a planetary theme before the timepieces were announced on March 24: eleven Swatch watches resembling the iconic Speedmaster Moonwatch, but battery-powered, in bright colors, and made from Swatch's Bioceramic material.

The colorways were inspired by the solar system: the Mission to the Sun in bright yellow; the Mission to Neptune in deep blue; the black Mission to the Moon, resembling the Omega original.

At 9 am on March 26, stores opened, each with fewer than 200 pieces. London's Carnaby Street location lasted half an hour before police were called, and all three London shops were forced to shut. In New York, scuffles broke out amid rumors of a stabbing in the line. A Swatch shop in Singapore closed for 10 days to let the mayhem pass. Deals were done within queues as scalpers flipped watches for profit on the street. Minutes after the first sales, MoonSwatches were hitting auction sites, attracting bids in the thousands. StockX, the marketplace of choice for Gen Z-ers in search of streetwear "grails", reported more than 2,000 MoonSwatch trades in less than a week after launch, and over 11,000 trades by June, making it the best-selling watch release in StockX history.

"We informed everybody: It's not limited; don't buy on the internet from flippers; you will, at some point in time, get your MoonSwatch," says Nick Hayek when we meet at Swatch Group's HQ in Biel, Switzerland, a couple of months after the launch. He rejects the idea that Swatch could have been better prepared. "We knew for sure this would be a success, because the product is beautiful, provocative, high quality, and the price is fantastic, and we kept it a secret. But what happened ... I think nobody in the world could have expected that. It was really crazy."

'It doesn't help if you have deep pockets. Even if you give us $10,000, you have to wait, you have to buy it in the store. That's the game changer.'

"It's very daring and very positive," says James Marks, head of Phillips Perpetual, the contemporary watch division of the Phillips auction house. "It's captivating the next generation of collector with a play on something that's otherwise inaccessible to them."

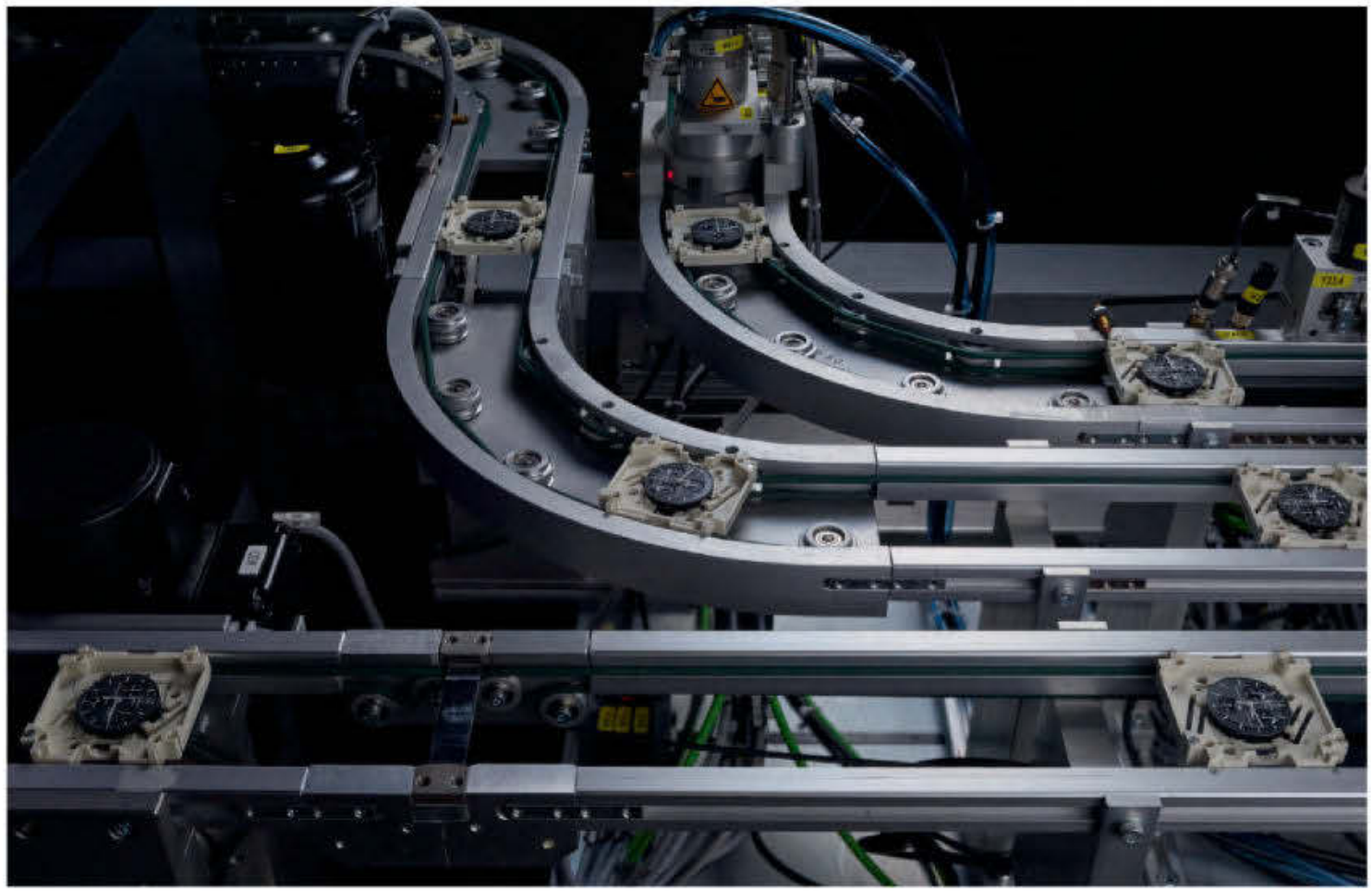
"I'd love to get one," Marks adds, "but I haven't even handled one."

The targeting of this next generation is perhaps the most enterprising part of the MoonSwatch launch. Luxury watch buyers are not young: A recent study of 8,000 people by an insurance firm in the UK found the average age of the Rolex owner in the country to be 68. Meanwhile, the Apple Watch now outsells the entire Swiss watch industry, taking its biggest chunks out of the market for battery-powered watches, where Swatch operates. What better way to expose a new, younger audience to Omega than an affordable collaboration? And it's working. Hayek says that since the arrival of the MoonSwatch, Omega stores are seeing a spike in sales and footfall. Morgan Stanley estimates Swatch could sell up to 500,000 MoonSwatches this year, providing revenue of $128 million. And keep in mind MoonSwatch has not yet been launched in China. Once it is, total annual sales could hit one million units.

Yet according to Hayek, it was a determination to highlight Bioceramic, the material introduced by Swatch in 2021, that inspired the MoonSwatch. Bioceramic amalgamates a polymer made from the oil of castor beans with zirconium oxide, a ceramic substance used for scratch-proof cases in high-end watchmaking. The

Above left: The original Omega Moonwatch, next to a new MoonSwatch Mission to the Sun. Above right: Robot arms lift completed timepieces to the next stage: strap fitting.

Above: An automated assembly line drops the completed movements for a Mission to Earth MoonSwatch into a Bioceramic case, ready for a robot arm to place the biosourced glass.



Above: The end of the assembly process of the 521 movement, including the fitting of the dials and hands. The movements are now ready to be placed in Bioceramic cases.

result is an evolved form of plastic with the scratch-resistance and solidity of ceramic, a silky matte finish that's noticeably different to that of "normal" plastic, and a greatly reduced carbon footprint (it should be noted, however, that Bioceramic is not biodegradable).

Other Swatch Group brands were interested in the material, but Hayek kept it Swatch-only, and realized that the status and heritage of a classic watch could raise Bioceramic's profile. Hayek built prototypes for potential Bioceramic versions of Blaincpain's famous dive watch, the Fifty Fathoms, and Omega's Seamaster 300. But there was only ever one real contender.

"We were doing the NASA Swatch [released late 2021], and it made me think about the Speedmaster," he says. "It was on the moon, it played a principal role in one of the most mythical moments in world history: There's a real story to be told to many young people in the world who don't know it. I thought a collaboration between Swatch—an icon—and the Omega Speedmaster, another icon … that would be a real provocation."

Hayek had a Speedmaster prototype made and showed it to the curator of Omega's museum, Petros Protopapas, who gave it an enthusiastic thumbs-up. Raynald Aeschlimann, Omega's CEO, took more convincing. "At first, he was pale when he saw the Omega Speedmaster as a Swatch, with a quartz movement," says Hayek. "I said maybe we do it as a customer service watch while you're getting your Speedmaster serviced. He said we can think about it." Once Aeschlimann saw a more fully realized product, however, he was sold.

In the meantime, Hayek was able to poach Omega's head of product, Gregory Kissling, to oversee "Galileo," the internal project code name. It was Kissling who thought of watches linked to the colors of the solar system and which referenced historic Speedmaster iterations. The red-and-white Mission to Mars, for instance, with its triangular chronograph hands, is inspired by the white dial and large red outer casing of prototypes made in the early 1970s for the "Alaska Project," a research program to produce the ultimate watch for space travel. The orange detailing on the Jupiter model quotes the so-called Ultraman Speedmaster worn in a 70s Japanese TV show of the same name, another collector favorite.

Conversely, the MoonSwatch's chronograph layout is the element that shows most clearly that it's a Swatch, with the two upper subdials at 10 and 2 o'clock rather than at 9 and 3 o'clock.

"There are all these layers, all the little subtleties," says Hayek. "If you want to find the historical connections, why this hand is like this or this detail is a certain way, you can—but even if you don't see the connection, it's cool."

Underlying all was the focus to push Bioceramic further, particularly its colors. "It's not easy. This is an entirely new material, so we're doing everything for the first time," says Hayek.

Through its network of intellectual property and technology, Swatch has been able to develop, patent, and manufacture Bioceramic entirely in-house. Other industries are sniffing around, claims Hayek, as the potential uses are myriad. But all the Bioceramic he can make, he needs for Swatch.

The Bioceramic MoonSwatch parts include the monobloc case, the pushers and crown, battery cover, and a loop for the Velcro bracelet. Every element of the process, from the initial combining of the feedstock elements to the injection molding of finished parts and their assembly, along with the manufacturing of the movement, dial, and crystal, is completely automated.

The Bioceramic extrusion and injection takes place at Swatch's HQ in Grenchen, while automated assembly

Above: A tray of biosourced glass ready for installation on MoonSwatches. Even this delicate operation is performed by robots on the fully automated production line.

lines are at its other factories nearby. Comadur, a pioneer in the field of ceramics (used by Omega and Rado within Swatch Group), creates the zirconium oxide powder; along with Asulab, an advanced research facility, Comadur also creates the chemical pigments for the Bioceramic feedstock.

"Many of the things we're doing are so new, we had to develop processes as we went," says Hayek. Even the microprinting of a photorealistic rendition of a given planet, found on each MoonSwatch's circular battery cover, required a new technique to deliver tiny ink droplets of just six microliters (one millionth of a liter).

The production has been remarkably quick. Gregory Kissling's concept was presented to Hayek in August 2021; the first MoonSwatches were made in February 2022—a month before launch. Hayek says that to make the injection mold tooling for the Bioceramic components usually takes six months. It was done in six weeks.

'If you want to find the historical connections, why this hand or a detail is like this, you can. But even if you don't see the connection, it's cool.'

Evidence of the speed of this process emerged when some owners of the deep-blue Mission to Neptune model found it left blue stains on their wrists. With Bioceramic, full saturation colors are harder to achieve than its more common pastel hues. For colors like the red of the Mission to Mars and the Neptune blue, the feedstock is given additional passes through the extruder to compound the material more densely, and fix a higher degree of pigmentation. But with the Neptune, it seems the scales were tipped too heavily. Swatch Group says that the staining occurred with a small proportion of wearers and lasted only a few days.

Nevertheless, the Neptune was swiftly withdrawn, and a new recipe for the color is being concocted. But the fault has had a diverting side effect: Due to their rarity, the few Neptune models appearing on resale sites are fetching eye-watering prices compared to the other models. As of June, the pre-owned sales platform Chrono24 was showing a handful of Neptunes listed at around $2,400 or more. Most MoonSwatch models, meanwhile, have settled at between $480 and $1,100.

Capacity, however, will increase: New manufacturing equipment is being installed, including two extrusion machines for the creation of the feedstock (which Hayek says is by far the most onerous part of the process), more injection tooling, and more printing machines. The investment in a single product line is colossal.

Hayek is probably right to reason that, while resellers are an inevitability of any hot product, the tight distribution has at least limited their access to the MoonSwatch. An online drop would expose Swatch to the bots and scalpers that bedevil everything from sneaker launches to the PlayStation 5. To frustrated customers, he reiterates that the MoonSwatch is neither limited nor a short-term product—there will be millions of MoonSwatches.

"The crazy prices of speculators will come down. Everybody wants to have it, but we cannot serve everyone at once," he says. In the post-pandemic consumer landscape, Hayek reckons, patience has become a vastly underrated virtue. "If the world is serious about sustainability, you cannot make everything available to everybody instantly and comfortably, with a click. This world thinks everything is a commodity, but the MoonSwatch is not a commodity. This is about innovation, beauty, fun, and positive provocation. And last, but not least, Swiss made."

By the slimmest of margins

The old adage, 'One can never be too rich or too thin', also seems applicable to timekeeping. By Tim Barber.

To the victor the spoils, no matter how slight the winning margin. It's 20 years, for instance, since Rubens Barrichello pipped Michael Schumacher to the US Grand Prix title by just 0.011 seconds, as the Ferrari pair attempted a dead-heat finish. The Scuderia's prancing horse logo now appears on the watch that, by an invisibly tiny degree, has swiped victory from under the nose of the assumed champion in watchmaking's most closely fought, high-tech contest: the attempt to make the thinnest ever wristwatch. It's a title Bulgari appeared to have sewn up back in April, when it revealed its Octo Finissimo Ultra, a watch measuring just 1.8mm deep. But the RM UP-01, from ultra-luxe watchmaker and Ferrari partner brand Richard Mille, has claimed the win at just 1/20th of a millimeter slimmer: 1.75mm thin. Until the watch was announced in July, it's a competition few outside Richard Mille were aware that the brand was even contesting.

However, super-thin watchmaking has become a significant technological flex among top-tier watch brands. The capability to reduce parts, push tolerances, and reconfigure the fundamentals of horology in the name of paper-thin timepieces has added a new dimension to the battles brands have long fought to out-do each other in complexity and complications. Where one draws the line between form and function, however, appears to be becoming increasingly moot: the RM UP-01 is as slim as a 20p piece, with a movement that weighs a wafer-like 2.82 grams, but its tiny time display, around 1cm wide, hardly makes it easy to read. It certainly wouldn't be worth a squint while driving an 812 GTS at pace. That miniscule dial, whose sapphire crystal covering is just two-tenths of a millimeter thick (which partly dictates its diameter—any wider would make it too fragile), sits in the top of a 51mm-wide surface that resembles nothing so much as a curve-sided titanium credit card. Beside the dial is an aperture revealing the fast-oscillating balance, while two further openings on the left-hand side are in fact sockets for inserting a special tool for

Richard Mille RM UP-01, $440,000 ***richardmille.com***

managing the watch (the mechanism is too thin for any traditional crown to work). The upper socket switches between modes for winding or setting, which can both then be carried out from the lower socket. Sandwiched within the two slithers of titanium that form the case, the watch's movement is also constructed in aeronautical titanium, and acts as a rigid supporting structure strengthening the whole. The movement is itself a lesson in lateral thinking—literally, since it redistributes elements sideways that would normally be superimposed, most obviously the red hands for timekeeping, which instead of sitting on an axis above the gear train, are on wheels turned directly by the gears.

The watch also features a patented, redesigned escapement (the regulating organ for any mechanical timepiece)—courtesy of Richard Mille's close reliance on the R&D department of Audemars Piguet, which holds a 10 percent stake in RM. It's proving a worthwhile investment for the firm: Richard Mille, founded in 2001, this year joined Audemars Piguet among the few brands turning over a billion Swiss Francs a year. It promises to make 150 of the RM UP-01 watch, each priced at $1.9 million—itself a statement of intent, in comparison to Bulgari's decision to make just 10 editions of its $440,000 Octo Finissimo Ultra.

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Opposite attracts

Around one in ten people are left-handed, but making a watch just for lefties brings many challenges.
By Chris Hall

For Rolex devotees, it's big news when a model is upgraded with slightly thicker crown guards, a marginally wider dial or fractionally more tapered bracelet. Seriously—this is the stuff that forum arguments are made from. So, you can imagine the frenzy that gripped the watch universe this April when Rolex teased, then announced, a left-handed version of its already enormously desirable classic, the GMT-Master II. Left-handed watches are incredibly rare, despite lefties making up around 10 percent of the population—and where Rolex is concerned, rare is good. This is the first left-handed Rolex to enter the mainstream collection. Over the last three or four decades, several left-handed models have emerged from its factory, including Submariners, Sea-Dwellers, Datejusts and Cellinis, but these have all been "special projects", usually from a private or corporate commission. Among collectors and connoisseurs, left-handed designs are nicknamed "destro" watches, from the Italian for right (on the basis that, typically, right-handers wear their watches on the left wrist, and vice versa). The logic goes that you want the crown to be easily accessible with your non-watch wearing hand. Of course, engineering a watch to be the mirror image of its previous self isn't the hardest challenge Geneva's watchmakers have ever faced, but it still requires careful thought. The movement (which in this instance is Rolex's in-house calibre 3285, accurate to +/- 2 seconds a day) can be simply rotated 180 degrees; you need to print a new set of numbered date wheels, otherwise they'd be upside down, but apart from that, it's good to go. What Rolex did have to alter was its testing processes; the machinery, automated lines and software configurations required to oversee the "superlative chronometer" certification process (as well as its obligatory water resistance) all needed to be tweaked for this piece.

Aside from the leap from one wrist to the other, the big change for the 2022 GMT-Master II was aesthetic: the green and black bezel marked a new direction for the brand, which has hitherto kept its stainless steel GMT-Master models to red/blue and blue/black color combinations.

The introduction of an on-trend green is a rare flash of recognition from a company that typically plows its own furrow in the face of the current vogue for more exciting hues in general, with green being particularly desirable.

It seems even when it's doing something totally unexpected, Rolex still lands right on the bullseye of popular opinion.

Rolex GMT-Master II £8,800 rolex.com

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Dark matter

Forget the horological razzle-dazzle, and embrace a stealthy style that's happy to stay in the shadows.
By Jeremy White.

> HUBLOT BIG BANG BLACK CERAMIC INTEGRAL TOURBILLON CATHEDRAL MINUTE REPEATER
Hublot launched its popular Big Bang back in 2005, but this is the very first completely ceramic minute repeater for the line. Just 18 Japan-only pieces are available in black, plus 18 in white. A minute repeater audibly strikes out the hours, quarters, and minutes on request, and to do this entirely in ceramic—an extremely hard material both to machine and finish—is quite the flex, and it's even water resistant to 30 meters. *£244,000 hublot.com*

> IWC PILOT'S WATCH CHRONOGRAPH 41 TOP GUN CERATANIUM

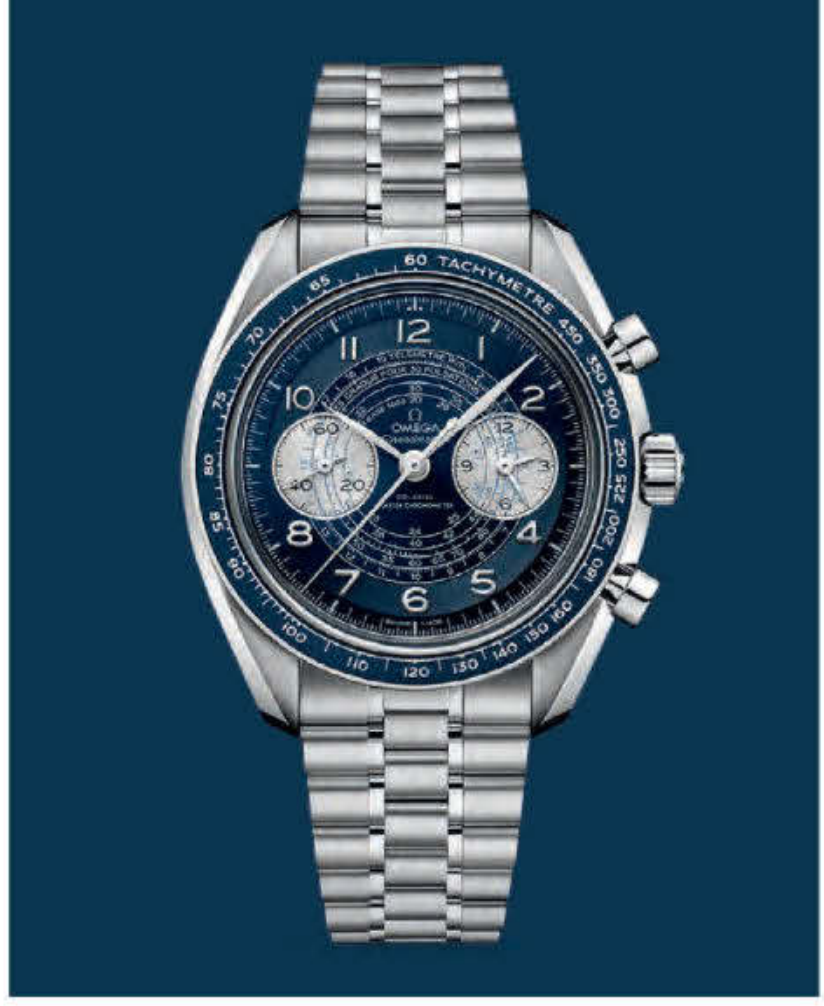
IWC's Ceratanium is almost tailor-made for sports watches, combining both the lightweight benefits of titanium, and the scratch-resistance of ceramic. Here, IWC applies it to create a stealthy case, pushers, and crown. And while the caseback shows off the 69385 chronograph movement, its tinted crystal maintains the dark aesthetic, as does the smart black fabric strap. You also get 100ms of water resistance, and 46 hours of power. *$12,600 iwc.com*

> PATEK PHILIPPE CALATRAVA 5226G

When you're rocking a Patek, there's no need to be showy, and this black-clad Calatrava oozes stealthy style. Beneath its black gradient rim, charcoal gray dial, and gold applied numerals with beige (yes, beige) luminescent coating, the 5226G is driven by the self-winding caliber 26-330 S C, powering the hours, minutes, central seconds, aperture date and stop-seconds mechanism. An embossed calfskin strap seals the deal. *£30,060 patek.com*

> TUDOR BLACK BAY PRO

The inky dial of the Black Bay Pro has an unexpectedly adventurous pedigree—feedback from real-world missions, such as 1952's British North Greenland Expedition, whose members wore the 34mm Tudor Oyster Prince, has all led to daredevil-worthy modern pieces. This 39mm iteration makes for a more-than capable alternative to the Rolex Explorer II, with its 70hr power reserve—and, of course, a bevy of Tudor strap-options. *From £2,170 tudorwatch.com*



Omega Chronoscope
£7,740 *omegawatches.com*

Show round-up 2022/23

Watch brands spent the lockdown letting their imaginations run free—and the results dazzle with technical ingenuity, refreshed styles, and pops of color. By Jeremy White.

Girard-Perregaux Laureato Pink Gold,
£42,000 *girard-perregaux.com*

Aera P-1 Pilot, £1,100
aera.co

Piaget Polo Date,
£24,300 *piaget.com*

Ressence Type 8, £11,300
ressencewatches.com

Pinion Neutron,
£1,200 *pinionwatches.com*

Panerai Submersible Forze Speciali, £tbc *panerai.com*

Spinnaker Piccard Auto, £430 *spinnaker-watches.com*

TAG Heuer Carrera Red Dial, £5,600 *tagheuer.com*

Panerai Submersible QuarantaQuattro ESteel, £9,300 *panerai.com*

Bell & Ross BR 05GMT, £4,700 *bellross.com*

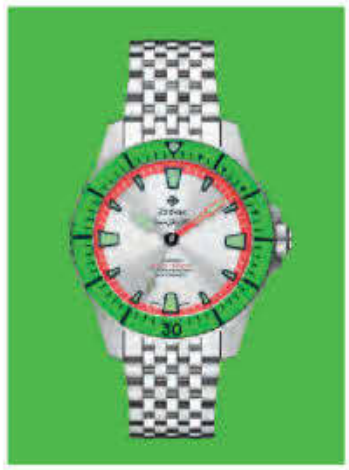
TAG Heuer Connected Calibre E4 Porsche Edition, £2,300 *tagheuer.com*

Hermès Arceau Le Temps Voyageur, £22,550 *hermes.com*

Rolex Air-King, £5900 *rolex.com*

Vacheron Constantin Historiques, £60,500 *vacheron-constantin.com*

Rado Captain Cook Fabric, £3,440 *rado.com*



Zodiac Super Sea Wolf,
£2,040 *zodiacwatches.com*

Montblanc 1858 Iced Sea,
£2,610 *montblanc.com*

Zenith DEFY Revival, CHF
6,900 *zenith-watches.com*

Casio G-SHOCK GM-B2100
£449 *g-shock.co.uk*

Longines Ultra-Chron,
£2,750 *longines.com*

Baltic Aquascaphe Titanium,
€710 *baltic-watches.com*

The influence of Instagram has enticed a new breed of watch consumer, and as a result, brands have injected more color to service their tastes.

Bremont Supermarine Waterman Apex Steel
43mm Automatic £4.795 *bremont.com*

Seiko Prospex Speedtimer
Mechanical, £2,740 *seikowatches.com*

When timing is everything.

Time does not respect machines, or the desire to be quick.
It exists to measure the margin of victory in a sport where precision is paramount.

The Bremont WR-22 is the first official timepiece designed in collaboration with Williams Racing, drawing on a shared British heritage and dedication to engineering expertise.

BREMONT
CHRONOMETERS

WILLIAMS
RACING

OFFICIAL PARTNER

PATEK PHILIPPE
GENEVE

BEGIN YOUR OWN TRADITION

ONLY HUMAN

A STORY ABOUT SKILL

"At Patek Philippe, it can take years to train our skilled specialists. It is one of the reasons we do not make more watches than we produce today.

We are not magicians. At our family-owned company, everything we do relies on the skills of our people. Very human skills which cannot be rushed or replaced.

Only humans can accept the challenge to always be at the edge of what is possible."

THIERRY STERN
PRESIDENT, PATEK PHILIPPE

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