

WORLD'S MOST ADMIRABLE COMPANIES

FORTUNE

FEBRUARY 2019

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**BIG
PHARMA
HAS
STRUCK
OUT.**

**COULD
THIS
RADICAL
NEW
APPROACH
TO**

ALZHEIMER'S

**LEAD TO A
BREAKTHROUGH?**

**POT: HOW TO BET
ON AMERICA'S
NEXT HIGH GROWTH
INDUSTRY**

ASIA PACIFIC
EDITION
NUMBER 2

Taking Connected Living to the Next Level

Samsung is bringing families closer together by making homes smarter.

TODAY'S CONSUMERS

want more control over their household appliances, regardless of whether they are home or not. Samsung is fulfilling that desire by interconnecting appliances, ensuring that life at home is as comfortable and convenient as possible.

Samsung's SmartThings open platform—part of its wider Internet of Things (IoT) strategy—presents itself as the gateway to that interconnected home. With a mere touch on the SmartThings app, family members can control and manage appliances such as televisions, washers, air conditioners, and robot vacuums. Home ambience and security can also be easily controlled with the app, providing remote access to audio systems, lights, thermostats, and anti-burglary systems.

While Samsung already has an expansive line of IoT-enabled appliances and devices for the home, including televisions and smartphones, the company's Family Hub refrigerator takes interconnected living to a whole new level. Featuring a 21.5-inch LED touchscreen embedded into the top-right door, the Family Hub has emerged as a digital command center for the home that goes beyond the traditional refrigerator's job of keeping food fresh.

The Family Hub was originally introduced in 2016, and since then Samsung's research and development team has gathered user data and harnessed its latest technology to produce smarter new versions.

The Family Hub refrigerator not only syncs food storage with meal preparation but also keeps family members better connected and organized. It serves as an entertainment center for playing music and videos when family and friends gather in the kitchen to cook, eat, and just enjoy each other's company. The refrigerator also has a camera inside that allows users to check the contents while on the go, as well as to

shop for food items directly from the touchscreen.

The screen on all three models of the Family Hub refrigerator powers a digital message board, calendar, meal planner with recipes, and shopping list. Users can sync their smartphones with the fridge to access photos, memos (goodbye fruit magnets!), and other content.

"These apps make our customers' lives more convenient, and much of the content is localized to each market," says Sunggy Koo, Samsung's vice president of Smart Appliances and Home IoT. Samsung is collaborating with a growing number of partners—among them Spotify, iHeartRadio, Ring, and GrubHub—to provide access to a network of third-party services.

Family Hub also includes Bixby, Samsung's artificial intelligence (AI) platform. Launched with a "Hi, Bixby" salutation, the Family Hub can recognize individual voices and obey commands to read the news, weather reports, and personal calendar items. Honored with a CES 2019 Innovation Award, Family Hub 2019 with the new Bixby





lets users interact in natural language to get answers to complicated questions.

Samsung is flexing its IoT muscles outside the home, too. For instance, its SmartThings Cloud platform serves as a smart dashboard to monitor and control connected devices from any location. Last August, the company announced that it will invest \$22 billion over the next three years in new growth drivers, with a major portion of those funds committed to AI.

In early 2018, International Data Corporation (IDC) forecast global spending on IoT will reach \$1.2 trillion by the year 2022. With this growth, however, will come new responsibilities, which Samsung is diligently working to address.

"While the IoT trend is expected to grow, there are also growing concerns about IoT and cloud security, as well as the rising potential for the theft of personal or other

sensitive data," says Miyoung Yoo, Samsung's vice president of software development. "It is essential to protect users' private data, and Samsung strives to be transparent about how we collect, use, disclose, transfer, and store data on our devices." For IoT applications like the Family Hub to succeed, for instance, consumers must be assured that their personal data is secure, she explains.

Recognizing the importance of security, Samsung has developed state-of-the-art security features to ensure that its entire product line is protected, beginning with the initial development stage. "For example, we encourage our partners to securely connect their devices to the SmartThings Cloud," Yoo says. "We have also specified security requirements that third-party devices must meet before connecting to the Cloud, setting the market mandate for security."

The Family Hub refrigerator not only syncs food storage with meal preparation but also keeps family members better connected and organized.

"The Family Hub refrigerator," she adds, "is secured with our Tizen platform security and hardware-backed security features, which incorporates a variety of measures already proven reliable in a wide range of Samsung consumer electronics products."

IoT technology is advancing to the point where virtually everything is likely to be interconnected in the near future. Samsung remains committed to being a major innovator in that brave new world, while also making sure that there's no place like home for enjoying it all. ●

SAMSUNG



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Though a government shutdown doesn't cost much overall, the resulting erosion of faith in the institution is a cost too big to calculate. Text by MATT HEIMER; graphics by NICOLAS RAPP

CORRECTION

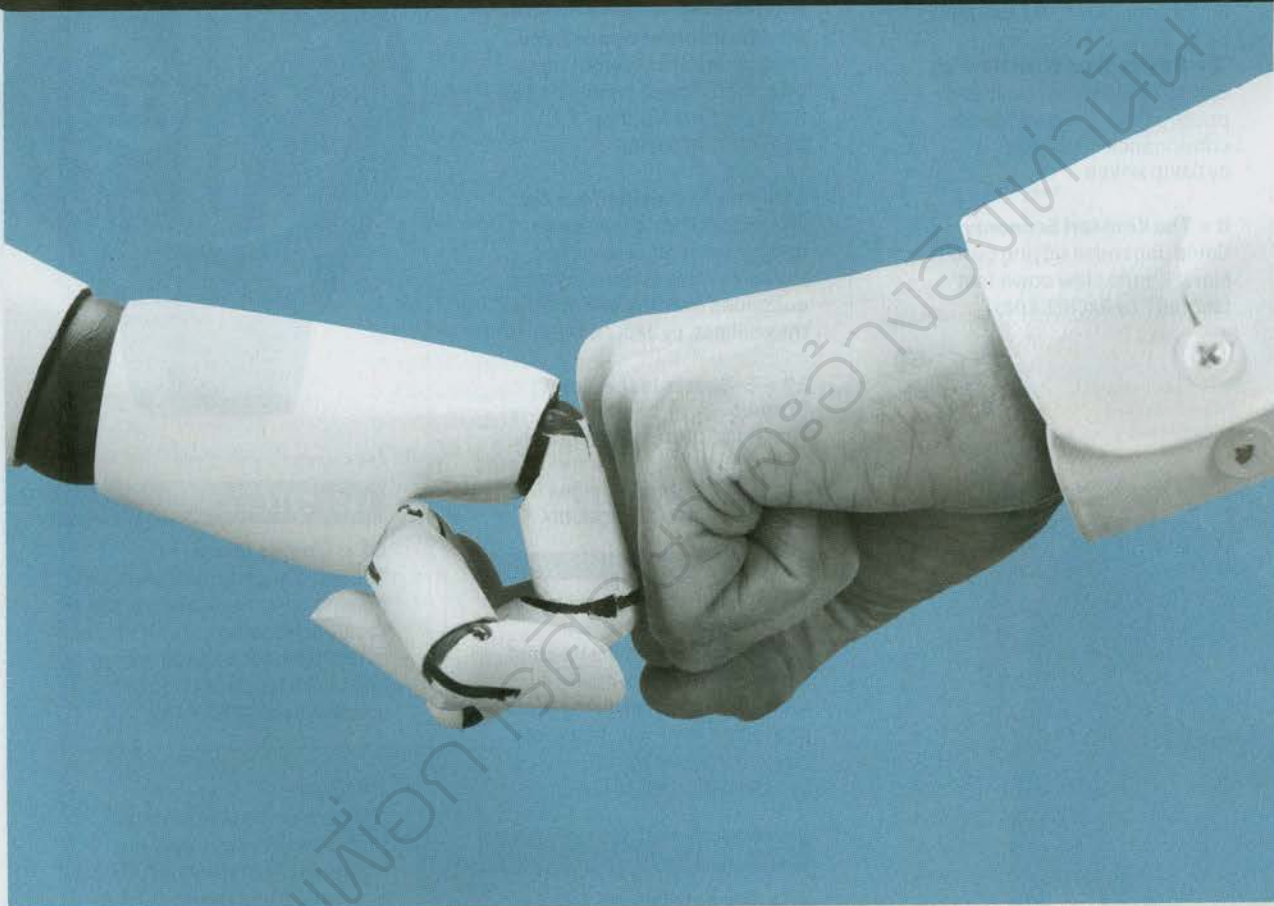
"Hot Under the White Collar" [Jan. 1] incorrectly said the predecessor of the fired whistleblower CEO of Japan's Olympus wasn't charged with wrongdoing for a massive fraud at the company. In fact, the previous CEO was sentenced to prison but never served jail time.



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BRIEFING



Cast a Critical Eye Over the A.I. Hype Merchants

Like mainframe computers in the 1960s, artificial intelligence has the potential to transform business. But the key to utilizing it will be realizing its limitations.

By Adam Lashinsky

TECH

LIKE BEES TO HONEY, tech trends generate hype. Merely appending the word “dotcom” to a company’s name drove up stock prices in the Internet’s salad days. Cloud computing, big data, and cryptocurrencies each have taken their turn in the hype cycle in recent years. Every trend brings genuinely promising technological developments, befuddling buzzwords, enthusiastic investors, and reassuring consultants offering enlightenment—for a fee, naturally.

Now the catchall phrase of artificial intelligence is shaping up as the defining technological trend of the moment. And yet, because the claims of what it will achieve are so grand, businesses risk raising their hopes for A.I. too high—and wasting money by trying to apply the technology to problems it can't solve.

Consider the bubbly warning signs. Venture capitalists are beyond eager to fund A.I. They staked 1,028 A.I.-related startups last year, up from 291 in 2013, says researcher PitchBook. Twenty-six of those companies had "A.I." in their names, compared with one five years earlier. Then there's the profusion of conferences promising to explain A.I. to the benighted manager. At the annual meeting of the World Economic Forum in Davos, Switzerland, the agenda this year included no fewer than 11 panels that reference A.I., with names like "Designing Your A.I. Strategy" and "Setting Rules for the A.I. Race." (*Fortune* has gotten into this act too: Its 2018 Global Tech Forum in Guangzhou, China, was dominated by A.I. discussions.)

The result is a serious subject running the risk of jumping the shark. "If advocates are not careful, they will have successfully Bitcoinized

A.I.," says Michael Schrage, a researcher at MIT's Initiative on the Digital Economy.

Make no mistake—artificial intelligence is more than a fad. It represents a whole new way of doing business by turbocharging the existing trends of automation, sensor-based industrial monitoring, and algorithmic analysis of business processes. Computer science was already helping machines perform routine tasks more quickly than humans. The new techniques of A.I.—combined with ever faster computing power and the accumulation of years of digitized data—mean that for the first time computers learn the tasks humans require of them rather than merely doing as they're told.

The result, says Tom Mitchell, a machine-learning professor at Carnegie Mellon University, is nothing less than "one of the major forces for society and lifestyle of the next decade." And commerce too: Researcher IDC predicts spending on A.I. will near \$80 billion in three years. Paul Daugherty, chief technology and innovation officer of consultant Accenture, reckons that figure will prove low because "it doesn't account for the investment companies are making in transformation around A.I."

Yet, as is the case with

**"IT IS NOT
SOMETHING YOU
CAN BUY AND
SUDDENLY FLIP
A SWITCH."**

any exciting technology, there are limits to what A.I. can accomplish. Self-driving cars are the perfect example. We already have the technology for them to operate under ideal circumstances, but even John Krafcik—CEO of Alphabet's self-driving car subsidiary Waymo—admits they'll *never* be able to drive in all weather conditions without some human input. What's more, computers are very good at learning clearly defined tasks, like identifying people in photographs or accurately transcribing speech. But understanding human motivations or drawing nuanced conclusions from text—insights at which humans excel—remains beyond the machines. Says CMU's Mitchell, "We're still in the very early stages of trying to productize this."

What A.I. can't yet do ought to be of some comfort to CEOs. Susan Athey, a professor of the economics of technology at Stanford University, reassures managers in her executive education courses of their worth—

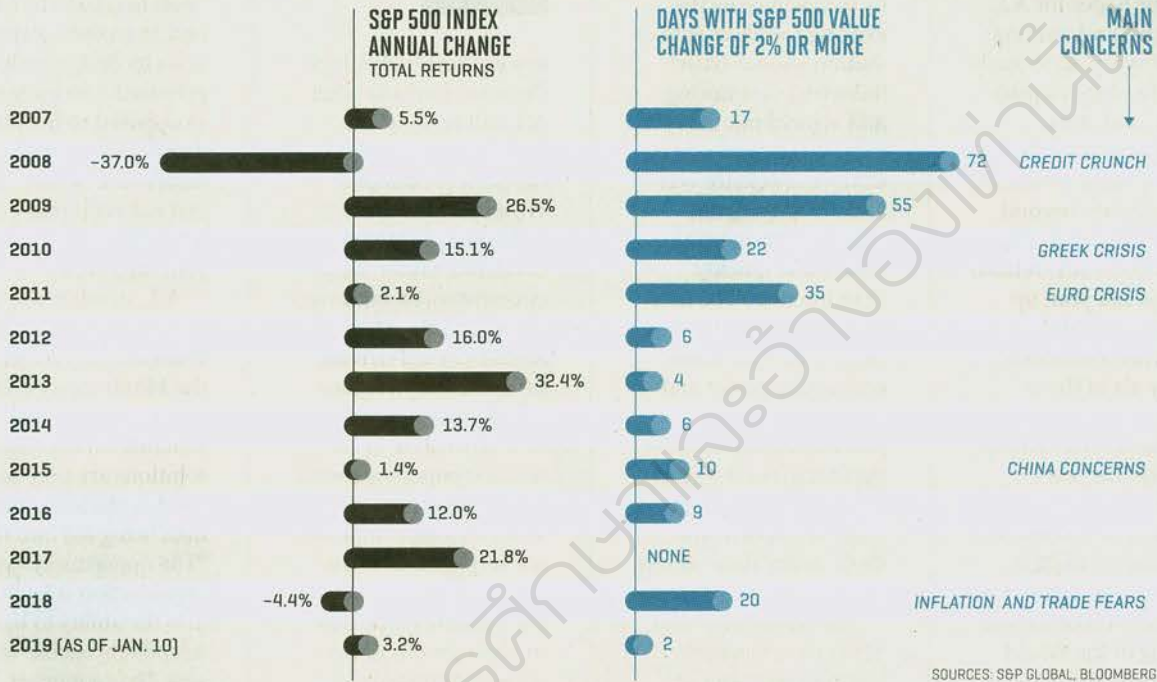
and also the limitations of the A.I. scientists they hire. "New Ph.D.s are all bought in, but they don't have the experience of what doesn't work, which projects not to do," she says. A.I., says Athey, justifiably "feels magical." But it is best at analyzing situations its designers have prepared it to interpret, as opposed to making decisions on subjects it hasn't seen before. "It's just not right that your A.I. will manage for you," says Athey.

A.I., in other words, is no silver bullet. Jean-François Gagné, CEO of the Montreal software startup Element AI, reminds clients that A.I. solutions are only as good as the accumulated data being fed into them. "The opportunity every organization is looking at is the ability to have adaptive systems," he says. "It is a journey. It is not something you can buy and suddenly flip a switch. By the very definition of A.I., it takes time to learn."

Gagné analogizes the process of building a useful A.I. to the difference between "teaching your children the right thing versus getting the right behavior in adulthood." It will take at least as long to know if businesses were able to properly grasp this A.I. moment—or if it was another extremely expensive and elusive money pit.

VOLATILITY IS BACK

AFTER AN UNUSUALLY CALM RUN in markets following the surprise election of President Trump, volatility came back with a vengeance at the tail end of 2018. Unsettled by escalating trade-war tensions, inflation fears, and concerns about a slowdown in China, equity investors grew jittery, which helps explain why, for the first time since 2008, the S&P 500 finished the year below where it started.

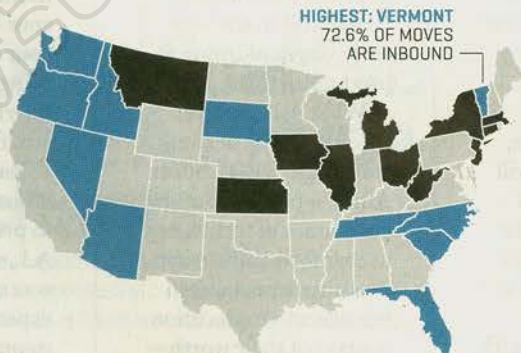


WHERE AMERICA IS HEADED

NEW YORK CITY MAY BE THE FINANCIAL HEART of the U.S., but New York State is losing people. Retirees and young job seekers are heading to the south and west for better weather and new opportunities [they also love Vermont].

NATIONWIDE MOVING TRENDS

- POSITIVE MIGRATION
- NEGATIVE MIGRATION
- BALANCED

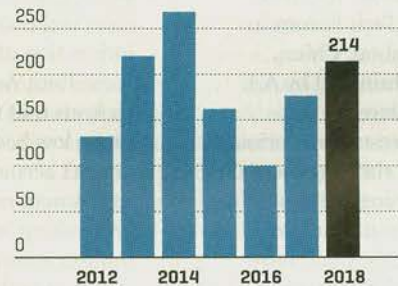


SOURCE: UNITED VAN LINES

APPROACHING PEAK IPO

THE YEAR OF THE DOG was host to a sizable pack of initial public offerings—and with unicorns such as Uber, Lyft, Palantir, and Pinterest ready for an IPO, 2019 could get investors wagging.

ANNUAL U.S. IPO VOLUME



SOURCE: PWC

MASS ADOPTION

Recreational cannabis in Massachusetts got off to a blazing start.

\$15M

CANNABIS SALES IN FIRST SIX WEEKS

Cannabis retailers in the Bay State have raked in \$2.5 million a week.

20%

TAX ON RECREATIONAL SALES

The legalization measure approved by state voters suggested a 12% tax. Lawmakers significantly increased it.

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RETAIL LICENSES APPROVED

Would-be retailers have to clear significant regulatory hurdles to obtain a license. Only two licensees had been approved by the Nov. 20 sales launch. [For more on legal weed, see page 20.]

—REY MASHAYEKHI



How to Deal With No Deal

British companies are already putting their “no deal” Brexit contingencies in place.

By David Meyer

NO-DEAL BREXIT

THE VERY POSSIBLE scenario that the U.K. leaves the European

Union without a negotiated exit deal would be a shock to everyone’s system. With no trade deals in place, tariffs would jolt into effect, causing shortages on shelves and blockages in ports.

So, how are businesses preparing for the possibility of no deal?

Many financial services firms are moving assets out of the U.K. and into the EU. As the consultancy giant EY reported, 20 companies have already publicly announced such shifts. EY put a “conservative estimate” of 800 billion pounds (\$1.02 trillion) on the total.

Barclays has shifted ownership of its French, German, and Spanish operations from its British subsidiary to its Irish subsidiary. More than a third of big U.K. financial services firms are moving staff abroad.

Many industries are stockpiling. Though the British government has announced that medicine imports will get priority at the ports in the event of no deal, pharma giants such as AstraZeneca and Merck are caching meds, just to make sure. (AstraZeneca has also begun parallel testing at a Swedish site, owing to likely sudden changes in regulation.)

And in the auto industry, Aston Martin and Volkswagen-owned Bentley are not only stockpiling components in order to avoid manufacturing disruptions, they’re also arranging to use ports other than Dover, the U.K.’s main ferry link with the European mainland, which is likely to become heavily congested.

“We have to prepare for the worst-case scenario,” Aston Martin CEO Andy Palmer told Reuters.



The KonMari Economy

Could Japanese tidying guru Marie Kondo slow down fast fashion? By Rachel King

RETAIL **NETFLIX SPARKED JOY** ... as well as social media buzz, memes, and possibly sales trends with its recent debut of *Tidying Up With Marie Kondo*.

Inspired by Kondo's KonMari method for decluttering and organizing living spaces, the series is prompting viewers to not only purge their closets but also perhaps rethink their spending habits beyond just New Year's resolutions.

Google searches related to Kondo and her method

hit breakout levels in early January—and there's a real possibility that Kondo's influence could push consumers toward fewer, higher-quality garments and housewares.

While this might spark mental and financial relief for consumers, it's not a joyful prospect for retailers—especially those in fast fashion, such as H&M, Zara, and Forever 21.

"We're now in a time of transformation, and we see the trend toward slow fashion away from fast fashion as much more powerful than a fad," says Jen Redding, a senior equity research analyst at Wedbush Securities.

That's not to say all mid-market fashion retailers are at risk if the trend takes hold. Redding named direct-to-consumer wunderkind Everlane as one example of newer retailers promising better-made basic apparel with perennial appeal.



TOP TOP SHELF

HUNGARY, NOT BURGUNDY, PRODUCES THE WORLD'S MOST EXPENSIVE WINE

A \$40,000 bottle of sweet, syrupy Tokaji Essencia from Hungarian winemaker Royal Tokaji now ranks among the most expensive wines in the world at release. The high price stems from both cost of production and scarcity. To make these high-sugar Aszú wines [somewhat similar to French Sauternes] each grape must be harvested by hand, and reaching the desired sugar concentration means each bottle can require more than 400 pounds of grapes, not to mention a lengthy maturation. As a result, only 18 magnums of the unique vintage will ever reach buyers.

—CLAY DILLOW

EUROPE

PARIS GETS A TOURISM ASSIST FROM NEW YORK POWER COUPLE

BEYONCÉ and Jay-Z's hit song "Apes**t" really did make everyone go, well, apes**t—to see the Louvre. More than 10.2 million people—a record—descended on Paris's fine arts and antiquities museum in 2018, largely boosted by the couple's music

video that was filmed there last summer. Riding the extra attention, the Louvre has been offering a 90-minute thematic tour of the iconic works that made appearances in the video.

—LINDSEY TRAMUTA



FOCUS

PRACTICAL
EXPERTISE

TECH

Several hopefuls have already started launching satellites into orbit.

THE INTERNET SPACE RACE

Companies are scrambling to offer high-speed online access from the final frontier.

By Aaron Pressman

THE NEXT BILLION PEOPLE who get connected to the Internet may be looking to the heavens. That's where a race is on to provide online access from fleets of satellites, led by a who's who of tech and several deep-pocketed startups.

The aim is to help connect people in developing countries, provide speedier online access to mainly rural users who depend on today's slower and more expensive satellite Internet services, and cater to business customers that want real-time data from their equipment, like oil rigs and ocean buoys. >>



▷▷ The biggest names in the race include Facebook, Elon Musk's SpaceX, and OneWeb, backed by Japanese billionaire Masayoshi Son's SoftBank Group. They're pitted against dozens of upstarts like Swarm Technologies, Astrocast, and Sky and Space Global that want to send cheap, toaster-size satellites called cubesats into orbit.

Wary of the competition, existing satellite-based Internet providers such as Viasat and EchoStar's Hughes Network Systems are moving to defend their businesses. They plan to launch new satellites that are far more powerful than their predecessors.

For now, the satellite-based broadband industry is relatively small. It will account for only \$4 billion in revenue this year, according to Morgan Stanley. But with all the planned networks, and a shift in consumer Internet habits, sales are expected to reach the stratosphere. By 2024, revenue is expected to rise to \$22 billion and then to \$41 billion in 2029.

The current space race harks back to the 1990s, when several satellite companies launched with similar aspirations. The Bill Gates-backed Teledesic, as well as Iridium and Globalstar, bragged about their big plans but ended up filing for bankruptcy after costs soared and money from investors dried up.

It's a sometimes dangerous adage, but this time really should be different. New rocket-launching companies, including SpaceX and Jeff Bezos's Blue Origin, are driving down the cost of launching satellites, while the miniaturization of computers has enabled smaller and cheaper spacecraft.

"Each kilogram that you can put at 300 miles above the earth's surface is many orders of magnitude superior to what we had in the '90s," explains Morgan Stanley analyst Adam Jonas.

Companies pushing into the satellite Internet business fall into different categories based on the size of the satellites they plan to use and how high into orbit they hope to send them. They also differ in whom they're targeting as customers and the kind of Internet access they want to provide.

For example, SpaceX's initiative, called Starlink, involves sending 12,000 satellites aloft over the next few years, or 50% more than the total number of objects blasted into space since Sputnik. The mini-refrigerator-size satellites would orbit at as low as 340 miles, well below typical communications satellites that are parked in geostationary orbit at 22,300 miles.

By launching so many satellites, Starlink says, one will always be overhead for customers. Though it may be difficult for Starlink to match the speed of ground-based broadband from the likes of AT&T and Comcast, the aim is to provide affordable high-speed service over vast areas of the globe that lack top-notch wired access, anywhere from rural Arkansas to Africa.

Last year, Starlink sent up its first two test craft—dubbed Tintin A and Tintin B after the Belgian comic book character—and received U.S. government approval for a full 12,000-bird fleet.

That puts it far ahead of Facebook, which just filed a request with the federal government to fly a single experimental satellite in low orbit. Facebook hasn't committed to deploy a full-fledged network or revealed much about its strategy.



One of the tiny satellites that startup Swarm plans to use in its space-based broadband network.

Some startups are trying to take advantage of declining satellite costs by using tiny cubesats, which can cost just a few hundred thousand dollars each. That's a big savings from typical satellites, which can cost hundreds of millions of dollars.

Swarm CEO Sara Spangelo, the aerospace engineer who previously worked at Google's experimental incubator X and at NASA, says her smaller, cheaper fleet will be operational years ahead of the bigger players. The company already has seven satellites aloft out of 150 planned.

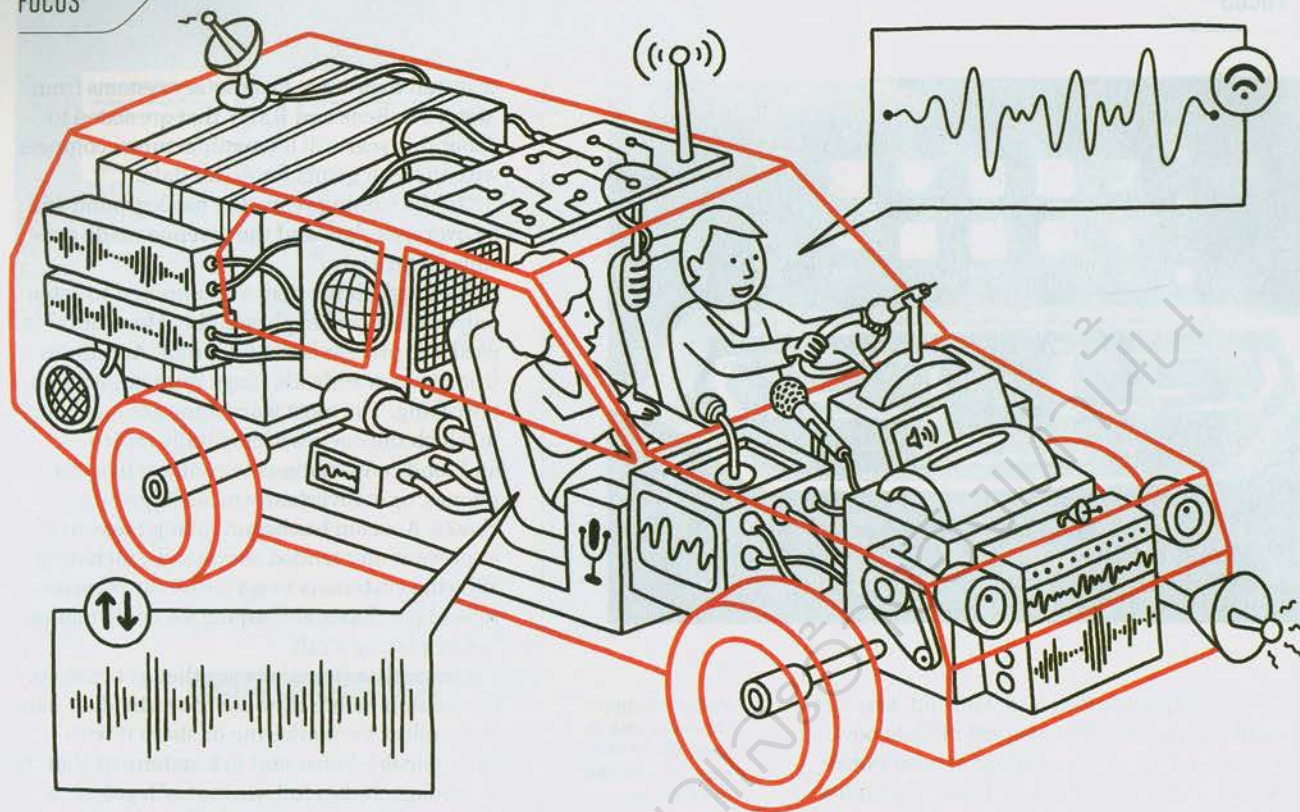
Of course, the network won't provide high-speed Internet access to millions of subscribers, either. Many initial customers will be businesses that want to collect data or need Internet connections only occasionally. In January, for example, Swarm partnered with Ford to use its satellite network to provide emergency communications in cars—much like GM's better-known OnStar network, which relies on regular wireless networks.

Compare those plans with Viasat's \$1.4 billion initiative to send two satellites aloft over the next two years. The satellites, each bigger than a school bus, would have twice the combined capacity of all 400 communications satellites currently in space, Viasat says.

Analysts note that small players may be able to succeed in a crowded market with their cheaper networks. Getting a foothold no longer requires a huge upfront investment.

Still, Tim Farrar, president of satellite consulting firm TMF Associates, doubts that all the challengers will survive, particularly the upstarts. Even with today's cheaper technology, they'll need big money to pay for their networks and to maintain them.

Says Farrar: "There will definitely be a shakeout." ■



THE SPY INSIDE YOUR CAR

Digital assistants may be a convenience for drivers, but they also raise serious privacy questions over the information they collect. **By Jaclyn Trop**

TECH **INCHING DOWN THE FREEWAY**, a driver realizes she's forgotten her weekend plans and asks her digital copilot to check her calendar. Within seconds, a voice emanates from the car's speakers telling the driver that she has RSVP'd to a friend's birthday party and then suggesting a gift—a Detroit Lions jersey.

The entire process ends less than two minutes after the driver asks the digital assistant to order the jersey. Meanwhile, the dialogue inside the car is sent to a distant data center, ready to be mined for ads pitching an NFL game, even though the driver dislikes football.

Once clunky and buggy, voice-recognition technology is improving and quickly spreading to the dashboard, allowing drivers to issue a wider range of commands using natural speech. Designed to keep drivers' eyes on the road, "personal assistants" powered by artificial intelligence can perform a variety of functions, from managing calendars to placing Amazon Prime orders.

When synced with smart-home gadgets, the software can also

turn up the thermostat, turn off the lights, and lock the doors from miles away. But if the benefits of bringing Amazon Alexa, Apple's Siri, or Google Assistant into the car seem endless, so do concerns about privacy and how the information collected will be used.

"Consumers have good reasons to be concerned about the use of voice-recognition systems in cars," says Christine Bannan, an attorney for the Electronic Privacy Information Center, a consumer advocacy group in Washington, D.C. "There is a false narrative that because consumers embrace new technology, that means they are indifferent about privacy."

An estimated 120 million cars will be equipped with voice-recognition systems next year, up from 40 million in 2018, according to IHS Markit. Currently, most in-car systems are smartphone-based, but Amazon and Google are also developing embedded devices that can work in cars without being tethered to a phone. >>



▷▷ “Apple CarPlay and Android Auto are available in even the cheapest models now,” says Ed Kim, a vice president at automotive research firm AutoPacific. “I would imagine that within five years, the vast majority of new vehicles will have some form of voice recognition.”

That means more drivers will have access to technology that alerts them to a sale at a nearby store—via an audio cue or an on-screen prompt—or ensures that their grande latte is ready when they swing by their local Starbucks.

But manufacturers, marketers, and other businesses may gain even more. Once artificial intelligence becomes better at understanding and interpreting speech across a range of dialects, accents, and colloquialisms, cars will be able to glean even deeper insight into drivers’ behavior and share that information with other companies.

While it may be convenient for cars to know your shopping habits and favorite places, that information can also be used to create targeted audio or visual ads, sell subscription services, or tip off third-party businesses. The more data that Amazon, Google, and Apple collect by placing their devices inside cars, the more opportunities they have to serve—or sell to—customers.

For now, automakers are gearing up to reap the rewards. Some manufacturers are forgoing technology from Amazon, Apple, and Google

Voice-recognition systems in cars are on the rise. The number of vehicles equipped with the technology is expected to reach 120 million next year, triple the number in 2018.

to install their own. Proprietary systems from Mercedes-Benz and BMW that are slated to debut this year will let manufacturers compete with the tech giants for driver data.

“In the coming years, the battleground will be over user data and the revenue made possible,” Kim says.

Although the devices are supposed to listen only when a “wake” phrase like “Hey, Alexa” is used, the process is not foolproof. Anecdotes from users worldwide range from amusing to horrifying. The most worrisome are incidents in which the devices accidentally record and send conversations to contacts in users’ phones, or inadvertently make large purchases. Amazon has begun taking measures to prevent unintended commands, including allowing customers to set a PIN for voice-activated purchases and asking for confirmation before placing a call.

Currently automakers say they get customer permission before they use the individual data they collect for marketing or share it with third parties. Volvo said in a statement that its technology “takes full account of legal, security, and privacy obligations on a global scale” and complies with a European Union law that lets residents control how their personal data is shared.

An Amazon spokesman says that the company merely shares “anonymized, aggregated performance data to help automakers improve the customer experience” and that it doesn’t provide personally identifiable information to car companies or developers.

BMW shares the data it collects but says it doesn’t make money from it directly. “Let’s say the person is listening to certain music, and we know there’s a big concert,” says Dieter May, senior vice president of digital products for BMW. “Then we would probably give that to our salespeople to make an offer for a special ticket.”

But even as governments and corporations begin to address security questions, it’s unclear who will control the data that is collected.

“It’s the latest shiny thing in the car, and the one with the best speech recognition will win,” says Roger Lanctot, associate director for automotive at Strategy Analytics, a market research and consulting firm. “In our winner-take-all world, that win will be very lucrative.” ■



E-SPORTS IS THE NEW PREMED

The Ohio State University is introducing a video game-related degree. Will other colleges follow suit? By Lisa Marie Segarra

TECH STUDENTS AT ONE OF THE LARGEST U.S. universities have video games on the brain during lectures. But it's not a distraction, because gaming is actually part of the class.

The Ohio State University recently announced an e-sports program for the upcoming fall semester that includes courses about coaching e-sports teams, marketing video games, and managing the business side of gaming. There's also a new major: a bachelor of science in game design and e-sports.

Bloody shooter games like *Call of Duty* are a long way from traditional college subjects such as literature or chemistry. But with billions of dollars invested in video games, plus the huge money that fans splurge on game-related merchandise, careers in e-sports are booming.

As a result, colleges are increasingly adding classes that are focused on e-sports, or the competitive side of video

gaming. For example, in recent years, both the University of California at Irvine and Lambton College in Sarnia, Ontario, introduced e-sports certificate programs, a step short of a full degree.

What sets Ohio State apart, other than its new e-sports focus, is its size—the school has 60,000 students—and its success in athletics like football. Other schools will inevitably take notice and introduce their own e-sports programs, predicts Nyle Sky Kauwelo, an assistant instructor at the University of Hawaii at Manoa whose Ph.D. research includes e-sports.

"It's a significant move," he says.

Before creating its e-sports program, Ohio State sought input from administrators and faculty across several departments. They brainstormed about which classes to offer and what they hoped students would ultimately learn, eventually settling on a general outline.

"We all had the same idea about what we wanted from this program," says Deborah M. Grzybowski, codirector of game studies and e-sports curriculum development at the university and an associate professor in engineering education.

Ohio State has already debuted three undergraduate e-sports courses. Ten more classes are planned for the fall, along with an e-sports arena that will seat 80 for the school's existing competitive e-sports team and for recreational play.

Although Ohio State's e-sports program has yet to start in earnest, interest is already high, Grzybowski says. A number of students and parents have contacted the school about it, but it's too soon to know how many people will ultimately enroll.

At the start of the current school year at the University of Hawaii at Manoa, around 45 students enrolled in an e-sports class, more than the 10 or 12 that had been expected, Kauwelo says. Based on its success, the school is now considering adding more e-sports courses.

Still, Kauwelo advised schools to think things over carefully before creating their own e-sports programs.

"What works in Ohio is not always going to work for us at U.H. or work for a school in New York," he says. "This is the Wild Wild West." ■

E-SPORTS

THE HIDDEN UPSIDE TO CEO DRAMA

When a company axes its chief executive, its stock often plummets. But when the firing is part of a bigger overhaul, investors can win in the long run. Here are some shake-ups worth celebrating. **By Ryan Drousseau**



INVEST

IN RECENT YEARS, few corner offices have had doors that revolved as fast as Mattel's. The toymaker has replaced its CEO three times since 2015—most recently last April, when former Google executive Margo Georgiadis stepped down from the post, to be replaced by Ynon Kreiz.

The turmoil isn't surprising: After all, Kreiz's predecessors weren't able to stanch the decline in Mattel's revenues, which dropped 23% from 2014 to 2017. With brick-and-mortar retail partners like Toys "R" Us struggling or collapsing under the Amazon onslaught, Mattel has fewer sales outlets, even as the ranks of its competitors grow. And Mattel's stock price, to borrow a phrase from one of its vintage games, has gone Ker Plunk.

But investors can find reason for hope in Mattel's most recent leadership change. There's growing evidence that CEO departures that are driven by a wider strategic realignment often result in substantial improvements—for the business and its shareholders.

These days, investors have many more changes than usual to consider. According to

outplacement firm Challenger, Gray & Christmas, 1,452 CEOs at U.S. companies with more than 10 employees left their jobs in 2018—a 25% increase from 2017 levels and the largest wave of departures since the 2008 recession. About a quarter of those leave-takings were classified as retirements, and a handful were driven by #MeToo issues and other misconduct. But the high turnover also reflects businesses coping with a changing economic environment in which recessionary trends have begun to undermine their earnings and share prices.

Amid all this disruption, there's one category of CEO change with potential to be particularly profitable. A recently published study indicates that in situations in which the CEO and the board disagree on strategy, leading to the chief executive's resignation or dismissal, companies are more likely to see a meaningful performance boost over the long term.

The study's authors found 97 cases between 1995 and 2012 in which a CEO was forced to leave a position owing to a disagreement over strategy with the board. Improvement doesn't

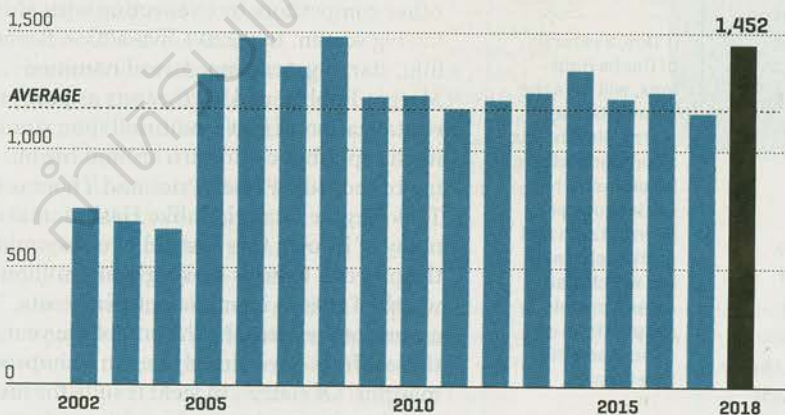
happen overnight, explains coauthor and University of Missouri finance professor Kuntara Pukthuanthong: The business problems and public disagreements surrounding the departure often depress the company's share price for the 12 months after the turnover. Over the ensuing years, however, such businesses narrow the gap. Pukthuanthong's team found that three years after the change, stock performance for companies in the group was back on par with their industry's—rewarding those who took a chance on the stocks at their nadir.

One reason for the success has to do with the way companies reoriented around longer-term goals after many leadership changes. The new hires the team studied were more likely than their predecessors to get more of their compensation in the form of long-term incentives, like restricted stock options, >>

GOODBYE ... AND GOOD LUCK?

In 2018 the S&P 500 had its first down year since 2008. Not coincidentally, American CEOs left their jobs at a near-record pace.

ANNUAL CEO DEPARTURES



SOURCE: CHALLENGER, GRAY & CHRISTMAS

▷▷ than in short-term ones, like bonuses for hitting quarterly benchmarks. Not coincidentally, there was evidence that such companies focused more on improving themselves than on using tactics like share repurchases to lift their stock in the short term. Three years after the firms underwent leadership changes, their capital expenditures had risen by 36% on average—an unusually fast pace. The book value of their assets had risen substantially too, another sign of greater internal investment.

THE PAST YEAR'S bumper crop of new CEOs, of course, leaves investors with plenty of opportunities to take a flier on a business in mid-shake-up. *Fortune* took a look at companies in that category and identified a few whose stocks could surge if new management executes well enough on a new vision.

John Milligan stepped down at the end of 2018 as CEO of **Gilead Sciences (GILD, \$68)**, which endured a 24% decline in its share price during his tenure. Revenue from Gilead's hepatitis C drugs, formerly blockbusters, has plummeted as rivals have entered the scene: Cowen analyst Phil Nadeau estimates sales will fall from \$9.1 billion in 2017 to just under \$3 billion by 2023. Former Roche Holdings executive Daniel O'Day will become CEO in March with a mandate to make up those losses in other areas—including in cancer treatment, where Gilead's recent purchase of Kite Pharma gives it a portfolio of immunotherapy drugs. Gilead is also capturing significant growth in its HIV segment. Its therapies, including Truvada and Genvoya, are used to treat 53% of those infected with HIV worldwide, and sales rose 12% over the past year. At today's prices, "it's very much a value stock," says Nadeau.

As if operating in a declining industry like printing weren't challenging enough, **Xerox (XRX, \$22)** spent much of 2017 and 2018 in a battle with activist investor Carl Icahn. As *Fortune* chronicled in a recent feature ("Paper Jam!" June 2018), Icahn and fellow shareholder Darwin Deason opposed CEO Jeff Jacobson's efforts to merge Xerox with longtime partner Fujifilm Holdings. The two investors secured election of a new board, the Fuji deal fell through, and Jacobson gave way to current CEO John Visentin. Xerox is still fighting with Fuji over a \$1 billion breakup

OLD BRANDS, NEW LEADERS, BIG CHALLENGES



YNON KREIZ
CEO, MATTEL

Kreiz is steering the troubled toymaker toward intellectual-property plays—including a live-action Barbie film. "I was shocked to realize we never made a movie," he told guests at a January *Fortune* event.



DANIEL O'DAY
CEO-DESIGNATE,
GILEAD SCIENCES

O'Day, a veteran of Roche Holdings, will take the helm at Gilead in March. He inherits a company whose blockbuster hepatitis drugs are losing steam and market share—but which also owns a promising portfolio of cancer and HIV treatments.

fee. But the drama has obscured the fact that Xerox "generates a bunch of cash," says JPMorgan analyst Paul Coster. Its operating cash flow adds up to an impressive 10% of revenues. That gives the company the ability to support a 5% dividend yield, as well as the flexibility to invest in innovations that could help Xerox offset the decline in printing. Visentin is scheduled to outline his strategy in February; investors will be watching to see whether it looks like the road map to a rebound.

A company further along in its revamping journey is clothing retailer **Lands' End (LE, \$16)**, which was spun off from Sears Holdings in 2013. Its previous CEO, Federica Marchionni, sought to woo a younger demographic, moving a brand known for khakis and casual wear to more fashionable designs. But her strategy neither gained traction nor won over the board. She left in 2016, and current CEO Jerome Griffith replaced her in March 2017. Griffith has gone back to the company's roots, focusing on coats and other outerwear. Short term, the strategy has worked for the \$1.4 billion company. Operating income flipped from a loss in the first three quarters of 2017 to an \$11.9 million gain over the same period in 2018. If the company's pace of sales growth—currently 6%—accelerates, Lands' End could be a good buy, says C.L. King analyst Steven Marotta, who's currently neutral on the stock.

And let's not forget turnover-plagued **Mattel (MAT, \$12)**. Kreiz, the latest CEO, comes from the world of television production, and he aims to follow the lead of Hasbro and other competitors by connecting with kids via the big screen. In 2020 a live-action Barbie film, starring Academy Award nominee Margot Robbie, will hit theaters as part of a revitalization of that iconic doll line; similar media splashes could turn around big but aging brands like Fisher-Price and Thomas the Tank Engine. Mattel, unlike Hasbro, makes many of its own toys instead of outsourcing the process. Kreiz is seeking \$650 million worth of cuts to its manufacturing costs, among other areas, by the end of the year, and those efforts have already begun to improve margins. Of course, to yield results for investors, he may need something his predecessors didn't get much of: time. ■

PASSIONS

TIME
WELL SPENT

WATCHES

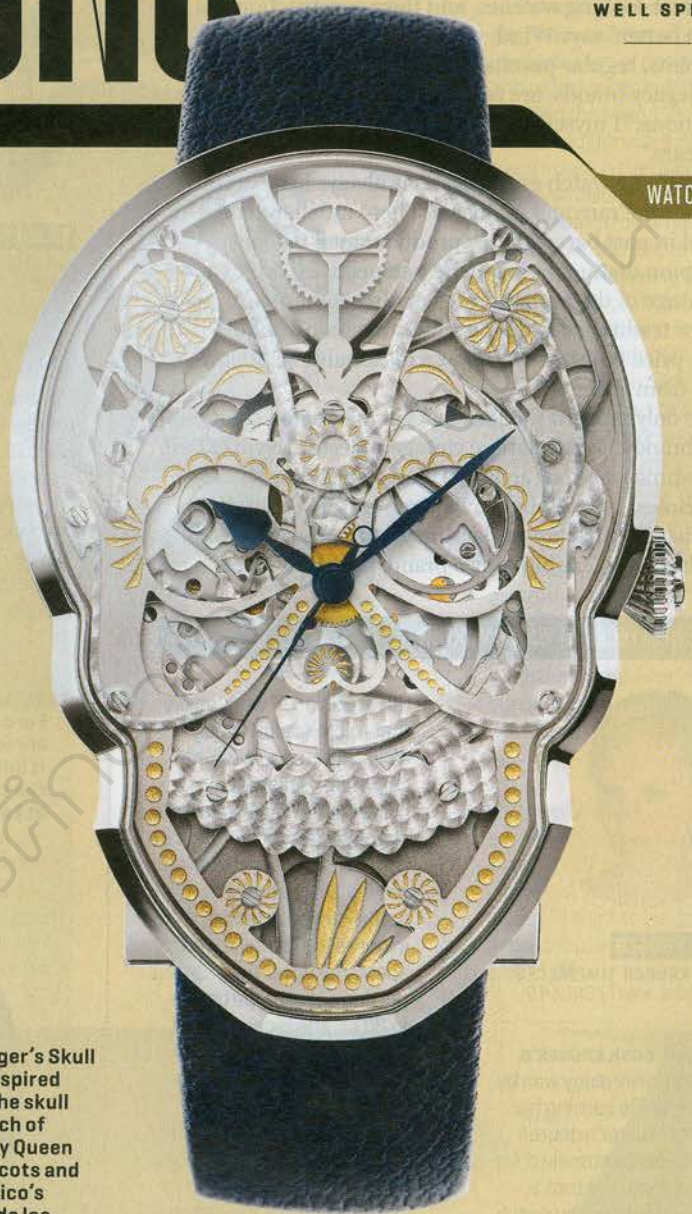
THE NEW FACES OF WATCH DESIGN

For horolophiles who want to stand out, microbrands are making a mark on a storied industry. By Stacy Perman

IF YOUR NOTION of a watchmaker conjures up images of a wizened man, loupe affixed to his face, tinkering with a variety of tiny cogs and wheels in the Vallée de Joux, Switzerland's famed horological hub, think again.

There's a new wave of independent watchmakers shaking up the timepiece world and gaining currency among both the wide-eyed newcomer and the seasoned, moneyed collector. Stretching across the globe, these makers and designers are bringing an untraditional twist to a very traditional industry. Unlike the marquee indies of recent vintage—Roger W. Smith, MB&F, Kari Voutilainen, Greubel Forsey, and Christophe Claret, to name a

Krüger's Skull is inspired by the skull watch of Mary Queen of Scots and Mexico's Día de los Muertos.



few—this crop is schooled in a number of disciplines, from art to physics, although not necessarily horology.

Eric Wind, a Florida-based watch dealer, says that while a number of these new indie microbrands have been percolating over time, they really exploded in the past year. "There are more of them, they're making >>

▷▷ great-looking watches, and their construction has gotten better," says Wind, who's noticed that many of his clients, regular purchasers of six-figure watches from legacy brands, are adding these new indies to their collections. "I myself have bought a number in the past two years."

The astute watch enthusiast has always been on the hunt for the rare and exclusive. These independents appeal in part because they produce small batches, champion distinctive aesthetic perspectives, can take advantage of the availability of quality components, and eschew traditional retail distribution chains. What's more, price points can start at a reasonable \$250 and go up from there.

"The only modern watches that get me excited are these indie brands," says longtime vintage collector Kevin O'Dell, who estimates he has about 70 pieces, including those from Rolex, Patek Philippe, Panerai, and IWC. "I feel like established watch brands lack inspiration," he says, finding that the indies "are building a brand, not just a name."

FOUR NEW FACES IN WATCHMAKING



FIONA KRÜGER

FIONA KRÜGER TIMEPIECES
FRANCE & SWITZERLAND

SCOTTISH-BORN KRÜGER'S entrée into horology was by chance. While earning her fine arts master's degree at the École Cantonale d'Art de Lausanne, she took a course sponsored by watch brand Audemars Piguet, where she was tasked with designing a timepiece: "I thought this was above my skill set. Watches weren't really on my radar." A visit to AP's factory and the Patek Philippe Museum soon changed her mind. "The first time I saw the assembled movements and

the precision of working on that micro scale, I thought, 'Wow, this is special.'" She calls Patek's historical collection "Willy Wonka's chocolate factory for designers." For her master's project she designed a skull-shaped watch, inspired by her childhood spent in Mexico. After putting a prototype online in 2011, she received over 100 inquiries. In 2013, Krüger along with her husband, Michael, launched her company with the Skull Collection. Last year, Krüger, who also makes custom orders, debuted her second collection, Chaos, inspired by the laws of thermodynamics and Roy Lichtenstein paintings. Timepieces range from \$12,900 to \$28,550: "I came to watchmaking as a complete outsider and discovered this whole magical world, a mix of storytelling and beautiful craftsmanship."



BRADLEY PRICE

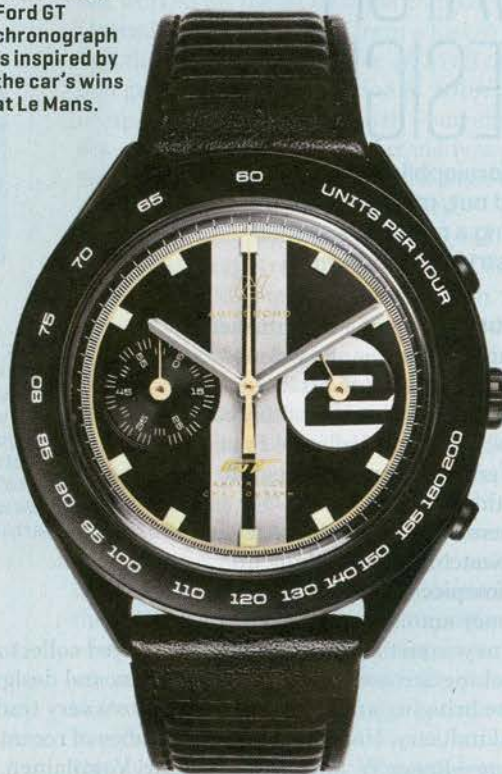
AUTODROMO
DOBBS FERRY, N.Y.

AN INDUSTRIAL DESIGNER

with a love for automobiles, Price debuted his car-gauge-inspired watches in 2011: "I've always been a car enthusiast, and there was nothing in the marketplace for me. I wanted an automotive-inspired watch that was tasteful and priced in an

affordable way." For Price, who says he had a wealth of ideas, the challenge was to transform them into timepieces. He went to watch fairs and brought his drawings to manufacturers. "I found I had to go back and start over. A lot of what I wanted to do had limitations, but I learned a lot from factory engineers." Price has launched two watches with Ford: One is a vintage-inspired chronograph celebrating the Le Mans race, priced at \$695, and the other, released last year, is a made-to-order customized piece available only to Ford GT owners. The watch is serialized to match their chassis number and priced at \$11,500. "What I'm trying to achieve each time is to come up with a new watch that makes people excited again and fall in love."

Autodromo's Ford GT chronograph is inspired by the car's wins at Le Mans.



KRÜGER: COURTESY OF FIONA KRÜGER TIMEPIECES; PRICE: COURTESY OF AUTODROMO (2)



MING THEIN

MING
SWITZERLAND & MALAYSIA

MULTIHYPHENATE RENAISSANCE man Thein—photographer, chief of strategy for Hasselblad, brand designer, and theoretical physicist—began designing watches because he found his tastes outpaced his wallet. About four years ago, on the way back from a Hong Kong watch fair, he joked with six of his friends, “Let’s make our own.” Tapping his contacts in the watch world



The Ming 19.01 with its gradient sapphire dial was a finalist in the 2018 Grand Prix d’Horlogerie de Genève.

and meeting with suppliers, Thein says the process involved years of designing and redesigning. In 2017 he unveiled the Ming 17.01, a limited-edition minimalist piece in which the depth and variety of color of the dial change based on ambient lighting. All 300 pieces sold out immediately. In 2018 the Ming 19.01 was selected as a finalist in the Grand Prix d’Horlogerie de Genève—the horological Oscars. Thein says he’s aiming for somewhere between the entry-level buyer and the moneyed vet (prices range from \$1,290 to \$7,850). “We want to make watches that are fundamentally interesting to us as collectors,” he says. “It’s a challenge to keep things continually fresh but not deviate from our design DNA.”

ALDIS HODGE

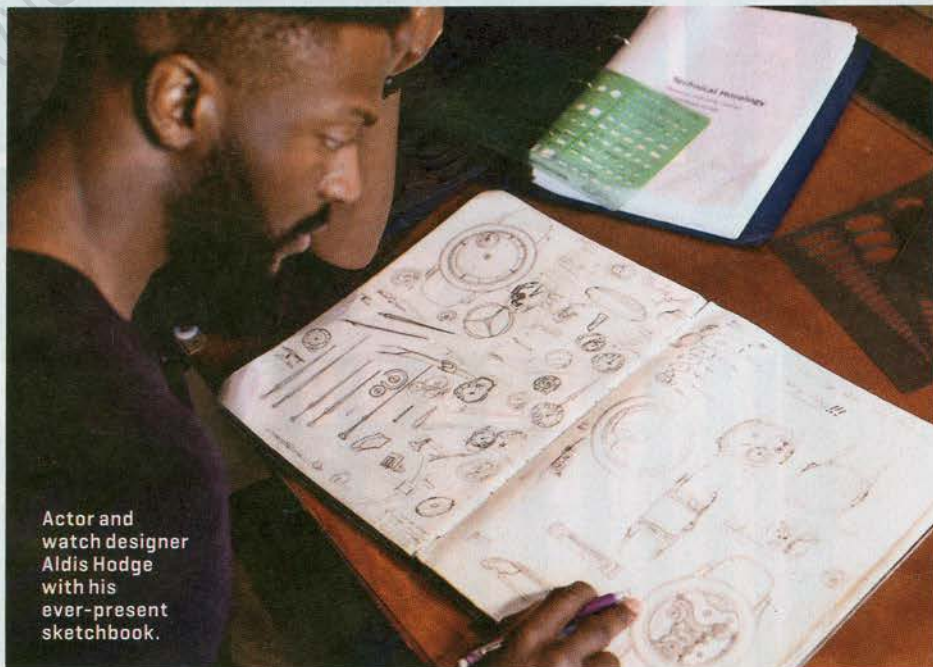
BASIL TIME
LOS ANGELES

FOR MANY, HODGE IS A FAMILIAR face as an actor, starring in *Hidden Figures*, *Straight Outta Compton*, and the upcoming Showtime series *City on a Hill*. Off-camera, he’s a devotee of horology and a watch collector. Inspired by the designs of Gerald Genta and Greubel Forsey, Hodge has been quietly developing a watch for several years and is in the process of manufacturing a prototype. Ten years ago he approached Hamilton about a collaboration, but he says they found his concept too complex, so he decided to go it alone. A serious student of engineering, design, and horology, he keeps a notebook full

of his renderings with him and can hold forth about the history and technical minutiae like others discuss wine or art. “[I studied] biochemical engineering and automotive engineer-

ing,” he says. “What I like is design. I like figuring things out and then figuring out how we make them play in different ways. And I want to give the world my vision.” Currently working with

partners to make his vision a reality, Hodge is keen to launch his line in the next two years. He’s aiming for legacy: “I want to be able to contribute something great.”



Actor and watch designer Aldis Hodge with his ever-present sketchbook.



RAISING CAPITAL
Light-controlled
marijuana grow
rooms at Tilray's
headquarters facility
in Nanaimo, B.C.

WALL STREET'S CONTACT HIGH

By Jen Wieczner

**Excitement about legal weed turned Canadian startup
Tilray into one of the world's hottest stocks—and turned
its American founders into billionaires. As
Big Cannabis goes mainstream, will the buzz wear off?**

GROWTH INDUSTRY: CEO Brendan Kennedy with marijuana "tissue culture clones" at Tilray's Nanaimo headquarters.



IT'S JUST AFTER 6, on a pitch-dark morning in December, and Brendan Kennedy is standing over the stove, wearing shorts and a vest, meditatively melting butter in a pancake pan. It will be nearly two hours before

the sun cracks the Seattle sky, and Kennedy, toddler son in tow, already has the pensive look of a man trying hard to keep the creep of the workday ahead from encroaching on a family ritual.

See, morning is a sacred time for the 46-year-old CEO, who has two rules for starting the day: Always eat breakfast. Don't eat with anybody but your kids. Though abiding by rule No. 2 means eating alone, if he's on the road—which is a lot these days, particularly since Kennedy's company, Tilray, went public in July. In a couple of hours he'll board his 135th flight of the year—a stat he can tell you because his assistant, knowing how he relishes data, sends him monthly analytics on his own travel (in 2018, he flew 23% more miles than he did the year before). At the moment, though, his 4-year-old daughter, in a pink tutu, is stirring the batter skeptically from her perch atop the kitchen island. "Papa, I think you forgot the flour," she chides. Kennedy's family moved into the new house a few weeks after Tilray went public, and he still struggles to find things in his own kitchen. He shrugs as he begins scrambling eggs and frying bacon in another pan: "My kids say pancakes are the only thing I'm good at."

Of course, his children are too young to know that what their dad is *really* good at is—at least for the moment—illegal in much of the U.S. and the world. Tilray sells cannabis, a.k.a. pot, weed, and more than 1,000 other colorful nicknames, for the medical-marijuana market and, more recently, the recreational one. It wears the crown as the hottest IPO of 2018, returning 315% for the year and valuing the Canada-based but American-run company at \$9 billion today. The kids don't know that the IPO—his daughter got to help ring the bell at the Nasdaq—made Kennedy not only a billionaire but the richest man in the legal marijuana business and maybe the face of its future. Or that after pancakes today, he'll shake hands with officials at Anheuser-Busch InBev, the behemoth behind Budweiser, to form a \$100 million partnership aimed at creating a cannabis-infused substitute for beer.

Tilray's 50% contribution to that venture exceeds the estimated \$45 million in revenue it made in 2018, a year in which its estimated losses hit \$47 million. But AB InBev's desire for a deal is just the latest sign of Big Business's belief that widespread cannabis legalization is an inevitability, and that Tilray—a global operation founded by finance veterans and data geeks with minimal interest in, um, testing the product themselves—will be uniquely poised to capitalize when Big Cannabis goes mainstream.

The day before the predawn pancakes, Kennedy and I had boarded a 10-seat Cessna prop plane at Seattle's Boeing Field for an hour-long flight to Tilray's official headquarters, in Nanaimo on Vancouver Island in British Columbia, the lush, rugged province renowned among cannabis connoisseurs for its "BC bud." It was cold enough to see your breath inside the plane. Preparing for takeoff, the pilot laid out a short list of stipulations: "Stay buckled, no talking on the phone, and no cannabis products on board." Marijuana became fully legal in Canada on Oct. 17. But flights crossing the border have nonetheless been warning passengers that the U.S. government still prohibits taking the drug with you—even when traveling from Washington State, where recreational cannabis has been legal since 2012. Then again, why push your luck? As a Canadian customs officer once put it nonchalantly to Tilray employees, "It's just like bringing sand to the beach."

Flying north from Seattle, the 360-degree view features Mount Rainier behind you, Mount Baker to your right, and Mount Olympus on the left. In the summer, when it's easier to go via low-flying seaplane, you can often glimpse a pod of orcas swimming just beneath the surface of Puget Sound. On the ground in Nanaimo, Kennedy is something of a local celebrity, having quickly become one of the largest employers in a community of 92,000 people. We clear customs without a word and proceed to Tilray's 65,000-square-foot cannabis lab and grow facility, where the whiff of freshly cut marijuana floods your nostrils as soon as you open the heavy steel door. The combination of the pharmaceutical-grade warehouse setup and the presence of thousands upon thousands of pot plants gives it the sterile but earthy smell of a Home Depot garden department—you know, if Home Depot sold weed. From here, the product will be shipped to tens of thousands of patients, as well as pharmacies and dispensaries, in 12 countries where medical or recreational pot use is legal.

But we haven't even made it past the vestibule when a facilities employee named Rudy stops the CEO in his tracks. "I never got to say thank-you for the whole stock thing," he tells



Kennedy, shaking his head reverently. “What a gift. Such a life changer, a game changer. The thought of being a Tilionaire one day.”

Kennedy swears this wasn’t a scheduled part of the tour. He claims he’s never even heard the expression “Tilionaire,” although his stock—which he’s doled out to all 750 of the firm’s employees, at all levels—has made many people much richer. He has yet to sell any of his own shares (and promises he won’t do so when post-IPO restrictions lift in January), meaning his 10-figure wealth is still only on paper. Kennedy, who previously started and sold two dotcom-era software companies before getting an MBA from Yale, claims he didn’t anticipate the investor frenzy that Tilray ignited as the first cannabis producer to go public on a major U.S. exchange. “We were caught off guard,” he says.

Indeed, virtually the entire business world is grappling with the sudden arrival of cannabis

as a force of disruption, even as marijuana teeters on the grayish line of legitimacy. Pot is now legal for either medical or recreational use in some 36 countries and 33 U.S. states plus the District of Columbia. And while its use and sale remain illegal in the U.S. at the federal level, many on Wall Street and beyond see that changing too. The recently passed Farm Bill exempted the hemp plant and its derivative cannabidiol, or CBD, from the federal ban, clearing the way for an anticipated surge in a product category that in some states has already swept across store shelves and café and cocktail menus. A new report from Arcview Market Research and BDS Analytics forecasts that legal pot sales will more than double from \$10.5 billion in 2018 to \$22.2 billion in the U.S. in 2022, and to \$31.6 billion worldwide. By then, Kennedy and others expect the U.S. will have legalized the drug, an issue that could even dictate who wins the 2020 presidential election.

Chasing this buzz, U.S. industries, including Big Beer, Big Tobacco, and Big Pharma, have made bets on cannabis companies,

Legalization's Green Wave

As of the end of 2018, 33 U.S. states and the District of Columbia allow medical marijuana, and 10 states plus D.C. have also legalized it for adult recreational use. But a federal ban means the U.S. [and its would-be pot entrepreneurs] still lags behind the rest of the world.



36 countries
HAVE LEGALIZED MEDICAL USE
(INCLUDING CANADA AND
URUGUAY, WHICH ALSO PERMIT
RECREATIONAL USE)

\$12.3 billion
GLOBAL SPENDING
ON LEGAL POT IN 2018

observing that consumers are increasingly turning to the drug as an alternative to booze, cigarettes, and painkillers. That has fueled tie-ups like Tilray's with AB InBev, as well as a global distribution deal Tilray struck with Sandoz, a division of Swiss drugmaker Novartis, for co-branded cannabis oils and pills to treat ailments such as epilepsy, sleep disorders, and post-traumatic stress—the only partnership to date between a cannabis company and a big drug company. Elsewhere, Constellation Brands, which makes Corona, and Marlboro cigarette purveyor Altria have made multibillion-dollar investments in Canadian cannabis companies.

Yet for all that interest, most money invested in marijuana is leaving America. Public and private cannabis companies raised \$13.9 billion in capital in 2018, quadruple the previous year's total, according to Viridian Capital Advisors, an investment bank that tracks cannabis deals. Of that sum, however, 69% was invested outside the U.S. As long as cannabis remains federally outlawed, American businesspeople have to reckon with the liability of, technically, aiding and abetting illicit activity, a risk many have decided is not worth taking. "It's kind of a damn shame that so much capital has escaped the U.S. to go up to Can-

ada," says Scott Greiper, Viridian's president and founder. For now, Cowen, the lead U.S. underwriter of Tilray's IPO, won't take any U.S.-based cannabis companies public, says CEO Jeffrey Solomon: "Until there's clarity on federal law broadly, we're going to continue to focus on the rest of the world."

That makes Tilray even more of an outlier. It was not only the highest-flying IPO of 2018, according to Renaissance Capital, but also one of the top 10 performers in the U.S. stock market. That ironic result was possible under stock exchange rules because Tilray operated exclusively outside America. The company will only do business in jurisdictions where cannabis is federally legal, and it has had zero U.S. sales to date. As a result, the only Americans who have so far enjoyed the fruits of its economic contributions are stock investors and its U.S.-based employees (including its entire C-suite).

Kennedy, whose predictions about legalization have been profitable so far, believes an end to the U.S. ban is close at hand. But for now, the precarious legal dynamic gnaws at him every time he crosses back from Nanaimo into his native country. "I would not mention what we just did," the CEO quietly advises as we sit on the tarmac in Seattle again, awaiting a customs officer to clear us to come home. While Kennedy has never been questioned, he has reason to be nervous: A few Canadian cannabis executives and investors have been detained at the border and even barred entry to the U.S. for life; a senior official at the U.S. Customs and Border Protection agency confirms that even American executives operating legally in Canada can face additional inspections upon their return. Adds Kennedy: "We generally don't talk about what we do when we go back in the U.S."

IN 2014, **FOUNDERS FUND**, Peter Thiel's venture capital outfit, became the first institutional investor to announce a stake in the cannabis industry. Geoff Lewis, the partner who led the investment (and has since started his own fund, Bedrock), had the same experience with a dozen cannabis startups while looking for one to back. The owners would offer him a "product sample" or ask "if I wanted to smoke a joint"—something that was illegal at the time because Lewis didn't

have a medical marijuana prescription. The first entrepreneur who *didn't* offer him a taste? Brendan Kennedy. "And that's what I wanted to invest in—I wanted a team that didn't use cannabis," says Lewis. "It was about founders who were living by the line of the law."

Kennedy can count on his fingers the number of times he tried pot before going into the business. He grew up in San Francisco as the sixth of seven children; his siblings would smoke, but Kennedy shied away. "I'm probably the quietest one of the bunch," he says. He was born with a cleft lip that required repair surgery when he was 8 days old; his parents, fearful for his welfare, summoned a priest to baptize him before he even left the hospital. During his time at the then all-boys Jesuit prep school St. Ignatius—where his dad was a science teacher—and at UC Berkeley studying architecture, Kennedy worked construction. "If it was summer, I was wearing a tool belt," he says. He later funneled his thirst for physical exertion into six Ironman triathlons. "We never got into illegal substances. It just wasn't in our DNA," says Christian Groh, Kennedy's high school friend, fellow triathlete, and current partner in the cannabis business.

What Kennedy did have in his DNA was a knack for scanning data for auguries of the future and an uncanny memory for dates and figures. "Brendan thinks in terms of a timeline," says Michael Blue, one of Kennedy's Yale MBA classmates and the third cofounder of Tilray. After business school, he landed in 2006 at Silicon Valley Bank, working for an internal analytics startup focused on helping venture capitalists and their portfolio companies value their private stock. During the spring of 2010, the data began telling Kennedy a story about cannabis.

California was planning a ballot question on legalization that fall, and anecdotes about the issue repeatedly crossed Kennedy's radar. Pulling Gallup poll charts on American attitudes toward controversial issues, he noticed a compelling trend: Support for gay marriage and marijuana legalization seemed to increase in lockstep, and state laws were following suit. The number of doctors willing to prescribe medical pot was steadily increasing. "It was inevitable the U.S. would legalize," Kennedy says. "The frustrating part was, how did everyone else not see it?"

The doubts that dogged Kennedy the longest stemmed from his own ambivalence

about the product. He began personally experimenting with pot after decades of abstinence, but he doesn't remember any catharsis and didn't like the unpredictability of the experience. His wife, Maria Chapman, says she's never seen him high. Kennedy struggled to reconcile the enthusiasm he was hearing for therapeutic use from military vets and cancer patients with his own antidrug upbringing. "That was the hardest part from a D.A.R.E., cracking the egg on the frying pan, 'This is your brain on drugs' perspective," Kennedy says. "How could this thing that Nancy Reagan said was so bad be a medicine that people use?"

At the same time, Kennedy was troubled by the law's failure to distinguish marijuana from other narcotics like heroin, even as cannabis seemed to truly help people without putting them at risk of an overdose. "You probably will never see it, but he's a real softie for those types of things, and it really affects his heart," says Chapman. "It's not all business." Kennedy and several of his backers felt they were doing more than starting a company or going public. In some ways, they were building a field of dreams within cannabis—give people a bona fide market, and investors and politicians will come. "Our IPO—I've always said this is really an important form of political activism, against prohibition," says Kennedy. His own non-pothead image makes him an ideal spokesperson to win over minds, says Solomon, the Cowen CEO, who has "a 'no joke' rule around cannabis" at his own firm. "If we can distance ourselves from the perception of Cheech and Chong, or two guys and a bong hanging out in the back of a van, then we have made huge strides in establishing this as a legitimate industry," Solomon says.

Kennedy officially quit his job in the spring of 2011. One morning a few months later, he showed up with a PowerPoint presentation at the home of his old boss, Jim Anderson, the former president of SVB Analytics. The presentation was the genesis of Privateer Holdings, a private equity firm with a mission to acquire and create cannabis companies and brands. Kennedy made a data-driven case for how he expected legalization would unfurl. "He laid out this picture of the next 10 years," recalls Anderson, now an administrator at the University of San Francisco. "He said, 'I think there's a sea change coming in opinion on cannabis.'" Anderson invested in Privateer's first, modest fundraising round—a bet that has yielded a return of more than 100x since Tilray, of which Privateer owns 73%, went public. After the IPO, Anderson wrote to Kennedy: "Almost everything you predicted back in 2011 has come to pass."

Privately, though, Kennedy and his cofounders often wondered if they were too early. Late in 2011, they spent their pooled savings (they won't say exactly how much) on their first acquisition: Leafly, a marijuana and dispensary review site. The startup had next to no sales, but it did publish ratings on cannabis strains—sold legally or on the street—from users all over the world, providing a road map to the best pot on the planet. The lack of data in the largely illicit industry "terrified me," says Kennedy; the Leafly purchase was "a gut decision in order to get data."

Once they had it, they needed to monetize it. The plan was to



sell advertising to dispensaries, turning Leafly into a kind of Yelp for cannabis. But Privateer struggled to attract investors, and revenue was slow to come. Soon Kennedy had drained his 401(k), maxed out his credit cards, and borrowed money from family members to pour into Leafly. He remembers emptying the jug of change next to his washing machine into the Coinstar at Safeway for a grand total of \$196. There was a night when he didn't even have enough money to order a pizza. "That was darkness unlike anything I'd ever faced," he remembers. More than being broke, Kennedy and his partners feared what flaming out on a Hail Mary bet on pot would do to their career prospects. "We were worried we would always be known as failed pot guys," Kennedy says.

Finally, the rest of the country started to prove Kennedy's hypotheses. In 2012, Washington and Colorado became the first states to legalize recreational marijuana, and investors—and Leafly advertisers—wanted in. But perhaps

CANNABIS COMMITTEE
From left: Privateer Holdings general counsel Patrick Moen with cofounders Kennedy, Michael Blue, and Christian Groh, at Privateer's Seattle offices.

the biggest opportunity came about almost by accident. In 2013, Privateer got a cold call from the health department of Canada, which was phasing in a new medical marijuana licensing process designed to professionalize that country's industry. Health Canada had dozens of eager applicants who lacked funding to support a commercial marijuana grow operation and wondered if Privateer might invest. Unimpressed with the offerings, Kennedy and his partners had a different idea: Why not become growers themselves?

All they needed was marijuana. That's where Leafly came in. The Privateer team crunched data from the site to identify the 20 most coveted, high-potency strains across Canada—creating a shopping list for themselves. Actually locating the bud was another story. "We would go and meet people at a Tim Hortons, and we would follow them down a road. Then we'd have to ditch a car," recalls Groh. "We'd be in rooms with a lot of cash and weapons." Patrick Moen, who left his job at the U.S. Drug Enforcement Administration to join Privateer in early 2014 and now serves as general counsel, accompanied Groh, typing up contracts on a laptop and handing out checks to backwoods cannabis growers. "It reminds me of my undercover days early on at DEA, you know, except I had backup," says Moen. "I look back on it, and I'm like, What the hell was I thinking?"

Those plants—from Master Kush to Island Sweet Skunk—were transported live to Nanaimo, in refrigerated trucks that rode the ferry to Vancouver Island, where they became the foundation of Tilray and its brand portfolio. Today, the genetic clones of more than 60 different "mother" plants grow in specimen jars in an R&D lab at Tilray's headquarters. They, in turn, have propagated Tilray's newer production facilities in Ontario and Portugal from scratch, a strategy the company will continue to employ as it scales up. "When you go to Starbucks—doesn't matter if you go in Seattle or Iowa—and you order a caramel macchiato, you expect it to be the same everywhere. You can do the same thing for cannabis," says Cowen's Solomon. "Brendan and his team understood early on that their success is in their ability to deliver that kind of consistency." The team has taken other cues from Starbucks too: To come up with the Tilray name ("til" as in tilling land, crossed with a sun ray) and logo, Kennedy hired the design firm of Terry Heckler, who created the iconic Starbucks mermaid emblem.

Pot Goes Legit: Big Business's Joint Ventures

Tilray's logo now appears on its dried (smokable) marijuana flowers, ingestible oils, and capsules. Each is packaged like prescription pills in bottles marked with the concentration of THC (the psychoactive ingredient that makes people high) and CBD—and, in Canada, warning labels about adolescent addiction. The company first recorded sales in April 2014 and had \$5.4 million in revenue in 2015. This year, Wall Street expects sales to more than quadruple, to around \$186 million, from \$45 million last year. Tilray should also pass a major milestone in 2019: In January, it unveiled plans to release newly legalized CBD-infused products, from whey protein to sunscreen, in the U.S.—a move intended to give the company U.S. revenue for the first time.

To stay ahead, Kennedy spends a lot of time trying to predict which country will be the next to legalize marijuana, so that Tilray will be there when it does. This summer, he commissioned a model with 99 different inputs, from gay marriage's legal status to a country's dominant religion, to predict medical and adult use legalization. So far, it has given him an early heads-up on South Korea, which in late November stunned the world by legalizing medical cannabis.

As we exit Tilray's Nanaimo warehouse, Kennedy excitedly notices the grass *outside* the building: "The lawn looks really good!" The last time he was here, he explains, the yard was overgrown with weeds—making a poor first impression on visitors. He let his displeasure be known inside the company. "It kind of drove me nuts," he says. "We're supposed to be growing things!"

THE TILRAY BRAND didn't really gain recognition in America until July 19, when it became the first cannabis company to have its IPO on a U.S. stock exchange. The offering raised \$153 million, with shares priced at \$17 apiece. At the stock's peak in September, it had risen 1,159% in just two months.

Though the debut turned Tilray into a market darling, up until then it had been treated by much of Wall Street as a sort of redheaded stepchild. Kennedy was in a rental car garage in San Diego in mid-April on his wife's birthday trip when he got the surprise phone call from the first bank that had agreed to underwrite Tilray's IPO—letting him know they were backing out. (He won't say which bank.) "I had to get out of my car because I was screaming so loudly, I didn't want to scare my children," he recalls. A second bank later had the same change of heart: Its board had nixed the deal for "reputational reasons." When Cowen and Canada's BMO eventually took it public, Tilray had to pay up for the privilege. To obtain the directors and officers liability insurance required of all public companies, Tilray had to pay five times as much as the typical rate for less than half the coverage, according to CFO Mark Castaneda.

In fact, while Tilray's business may be perceived as involving a taboo or a vice, there's no legal reason for banks or investors to

As marijuana legalization expands, these big companies are teaming up with Canada's legal-weed startups.



BIG BEER

Constellation Brands

The parent of Corona beer and No. 386 on the *Fortune* 500, Constellation in August invested \$4 billion in Canadian cannabis producer Canopy Growth, anointing it the beverage company's "exclusive global cannabis partner." Constellation's 37% stake sent Canopy's stock—and all the other cannabis stocks—soaring.



BIG BEER

Molson Coors

In August, Molson Coors (No. 275) teamed up with Quebec-based HEXO Corp., purveyor of the medical marijuana brand Hydrophocary, to create "reliable and consistent" nonalcoholic cannabis beverages. In December, Tilray struck an analogous deal with AB InBev to research THC- and CBD-infused beverages, seeking a Bud with a different buzz.



BIG TOBACCO

Altria

The company behind Marlboro cigarettes (No. 154) in December bought a 45% stake in Canada-based Cronos Group for \$1.8 billion. The tobacco giant expects the partnership to lead to "cannabis vape products," among other marijuana-based offerings.



BIG PHARMA

Novartis

In December, Tilray inked a deal with Sandoz, a division of Swiss drugmaker Novartis (No. 203, Global 500), to expand their distribution partnership for cannabis oils and pills. It's the only such deal between Big Pharma and a cannabis company to date.

be squeamish about working with it, according to John F. Walsh, the former U.S. attorney for Colorado who is now a partner at WilmerHale. "Under U.S. law, if there is essentially drug activity going on in another country that is entirely legal in that other country, it is not a U.S. federal narcotics crime," Walsh says. Importantly for investors, he adds, that means Americans who finance such a "foreign legal marijuana business" would not be violating U.S. anti-money laundering laws: "It is pretty clear-cut."

Yet no one imagined Tilray would soon be worth more than Snapchat. Kyle Lui, a partner at DCM Ventures, strikes a wistful tone when he admits that he passed on investing in Tilray when it raised money privately, balking at its nearly \$1 billion valuation, in early 2018. "I don't think we could have anticipated that the public markets in the U.S. would have received Tilray to the extent that they have," says Lui.

Even after retreating more than halfway from its peak, Tilray's stock is the poster child of the so-called marijuana bubble. Valuations like Tilray's—trading at around 50 times estimated sales—have rarely been seen since the dotcom boom, says Chris Brown, founder of the \$111 million hedge fund Aristides Capital. Brown didn't even bother to model Tilray's future sales before deciding to short it, a move that so far has earned him nearly \$1.5 million: "When the price for something is so high, I think the onus is on Tilray to be the most perfect, magical, wonderful exception in the world."

That world is a highly fractured one. Tilray has the largest international footprint among legal-weed companies and is cannabis's second-biggest player (after Canada's Canopy Growth), but its estimated market share is only 8% in Canada, and less than 1% everywhere else. Still, Moez Kassam, cofounder and principal of Toronto hedge fund Anson Funds, which financed most of Canada's public cannabis companies, was convinced after visiting Nanaimo that Tilray would eventually take the lead. "You knew this was a best-in-class business," Kassam says. "I think Tilray will be considered cheap in a few years."

Even Kennedy, previously a valuation expert, has trouble putting a number on how big Tilray could be. For the foreseeable future, he notes, his priority is growth, not profit. ("Think Amazon, not Kroger.") Because black market sales dwarf legal ones globally, it's impossible to size up true demand for cannabis, or how large it might become. Legalization will enable clinical research that could discover veritable Russian nesting dolls of new uses for cannabis's hundreds of compounds, but that research could also bring new complications: Initial studies show possible ugly side effects to regular pot use, from dependence to psychosis.

Legalization also means more competition—including from small American operators currently confined to states that have legalized—and the price pressures of what is ultimately a commodity-driven business. Kennedy has already become familiar with the singular joys of agriculture. Before Tilray could open its Ontario marijuana farm, it first had to harvest the red and green peppers that were growing there. Then there's the

matter of the bugs. In lieu of pesticides, Tilray spends about \$100,000 a month on insects that eat other pests (they arrive in pouches that look like tea bags).

In five years, Kennedy hopes, 90% of the pot Tilray sells will be cultivated by other companies. "I never thought, 'In my next business, I want to be a farmer,'" he says. Rather, he models himself after Joseph Kennedy (no relation), the patriarch of the political dynasty who, as Prohibition was sunsetting, traveled abroad acquiring import rights to liquor brands like Dewar's Scotch whisky and Gordon's gin. And Brendan Kennedy has complete conviction that "the end is near" for U.S. cannabis prohibition. "I don't know when the Berlin Wall will topple over, but we're getting closer and closer to that point," he says.

It may happen sooner than people think, thanks to the drumbeat of next year's presidential election. More of the public now views marijuana as a salve for confounding problems from the opioid crisis (overdose deaths dropped 21% to 25% in states with medical marijuana laws, a 2018 study by the think tank Rand found) to government deficits. Democratic hopefuls have signaled they will champion the issue. On the other side of the aisle, a recent Gallup poll found 53% of Republicans now support legalizing marijuana. That shift is owing in part to a concerted effort by advocates to reframe the debate in terms of states' rights.

Among the people persuaded by that argument is President Trump, who has pledged to back legislation that would protect states' marijuana laws from federal interference. And in a fraught campaign season, legalization could be a winning play. "We could envision a scenario in 2020 where the Trump administration could actually deem it politically advantageous to co-opt the issue from the Democrats and come out the hero," Vivien Azer, an analyst at Cowen, told reporters in early January.

If Kennedy were setting a line in Vegas, he likes to say, he would pick 2021 as the year the U.S. will legalize cannabis. If he's wrong, and the U.S. doesn't budge? Not the end of the world, he says; he expects medical legalization to double to 70 other countries by then. Sure, as an American business leader, he'd feel let down by his government: "They'll basically be ensuring that the companies that dominate this industry in the next decade are all based outside the U.S." For the CEO of a Canadian company, though, that's not really a problem. ■



FORTUNE

THE LIST 2019
THE WORLD'S
MOST ADMIRABLE
COMPANIES

THE WORLD'S MOST ADMIRABLE COMPANIES

► **SUCCESS COMMANDS RESPECT.** WE POLLED 3,750 EXECUTIVES, DIRECTORS, AND ANALYSTS TO FIND OUT WHICH COMPANIES ARE THE WORLD'S CORPORATE ROLE MODELS.

IS A DYNASTY AT RISK? For the 12th straight year, Apple tops *Fortune's* annual ranking of corporate reputation. But the iPhone maker has been hard-hit by trade tensions and slowing sales. How CEO Tim Cook navigates the storm will likely determine whether Apple keeps that crown. Rivals Amazon (No. 2 this year), Microsoft (No. 6), and Alphabet (No. 7) have recently passed Apple on the list of the world's most valuable companies; Microsoft's Satya Nadella was voted most underrated CEO by our respondents. Alibaba, UnitedHealth Group, and Mastercard make their debuts on our top 50 this year. And we say farewell to GE, a top 10 brand as recently as 2017, whose epic disarray drove it off our All-Stars list. Staying on top, it seems, can be just as hard as getting there.

THE LIST 2019
THE WORLD'S
MOST ADMIRED
COMPANIES

**MOST UNDERRATED
CEOs**
BASED ON 4,243 RESPONSES

Satya Nadella
► MICROSOFT
217 VOTES



Jeff Bezos
► AMAZON
98 VOTES



► **THE 50 ALL-STARS**
THIS ELITE GROUP WON VOTES
FROM INSIDE AND OUTSIDE
THEIR OWN INDUSTRIES.

1	Apple	[Prior year: 1]	26	Goldman Sachs Group	[27]
2	Amazon	[2]	27	3M	[21]
3	Berkshire Hathaway	[4]	28	Delta Air Lines	[31]
4	Walt Disney	[6]	29	BMW	[19]
5	Starbucks	[5]	30	Toyota Motor	[29]
6	Microsoft	[7]	31	Procter & Gamble	[34]
7	Alphabet	[3]	32	Target	[38]
8	Netflix	[11]	33	UPS	[33]
9	JPMorgan Chase	[10]	34	Alibaba Group Holding	[-]
10	FedEx	[9]	35	CVS Health	[39]
11	Southwest Airlines	[8]	36	Accenture	[40]
12	Costco Wholesale	[13]	37	McDonald's	[37]
13	Nike	[16]	38	Adidas	[42]
14	Salesforce	[15]	39	Unilever	[44]
15	Coca-Cola	[18]	40	IBM	[35]
16	American Express	[14]	41	PepsiCo	[41]
17	Johnson & Johnson	[17]	42	Visa	[46]
18	Singapore Airlines	[32]	43	Caterpillar	[43]
19	Boeing	[25]	44	Facebook	[12]
20	Nordstrom	[28]	45	Publix Super Markets	[-]
21	Home Depot	[22]	46	UnitedHealth Group	[-]
22	BlackRock	[23]	47	Nestlé	[47]
23	Marriott International	[24]	48	Mastercard	[-]
24	USAA	[20]	49	Charles Schwab	[50]
25	Walmart	[26]	50*	Exxon Mobil	[36]
			50*	Samsung Electronics	[-]

► THE 50 ALL-STARS BY CATEGORY

- COMPUTERS AND COMMUNICATION
- CONSUMER PRODUCTS
- CONTRACTED SERVICES
- FINANCIALS
- MEDIA AND ENTERTAINMENT
- NATURAL RESOURCES
- POWER
- PRECISION
- SHELTER
- STORES AND DISTRIBUTORS
- TRANSPORT



INDUSTRY STAND

THE MOST REPUTABLE COMPANIES, AS RANKED BY



COMPUTERS AND COMMUNICATION

COMPUTER SOFTWARE

1. Microsoft [1]
2. Adobe¹ [3]
3. Salesforce [2]
4. SAP [5]
5. Workday [-]
6. Intuit [6]
7. Autodesk [8]
8. Red Hat [4]

COMPUTERS

1. Apple [1]
2. Dell Technologies [2]
3. HP [5]
4. Canon [4]
5. Asustek Computer [7]
6. Lenovo Group [9]
7. Hewlett Packard Enterprise² [10]
8. Seagate Technology [10]

INFORMATION TECHNOLOGY SERVICES

1. Accenture [1]
2. IBM [2]
3. Gartner [4]
4. Booz Allen Hamilton Holding [3]
5. Cognizant Technology Solutions [7]
6. CACI International [5]
7. Fujitsu [9]
8. Science Applications International [8]

INTERNET SERVICES AND RETAILING

1. Amazon [2*]
2. Alphabet [1]
3. Booking Holdings³ [6]
4. Wayfair [5]
5. Facebook [2*]
6. Tencent Holdings [7]

NETWORK AND OTHER COMMUNICATIONS EQUIPMENT

1. Cisco Systems [1]
2. Juniper Networks [2]
3. Motorola Solutions [3]
4. Ciena [4]
5. F5 Networks [7]

TELECOMMUNICATIONS

1. AT&T [1]
2. Verizon Communications [2*]
3. Telefónica [2*]
4. Deutsche Telekom [7]
- 5.* SoftBank Group [9]
- 5.* Vodafone Group [4]
7. Orange [6]
8. NTT (Nippon Telegraph and Telephone) [12]

CONSUMER PRODUCTS



APPAREL

1. Nike [1]
2. VF [2]
3. Kering [3]
4. Adidas [5]
5. PVH [4]

BEVERAGES

1. Diageo [1]
2. Coca-Cola [2]
3. Anheuser-Busch InBev [3]
4. Suntory Holdings [5]
5. Heineken Holding [4]
6. Keurig Dr Pepper⁴ [7]
7. Coca-Cola Consolidated⁵ [6]

CONSUMER FOOD PRODUCTS

1. Nestlé [1]
2. PepsiCo [2]
3. Danone [3]
4. Mondelez International [5]
5. General Mills [4]
6. Conagra Brands [12]

Mary Barra

► GENERAL MOTORS
83 VOTES



Jamie Dimon

► JPMORGAN CHASE
80 VOTES



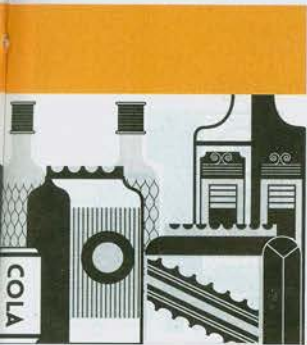
Tim Cook

► APPLE
79 VOTES



OUTS

PEERS IN THEIR SECTOR.



FOOD PRODUCTION

1. Tyson Foods [1]
2. Archer Daniels Midland [4]
3. Wilmar International [2]
4. Ingredion [3]
5. Louis Dreyfus [6]

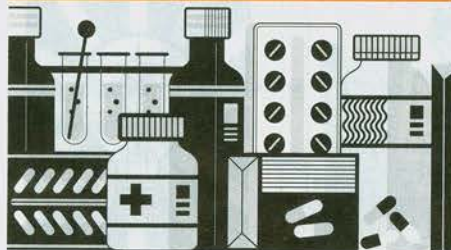
HOME EQUIPMENT, FURNISHINGS

1. Steelcase [3]
2. Fortune Brands Home & Security [7]
3. Whirlpool [1]
4. Leggett & Platt [4]
5. Stanley Black & Decker [2]
6. Qingdao Haier [-]

SOAPS AND COSMETICS

1. Estée Lauder [7]
- 2.* Procter & Gamble [6]
- 2.* Unilever [1]
4. L'Oréal [2]
5. Colgate-Palmolive [3]
6. Kimberly-Clark [5]

CONTRACTED SERVICES



DIVERSIFIED OUTSOURCING SERVICES

1. Robert Half International [1]
2. Sodexo [3]
3. ManpowerGroup [2]
4. Compass Group [9]
5. Waste Management [-]
6. Adecco Group [6]

HEALTH CARE: INSURANCE AND MANAGED CARE

1. UnitedHealth Group [1]
2. Centene [6*]
3. Humana [2]
4. Cigna [3]
5. Anthem [6*]

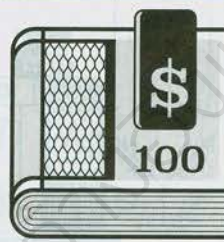
HEALTH CARE: MEDICAL FACILITIES

1. HCA Healthcare⁶ [1]
2. Universal Health Services [4]
3. Fresenius [3]
4. DaVita [2]
5. Tenet Healthcare [8]

HEALTH CARE: PHARMACY AND OTHER SERVICES

1. CVS Health [2]
2. IQVIA Holdings [1]
3. Quest Diagnostics [3]
4. Cerner [4]
5. Laboratory Corp. of America [5]

FINANCIALS



CONSUMER CREDIT CARD AND RELATED SERVICES

1. Visa [1]
2. Mastercard [2]
3. PayPal Holdings [3]
4. American Express [4]
5. Capital One Financial [5]

FINANCIAL DATA SERVICES

1. Broadridge Financial Solutions [4]
2. Automatic Data Processing [2]
3. Fiserv [3]
4. S&P Global [5]
5. Fidelity National Information Services [6]

INSURANCE: LIFE AND HEALTH

1. Prudential Financial [1]
2. New York Life Insurance [6]
3. TIAA [8]
4. Northwestern Mutual [7]
5. Massachusetts Mutual Life [2]
6. Prudential PLC [U.K.] [9]
7. Aflac [3]

INSURANCE: PROPERTY AND CASUALTY

1. Berkshire Hathaway [1]
2. Chubb [5]
3. USAA [3]

4. Travelers Cos. [2]
5. Swiss Re [6]
6. Allstate [4]
7. Progressive [-]
8. State Farm Insurance [8]

MEGABANKS

1. JPMorgan Chase [1]
2. Bank of America [4]
3. Goldman Sachs Group [2]
4. Morgan Stanley [3]
5. Citigroup [8]
6. Royal Bank of Canada [5]
7. HSBC Holdings [7]
8. UBS Group [15]

SECURITIES AND ASSET MANAGEMENT

1. BlackRock [1]
2. Charles Schwab [2]
3. T. Rowe Price [3]
4. Jones Financial (Edward Jones) [6]
5. Raymond James Financial [4]
6. Franklin Resources [9]

SUPERREGIONAL BANKS

1. U.S. Bancorp [1]
2. PNC Financial Services Group [2]
3. Northern Trust [3]
- 4.* Bank of New York Mellon [6]
- 4.* State Street Corp. [5]
6. BB&T Corp. [4]

FROM LEFT: GETTY IMAGES FOR WIRED2S [2]; BILL PUGLIANO - GETTY IMAGES; BLOOMBERG/GETTY IMAGES; VCG/GETTY IMAGES

THE LIST 2019
THE WORLD'S
MOST ADMIRED
COMPANIES

MOST OVERRATED CEOs

BASED ON 3,163 RESPONSES

Mark Zuckerberg

▶ FACEBOOK
635 VOTES



Elon Musk

▶ TESLA/
SPACE X
340 VOTES



▶ TOP COMPANIES BY ATTRIBUTE

INNOVATION: 1. Netflix 2. Nike 3. Apple ▶ QUALITY OF MANAGEMENT: 1. Microsoft 2. BlackRock 3. Walt Disney

QUALITY OF PRODUCTS: 1. Netflix 2. Walt Disney 3. Apple ▶ TALENT ATTRACTION: 1. Apple 2. Walt Disney 3. Target

MEDIA AND ENTERTAINMENT



ENTERTAINMENT

1. Walt Disney [1]
2. Netflix [2]
3. Activision Blizzard [4]
4. Electronic Arts [3]
5. Discovery [6]
6. Live Nation Entertainment [7]
7. Liberty Media [5]
8. Twenty-First Century Fox [11]

HOTELS, CASINOS, AND RESORTS

1. Marriott International [1]
2. Hilton Worldwide Holdings [2]
3. Hyatt Hotels [5]
4. Wynn Resorts [3]
5. MGM Resorts International [4]
6. Las Vegas Sands [6]

NATURAL RESOURCES



CHEMICALS

1. 3M [2]
2. Ecolab [3]
3. PPG Industries [4]
4. LyondellBasell Industries [5]
5. BASF [1]
6. Huntsman [-]

METALS

1. Steel Dynamics [2]
2. Nucor [1]
3. Reliance Steel & Aluminum [4]
4. ArcelorMittal [5]
5. POSCO [7*]
6. Alcoa [3]
7. Nippon Steel & Sumitomo Metal [7*]

MINING, CRUDE-OIL PRODUCTION

1. ConocoPhillips [2]
2. Occidental Petroleum [1]
3. EOG Resources [3]
4. BHP Billiton [9]
5. Rio Tinto [12]
6. Devon Energy [4]
7. Apache [5]
8. Vale [14]

PACKAGING, CONTAINERS

1. Sonoco Products [1]
2. WestRock [2]
3. International Paper [3]
4. Avery Dennison [6]
5. Packaging Corp. of America [5]

PHARMACEUTICALS

1. Johnson & Johnson [1]
2. Merck [2]
3. Roche Group [4]
4. Novartis [3]
5. Amgen [6]
6. Bristol-Myers Squibb [5]
7. Pfizer [10]
8. AbbVie [8]

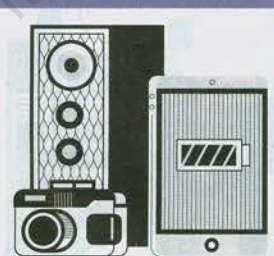
POWER



ELECTRIC AND GAS UTILITIES

1. NextEra Energy [1]
2. Xcel Energy [4]
3. Dominion Energy [2]
4. Exelon [11]
5. Duke Energy [5]
6. American Electric Power [6]
7. Sempra Energy [3]
8. DTE Energy [7]

PRECISION



ELECTRONICS

1. Honeywell International [1]
2. Samsung Electronics [2]
3. Eaton [3]
4. LG Electronics [7]
5. Schneider Electric [5]
6. TE Connectivity [4]
7. Sony [6]
8. Mitsubishi Electric [11]

MEDICAL PRODUCTS AND EQUIPMENT

1. Abbott Laboratories [1]
2. Boston Scientific [3]
3. Stryker [5]
4. Thermo Fisher Scientific [4]
5. Becton Dickinson [8]
6. Danaher [9*]

SEMICONDUCTORS

1. Nvidia [1]
2. Taiwan Semiconductor [2]
3. Applied Materials [5]
4. Micron Technology [7]
- 5.* Qualcomm [8]
- 5.* Texas Instruments [3*]
7. Lam Research [6]
8. Intel [3*]

Tim Cook
▶ APPLE
183 VOTES



Jeff Bezos
▶ AMAZON
179 VOTES



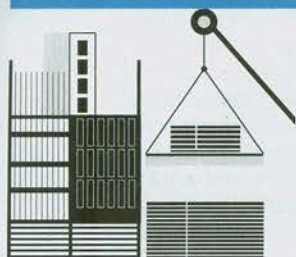
Jamie Dimon
▶ JPMORGAN CHASE
167 VOTES



▶ LONG-TERM INVESTMENT VALUE: 1. Berkshire Hathaway 2. Walt Disney 3. UnitedHealth Group

▶ CORPORATE ASSET USE: 1. Walt Disney 2. Berkshire Hathaway 3. Toyota Motor

SHELTER



ENGINEERING, CONSTRUCTION

1. Jacobs Engineering Group [5]
2. AECOM [2]
3. EMCOR Group [1]
4. Fluor [3]
5. Quanta Services [6]

HOMEBUILDERS

1. Toll Brothers [1]
2. Lennar [4]
3. Taylor Morrison Home [8]
4. PulteGroup [3]
5. NVR [6]

REAL ESTATE

1. CBRE Group [2]
2. Host Hotels & Resorts [1]
3. Simon Property Group [3]
4. Jones Lang LaSalle [JLL] [4]
5. Welltower [6]

STORES AND DISTRIBUTORS



FOOD AND DRUGSTORES

1. Walgreens Boots Alliance [2]
2. Publix Super Markets [1]
3. Sprouts Farmers Market [4]
4. Kroger [3]
5. Royal Ahold Delhaize [9]
6. Seven & I Holdings [8]

FOOD SERVICES

1. Starbucks [1]
2. Domino's Pizza [-]
3. McDonald's [2]
4. Yum Brands [3]
5. Yum China Holdings [6]

GENERAL MERCHANDISERS

1. Target [4]
2. Nordstrom [1]
3. Walmart [2]
4. Costco Wholesale [3]
5. Kohl's [5]

SPECIALTY RETAILERS

1. Home Depot [1]
2. TJX [2]
3. Lowe's [3]
- 4.* CarMax [8]

- 4.* Penske Automotive Group [5]
6. AutoNation [7]
7. L Brands [4]
8. Best Buy [6]

WHOLESALE: DIVERSIFIED

1. W.W. Grainger [1]
2. Graybar Electric [2]
3. Fastenal [-]
4. WESCO International [3]
5. Boise Cascade [-]
6. HD Supply Holdings [5]

WHOLESALE: ELECTRONICS AND OFFICE EQUIPMENT

1. Arrow Electronics [1]
2. Tech Data [2]
3. ScanSource [4]
4. Avnet [5]

WHOLESALE: HEALTH CARE

1. Henry Schein [2]
2. McKesson [1]
3. AmerisourceBergen [4]
4. Cardinal Health [3]

▶ NOTES

A DASH IN PRIOR YEAR'S RANK MEANS THE COMPANY WAS NOT IN THE SURVEY LAST YEAR.

*TIE IN RANK.

¹ CHANGED NAME FROM ADOBE SYSTEMS.

² RANK IN INFORMATION TECHNOLOGY SERVICES LAST YEAR.

³ CHANGED NAME FROM THE PRICELINE GROUP.

⁴ CHANGED NAME FROM DR PEPPER SNAPPLE GROUP.

⁵ CHANGED NAME FROM COCA-COLA BOTTLING.

⁶ CHANGED NAME FROM HCA HOLDINGS.

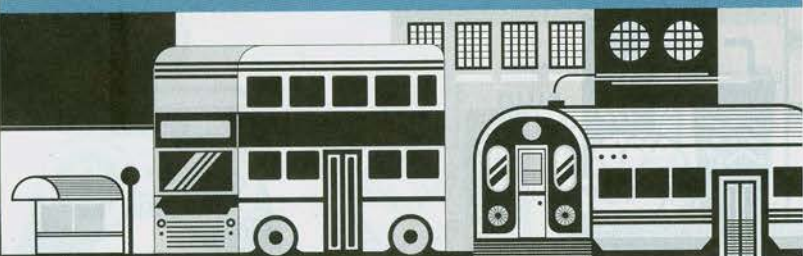
⁷ CHANGED NAME FROM DISCOVERY COMMUNICATIONS.

⁸ RANK IN MEDICAL PRODUCTS AND EQUIPMENT LAST YEAR.

◉ FROM LEFT: LACHLAN CUNNINGHAM—BREAKTHROUGH PRIZE/GETTY IMAGES; ROBYN BECK—GETTY IMAGES; VCG/GETTY IMAGES; GETTY IMAGES FOR WIRED25; BLOOMBERG/GETTY IMAGES

INDUSTRY STANDOUTS

TRANSPORT



AEROSPACE AND DEFENSE

1. Boeing [1]
2. Raytheon [5]
3. Northrop Grumman [3]
4. United Technologies [4]
5. Lockheed Martin [2]
6. General Dynamics [6]
7. Airbus Group [7]
8. BAE Systems [9]

AIRLINES

1. Delta Air Lines [1]
2. Southwest Airlines [3]
3. Singapore Airlines [2]
4. Air France-KLM Group [5]
5. Lufthansa Group [4]
6. United Continental Holdings [11*]
7. Qantas Airways [6]
8. SkyWest [-]

CONSTRUCTION AND FARM MACHINERY

1. Deere [1]
2. Caterpillar [2]
3. Volvo [6]
4. Komatsu [3]
5. Oshkosh [4]

DELIVERY

1. UPS [1]
2. FedEx [3]
3. Deutsche Post DHL Group [2]
4. La Poste [6]

INDUSTRIAL MACHINERY

1. Siemens [1]
2. Emerson Electric [2]
3. Ingersoll-Rand [4]
4. Illinois Tool Works [5]
5. ABB [3]
6. Cummins [6]

MOTOR VEHICLE PARTS

1. Toyota Industries [2]
2. Bosch Group [1]
3. Lear [3]
4. Michelin [5]
5. Continental [4]
6. Denso [7]
7. ZF Friedrichshafen [9]
- 8.* Aisin Seiki [15]
- 8.* Magna International [8]

MOTOR VEHICLES

1. Toyota Motor [1]
2. BMW [2]
3. Daimler [3]
4. General Motors [5]
5. Honda Motor [6]
6. Nissan Motor [8]
7. Hyundai Motor [10]
8. Ford Motor [4]

TRUCKING, TRANSPORTATION, LOGISTICS

1. XPO Logistics [4]
2. C.H. Robinson Worldwide [3]
3. Union Pacific [1]
4. Ryder System [5]
5. Maersk Group [2]
6. J.B. Hunt Transport Services [6]

HOW WE DETERMINE THE LIST

AS WE HAVE IN THE PAST, *Fortune* collaborated with our partner Korn Ferry on this survey of corporate reputation. We began with a universe of about 1,500 candidates: the 1,000 largest U.S. companies ranked by revenue, along with non-U.S. companies in *Fortune's* Global 500 database that have revenues of \$10 billion or more. We then winnowed the assortment to the highest-revenue companies in each industry, a total of 680 in 30 countries. The top-rated companies were picked from that pool of 680; the executives who voted work at the companies in that group.

To determine the best-regarded companies in 52 industries, Korn Ferry asked executives, directors, and analysts to rate enterprises in their own industry on nine criteria, from investment value and quality of management and products to social responsibility and ability to attract talent. A company's score must rank in the top half of its industry survey to be listed.

Results were not published in the following categories owing to insufficient response rates: cable and satellite providers, petroleum refining, pipelines, and U.S. energy.

To select our 50 All-Stars, Korn Ferry asked 3,750 executives, directors, and securities analysts who had responded to the industry surveys to select the 10 companies they admired most. They chose from a list made up of the companies that ranked in the top 25% in last year's surveys, plus those that finished in the top 20% of their industry. Anyone could vote for any company in any industry.

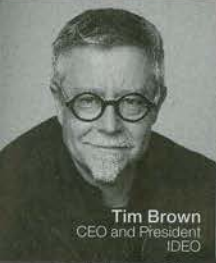
The difference in the voting rolls explains why some results can seem at odds with each other. For example, AT&T fell off the All-Stars list this year but ranked No. 1 within the telecommunications category when votes from only those in that industry were counted.

—Scott DeCarlo



FORTUNE Wallpaper*

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VISION EMPATHY SCALE

SINGAPORE 5-7 MARCH
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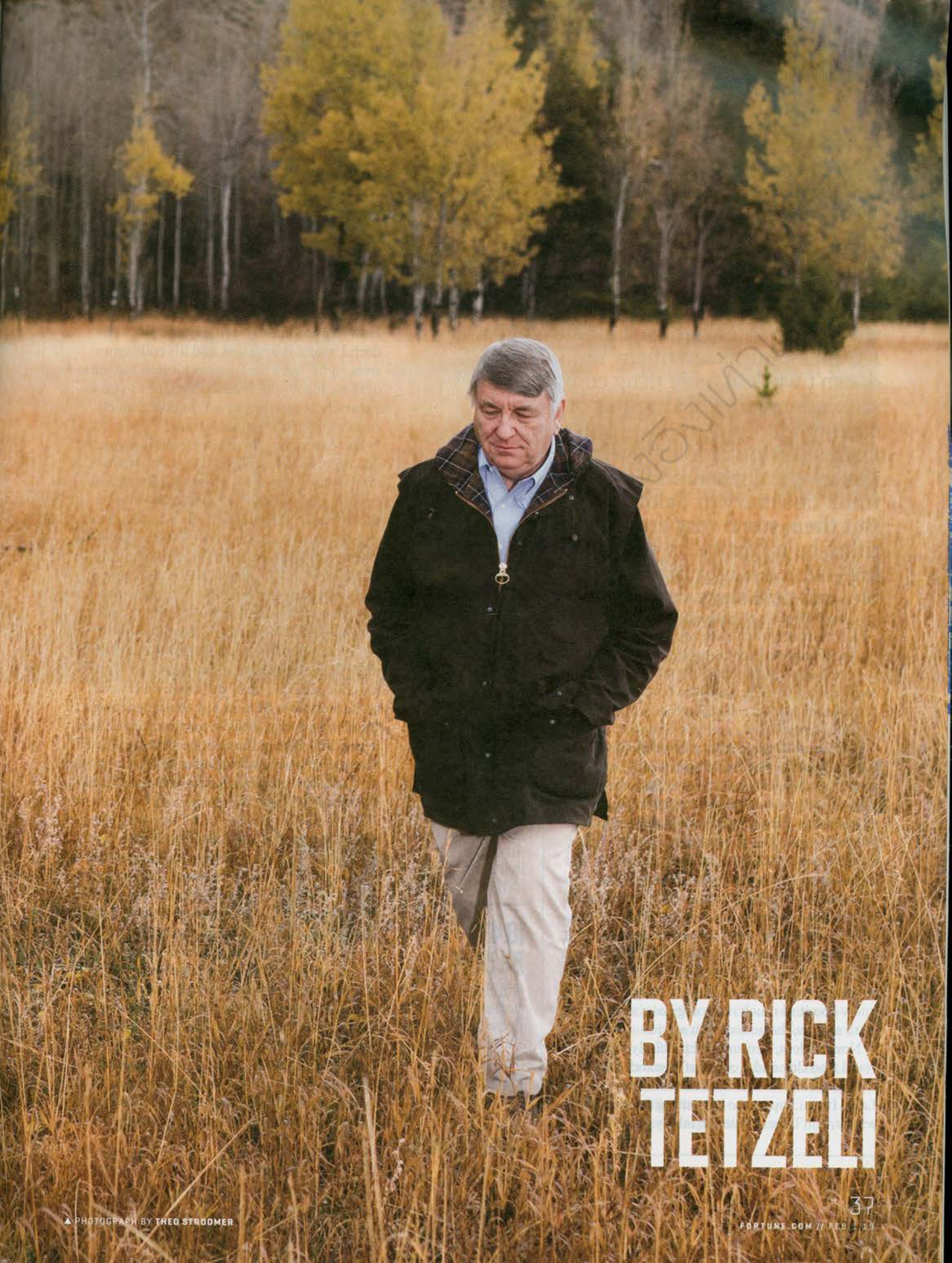


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A photograph of a birch tree with yellow leaves in a field of tall grass. The tree is the central focus, with its trunk and branches clearly visible. The background is a dense forest of similar trees, and the foreground is a field of tall, golden-brown grass. A fallen log lies on the ground in the middle ground. The overall scene is a natural, autumnal landscape.

PAUL COX

**HAS A RADICAL THEORY
FOR WHAT'S
CAUSING ALZHEIMER'S.
HERE'S WHY WE
SHOULD LISTEN.**



**BY RICK
TETZELI**

IN A SMALL LAB IN JACKSON HOLE, Wyo., 65-year-old Paul Cox believes he's closing in on a treatment that might prevent Alzheimer's disease. And ALS. And a host of other neurodegenerative diseases, for that matter. Cox, we should point out, isn't a neurologist. He isn't a physician of any kind. He doesn't work at a big drug company or an academic medical center or a government laboratory. His ideas come from so far outside the mainstream of neurological research that you might think he's crazy or deluded or worse. But then, some very credible people think he might be on to something big—which might make the improbable, quixotic story you are about to read one of the most important as well.

Our unusual tale begins with ethnobotany: the study of the way indigenous people use plants in their customs and diet. You see, Cox is an ethnobotanist, and a darn good one by all accounts. "You'd enjoy walking through a jungle with me," he once told me. He's a cheerful gray slouch of a man, quick-witted and sincere, given to club ties and blockish suits when he's not rocking a fleece. But neurology? When it comes to the study of neurons—the critical cells of the central nervous system that degenerate and die in diseases such as Alzheimer's and ALS—Cox describes himself as something of a piker. "One colleague says I know about as much neurology as a neurologist's spouse," he added with a grin.

Nonetheless, neurons are precisely what you'll find Cox and a covey of researchers studying at his nonprofit Brain Chemistry Labs. If you happen to be visiting Jackson this winter, you'll recognize the lab by the cartoon-

ish wood carving of a bespectacled bear (holding a beaker, naturally) just above the front portico. You might even spot a wealthy local patron wearing one of the lab's "Serine Dipity" sweatshirts. That's a wordplay on L-serine, an amino acid that serves critical functions in the central nervous system, among other things. That's the second strange part of this story: How extraordinarily unlikely and yet wonderful would it be if Cox and his colleagues were right—and the best prevention for some of these terrifying diseases turns out to be a naturally occurring protein building block rather than a high-priced drug?

You can buy a kilo of powdered L-serine for \$53 on Amazon. A Serine Dipity sweatshirt, on the other hand, will cost you a \$150,000 donation to Cox's lab. Which leads us to the third twist in this marvelously odd tale. The sweatshirt buyers (and Cox's wealthy backers) seem to believe just as fervently in the man's innovative research model as they do in his purported cure. Indeed, it's fair to say that whether or not Cox's theory pans out, the style of medical investigation he's pioneering is gaining fans—even in some traditional and elite academic quarters. So if Cox and his colleagues do push the science forward on Alzheimer's, ALS, or any other neurological disease even a little, it may have an added benefit of offering the culture of medical research a fresh model to emulate.

And that—in a nutshell—is what the Paul Cox story is all about.

\$3,750

Average monthly cost of basic services in an assisted living facility in the U.S.

18.4 BILLION

Hours of unpaid care provided by caretakers to Alzheimer's patients in U.S. (2017)

C

COX'S INTEREST in neurodegeneration began when he set out to solve a puzzle that had bedeviled researchers for decades: Why did an extraordinary number of the Chamorro

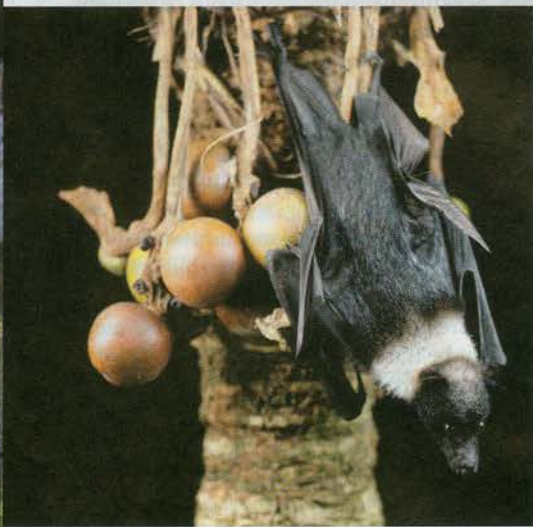
people of Guam develop an odd hybrid of ALS and Alzheimer's symptoms? Cox's answer: They had been poisoning themselves every time they indulged in their greatest culinary delight, a bat boiled in milk—eyeballs, wings, and all. That was 16 years ago. Since then, Cox has been trying to see if that insight could eventually lead to some kind of treatment against brain diseases.



Working on a tiny budget, Cox has built a consortium of 50 scientists from a wide range of disciplines, who share their unpublished research with one another and push Cox's theories in directions he never would have anticipated. Within this loose-knit group, the spirit of inquiry seems to thrive, uninhibited by strictures that rein in scientists in academic research centers and pharmaceutical labs. "He's a visionary," said Deborah Mash, who runs the Brain Endowment Bank at the University of Miami's Miller School of Medicine and who has worked with Cox on several experiments. "I was a skeptic. But he's a fiercely intelligent man. The way he's pushed this forward is unbelievable." Cox's "virtual pharma," as he calls it, has fostered a more innovative, organic, and patient-focused form of scientific research than what's often found at the world's leading drug companies, its members say.

Those companies have failed miserably in

Above: Paul Cox at a cemetery in Umatac Village, Guam, 2003; right: a flying fox on a cycad.



their own efforts to attack Alzheimer's. The FDA has approved just five treatments for Alzheimer's, and they provide only limited, temporary relief. The agency hasn't signed off on any new ones since 2003, despite more than 500 clinical trials of Alzheimer's drugs. In 2018 alone, trials of once-high-profile drugs made by AstraZeneca, Eli Lilly, Johnson & Johnson, Merck, Takeda, and others collapsed or faded away in a statistical whimper. Some big companies, including Pfizer, have completely abandoned the field. (For more on this epic washout, see "Can Biogen Beat the Memory Thief?" in the Fortune.com archive.)

What do these serial failures have in common? The great majority of the drugs were built on a single idea, the "amyloid hypothesis," which posits that clumps of protein fragments called beta-amyloid—which are found in the brain of every Alzheimer's patient—are the primary cause of the disease. (Another hallmark is the presence of neurofibrillary tangles of a protein called tau.) The amyloid theory is based on decades of perfectly good science, and the idea that if you eliminate those plaques you might also slow or reverse the disease still holds sway. But it's not the only science—and targeting these plaques directly may not ultimately be the best (or only) way to fend off or treat Alzheimer's.

For decades, though, Big Pharma hasn't

been very interested in less conventional theories. Seeking an enormous payout of perhaps \$10 billion a year in sales, they have thrown thousands of scientists and billions of dollars at this one idea, again and again, with no luck.

"You know that definition of insanity?" Cox asked, the first time we met. "Doing the same thing over and over again despite getting the same results? Each trial is a billion bucks; each targets the same thing. None have worked. It seems to me that if you'd put in a billion bucks and failed, you'd say, 'Let's try something else.'"

If there is any good news about Alzheimer's, it might be this: After three decades of cureless consensus, the scientific community may finally be ready to seriously consider alternative approaches. One sign of change has been the entreaties in top-tier journals ranging from *The New England Journal of Medicine* to *Brain to Frontiers in Neuroscience* to rethink the orthodoxy. (As a *New England Journal* editorialist put it: "We may very well be nearing the end of the amyloid-hypothesis rope, at which point one or two more failures will cause us to loosen our grip and let go.") Another sign, perhaps, is the willingness of scores of scientists to sign on to the exploration of a bizarre moonshot of a theory born in the rain forests of Guam.

T

HE EPIPHANY came while Cox was reading a book, *The Call of Service*, by Robert Coles. "Coles writes that when your experience, interest, and talents are orthogonal to a societal need, you are hearing a call," Cox explained to me in Jackson in 2016. We had repaired to the foyer of a bed and breakfast near his lab. Cox was tired after seven hours of meetings with his board of directors, and he sank into a wingback chair, yellow legal pages full of scribbled notes threatening to escape from the binder on his lap.

His mother had died of cancer in 1985, and Coles's call to arms offered a way forward apart from grieving. So he grabbed some paper and began jotting down his experiences, interests, and talents. "I'm fluent in a couple of Polynesian languages, I'm a marine forest biologist, I've studied with the world's greatest ethnobotanist, and I really want to defeat disease," he recalled. "If I become an oncologist,

"I would not sell one of those for any price," a village elder said of the Chamorro bat delicacy. "If I had one, I would lock the door, bolt the windows, cook it, and eat it."

A TRAIL OF DISAPPOINTMENT

Lilly

FEW SPACES in the life sciences have fathered failure to the extent that experimental Alzheimer's drugs have. In the past year alone, at least a half-dozen Alzheimer's drug hopefuls from major pharmaceutical companies bit the dust. What's more, there's an ongoing debate about what should be the main focus area—amyloid plaque, some other biological marker, or a combination strategy? Here are some of the notable flameouts—and ongoing studies—in the field.

—Sy Mukherjee

Indianapolis-based Eli Lilly may have experienced the biggest heart-break in the field—both financially and in unfulfilled promise—with the demise of solanezumab. Data released in early 2018 confirmed that solanezumab couldn't slow cognitive deterioration even in patients with the mildest forms of Alzheimer's. Various disappointments related to the drug, in part, led Lilly to lay off some 3,500 workers, or 8% of its global staff. The firm also shuttered several other mid-to-late-stage trials of BACE inhibitors [drugs that target amyloid] last year, including a project with partner AstraZeneca.

maybe I can help dozens of people. If I could discover a new drug, I could help millions of people. What are the chances of that? Oh, about next to zero. But why not give it a shot?"

Two months after his mother's death, he, his wife, Barbara, and their three kids set off for Falealupo, a tiny village on Savai'i, a Samoan island where they would live, off and on, for several years. The funding came from a 1985 Presidential Young Investigator Award, presented by President Reagan.

Cox didn't discover a cure for cancer in Samoa. He did, however, find a substance in tree bark that local healers ground into a salve, which Cox suspected might have activity against HIV. (He later licensed the compound to the AIDS Research Alliance of America, but it was never developed into a drug.) He also brokered a deal that helped save 30,000 acres of Samoan rain forest—home to many



Axovant has taken a very different approach to drug development relative to the conventional pharma players. Part of parent company Roivant Sciences' federation of drugmakers, Axovant picked up experimental treatments that had been cast off by other biopharmas in an attempt to carry them across the regulatory finish line. Unfortunately, the novelty hasn't panned out so far. Intepirdine, Axovant's first marquee treatment (and licensed from British drug giant GlaxoSmith-Kline), failed in late 2017. The company's new CEO is now focused on a gene therapy strategy for Alzheimer's and dementia.



Yet another of 2018's high-profile "BACE drug" failures came from Merck. The firm's experimental verubecestat proved ineffective in early stage trials at treating "prodromal" patients—i.e., the patients showing the earliest symptoms of the disease. The treatment had already failed in earlier trials of patients with more advanced forms of the disease, and its demise raised open questions about whether or not beta-amyloid, at least by itself, should be the focus of treatment.



Despite the amyloid-centric roster of the dismal record of Alzheimer's treatments, not all companies are ready to give up hope on targeting the plaque-causing protein. Biogen and Japan-based partner Eisai are forging on with studies of BAN2401, aducanumab, and elenbecestat. The hope is that at least one of these treatments will show enough of a slowdown in cognitive impairment to justify an FDA approval, which would be the first Alzheimer's medicine green-lit since 2003.

NEW APPROACHES

The failures listed here are far from the only big-name recent disappointments for Alzheimer's R&D. Japan's Takeda crashed and burned with pioglitazone in early 2018; Johnson & Johnson has had multiple setbacks in the space; Pfizer has ditched the neuroscience field altogether.

But newer companies are hitching their wagon to fresh approaches, as our understanding of Alzheimer's evolves. For instance, Denali Therapeutics and partner Sanofi are testing out a drug that uses a different biological pathway to halt brain deterioration; other companies, including the upstart United Neuroscience, are focused on even earlier stages of Alzheimer's, before symptoms begin to develop, acknowledging that prevention may be more effective than medication after the fact.

native species, including *Pteropus samoensis*, a flying fox, or genus of bat, whose wingspan can stretch nearly three feet wide. Cox and a tribal chief named Fuiono Senio were awarded the Goldman Environmental Prize for the rain forest agreement.

Cox's interest in bats led him to Guam, and to the mysterious ailment the Chamorro people called *lytico-bodig*. In the years after World War II, the Chamorro were up to 100 times as likely as people elsewhere in the world to develop symptoms often associated with neurodegenerative diseases like ALS, Alzheimer's, and Parkinson's: slurred speech, facial paralysis, loss of motor skills, immobility and dementia. Believing that this cluster might hold essential clues to neurodegeneration, scientists advanced several theories. Some targeted a toxin found in the seeds of local cycad trees. Called BMAA, it killed nerve cells in lab tests

and induced symptoms of *lytico-bodig* when fed to monkeys. The Chamorro cleaned the seeds thoroughly before grinding them into a flour for their version of tortillas. But later research suggested that humans would have to ingest, literally, a ton of cycad flour each month for the toxin to have any effect, and the purported BMAA link fell out of favor.

Cox approached the mystery through the lens of ethnobotany—examining the Chamorro not in the clinic, but in their culture. "And we discover that the flying fox is the most important item in their whole diet," he said. "They identify themselves as the hunters of flying foxes. One village elder told me, 'You don't get this. I would not sell one of those for any price. If I had one, I would lock the door, bolt the windows, cook it, and eat it, and people would be trying to break in to get some.'"

Cox believed that this culinary predilection might explain *lytico-bodig*. One clue was that only older generations of the Chamorro got ill. They had hunted the native bats into extinction. Young Chamorro, who hadn't grown up feasting on those flying foxes, weren't getting sick. A second clue was that the Guam bats lived on cycad seeds. If, as Cox believed, BMAA (or another

noxious substance) accumulated and magnified over time in bat fat, then every bowl of flying fox stew was toxic. In 2002, he and Oliver Sacks, the late neurologist and author of such books as *Awakenings* and *The Man Who Mistook His Wife for a Hat*, published a paper in the journal *Neurology* that laid out his theory.

Over the next two years, Cox set out to confirm his thesis with Sandra Banack, another bat-loving biologist, and Canadian chemist Susan Murch. In *Neurology*, they reported finding massive levels of BMAA in museum specimens of the bat. They subsequently discovered BMAA in the brain tissue of Chamorro who had died of *lytico-bodig*—and also, notably, in the brains of Canadian Alzheimer's victims. (The toxin, meanwhile, was nowhere to be found in the brains of Chamorro and Canadians who had died of other causes.) The team even made a discovery that seemed to link *lytico-bodig* to brain diseases around the world. Cycad trees get their sustenance via strange, coral-like, aerial roots. Cox found cyanobacteria, the oldest organism on earth, in those roots.

Cyanobacteria, which are often referred to as blue-green algae, are all around us, in oceans and lakes, in puddles and ponds, even under the crust of deserts from Kuwait to Arizona. And cyanobacteria are loaded with toxins, including BMAA. The Chamorro were just getting ultrahigh doses of a toxin that the rest of us are exposed to all the time. If Cox was right, every green stinky body of water around the world might harbor an insidious source of neurological disease. "It was like staring into the abyss," he said.

While Cox undertook this initial research, he also had a day job: director of the National Tropical Botanical Garden, a group of five preserves in Hawaii and Florida set aside by congressional mandate for research and conservation. Cox kept his employers abreast of his investigations, and eventually, Doug Kinney, a retired investment banker who chaired the garden's board, decided that he should move on. "Paul was okay as a garden director," Kinney told me. "But spending time thinking about who would take care of a particular plot of nasturtiums is not what a great scientific mind ought to be doing."

Kinney and a couple of friends, including Bill Egan, the former EVP of Johnson & Johnson's worldwide consumer products division, told Cox they'd fund a lab where he could research his theory linking the BMAA toxin and neurological disease. They wouldn't hobble the lab with the red tape typically faced by researchers at pharmaceutical companies and academic labs. Cox and his researchers would decide what experiments to conduct, they'd get new equipment when they asked for it, and neither the board nor Cox would expect any commercial return. The scientist, in turn, promised he'd be efficient; the lab, which was launched in 2006, has an annual budget of around \$2.5 million.

Kinney, Egan, and the other initial funders weren't the only people fascinated by Cox's tale of the Guam puzzle. Cox is a good storyteller—at Harvard, he twice won the prestigious Bowdoin Prize for essay writing (other winners include Ralph Waldo Emerson and John Updike). And he has attracted a fair amount of publicity, including from *Time* magazine, which once named him

one of 11 "Heroes of Medicine." Early on, criticism accompanied the attention, often from scientists accusing him of dubious methods and bad science. "Every time [he] comes up with another award or a big glossy story about him, we all just cringe," one told *The New Yorker* in 2005. I tried to contact several of his critics for this story, but none returned my emails or phone calls.

Cox, who earned a Ph.D. in biology from Harvard and undergraduate degrees in botany and philosophy from Brigham Young University, acknowledges such skepticism—and seems even to welcome it. Doubt and derision are helpful reminders for scientists—reminders not to be trapped by your own ideas and certainty: "It's really important, as a scholar and a scientist, to have a contour map of your knowledge," he told me. "And it's just as important to have a contour map of your ignorance."

As he pursued his scientific inquiry on BMAA, he began cobbling together a group of scientists that could fill in the many gaps in his own training. He started with neurologists at the Karolinska Institute in Stockholm. Since then, he told me, "I've gone to over 50 people in 28 labs in a dozen countries with the same pitch: 'Hi, please stop what you're doing. Help us solve Alzheimer's and ALS.'"

By all accounts, he's persuasive. "In 2008, he came to meet us in Sydney," said Rachael Dunlop, a molecular biologist in Australia. Cox was trying to understand just how the toxin BMAA did its damage in the brain. He believed that it insinuated itself into protein chains in place of one of the 20 standard amino acids, causing misfolding that can trigger the death of neurons. He didn't know which of the 20 was being displaced, although he suspected glutamate, an important neurotransmitter. Dunlop and her then boss, Ken Rodgers, were expert on this kind of misincorporation, so Cox asked them if they'd investigate. "It's so gripping when he tells you the story about Guam and Oliver Sacks and the Chamorros and cyanobacteria—how could you not want to work on the project, right?" says Dunlop. "It's the ultimate scientific detective story. That's what did it for us." The research she and Rodgers conducted for Cox proved critical—and also proved him wrong. BMAA was passing for L-serine, not glutamate. Rodgers and Dunlop had handed



Molecular biologist Rachael Dunlop (right) talks with research colleague Sandra Banack at the Brain Chemistry Labs in Jackson Hole.

Cox a potential treatment to combat his toxin. Dunlop eventually went to work for Cox in Jackson, while Rodgers now directs a lab at Sydney's University of Technology.

Cox is the consortium's ringleader, emcee, flack, and switchboard operator. He says he's on email or phone calls with a handful or two of the scientists every week, learning about new research, suggesting new avenues to pursue, and connecting them to others in the group. The consortium gathers once a year, often in Jackson but sometimes in places like Johannesburg or Stockholm. "We're all in different fields," marine biologist Larry Brand told me. "We all present our results and try to connect the dots on everything from causes of algae blooms to medical problems to possible prevention and treatment." Brand's work has evolved as a result of these collaborations. A decade ago, when he first joined the consortium, Brand was trying to understand what causes the huge algae blooms that Florida sees so often. Now he's trying to figure out how much BMAA is getting into the food chain via crabs, shrimp, and other marine life that can be found in those blooms. "Paul's something of a Renaissance man," Brand told me. "He's

very knowledgeable in a lot of different fields, and he's very good at connecting the dots."

Neurologist Aleksandra Stark, who runs the Alzheimer's clinic at the Dartmouth-Hitchcock Medical Center in Hanover, N.H., attended her first conference last October. "It's unbelievable," she said. "All these brilliant people get together and talk about their research around BMAA and cyanobacteria. There was stuff on zebra fish, on cyanobacteria carried by different species of butterflies, on all the various toxins found in blue-green algae. It spanned all domains of science. It was kind of ridiculous—in a good way."

Cox's own work has now been cited by other researchers more than 12,000 times in scientific journals. But it's the consortium as a whole that has really turned his initial insight about the Chamorro into an expansive body of research:

□ **IN SWEDEN**, neuropharmacologist Eva Brittebo revealed that rodents dosed with high levels of BMAA develop neurofibrillary tangles and behavioral aberrations—but only once they become adults, mimicking the long latency period seen in humans who develop Alzheimer's.

□ **DARTMOUTH** neurologist Elijah Stommel pinpointed epidemiological clusters of ALS around certain lakes in New England that have had cyanobacteria blooms.

□ **ALS EXPERT** Walter Bradley traveled with Cox to Qatar, where they found swaths of blue-green cyanobacteria laden with BMAA under the desert crust. They believe this might help explain a reported spike in ALS among U.S. veterans of 1991's Operation Desert Storm. They have since found cyanobacteria under desert crust in Arizona and Utah.

□ **ALGAE BIOLOGIST** Larry Brand discovered that certain blue crabs off the coast of Florida that are commonly eaten by humans had levels of BMAA as high as the bats in Guam. "If BMAA were a man-made chemical," Brand told me, "I don't think it would ever be allowed to be added to food."

□ **CLEVELAND CLINIC** neurologist Erik Pioro has plotted 1,000 cases of ALS in the northwest corner of Ohio, near Lake Erie, which is polluted with BMAA and several other neurotoxins.

All this research has inspired other scientists as well. A Norwegian team, for example, has looked at how BMAA affects proteins in zebra fish. In Canada, researchers have shown that BMAA is released from algae blooms as the cyanobacteria die. And in 2016, Chinese scientists showed that rats injected with BMAA developed ALS-like symptoms.

D **ESPITE SUCH FINDINGS**, the consortium's work is far from accepted science. A 2017 review of the literature on BMAA by scientists at an EPA lab in North Carolina's Research Triangle Park concluded that "the hypothesis of a causal BMAA neurodegenerative disease relationship is not supported by existing data."

Undeterred, Cox has steered the focus of the Jackson lab to L-serine, which he believes could significantly delay the onset of Alzheimer's and the progress of its symptoms. The FDA has previously approved the use of L-serine as a safe dietary supplement, and doctors sometimes prescribe it for chronic fatigue syndrome. The Cox team believes L-serine may play a neuroprotective role.

**\$277
BILLION**

Estimated cost of caring for people with Alzheimer's and dementia in 2018 in the U.S.

**\$20.2
TRILLION**

Expected cumulative cost of U.S. care between 2018 and 2050

66.7%

Share of Alzheimer's care expected to be paid for by Medicare and Medicaid

When I met with Cox recently in New York City, he was quick to share some newly published lab research on the role L-serine plays at the cellular level. We spoke over breakfast at the dreary Times Square hotel he frequents when courting funders or accompanying his wife, Barbara, to Broadway shows. "Here's what we now think is astonishing about L-serine," Cox said. "It appears to be neuroprotective against all possible protein misfolding. It basically turns on a system in our brains that looks for unfolded proteins and is quickly poised to act on them."

For Cox, the most powerful illustration of L-serine's potential is a 2016 study he and the University of Miami's Mash oversaw on St. Kitts in the British Virgin Islands. A team at an animal research lab there fed bananas loaded with BMAA, L-serine, or a combination of both to vervet monkeys who have a gene that is thought to increase the risk of Alzheimer's in humans. (The control group got bananas with rice flour.) Monkeys given BMAA showed both the plaques and tangles common to Alzheimer's patients. But those given an accompanying dose of L-serine had 80% to 90% fewer tangles in their brain tissue, the study found. The results astounded Mash and Cox, so they repeated the effort with another 140 vervets and got comparable results. Their findings were published in the *Proceedings of the Royal Society*.



E **ARLY IN 2017**, Cox published the results of a six-month clinical trial of L-serine given at varying doses to ALS patients. The Phase I trial, conducted by independent labs in San

Francisco and Phoenix, showed once again that L-serine is safe for humans. One piece of data dangled alluringly from the paper, which was published in a respected ALS journal. The four patients who received the highest doses of L-serine (30 grams per day) saw the progress of their symptoms, as measured on a widely used scale known as ALSFRS-R, slow by 85%. The number of patients, in this case, was too small for the finding to reach statistical significance, but if further clinical trials replicate anything close to that percentage, L-serine would slow the progress of symptoms

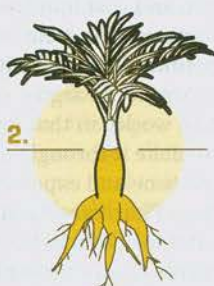
A FATAL FOOD CHAIN

By studying the diet of the Chamorro people of Guam, ethnobotanist Paul Cox unlocked clues that could lead to future treatments of diseases like Alzheimer's.



1. Cyanobacteria, often called **blue-green algae**, contain many toxins, including BMAA, which interferes with amino acids crucial to brain development.

BMAA
CONCENTRATION:
0.3 UG/G



2. On Guam, algae accumulate in shallow pools. BMAA from the algae leaches into **cycad trees** via their roots and accumulates in their seeds.

BMAA
CONCENTRATION:
37 UG/G



3. **Flying foxes**, huge bats with three-foot wingspans, eat the cycad seeds. BMAA accumulates in high quantities in their fat.

BMAA
CONCENTRATION:
3,556 UG/G



4. Flying fox stew, a prized delicacy among the Chamorro, exposed those who ate it to massive doses of BMAA. In the mid-20th century, the Chamorro were **100 times as likely as others to develop neurodegenerative symptoms.**



5. After the flying fox is hunted to extinction, the rate of neurodegenerative disease plummets among the Chamorro. But **research has linked BMAA to clusters of brain disease** in other parts of the world.

far more than any existing drug, potentially buying patients years of life. (The average ALS patient dies 2½ years after diagnosis.)

Such “ifs” can be tantalizing and dangerous, particularly if the driving hope behind them masks self-deception or persistent blind spots in the science. In the case of the L-serine conjecture, though, we should at least get a little more evidence, one way or another, next year. That’s when a pair of clinical trials currently underway in Hanover, N.H., are due for completion. Dartmouth’s Elijah Stommel is overseeing a Phase II trial of ALS patients taking 30 grams of L-serine a day, while his colleague Aleksandra Stark supervises a Phase II trial of Alzheimer’s patients receiving the same dosage. Starck is 39 and has been seeing Alzheimer’s patients since her neurology residency at University of North Carolina in 2011. “Ultimately, I am hopeful and optimistic,” she said. “There will be some kind of meaningful slowing of the progression of Alzheimer’s within a decade, even if a cure seems like wishful thinking.”

“This is where we stand,” Cox told me. “We think that chronic exposure to BMAA is a risk

factor for ALS and Alzheimer’s. It’s not deterministic. It’s like tobacco and lung cancer: If you smoke, you might not get it, and if you don’t smoke, you still might get it. With L-serine, it’s possible that it could significantly reduce our risk of these diseases. It’s cheap and it’s safe, so it could prove to be the molecule of choice for disease prevention. If the research pans out, we could possibly provide L-serine to all people who are deemed at risk of developing the disease in the future.”

Then he added: “There’s lots of L-serine in bacon. Did I mention that?”



BY 2002, when Cox and Sacks first proposed their Guam theory, leading pharmaceutical companies were well into their massive, collective bet on the amyloid hypothesis—a theory that, at least in part, dates back more than a century. In 1906, when Alois Alzheimer examined the brain of a woman

who had suffered from dementia and died at 51, he found plaques and neurofibrillary tangles (twisted fibers of protein that may impede a neuron’s normal function). These plaques and tangles are the pathological markers of the disease that came to bear his name. In the mid-’80s, researchers identified amyloid-beta as the misfolded protein in plaques and tau as the misfolded protein in tangles. By the end of that decade, many scientists had settled on the accumulation of amyloid as the

primary cause of Alzheimer's.

Many in the field (and perhaps even most) argue that this remains the case—and that the serial failures of drugs targeting this plaque is simply bad luck. Or perhaps blame is owed to faulty measures in the clinical trials that don't quite capture the drugs' beneficial effects. Or perhaps the dosing has been wrong—or the therapy given too late in the game. "The evidence for the amyloid hypothesis has continued to strengthen," I was told by Daniel Skovronsky, chief scientific officer at Eli Lilly. "There is very strong genetic evidence. And imaging data has made clear that amyloid is there in the brain years before the onset of symptoms. If you have amyloid, you're at risk of developing Alzheimer's. If you don't, you're not."

Others, however, see the same data points—hundreds of billions of dollars spent, countless hours of human effort, tens of thousands of patients in ineffectual trials—and see a failure of the drug development process, starting in the academic research institutions. "The problem is the way science is done and funded," said Zaven Khachaturian, editor-in-chief of trade journal *Alzheimer's & Dementia* who formerly directed Alzheimer's research across the National Institutes of Health, during one of several long phone calls. "It's populated by people who follow the orthodoxy. To get continuous support, scientists must follow existing orthodoxies. Everybody says they value the individual or the maverick, but nobody will fund them because they say it's a fishing expedition." Research has shown that evaluators on panels that award government funding to scientists at research universities regularly give higher scores to conservative proposals than to those trying to break new ground.

Caution is rewarded at the corporate level as well. Pharmaceutical companies trying to move a drug from discovery to approval face a daunting and expensive process. After discovery of a molecule that might have disease-altering potential, pharma companies are required by the FDA to vet their compound with a Phase I clinical trial (to test safety), at least one Phase II trial (to establish potential efficacy), and a massive Phase III clinical trial—often involving thousands of patients tracked over two or more years—to verify its

5

Number of drugs currently approved for treatment of Alzheimer's symptoms

\$5.69 BILLION

Average total cost of an Alzheimer's drug development program (roughly twice the cost of the average drug R&D program)

effectiveness and prove its safety for a wide market. The process can take a decade or even two and cost hundreds of millions of dollars or more. The great majority of tested compounds don't make it through.

You could argue, as many have, that the system works, in that unsafe drugs are unlikely to make it through all these hurdles. However, the time and expense can discourage innovation. Pharmaceutical companies believe it's safer for them to bet on marginal improvements to an existing therapy than to gamble on an unconventional drug. Repeated failures deter exploration even more: ClinicalTrials.gov, the NIH's official registry for clinical trials, lists just 215 active studies in Alzheimer's disease in the U.S., vs. nearly 7,000 directed at cancer, where a variety of treatments have successfully lowered age-adjusted death rates.

There's been a hefty cost to Big Pharma's fearful orthodoxy on Alzheimer's. "Billions of dollars have been spent pushing bad drugs into clinical trials," said Michael Gold, VP of developmental neurosciences at AbbVie. "There's the opportunity cost—every dollar that you sink into one program, you can't sink into something else," he continued. "Drug discovery programs have been terminated. Expertise has been lost. And some of the biggest companies with the best track records of drug development in neuroscience have left the space."

By betting so heavily on the amyloid thesis, Big Pharma has slighted other approaches that might hold more promise. There has been much less focus, for example, on the tau protein, even though recent studies suggest that tau is a better indicator than amyloid of when symptoms are going to start seriously affecting patients. Of 19 disease-modifying agents now in Phase III Alzheimer's trials, 10 target amyloid. Just two focus on tau (though there are additional studies now in Phase II).

In the absence of a cure, the pool of Alzheimer's patients will soar: while 47 million people worldwide live with Alzheimer's today, 141 million may have the disease in 2050, according to the Alzheimer's Association. In the U.S. alone, the financial cost of caring for today's 5.7 million patients is a staggering annual \$277 billion. By mid-century, Americans may spend \$1.1 trillion annually on Alzheimer's, a crippling blow to a reeling health care system.

The ultimate cost, of course, is that we are no closer to curing Alzheimer's than we were 20 years ago. Alzheimer's still looms as a kind of living death for so many of us. One of every two people over 85 gets the disease, and since Alzheimer's patients don't develop new memories, its onset seems like a premature termination of the experience that is supposed to give meaning to our final years. "If you look at this as a public health issue, in terms of are we solving the problem of reducing the disability of patients, we haven't made a dent," said Khachaturian, the *Alzheimer's & Dementia* editor. Since the beginning of this century, annual deaths from heart disease, stroke, and HIV have gone down. Annual deaths from Alzheimer's disease have increased by 89%. As I was told several times while reporting this story: "Nobody knows an Alzheimer's survivor."

W

HEREVER PAUL COX'S exotic-sounding theories might lead, it's hard not to see in his grassroots international consortium a research model that's more flexible, responsive,

curious, and humbly collaborative than the siloed, conservative approach of the pharmaceutical industry. It would seem a no-brainer that better collaboration among scientists—across disciplines, companies, and countries—is critical to solving this ancient biological mystery. "We have a lot of exciting facts. But they are isolated, and we haven't connected the dots," Khachaturian told me. "A model that brings different perspectives from biology, genetics, pharmacology, psychiatry—even physics and chemistry—that's the kind of thing that's needed to solve the big problem, the problem of reducing disability caused by dementia. One doesn't have to judge whether [Cox's] idea is good or not. His process is important."

Neurologist Dale Bredezen, a professor at UCLA's Geffen School of Medicine and author of *The End of Alzheimer's*, agrees. "Paul's work is exciting," he told me. "Step 1, he's found a contributor, BMAA. Step 2 is to figure out how you address the insult, and he's developed L-serine to do that." Like Cox, Bredezen believes that the amyloid plaques in the brains

of Alzheimer's patients are symptoms of the disease, rather than the cause.

In fact, the steady, accretive science of the Brain Chemistry Labs consortium has become a fixture of academic journals for so long that, to some, it no longer feels so unusual. As physician and author Andrew Weil put it succinctly: "Cox's work doesn't feel so far off the mainstream now."

F

AR OFF OR NOT, the globe-trotting ethnobotanist seems forever to be far away. "I've gone to every place where we knew there was an increase in neurological disease," Cox told me during one of our long, rambling conversations in Jackson. "Then one day I thought, 'Why don't we go to places that don't have any record of Alzheimer's or ALS at all?' Where are those places? Well, they must be places where people have intact motor neuron systems, which means they can grow to old age. So we went to the village in Japan which has the oldest people."

Ogimi is an isolated village of fewer than 4,000 people in the Kunigami district of Okinawa, on the northern side of the island. Ogimi advertises itself as the Village of Longevity; it has the most centenarians per capita, according to the World Health Organization. Scores of researchers and reporters have descended on the hamlet, searching for the secrets of a healthy old age. They've fingered any number of factors: years of exercise, an intimate community, a matriarchal society, and a diet rich in tofu and sweet potato.

Cox has now visited Ogimi six times. "These people are mind-blowing," he said. "I go to interview them, and I say, 'Tell me about the war.'

'Which war?' they say.

'The World War.'

'Which World War?'

"These women, they move like ballerinas. A 98-year-old who can bend over and touch the mat with her palms. I met a 54-year-old who came to the village from mainland Japan when she married a matriarch's son. She looks like she's 19. On a hunch, I ask if she has a sister. She says yes, and when she brings out the photograph, it's like looking at the portrait of Dorian Gray!" Cox clapped his hands together.

"I got dead serious about looking at their diet," he said. Cox interviewed dozens of locals, most often over breakfast, lunch, or dinner. He went to the market and bought samples of all the local produce. He even walked the beach to collect seaweed after observing locals doing that at sunset. He shipped it all back to the lab, where his colleagues analyzed the molecular makeup of the Ogimi diet.

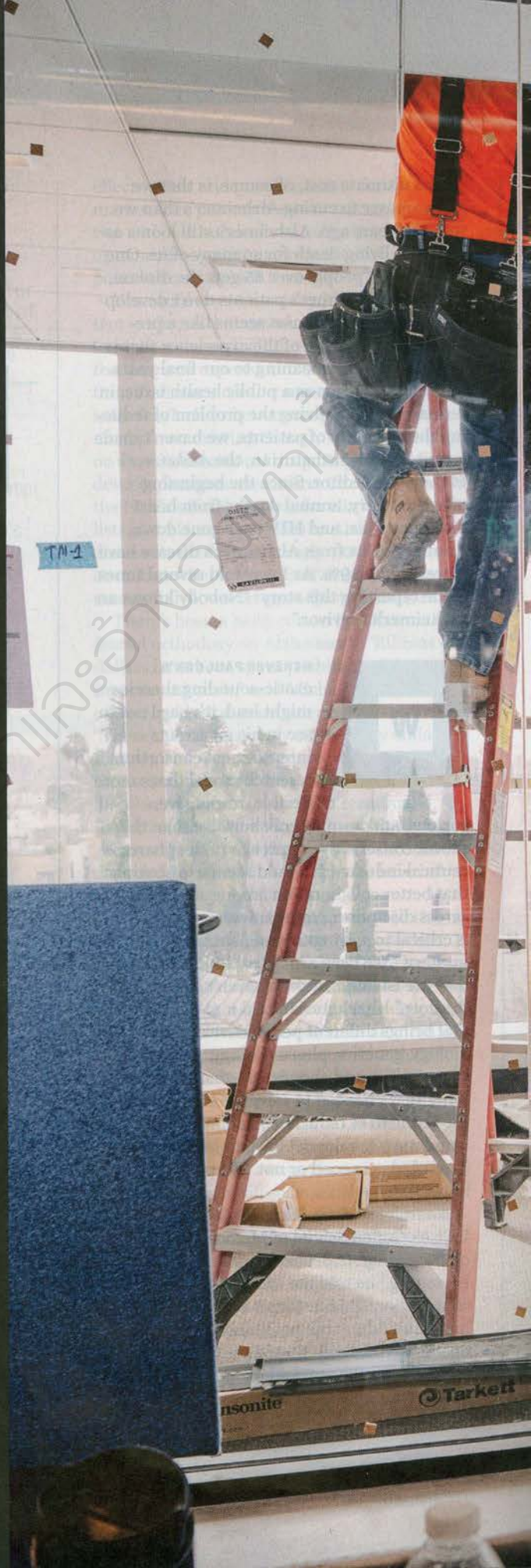
"Wouldn't you know it! The Ogimi people are getting three to four times the level of L-serine that Americans get in their average daily diet," Cox said. "They have the highest L-serine content of any population that I've ever measured. They look unbelievable. And they live forever!" ■

HOLLYWOOD'S NEW ODD COUPLE

Jeffrey Katzenberg and Meg Whitman have big plans for short videos. Quibi, their yet-to-launch service, aims to dominate the market in high-quality hot takes for mobile phones. They've raised a billion dollars and paid big bucks to attract top talent. Now all they need are customers.

By SHEILA MARIKAR

▲ PHOTOGRAPHS BY BRINSON + BANKS





IT'S DINNERTIME midweek at the celebrity-heavy Los Angeles restaurant Craig's, and Jeffrey Katzenberg and Meg Whitman are holding court in a highly visible corner booth. If Hollywood were a high school cafeteria, theirs would be the cool kids' table. Other diners smile and nod in their direction. The record executive Tommy Mottola stops by. The restaurant's owner, Craig Susser, leans in to shake hands. "I haven't heard much about you lately," says Susser. "Are you doing anything?" All laugh uproariously. The joke's on whoever thought gobs of money and a pair of expired executive titles would force these two into retirement.

At first glance, Whitman and Katzenberg seem a bit like the oil and vinegar that dress the \$16 kale salad at this joint. She made her name in left-brain Silicon Valley, running eBay and then Hewlett-Packard. He looms large over right-brain Hollywood as the former chairman of Walt Disney Studios and longtime CEO of DreamWorks Animation. She ran for governor of California as a Republican. He's raised big bucks for Democrats. She wears paisley scarves; he prefers Stan Smiths. It's kind of hard to imagine them enjoying a meal together, let alone joining forces to create Quibi, a short-form video platform—its name is short for "quick bites"—that has raised a billion dollars from the likes of Disney, Fox, Time Warner, and NBCUniversal, all before writing a line of code or releasing a snippet of video.

Yet this odd couple finish each other's sentences like friends who have known each other for decades, which, in fact, they have. They met in 1989 at Disney, where Whitman worked in the entertainment giant's famed strategic-planning group while Katzenberg was busy reviving Disney's motion picture arm. Katzenberg claims Whitman was the only business type he enjoyed talking to back then. Years later, when she was CEO of eBay, he asked her to join the board of DreamWorks Animation. Whitman stayed for five years before stepping down for her 2010 gubernatorial campaign. (Katzenberg's reaction upon learning Whitman would run as a Republican: "Are you fucking kidding me?") She was trounced by Democrat Jerry Brown.

So when HP announced in late 2017 that Whitman would be leaving her latest corporate gig, Katzenberg, who had just started raising money for a then-unnamed video venture, called within minutes to ask what she was up to. Despite having vied months earlier for the job of running troubled ride-hailing startup Uber, Whitman told Katzenberg she was thinking of taking some time off. "I said, 'No, I mean, what are you up to tomorrow night?'" Katzenberg recalls. The next day he flew up to the Bay Area for a

three-and-a-half-hour dinner at Nobu, a high-end Japanese restaurant, to pitch Whitman on running his new company. "I told him, 'You know what, this might be kind of fun,'" says Whitman.

"Fun," to these two overachievers, is a plan so grandiose that success means nothing less than becoming the entertainment industry's next big thing. Whitman, the new company's CEO, and Katzenberg, its chairman, aspire for Quibi to be to short-form video—think: 10 minutes or less and viewed on a phone—what Kleenex is to tissues and Google is to search. "We'll actually create the next chapter of film narrative," says Katzenberg, never short of ambition. "Five or 10 years from now, we'll look back and go, 'There was the era of movies, there was the era of television, and there's the era of Quibi.'"

Confident but not naive about the magnitude of their gambit, the two are out hustling like interns, pitching until their voices grow hoarse. Quibi hasn't even launched its service—it plans to by the end of the year. But thanks to the prodigious networking ability of its two top dogs, it already has landed impressive talent, from A-list directors to industry big shots like journalist Janice Min and music executive Doug Herzog.

In fact, Quibi's most important selling point may just be the juice Katzenberg and Whitman bring to the project. Lena Waithe, an Emmy Award-winning actress, producer, and screenwriter, attributes her interest in Quibi to "Katzenberg and his brand and the fact that he's proven himself time and time again." She's developing a documentary series for Quibi about sneaker culture that she had been close to selling to a streaming service when Katzenberg swooped in. As for Whitman, "her network is gigantic, everybody trusts her, and everybody likes her," says venture capitalist Marc Andreessen, a fellow HP board member.

Reputations alone won't guarantee Quibi's success, of course. The company seeks to capture 18- to 35-year-olds during their "in-between" moments: on the train to work, waiting in line at Starbucks, boarding a flight. Yet its business model is to sell these youthful viewers subscriptions in an era of ubiquitous free video. "Trying to create what's essentially 'lean back' content, even if it's shorter, and delivering that to mobile platforms exclu-



DYNAMIC DUO: Chairman Jeffrey Katzenberg and CEO Meg Whitman in the Hollywood headquarters of Quibi, located in a complex of shared office space.

sively is a nonstarter,” says Paul Verna, a video analyst with the consulting firm eMarketer. “The people who are going to be the audience for this have no idea who Jeffrey Katzenberg or Meg Whitman is. They don’t care, and they don’t want to pay.”

If it seems audacious for two relative dinosaurs to think they’ve cracked the code for what people young enough to be their grandchildren want to watch—Katzenberg is 68, and Whitman is 62—it’s also an opportunity for each to rewrite their legacies. Katzenberg started raising money for Quibi shortly after selling DreamWorks Animation to NBCUniversal in 2016, a move seen as a defeat in Tinseltown even though he walked away

with \$420 million. And Whitman, a billionaire since her eBay days, took the HP job only after her short-lived political career flamed out and HP’s stock sputtered under her watch. They’ve both scaled mountains, yet each has something to prove.

QUIBI SPRANG FROM KATZENBERG’S fertile mind, and it’s the crown jewel of his WndrCo, a consumer technology holding company he founded in 2017. WndrCo incubates its own startups (such as Quibi) and invests in existing businesses, like The Infatuation, a digital dining guide, and AnchorFree, which makes security software. Katzenberg modeled WndrCo after IAC, the media and technology holding company helmed by his mentor, Barry Diller. (Katzenberg moved from New York to Los Angeles in 1977 to answer the phones of Diller, then CEO of Paramount Pictures.)

Just as IAC was a pioneer at applying Internet technology to traditional media, Quibi aims to update old-school video techniques for the mobile age. Leaving aside the movie trailers, music videos, and commercials that have been with us for a long time, short-form video has until now fallen into two categories: user-generated content, like the cat chronicles that populate YouTube, and more-produced fare, made for a fraction of what traditional television would cost. The user-generated content succeeds because of the element of surprise, the perceived scrappiness of the subjects behind and in front of the camera. Low-cost videos seen on services like Facebook Watch bring to mind the sale rack of a T.J. Maxx: There are some gems to be found, sure, but more junk than not.

This kind of content can attract eyeballs, but it's relatively undesirable to advertisers, and it's nearly impossible to get consumers to pay for it. "If mobile video is all you're doing, you're limiting yourself," says Verna, the eMarketer analyst. "If you look at Facebook Watch and Instagram TV, they're having enough trouble getting traction for their programming, and they're free." YouTube, for example, announced in November that it will abandon a subscription-based model for its original content and instead make all of its videos free.

Quibi's proposition is to take the short-form market upscale. The company plans to charge \$5 a month for viewing with limited ads and \$8 a month for an ad-free version. By charging for access, Quibi reckons it can pay around \$100,000 a minute for its premium shows. That's far less than the \$200,000 to \$300,000 a minute that Katzenberg says Netflix and HBO pay for top-tier fare but more than what producers are paying for existing short-form videos. "In order for this to succeed, you need quantity of quality," he says.

Quibi sold stakes to 10 film and TV companies. According to sources, the 10 studios invested about \$25 million each in the startup, which wouldn't confirm the amount—enough to give each a stake in its success. The aim of such deals, in part, is to allow Quibi to tap the studios' creative talent and resources.

Fighting back against the tech companies that have invaded Hollywood is another incentive for Quibi's entertainment-industry backers. "Google, Facebook, Snap, and oth-

ers have wanted people to make short-form content for them," says Peter Rice, president of 21st Century Fox. "But there's been no real business model. It was for the greater glory of those platforms only."

Quibi's near studio-grade budgets have succeeded in reeling in acclaimed creative collaborators too. Oscar-winning director Guillermo del Toro, *Spider-Man* director Sam Raimi, *Get Out* producer Jason Blum, *Training Day* director Antoine Fuqua, and *Twilight* director Catherine Hardwicke are all developing series for Quibi.

Besides the money, why would box-office stalwarts want to make 10-minute videos for cell phone screens? "Our short attention spans demand this," says Hardwicke, whose Quibi series follows a teenage girl grappling with the problems of the future as well as the known pains of adolescence. Quibi creations will be short, but a series might run for any number of episodes. So a story that might have been told on a film screen in 120 minutes can be cut down and doled out over the course of two weeks. "We love the idea of 'one a day' because we think it builds watercooler," says Katzenberg, using Hollywood shorthand for casual workplace conversations. "The problem with streaming is that on the one hand, it has a lot of convenience; you're in control of it. But on the other, you and I are never ever watching the same thing." Unlike Netflix shows, Quibi programs will be released episodically and then be available on demand, a hybrid of appointment viewing and bingeing.

Given that it's a brand-new offering, Quibi also is dangling an inducement in the form of a shorter period in which it has exclusive rights to the content it's buying. For two years, Quibi retains the rights to broadcast and distribute the content it orders. After that, producers can stitch together the bites and shop them elsewhere. "It's a big selling point," says Blum, the *Get Out* producer. "It's harder and harder to own your own IP, especially with the streamers. Netflix and Apple, they want to own all the rights. In the movie business, it's impossible unless you're a distributor."

That's all good and fine, provided that Quibi succeeds in signing up customers, which will be the focus of its marketing efforts later this year. If it can't, its clever approaches to content creation won't much matter. "If

"In order for this to succeed, you need quantity of quality."

BIG PROJECTS, LITTLE SCREENS

SIX HOLLYWOOD HEAVYWEIGHTS HAVE COMMITTED TO CREATE SHORT-FORM CONTENT FOR QUIBI. HERE'S WHAT THEY'RE WORKING ON.



CHRIS ROCK "Wild Kingdom"

Chris Rock will narrate wildlife mini documentaries [four to five minutes each] produced by National Geographic. It sounds like a mashup of *Planet Earth* and the *Planet Earth* spoof voiced by rapper Snoop Dogg.

GUILLERMO DEL TORO Untitled project

The reigning best director and best picture Academy Award winner [*The Shape of Water*] is working on a series based on the 1980 horror novel *The Vampire Tapestry*, according to Katzenberg.

JUSTIN TIMBERLAKE Untitled project

Katzenberg loves to ask musicians about the song that inspired them to get into the industry. Timberlake will ask other singers just that—"What was the song and who was the singer?"—and then perform a duet with them.

LENA WAITHE "You Ain't Got These"

Waithe, an Emmy-winning screenwriter [*Master of None*] and actress, will produce an unscripted documentary series about sneaker culture, told through the lens of race, gender, commerce, and fashion.

ZAC EFRON "Kill the Efrons"

Premise: Zac Efron and his brother get sent to some remote part of the world with no food, shelter, or technology—except for the cameras chronicling what happens, of course. What could go wrong?

ANTOINE FUQUA "Free Ray Sean"

The *Training Day* director is taking his thriller expertise to Quibi with a story about a hostage situation that features themes of racism, law enforcement protocol, and post-traumatic stress disorder. —S.M.

they don't get the subscribers, and the cards are stacked against them getting subscribers, your series won't be a hit, and who's going to want to buy it?" wonders Dan Rayburn, who tracks streaming media for the consultancy Frost & Sullivan. "You don't see people clamoring to rebroadcast stuff from go90," he says, referring to Verizon's mobile-video platform that went dark in July.

WHITMAN AND KATZENBERG SHOW UP at the same office every day, an unfussy steel-and-glass low-rise on a Hollywood side street. Whitman started at Quibi last March, after putting her home in the tony Bay Area suburb of Atherton up for sale and moving into a West Hollywood condominium. (She did manage to squeeze in a trip to Africa with her family between CEO posts.) Quibi is in a shared-office complex, similar to WeWork, with room to grow. Says Whitman: "We can *Pac-Man* our way as we get more people."



TEAM OF [FORMER] RIVALS: Quibi's industry recruits (clockwise from top left): Rob Post (Hulu), Janice Min (*The Hollywood Reporter*), Diane Nelson (DC Entertainment), Doug Herzog (Viacom), Tim Connolly (Hulu), Juan Bongiovanni (Netflix), and Tom Conrad (Snapchat).

Whitman has been doing a lot of recruiting and hiring in the months leading up to the intended launch toward the end of the year. "Right now, it's super similar to eBay," she says, which she joined in 1998, when the fledgling auction site had 30 employees. (Unlike Quibi, eBay already had revenues that were growing freakishly quickly when Whitman joined, which was one thing that attracted her to the job.) Quibi had 75 employees as of January, including a surprising number of entertainment-industry titans in their own right. These include Diane Nelson (former president of DC Entertainment), Doug Herzog (former president of Viacom Music and Entertainment), and Juan Bongiovanni, former director of digital marketing at Netflix. "Figuring out how we're going to work together, hiring the right people, the company being a different company every month—it's super familiar to me," says Whitman.

On a recent morning, Whitman leads a tour of the second-floor space Quibi has claimed, gliding past her standing desk (a paperback copy of her leadership book, *The Power of Many*, sits by the keyboard), past an empty room that the finance team is about to move into, explaining all her expansion plans. On the way to the conference room—which Quibi is sharing with another tenant—Whitman waves to Janice Min, former *Hollywood Reporter* editor-in-chief who now oversees Quibi's content, and pauses for one last tour stop. She opens a blond-wood door and fumbles for the lights, revealing a screening room with cushy, oversized armchairs. A screening room isn't an unusual tenant improvement in Hollywood. But Quibi has no use for the setup.

"We've had all-employee meetings here," Whitman says. "When we first saw it, someone said, 'Oh, look, we can watch our product in here,' and I said, 'Yeah, we're going to be sitting on these couches with our phones. We're not putting our stuff on that.'" She points derisively at the screen and flicks off the lights.

Whitman, intent on proving herself as a woke techno-entertainment executive, is walking the mobile content walk. She claims, improbably, that she no longer streams TV shows or movies on anything larger than a smartphone screen. "I had my brightness slider all the way up while watching *Bodyguard*," the (long-form) British terrorism thriller distributed by Netflix, "over the weekend, and it was still dark," she says. "And that's because the original film was not shot with enough contrast." While Katzenberg reels in A-list talent to create content, Whitman is figuring out how the company can make mobile viewing more immersive, more encompassing, more like the experience one would have in that screening room she uses only for meetings. Beyond boosting film brightness, she wants to optimize sound. "While you're on the bus, commuting, it's quite quiet, and suddenly you get out and there's all this noise, but you still want to watch," she says. "You know what drives me crazy? When they make the flight announcements, and you can't hear a thing. It's so loud, and it goes on for a long time."

Quibi does not yet have a media player to test, and there's no "sizzle reel" to entice would-be collaborators. Instead, it has Katzenberg and Whitman, who have been tooling around Hollywood with a spiral-bound, 32-page presentation, selling roomfuls of producers, executives, and talent agents on why they and their clients should carve out time for Quibi. They have proved to be a curiosity. "Typically, when we have someone come up and tell us what's happening at Warner Bros. or HBO, you get 20 people in a room," says Ari Greenburg, a partner at the William Morris Endeavor talent agency. "This was a single email, and 150 people showed up."

Lately, Quibi has generated enough industry buzz that creatives are coming to pitch. One morning in November, actress Zoe Saldana (*Avatar*; *Avengers: Infinity War*) glides into the shared conference room with her sisters,

Cisely and Mariel Saldana. Katzenberg and four Quibi staffers follow, taking seats around a big square table illuminated by a light fixture that looks like a giant white lima bean.

At first it's the Saldanas who are in full-on pitch mode, talking about how Latinx millennials like themselves are "fed up with the maids and the gangsters and the narcos." "I want to see a *Riverdale* with a multicultural cast and have it be super-elevated," says Zoe, referencing the subversive TV take on the Archie comics characters. The Saldana sisters' production company, Cinestar Pictures, has a number of multicultural, millennial-leaning show concepts looking for a home, and they lob a few ideas at the table.

But about 15 minutes into the meeting, Katzenberg takes over, describing one star-laden series after the next. He drops names like loose change, talking about how he's signed on Justin Timberlake to ask famous musicians about the song that inspired them to get into the industry, then do a duet of it. He's persuaded Zac Efron and his brother to go to a remote corner of the earth and attempt to survive without food, water, and technology for a to-be-determined number of days. (Katzenberg says he told them, "We're only going to do this if you're in real danger.")

He's wrangled Chris Rock to narrate wildlife mini documentaries produced by National Geographic that sound like a mashup of *Planet Earth* and the *Planet Earth* spoof voiced by rapper Snoop Dogg. "It's just sort of a circle of life of an animal, an elephant one week, a salamander the next week. It doesn't really matter what the animal is," Katzenberg says, shrugging. If there were a thought bubble above his head, it might read, "Who cares about the freaking animals? We got Chris Rock."

As he begins to wrap up with Zoe and her sisters, Katzenberg leans into the table separating them with a plea: "We need you, we need your celebrity, we need your buddies. We need to get the stars, the people who mean something to this audience, on our platform." "Like, in front of the camera?" Zoe asks, warily. "Absolutely," says Katzenberg. The cool kids' table, after all, relies on perception. What Katzenberg and Whitman need right now are known quantities who mean as much to Quibi's target demographic as Quibi means to these two ambitious boomers. ■

BIG FOES FOR SHORT VIDEOS

QUIBI AIMS TO BE THE LEADER IN VIDEOS FOR A FLEDGLING FORMAT. IT WILL FACE FIERCE COMPETITION FROM A BEVY OF MULTIBILLION-DOLLAR COMPETITORS WITH A YEARS-LONG HEAD START IN VIDEO PRODUCTION.



AMAZON

The e-commerce giant financed three *Funny or Die* comedy shorts, which premiered on its Prime Video service in fall 2017. It marked Amazon's first investment in original and exclusive content through its content creator-friendly Video Direct program.

YOUTUBE

The gold standard of digital short-form, though its success was built more by amateur vloggers than professional filmmakers. YouTube Originals could bridge the gap. The premium programming—soon supported by ads—will be available to all users later this year.

SNAPCHAT

Desperate to win teens back from Facebook's Instagram, Snap Inc. has rolled out a dozen exclusively produced scripted series and docuseries this fall. Dubbed Snap Originals ("Class of Lies," above), the shows are designed for mobile viewing and encompass a variety of genres.

NETFLIX

Recent Netflix Originals include short documentaries produced with media partners (Vox's "Explained" and BuzzFeed's "Follow This") as well as Jerry Seinfeld's popular "Comedians in Cars Getting Coffee" series, and 15-minute stand-up specials with up-and-coming comics.

FACEBOOK

Longer-form shows are finding success on Facebook Watch, including the Elizabeth Olson-starring *Sorry for Your Loss*. But short news and lifestyle clips are still available. And Facebook-owned Instagram's IGTV is like a user-generated Quibi.

APPLE

Behind the scenes, the Cupertino, Calif., company is assembling a roster of exclusive TV content. Short-form will join the lineup as well. Apple in June gave a 10-episode straight-to-series order for an English adaptation of the French short-form series "Calls."
—Aric Jenkins



CLOSING COSTS

FROM A 30,000-FOOT VANTAGE, a government shutdown doesn't cost much. S&P Global estimates that the border-wall impasse—the longest in history, unresolved at press time—shaved only \$3.6 billion off the U.S. economy over its first three weeks. But other barometers, including rising airport delays and a screeching halt in IPOs, remind us how much our commerce depends on a well-functioning state. And a recent tumble in consumer confidence points to the ripple effects of an erosion of faith in a system that routinely stops public servants from serving the public. That's a cost that could become incalculably high. —MATT HEIMER

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POWERING THE PRESENT

Universities will bridge gaps to find global solutions in the digital age

At some point recently, while we were speculating about the future, it arrived. This year, Davos brings together public and private sector leaders to think about how to navigate Globalization 4.0—an unprecedented era of transformation affecting nations, societies and individuals. It is not surprising that industry is often seen as the place to turn for innovative solutions that will change our way of life. This is frequently true and is happening right in front of us every day. But we should take a renewed look at research universities and their important role in supporting industry and powering our new world.

Understanding the present can be as daunting as imagining the future. For all intents and purposes, the two have merged. The term “digital revolution” already seems outdated in our fast-paced reality. The digital age is here, and digitization is both enabling the transformation we see today and an ongoing product of it.

We all feel an urgency to innovate, anticipate, adapt to and harness the fruits of digitization. For the better part of my professional life, my job has been to think about how a research university

should contribute to—and engage with—the world in the 21st century. One answer I am sure of: It should do so deliberately.

I believe universities of science and technology (USTs) have a unique perspective and can be a major resource to industry and society in the digital age. When we work with companies on applied research—that is, research that addresses real-world problems—we support our partners’ business needs and create a special brand of innovation.

Because of this, USTs are going to be one of the most critical bridging mechanisms between industry and innovation in this era. USTs can contribute on many levels and in varying contexts, including building infrastructure and knowledge for the digital age, advancing cutting-edge R&D, increasing sustainability and educating the new generation of innovators.

King Abdullah University of Science and Technology (KAUST) is an example of one such institution. We are an international UST in Saudi Arabia with a mission to address global scientific challenges while at the same time facilitating ambitious domestic economic and innovation growth. We provide a supportive environment for the best scientists from around the world

to pursue knowledge discovery and translate it to have an impact on society.

Core to our success in both areas is our partnership with industry. Our approach with our national and international collaborators rests on conducting the most advanced scientific research, powered by a robust technological and digital strategy. This allows us to support industry priorities and fill critical knowledge gaps. We are making significant breakthroughs in our strategic area—water, food, energy and the environment—that can change the way businesses innovate.

“Science and technology universities can be a major resource to industry and society in the digital age.”

A recent example of this is our role in helping to change the way the world’s largest oil company does natural-resource exploration. Through a partnership with Saudi Aramco, we set a global record in digital innovation when we worked with the company’s researchers to run a trillion-cell reservoir simulation on our supercomputer, one of the fastest in the world. And earlier this year, we inaugurated the Dow Innovation Center on campus, which epitomizes the crucial university-industry relationship to find solutions through research and data. At KAUST, Dow will be focusing on increasing energy efficiency and reducing environmental footprints through solutions in oil and gas and industrial chemicals.

In a time of many unknowns and opportunities, USTs can help to focus and guide a global digital agenda. USTs have an incredible ability to help industries apply technology and digitalization to their core work, increasing their ability to innovate and look into the future. In addition to improving existing industry functions, we can see entire new industries spring



up by applying things like artificial intelligence and machine learning to businesses and infrastructures.

For as much as digitization gives industry an edge, this disruption has also proved to be something of an equalizer. We find ourselves at a unique time that brings us face to face with the need to innovate at a pace that is historically unparalleled. It will be the industries that recognize this and stay at the forefront that will succeed. I am encouraged and excited by the role that USTs are playing in facilitating industrial transformation. This success in itself is noteworthy. But the heart of a modern UST’s mission is to improve life for people and communities. When we let this principle guide us in our collaborations, it has ripple effects for society, and we accomplish sustainable change and lasting impact.

Tony Chan,
President, KAUST,
Saudi Arabia



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