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that just might end
the pandemic

The Vaccine Issue 37



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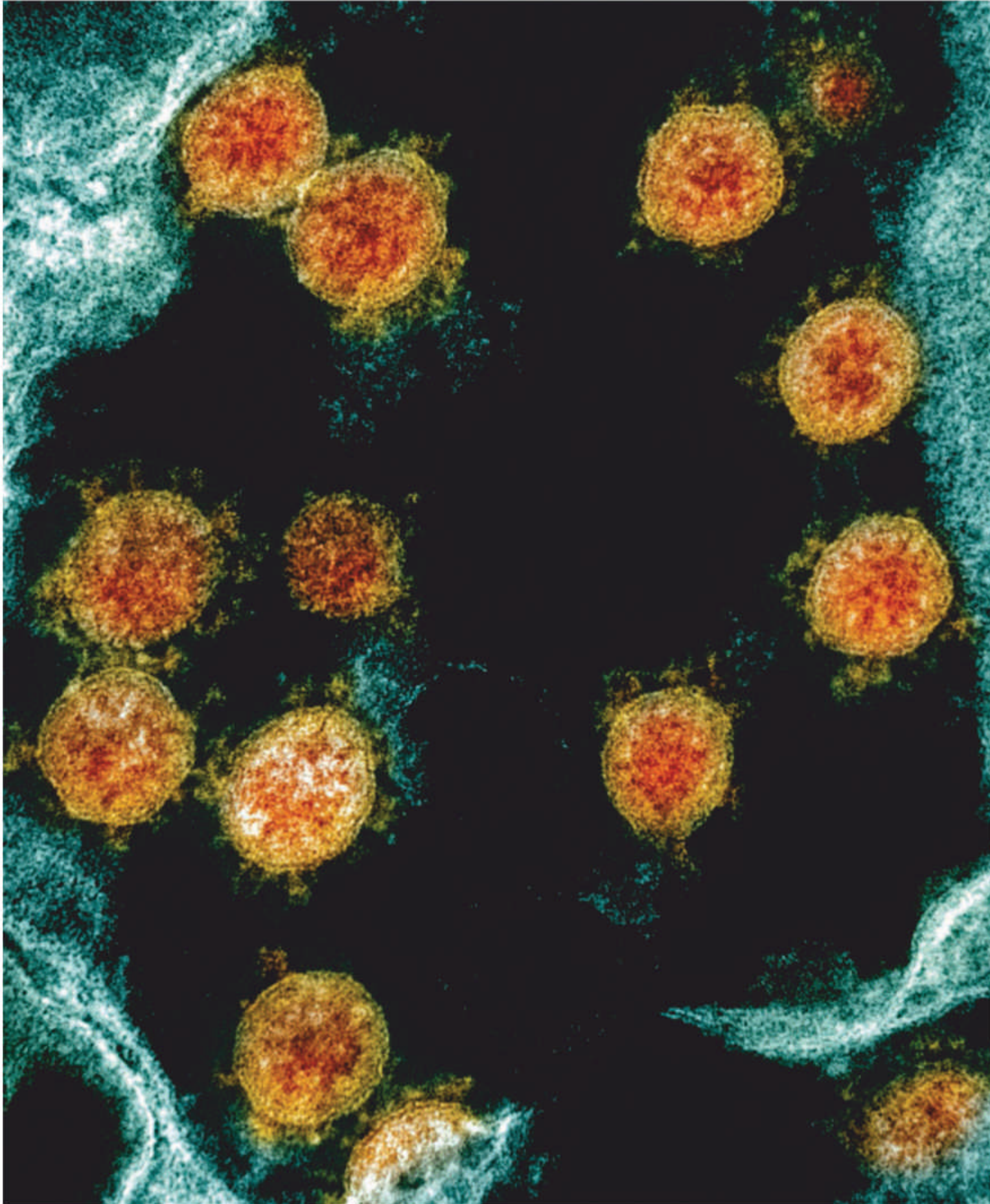
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◀ A transmission electron micrograph of SARS-CoV-2 particles

SPECIAL ISSUE

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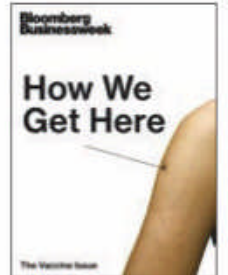
■ COVER TRAIL

How the cover gets made

1

"So this week it's all about the path to a vaccine."

"I'm thinking we play this very direct and just mainline it."



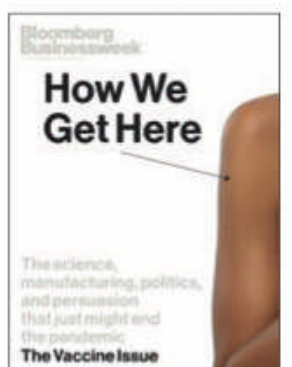
"I sure hope it's not an oral vaccine, but the no-needle thing is clever!"

"Can I see some different arms?"



"FYI, you don't give a baby a shot in the arm."

"I've looked at so many arms, I don't even know what they look like anymore."



Cover: Getty Images

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ATEM Mini Pro.....**US\$595**

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● Globally, the number of Covid-19 cases breached

20m

after doubling in six weeks. More than 745,000 have died. Russia registered the first vaccine, which it claims effectively provides immunity. Among those who've already been vaccinated: one of President Vladimir Putin's daughters. ▷ 54



● Protesters continued demonstrating in Belarus, despite clashes with riot police. President Alexander Lukashenko, who's been in power for 26 years, claimed a landslide victory in elections on Aug. 9. His rival, opposition leader Svetlana Tikhanovskaya, fearing for her safety, fled to neighboring Lithuania.

● Lebanon's embattled government stepped down on Aug. 10.

Protesters say years of negligence and mismanagement caused the devastating explosion that rocked Beirut on Aug. 4. The blast in the city's port district, where dangerous materials had been stored without precautions, killed more than 150 people and left hundreds of thousands homeless. ▷ 24

● Hong Kong police on Aug. 10 arrested media tycoon Jimmy Lai and several of his top executives, applying a new security law that opponents say seeks to silence political criticism and dissent.

● President Trump signed an executive order on Aug. 7 banning U.S. entities from dealing with WeChat—along with ByteDance's video platform TikTok—as of Sept. 20. The messaging app, which is owned by Chinese social media empire Tencent, has about

19m

users in America; it now risks being dropped from Apple's and Google's mobile stores. ▷ 16

● McDonald's sued former CEO Steve Easterbrook for attempting to cover up sexual relationships with several employees.



The fast-food chain is trying to recover tens of millions of dollars in severance pay from Easterbrook, who was terminated last fall.

● After the promise of a **\$765m** government loan on July 28 caused a frenzied stock surge for Eastman Kodak, the shares came crashing back down to Earth. Congress and regulators are looking into whether the company illegally disclosed the loan—which has now been suspended—to news outlets before informing investors. Kodak said it's aware of the probe related to the loan announcement.

● “This is a good day for our country. Now let's go win this thing.”



Former President Barack Obama lauded Joe Biden for picking California Senator Kamala Harris as his running mate. Harris is the first Black woman and first Asian American on a major party presidential ticket.

● On Aug. 12, the S&P 500 jumped above its highest-ever closing level, briefly topping **3,387**. The index went through the trough following its last peak in only 175 days, faster than any prior return from a 20% plunge.

● Media mogul Sumner Redstone has died at the age of 97.

Over five decades, Redstone amassed an entertainment empire that included Viacom, Paramount Pictures, and CBS, controlling a library of pop culture titles stretching from *Rugrats* to *Titanic*.

Biden's Smart VP Pick Tells Us a Lot

● By Michael R. Bloomberg

Every smart executive knows that you're only as good as the team you build around you. It's a lesson I've learned over my entire career, and a lesson that clearly escaped our current president. Joe Biden just proved he gets it. By picking Senator Kamala Harris as his running mate, Biden has selected a strong governing partner for his White House.

At a time when the country is facing the worst series of crises in generations, we have seen how debilitating it is to have a White House that's in a constant state of chaos and turmoil, bouncing from one scandal to another, from one reckless decision to another, from one broken promise to another, and from one petty Twitter fight to another.

The country needs stable, mature, responsible leadership to pull us out of this ongoing disaster—and Senator Harris will help Joe Biden deliver it. With his eight years as vice president, Joe understands the value of having a partner who can complement and balance the chief executive's experience. Joe's decades in the Senate proved to be a major asset for President Obama, especially his successful work with legislators to pass the Affordable Care Act. In the same way, Senator Harris's experience on Capitol Hill—and her leadership on issues of racial equity and criminal justice reform—will be invaluable in a Biden administration.

For instance: As district attorney of San Francisco, Harris created one of the first reentry initiatives in the country, helping to better prepare people who'd been incarcerated to apply for jobs and rejoin their communities. She also pulled back the curtain on problems within California's criminal justice system by making the data more transparent—because she understood the mantra we always lived by at City Hall in New York: “If you can't measure it, you can't manage it.” Harris also brings management experience to the job. As attorney general of California, she ran the second-largest justice department in the nation. In that job, and in the U.S. Senate, she strongly supported universal background checks for gun sales and laws that keep guns out of the hands of domestic abusers and other dangerous people.

I supported her in her race for the Senate in 2016 because it was clear she wasn't afraid to take on tough fights, and that includes the fight for voting rights. The voter suppression efforts made by Republicans across the country are an affront to democracy and a major setback for civil rights.

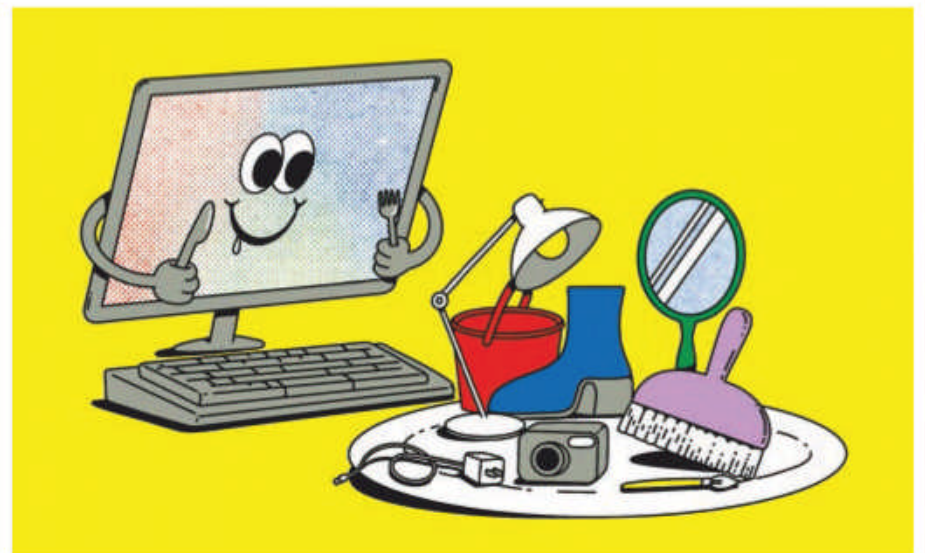
There are a lot of other reasons Biden picked Harris, including that, over the course of the campaign, she demonstrated she was ready to be commander-in-chief. But as attention focuses on her, it's important to remember what the selection says about Joe. During the campaign, the two of

them had their differences and disagreements. But that didn't stop him from picking her.

In fact, knowing Joe as I do, I'd be willing to bet it made her even more appealing. And here's why: Biden knows that in building a strong team, it's imperative to surround yourself with people who aren't afraid to tell you exactly what they think—especially when they think you're wrong. Harris has the guts to do that for Biden, just as Biden did it for Obama. It may be the most important role a vice president can play. And over the past four years, we've seen what happens when a vice president insists that a naked emperor is fully clothed.

Biden's selection bodes well for the kind of president he would be: someone who prioritizes competence, listens to and respects different viewpoints, embraces diversity, and builds teams with strong leaders. We need those values back in the White House more urgently than ever. **B** For more commentary, go to [bloomberg.com/opinion](https://www.bloomberg.com/opinion)

■ AGENDA



► Shopping Well Is the Best Revenge

Alibaba reports first-quarter earnings on Aug. 20. Post-lockdown, China's consumers are spending more on food again, but apparel—the online-commerce giant's strongest category—has been slower to rebound.

► Qantas releases its quarterly earnings on Aug. 20. The Australian carrier, which specializes in long-haul routes, is cutting 6,000 jobs to adapt to an implosion in travel.

► On Aug. 19 the Federal Reserve provides the minutes from its July 28-29 meeting, when the Open Market Committee decided to keep borrowing costs at close to zero.

► The Joint OPEC-Non-OPEC Ministerial Monitoring Committee holds its next meeting on Aug. 18 to craft a response to slack oil demand, which has fallen during the pandemic.

► Norway's central bank, Norges Bank, sets its benchmark rate on Aug. 20. Borrowing costs are expected to remain at zero through the end of 2020 after three cuts earlier in the year.

► Streaming their Covid-era convention from Milwaukee on Aug. 17-20, Democrats will officially name Joe Biden and Kamala Harris as their candidates for president and vice president.

► Brazil's central bank publishes its survey of economists on Aug. 17. The estimates on growth, inflation, and the key rate will provide insight into the state of the country's economy.



QAnon Crashes The Internet Party

● Is it too late to keep the amorphous online conspiracy movement from breaking into the mainstream?

● By Daniel Zuidijk

Imagine it's Thanksgiving or Christmas dinner, the one where the entire extended family shows up. There's a little corner of the long dinner table where you put the relatives most likely to be awkward, so they can chat among themselves. You know who they are, the uncle and cousins who go on rants about Trump's righteous war against an international cabal of pedophiles or Hillary Clinton's imminent arrest. Everyone else in the family remembers the stir that corner caused when they claimed that Tom Hanks had a sex slave. No one with any sense took them seriously. Picking a fight would sap your energy and divide the clan.

For the most part, social media companies have been content to treat QAnon like those relatives. (And those are actual QAnon beliefs.) None of the tech giants were really happy the amorphous online conspiracy movement was at their party, but it wasn't worth the trouble to disinvite them. As long as they kept to their own corner of the internet, the QAnon faithful could enjoy turkey and stuffing with everyone else.

But everything has changed. In the annus horribilis of 2020, the social networks can no longer afford to treat QAnon the same way. Why? Because it's left its corner and is messing with the rest of the table.

Memes emanating from the conspiracy group—which are tenuously united in the discredited belief that there's a plot to oust Trump from the presidency—have made their way into the social media accounts of everyone from Michael Flynn (who was briefly national security adviser) to White House social media adviser Dan Scavino. Sometimes these memes can be as innocent as an image featuring Trump with a QAnon slogan (as was the case for Scavino), but at other times they take on more sinister overtones such as the oath to QAnon—“Where we go one, we go all”—which Flynn posted on July 4. Trump's account has been known to retweet accounts aligned with QAnon.

It goes down the political chain. QAnon-sympathetic Republican candidates will be on the ballot for the Senate and the House in November, including Lauren Boebert in Colorado, Jo Rae Perkins in Oregon, and Marjorie Taylor Greene in Georgia (who won an Aug. 11 runoff against an opponent endorsed by the House minority whip). It also seems to be manifesting outside the U.S. In February, in Hanau, Germany, a lone gunman espousing QAnon-like beliefs massacred nine people in bars frequented by immigrants before killing his mother and himself.

The Covid-19 pandemic has only helped the movement expand: Hundreds of thousands of people with nothing else to do have been exposed to the fringe fulminations. The Institute for Strategic Dialogue (ISD), a London think tank, says that from March through June, QAnon-related posts surged on Facebook and Twitter. While its believers were far from the only ones trying to discredit the use of masks or cast doubt on vaccines, they were among the largest groups.

Twitter took action on July 21, announcing measures targeting “so-called ‘QAnon’ activity” across its platform.

“We've been clear that we will take strong enforcement action on behavior that has the potential to lead to offline harm,” the company tweeted as it detailed the crackdown. Twitter is suspending accounts for breaking existing rules and will no longer highlight as “trending” or recommend content and accounts associated with QAnon. It will also try to stop the movement from being played up in search. Users will no longer be able to share URLs associated with it.

Twitter's plan has parallels with an earlier crackdown by Reddit in 2018 after its forums became QAnon hotbeds. The most prominent subreddits associated with the movement came down, and new ones even hinting they had something to do with it could not be created. Reddit's move is considered to be among the more significant blows against QAnon.

But the tactics so effective on Reddit in 2018 may not work for Twitter. The QAnon movement is now a very different beast from the one that used to populate now-deleted subreddits such as r/TheGreatAwakening. If Twitter no longer wants QAnon to come to Thanksgiving, the conspiracists can still put on a mustache and a hat and sneak in through the back door. There's nothing to stop banned QAnoners from returning to engage in “digital guerrilla warfare,” says Marc-André Argentino, a researcher at Concordia University in Quebec who studies how extremist groups use online technology and co-authored a report from West Point's Combating Terrorism Center titled “The QAnon Conspiracy Theory: A Security Threat in the Making?” All they have to do is get “a bunch of new sock puppet accounts”—camouflaged identities—to stage incursions on Twitter with fresh tweets.

For QAnon adherents, Argentino says, “Twitter is the battlefield.” A ban just reinforces and vindicates its ideology, which posits that any action taken against it is “part of war.” “It might motivate people more, because you're doing something more than just posting memes,” he says. “The damage can still be done, so I don't think they are going anywhere.”

Data from Facebook-owned analytics platform CrowdTangle show a surge in interactions around QAnon content on other platforms following Twitter's July 21 announcement. Posts on social networks seen to be friendlier to QAnon—such as Parler and MeWe—rallied supporters not to take the Twitter crackdown lying down. “The fight needs to continue on Twitter,” as one Parler account put it.

Argentino isn't the only one who's skeptical about the effect of bans. “Account and content takedowns play a useful role in limiting the spread of harmful content, but they can only ever be one part of the solution,” says Jacob Davey, one of three authors of “The Genesis of a Conspiracy Theory,” the ISD's recent report on QAnon. It details the evolution of the movement from late 2017, when several anons—nameless online personalities—coalesced around posts by another who claimed to have “Q” security clearance from the U.S. Department of Energy. “A cursory search of Twitter reveals that it still has a thriving QAnon community,” Davey says. ▶

◀ Indeed, a Bloomberg search of terms associated with the conspiracy movement brought up multiple Twitter accounts with tens of thousands of followers. While they didn't bear the usual hallmarks of QAnon supporters—such as the use of an illustrated Q—they all circulated QAnon posts from the forum 8kun, the movement's current home base. They shared misinformation about Black Lives Matter and Covid-19.

Crackdowns by one platform may no longer have much of an impact on the movement. Travis View, a longtime observer of QAnon and presenter of the *QAnonAnonymous* podcast, says that even if companies were able to push the movement off their platforms, the “delusional QAnon style of thinking” would survive. He says there's no way to “stamp down every single delusional conspiracy theory that grabs hold in the online community.” Case in point is the recent popularity in QAnon and far-right circles of the “demon sperm” video, featuring several self-described medical experts pushing the merits of hydroxychloroquine, including Dr. Stella Immanuel, who made the claim about the satanic origins of the illness.

If crackdowns don't work, how can tech companies and others deal with a movement built around this miasma of misinformation? A good start would be for social media platforms to enforce existing rules, Davey says. “If platforms were more effective in enforcing policies around authentic and transparent use, this could help strike a blow to the network.” Better enforcement of Facebook's community standards on authenticity and safety could have devastating effects on the QAnon presence on its platforms. Policies designed to tackle disinformation also need to be more rigidly enforced.

Still, it's complicated. There are corporate regulations and then there are constitutional guarantees. Argentino points out that many of QAnon's followers aren't actually doing anything against the law. “Is QAnon really a problem to solve?” he asks. Before the pandemic, a lot of what QAnon did, as toxic as it was, could be classified as protected speech. Argentino says “there's a delicate balance where you can be very shortsighted and want to deal with QAnon, especially ahead of an election. But what are the ramifications where this can be applied in other contexts that may have impacts on freedom of expression?”

“QAnon is not ISIS,” he says. The Islamic State group used platforms such as Twitter for recruitment or propaganda, and QAnon isn't that sophisticated. While QAnon beliefs have a way of rapidly radicalizing some adherents, Argentino says, it would require “individuals with greater organizational skills and operational acumen” to become an actual threat. But, says View, “the potential for greater harm is there.”

QAnon isn't likely to be as harmlessly batty as the flat Earth movement. Not with friendly platforms continuing to let its followers post what they want. The conspiracy isn't going to go away soon and, as the Republican Party begins

to count on QAnoners for votes, its paranoid style is almost on the verge of political normalization.

In one important aspect, though, QAnon is like Islamic State: Adherents often start from a feeling of alienation and then acquire an unquestioning faith in the righteousness of a cause that gives vent to their frustrations. Davey says longer term solutions are needed to minimize the damage. These include the “mass rollout of digital literacy initiatives, which can help limit the uptake of conspiracy theories.” He says it's necessary to engage with and talk to believers and “hopefully help them disengage from the QAnon movement.”

A model for that kind of dialogue can already be found on Reddit. Created in July 2019, the subreddit r/QAnonCasualties aims to be a resource for people with loved ones who've been taken in by the movement. It currently has more than 9,000 members. Posts with titles such as “A letter to my Q BF!” and “This madness cost us our home” detail the consequences of having a friend or family member start believing in QAnon. The posts, describing angry confrontations in families, closely echo the experiences of people who confront friends and relatives who've joined cults.

Underneath each post about losing a friend or relation to QAnon, the subreddit's users leave advice or words of encouragement. “Feeling like their whole personality has changed is such a shock,” said one comment. “The next few days are gonna suck,” another said on the prospect of having to spend just a few days with their QAnon-believing mother. “We can't deprogram people or get a loved one out of the cult, but at least we can offer support,” said ‘OreWins,’ one of the moderators of the subreddit, communicating via Reddit's chat function. OreWins said the forum “helps people understand what QAnon is and how it gets its hooks into people.”

Bloomberg couldn't verify the accounts in the forum, but they match what View has seen. “I sometimes call it the digital zombie apocalypse, because it feels like this virus that has been spreading to people's minds through the internet,” he says. He urges more investment in mental health as one way of dealing with QAnon, but he's one of several experts who recognize that's just one part of the battle. A lot of QAnon supporters “feel like they've been let down by institutions, and they don't understand what's going on behind the scenes,” he says. Recent criminal cases—including the Hanau shootings and a 2019 mob boss murder in New York—involved apparently troubled and erratic individuals who've latched onto the catch-all ideology.

The big social media companies are now turning against QAnon and its theories. But it may not matter if Twitter is joined by Facebook and all the other apps in this campaign. QAnon and its followers still have ways to come to Thanksgiving dinner. Perhaps the best thing to do is what should have been done all along. Don't relegate your crazy relatives to the far side of the table. Learn to engage with them even if you disagree, even if it's difficult. Maybe that's the best way to save them—and help everyone—while we still have time. **B**



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Chevron Keeps It Old-School

● As rivals go green, it's sticking with fossil fuels

Speaking to the Texas Oil & Gas Association in July, Chevron Corp. Chief Executive Officer Mike Wirth assured his audience that the global clamor for clean energy “doesn’t mean the end of oil and gas.” On the contrary, Wirth said, the energy business is simply undergoing another of its natural transitions. “We’ll find ways to make oil and gas more efficient, more environmentally benign,” he said. “And it will be a

part of the mix, just as biomass and coal are still enormous parts of the mix today.”

To activists alarmed at the urgency of the climate crisis, Wirth’s comments are as out of touch as they are predictable, coming from someone who profits from the status quo. For unlike its rivals in Europe, Chevron is betting its future less on renewable energies such as wind and solar and more on the subterranean stuff derived from hydrocarbons. It’s a multibillion-dollar gamble that would have been even less surprising before the coronavirus reared its spiky head. By eviscerating demand for petroleum products when business and consumer activity suddenly slowed, Covid-19 has shown the world’s biggest oil and gas companies a vision of a bleak future in which they’re neither wanted nor needed.

A chastened BP Plc responded on Aug. 4 by announcing dramatic steps to address climate

change, including an unexpected vow to reduce oil and gas production 40% over the next decade; CEO Bernard Looney said the strategy was “amplified by Covid.” In sharp contrast, Exxon Mobil Corp. has reiterated its commitment to being oil’s last man standing decades from now. Chevron, for all of Wirth’s prognosticating about crude’s bright future, is pursuing a more nuanced path that embraces something frequently alien to Big Oil: flexibility.

A chemical engineer and Chevron lifer, Wirth rose through the business’s refining side, where he says you can’t rely on oil prices and must “make your own margin” each year. He has a wait-and-see, stick-to-what-you-know, no screw-ups approach. The company he took over in 2018 was contending—like Exxon—with a slew of globe-trotting missteps that cost too much and produced too little in returns.

Wirth cut Chevron’s capital spending to half what it was in 2014 and shifted its focus to shale. Although drilling in shale can be more pricey than conventional oil extraction, it also produces energy more quickly. Wells can be drilled and crude flowing within weeks, vs. 5 to 10 years for offshore platforms or liquefied natural gas terminals. Shale wells also can be shut down quickly when falling prices dictate—as they were when oil dropped below zero dollars per barrel in April, and some producers had to pay buyers to take crude off their hands because there was no room to store it. Other supermajors have expanded their shale production, but none has been as aggressive as Chevron. It’s now the biggest producer in West Texas’ prodigious Permian Basin.

The day before Wirth’s speech to the Texas oilmen and -women, Chevron acquired Noble Energy for \$5 billion in stock. The rare post-virus deal gave the company additional shale acres in both the Permian and a basin in Colorado, as well as a gas field off the coast of Israel. The price was right; only a few months before, Noble was worth \$10 billion.

“We certainly believe that having a balanced capital program that has some large-cycle complex projects but also a very healthy component that is more flexible is the right mix for our company,” Wirth said after the transaction. He likes to talk about being able to react quickly to what he calls “price triggers,” a big departure from the days when standard industry practice was to accumulate as much carbon as possible and pump at full tilt.

So far, Chevron’s public approach to climate change is in contrast to those of BP, Shell, and France’s Total. All three have pledged to speed up their shift to cleaner fuel sources so as to align with the Paris climate agreement and become “carbon zero” by 2050. To underwrite their green transitions at a time of low oil prices, BP and Royal Dutch

Shell Plc have cut their highly prized dividends.

Chevron and Exxon, which have pledged to sustain their quarterly payouts, say they support the “goals of the Paris Agreement,” but they haven’t committed to zero carbon. They have targets to reduce emissions from their own operations but not those of their products, unlike the Europeans. Their stances are politically easier in the U.S., where fossil fuels are a big job generator with strong advocates in Congress.

Rather than switching to low-carbon fuels like the Europeans, Chevron is avoiding extravagant bets and resisting moves into renewables, where it has little expertise and perceives returns to be lower. Wirth is leery of repeating mistakes such as Chevron’s disastrous investments in geothermal power 20 years ago. “For our shareholders, we’ve got an obligation to invest in things we can do wisely and that can generate good returns,” he told Bloomberg last year. “We haven’t seen that in the power sector.” A Chevron spokesman says many experts believe oil and gas will constitute half of global energy consumption for at least two more decades, especially in developing countries. “All our actions are consistent with our long-standing financial priorities—and No. 1 is to protect the dividend,” he says.

In theory, Chevron wants to become a nimble, low-cost energy operator, capable of swift responses to global demand patterns. In practice, that’s a ways off. Just last year the company admitted it ran 25% over budget on a \$45 billion oil project in Kazakhstan, recalling some of the worst excesses of the days before 2014, when oil traded at more than \$100 a barrel. Chevron also posted a second-quarter loss of \$3 billion—its worst in at least three decades—and wrote down \$4.4 billion in assets. It’s ratcheting back on the Permian and other shale plays. To Wirth, this is flexibility in action. To critics, the deep losses are another nail in the coffin of fossil fuels.

Climate activists scoff at Chevron’s relatively small investments in biofuels, wind, and solar to support oil production, claiming they have little discernible effect on global emissions. But Mariana Liokopoulou, energy security research fellow at the NATO Association of Canada, says Chevron’s approach, though not purely climate-driven, “can help them generate the quickest possible cash flows in the short to medium term.” She says that revenue could then be used “to progressively diversify into low-carbon assets and renewables, provided that climate change is also recognized as a priority of the U.S. administration.”

But what if oil demand doesn’t recover for years, as Shell CEO Ben van Beurden recently suggested? And BP’s Looney won’t rule out the possibility ►



● Wirth

◀ that post-pandemic demand has already peaked. Those are horrifying prospects for oil companies, which have long thrived as providers of a scarce resource that underpins the world economy. The resource is scarce no longer, because of shale, and BP is predicting that crude prices in coming decades could trend as much as 20% lower than the company forecast only two months ago.

The risk for Chevron is that it gets left behind, producing a lot of climate-endangering oil and gas that no one needs. Wirth insists he's comfortable with that risk, because, like so many energy transitions, this one is "misunderstood." As he told the Texas Oil & Gas Association, new technologies buttressed by free markets will help oil giants prosper even as they tackle climate issues.

Wirth pointed to whales as a case in which oil companies were able to expand their traditional business while producing positive change for the environment. Back in the 19th century, the creatures "were being whaled into extinction," Wirth said, because their oil was needed as fuel for lighting. Then crude oil companies came along with kerosene to replace it. "Ironically, 'Save the whales' is a catchphrase for saving the environment," he said. "In fact, our industry helped save the whales." Whether sticking with fossil fuels will make endangered species of Chevron and its brethren remains to be seen. —Kevin Crowley and Bryan Gruley

THE BOTTOM LINE Chevron's recent \$5 billion buyout of Noble Energy is a testament to its belief that expanding in shale and other fossil fuels makes sense, despite fears that oil demand is peaking.

Airports Are Catching Covid, Too

● After they spent big to become retail and leisure hubs, a travel dearth grounds their plans

In surveys of the world's best airports, Singapore's Changi regularly ranks near the top. A leader among utilitarian transportation hubs that have been transformed into upscale shopping destinations, Changi Airport in 2019 added Jewel, a futuristic playland with 1.5 million square feet of stores and attractions including a rainforest, hedge maze, and the world's highest indoor waterfall. And the government had planned this year to begin selecting contractors to work on a huge fifth terminal to boost annual capacity 55%, to 140 million passengers.

Then came Covid-19. Traffic at the airport—long a preferred hub for globe-girdling business travelers—fell more than 99% in April, May, and June from a year earlier. Changi is hunkering down, mothballing two of its four terminals and delaying plans to build the additional one.

At airports the world over, the pandemic has wrecked a business model that relies on a steady influx of airlines and their free-spending passengers. So operators stuck with lifeless buildings are trying to dream up fresh ways to generate income. Changi is encouraging Singaporeans who aren't traveling to shop tax-free at the airport's struggling retailers. It's also selling three-month admission packages to Jewel's activity area. For other airports,

new ways to make money include turning parking lots into drive-in movie theaters or unused land into renewable-energy farms. "What Covid-19 has taught airports is they need to diversify their revenue sources," says Max Hirsh, research fellow at the University of Hong Kong and managing director of Airport City Academy, which offers airport-related executive training courses. "Airports are going to have to figure out different ways to make money."

It's a stark change from the pre-virus era, when airlines were desperate for more runways, gates, and terminals to sustain a global aviation boom. Now pandemic fears and travel bans have chilled interest in taking to the skies and brought much business and international travel—the most lucrative kinds for airlines and airports alike—to a halt.

France's Vinci, which operates London's Gatwick and 44 other airports in Asia, Europe, Latin America, and the U.S., reported a 96% plunge in passenger traffic in the second quarter. Japan Airport Terminal Co., which runs Tokyo's Haneda, had an operating loss of about 17.5 billion yen (\$165 million) in the three months ended in June, with revenue falling 87%.

The International Air Transport Association expects \$100 billion in aviation industry losses by ▶



◀ Beijing's Daxing (top) and Singapore's Changi airports



◀ next year, with a return to pre-pandemic traffic not happening until 2024. Even worse, international traffic may not recover before 2027, Philippe Pascal, executive director of finance, strategy, and administration for Aeroports de Paris, said in a July 28 call with analysts.

Still, even though their customers are largely gone, facilities must stay open for business, says Mirjam Wiedemann, a lecturer and researcher in aviation at the University of South Australia. “No government can allow the hub to close,” she says. “A major airport closing, that’s unthinkable.”

Large operators are asking creditors for help. Heathrow Airport Holdings Ltd. on July 9 said it secured a covenant waiver until 2021. Fraport AG Frankfurt Airport Services Worldwide has also asked lenders for assistance. The top 10 airports in the U.S. face payments in interest and principal totaling almost \$14 billion by 2022, according to Bloomberg Intelligence.

While they await a rebound, some airports have tried to put their real estate to use. Southern California’s Ontario International operated a free drive-in movie theater in a parking lot in June and July. To generate long-term revenue, Edmonton International in Alberta last month announced plans to open a 627-acre, 120-megawatt solar farm. Munich Airport in June reached a deal with DHL Express Germany to build a €70 million (\$82 million) cargo facility on land currently used for parking.

To save money, many are firing workers or closing facilities. Copenhagen Airports will cut 25% of its 2,600-person workforce and reduce costs by 325 million Danish kroner (\$51 million), the operator said on Aug. 5. Corporación América Airports last month said it would temporarily close Aeroparque Airport, one of two airports serving Buenos Aires, for about four months to do renovation and expansion work.

There’s also the possibility of government aid. In the U.S., the Cares Act included \$10 billion that went mostly to regional and commercial airports. In negotiations for the next round of stimulus, Republicans have proposed another \$10 billion, mostly for large hubs. Debt investors have so far been accommodating: Dallas Fort Worth International Airport sold \$2 billion of bonds in July, though coronavirus cases in Texas were surging.

Some Asian governments are betting the pandemic will be over by the time expansion projects are done. In Thailand the first phase of a \$9.4 billion airport project south of Bangkok is due to open in 2024. Hong Kong is spending \$18 billion to expand its airport. China, South Korea, and Vietnam are continuing costly building projects, too.

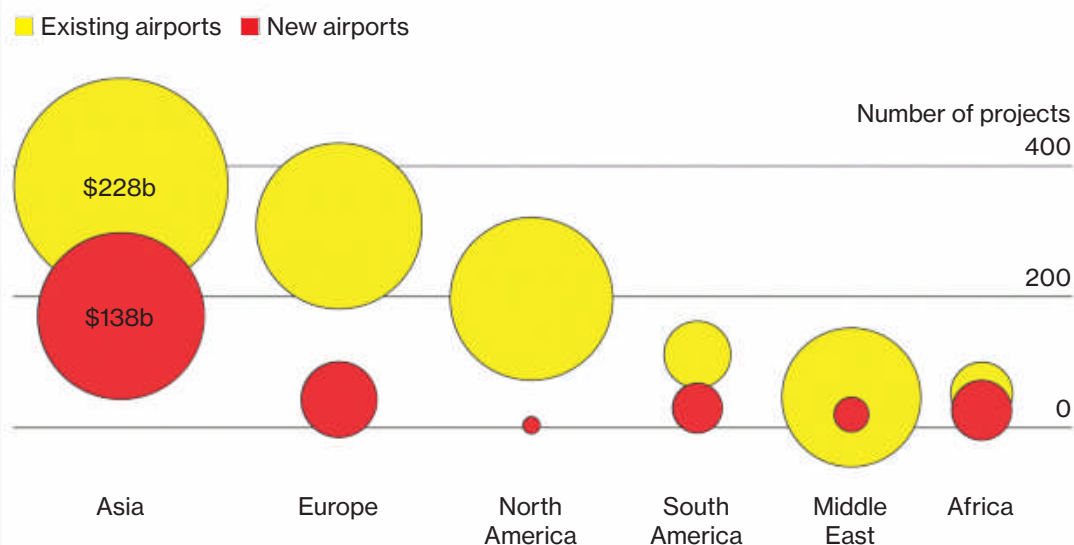
Planners must look beyond Covid-19, Airport

Authority Hong Kong Chairman Jack So said in June, when announcing a HK\$35 billion (\$4.5 billion) loan for its expansion project, known as the Three-runway system (3RS). “The pandemic crisis has not distracted us from our long-term vision of securing the airport’s position as a leading international aviation hub, for which the development of the 3RS holds the key,” he said.

When passengers return, airports should reassess how they make money, says Greg Fordham, Melbourne-based managing director of Airbiz, a consulting firm that’s worked on airport projects in Brussels, Dubai, Hong Kong, and Singapore. This could include arranging hotels for air crews and directly providing passengers with everything from fine dining to health treatments. The crisis “is a great opportunity for airports to get involved in things that they haven’t in the past,” he says.

But for now, airports are concentrating on tweaking their operations to address the realities

Total Value of Airport Construction Projects as of October 2019



DATA: CAPA CENTRE FOR AVIATION

of pandemic-era travel. New Zealand’s Auckland International said on Aug. 3 that it will split its international terminal into two zones—one for passengers traveling to and from countries in New Zealand’s safe-travel corridors, the other for travelers requiring isolation or quarantine. The airport has also suspended NZ\$2 billion (\$1.3 billion) of capital projects.

“It’s still unclear what the recovery looks like,” says Auckland International Chief Executive Officer Adrian Littlewood. “You can’t expect governments to come up with all the answers. The sector needs to get on its feet and propose answers to help figure out what living with this looks like.” —Bruce Einhorn and Angus Whitley, with Kyunghee Park

THE BOTTOM LINE Airports such as Singapore’s Changi saw traffic crater in the months following the pandemic’s surge. That’s forcing many of them to put expansion plans on hold.

U.S. tech giants have enormous influence over what we buy, read, see, and think. But is their market power illegal? At a July 29 House hearing, lawmakers leveled monopoly-abuse accusations at the leaders of Amazon, Apple, Facebook, and Google. We sift through the charges, compile the evidence, summarize the CEOs' defenses, and ask experts whether the lawmakers made their case. —*David McLaughlin, Ben Brody, and Naomi Nix*

Amazon

Apple

Facebook

Google



THE ALLEGATION

Amazon.com Inc. uses predatory pricing to crush rivals. In 2009 it decided Diapers.com was a significant threat and started a price war against it. Amazon slashed prices so much it lost \$200 million in a month on diapers. It then acquired Diapers.com owner Quidsi Inc., cut promotions and discounts, and ultimately increased prices, said Democratic Representative Mary Gay Scanlon of Pennsylvania.

THE EVIDENCE

In an internal email, North American consumer sales chief Doug Herrington said Amazon needed "to match pricing on these guys no matter what the cost."

THE CEO DEFENSE

At the hearing, Chief Executive Officer Jeff Bezos said he didn't remember raising prices after the Quidsi deal. "This was 11 years ago," he said, adding that price discounts to attract customers are a traditional retailer tactic and that customers had many other options for diaper purchases.

THE LEGAL ANALYSIS

Predatory pricing cases are difficult. The government would have to show that Amazon set diaper prices below acquisition costs and that, once a rival was driven out of business, Amazon was able to recoup losses by raising prices above a competitive level. "The hardest part of this burden is this recoupment requirement," says George Washington University law professor William Kovacic. "Show me how consumers are worse off."

THE ALLEGATION

Apple Inc. is an unfair gatekeeper to its App Store, controlling the fate of developers by deciding which apps get in and sometimes playing favorites. Democratic Representative Val Demings of California said Apple's policies allowed it to pick app winners and losers. "Apple rules mean Apple apps always win," she said.

THE EVIDENCE

Apple agreed in 2016 to halve its typical 30% App Store fee for Amazon in a deal to put its Prime Video app on Apple's mobile devices and TV set-top box. The companies agreed to a 15% revenue share for customers who signed up through the app and no share for users who'd subscribed elsewhere. Internal emails also show that CEO Tim Cook promised to fast-track approvals for apps from China's Baidu.

THE CEO DEFENSE

Cook said access is "very wide," to the App Store. "There's fierce competition for developers, and we want every app" on the platform, which has about 1.7 million available. He equated the competition to attract developers to a "street fight for market share in the smartphone business." Cook said Apple has never increased the commission it charges developers, and all apps are treated equally.

THE LEGAL ANALYSIS

Just charging developers a high commission isn't enough to bring an antitrust case, says Hal Singer, a managing director at consulting firm Econ One. There needs to be evidence of some restraint that harms competition.

THE ALLEGATION

Facebook Inc. uses "copy, acquire, and kill" against rivals. It bought Instagram in 2012, seeing the site as an emerging threat. In 2014 it bought WhatsApp, a rival to its Messenger. Democrat Pramila Jayapal of Washington said Facebook identified Instagram as a competitive threat "and told them that if they didn't let you buy them up, there would be consequences."

THE EVIDENCE

Emails and texts show that CEO Mark Zuckerberg asked former Chief Financial Officer David Ebersman in February 2012 about buying Instagram and Path, a now-defunct social media company. Zuckerberg said they had established "meaningful" brands, and "if they grow to a large scale they could be very disruptive to us." He agreed that part of his motive in buying Instagram was to "neutralize a potential competitor."

THE CEO DEFENSE

Zuckerberg said Instagram succeeded because Facebook invested in it. "With hindsight it probably looks like, obvious that Instagram would have reached the scale that it has today, but at the time it was far from obvious."

THE LEGAL ANALYSIS

Jennifer Rie, an antitrust expert at Bloomberg Intelligence, says a monopoly-abuse case might succeed, but forcing Facebook to divest Instagram would be tough, unless the U.S. can prove there's been an actual loss to competition that needs restoring. That will be difficult to show given Instagram's current success and uncertainty about any independent future.

THE ALLEGATION

Democrat David Cicilline of Rhode Island, who chairs the House antitrust subcommittee, fired off the hearing's first question to Google CEO Sundar Pichai: "Why does Google steal content from honest businesses?" Cicilline said the company uses that content to create a "walled garden" and to keep users on Google properties rather than directing them to sites that originated the information or offer more relevant data.

THE EVIDENCE

Cicilline cited an internal Google memo from 2006 that observed other websites were getting "too much traffic," so Google decided to "put an end to that."

THE CEO DEFENSE

Pichai disagreed with Cicilline's "stolen content" characterization. He said Google supports 1.4 million small businesses with more than \$385 billion in economic activity. Pichai also said Google conducts itself "to the highest standard," adding that it has numerous competitors, including Amazon, where "over 55% of product searches originate."

THE LEGAL ANALYSIS

An antitrust challenge against Google could have a shot at success, says Bloomberg's Rie, if it could show the company's actions are excluding or substantially foreclosing rivals from access to the market. A case could claim that Google, without legitimate business justification, demoted rivals' content in search results so that users couldn't readily see it.

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A Dangerous Dance For Microsoft



16

Edited by
David Rocks

Buying TikTok would give the software giant a lift with consumers but risks unwelcome scrutiny

For the better part of a decade, Microsoft Corp. has largely steered clear of the kinds of products and services that stir up controversy—it is, after all, a company whose boldest foray into social networking is the buttoned-down LinkedIn. A deal to buy the video streaming app TikTok, an idea President Trump is pushing, would change all that, landing Microsoft in the kind of political minefield it’s managed to avoid in recent years. “Microsoft has happily stayed out of the techlash so far,” says Ashkhen Kazaryan, director of civil liberties at TechFreedom, a libertarian think tank in Washington. “If they get TikTok, that’s going to change.”

Four days after the bosses of Amazon.com, Apple, Facebook, and Google were blasted as “cyberbarons” in congressional hearings (page 15)—a grilling Microsoft was spared—the company said it was in talks to buy TikTok. Like other social media companies, TikTok faces criticism that it hasn’t done enough to battle harassment and hate speech. A purchase would be a major shift for Microsoft, potentially exposing it to the kinds of concerns that landed its rivals in trouble with lawmakers: privacy, misinformation, political debate, and the protection of minors. “Any company that voluntarily enlists in the content moderation wars is a glutton for punishment,” says Nu Wexler, an independent communications consultant who has worked at Twitter, Facebook, and Google coaching executives on how to deal with Congress.

TikTok initially became a hit among teenagers posting silly videos—typically just a few seconds long—of themselves singing, dancing, and goofing around, often challenging friends to respond with similar clips. As people across the globe looked for ways to ease the ennui of lockdown this spring and summer, TikTok swelled into a torrent of bite-size content. Today it’s a profitable business with worldwide sales of about \$2 billion a year, Wedbush Securities Inc. estimates. The app has been downloaded more than 2 billion times globally, including 165 million U.S. downloads, giving it the potential to challenge Facebook Inc. and Google for online advertising.

That growth has brought scrutiny from U.S. lawmakers, who say ByteDance Ltd., the owner of the service, might be harvesting Americans’ data on behalf of the Chinese government. This spring, Trump got involved, saying he wanted to restrict TikTok for security reasons and to punish China for its handling of the coronavirus. On Aug. 6, Trump escalated his squabble with China, signing a pair of executive orders barring Americans from doing business with TikTok and the WeChat messaging service from mid-September. For TikTok, at least,

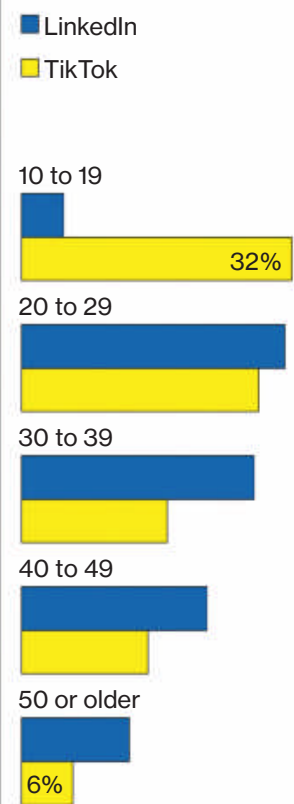
there’s a potential way out via a Microsoft deal. ByteDance has repeatedly denied allegations that it shares data with the Chinese government. But after it became clear Trump wasn’t going to back down, the company indicated it might be open to selling part of its video service.

A purchase would steer Microsoft into treacherous territory, as many users are children, sometimes dressing or dancing provocatively or exchanging messages with adults without parental consent. And mixed in with all the goofy stuff are clips promoting dangerous Covid-19 conspiracy theories, nationalists raging about undocumented immigrants, or white supremacists calling for the murders of Jews and Black people. In the second half of 2019, TikTok took down almost 50 million videos it deemed inappropriate—more than triple the number YouTube deleted in the same period.

Last year the U.S. Federal Trade Commission fined TikTok \$5.7 million after determining the personal information the app collected from children broke U.S. privacy laws. And it’s now the subject of a further inquiry by the FTC and the U.S. Department of Justice over allegations it didn’t clean up its act, according to privacy advocates who say they’ve been interviewed by the agencies. One of those people, Josh Golin, executive director of the Campaign for a Commercial-Free Childhood, notes that Microsoft has dealt with child safety before, particularly for services on its Xbox game consoles. And the company in 2009 developed PhotoDNA, a web scanner that hunts down photos and videos of sexual abuse of children. But the trust and safety problems at TikTok go far beyond what Microsoft has faced in the past, Golin says. “It’s easier to crack down on those things from the beginning,” he says. “When you inherit a site where those practices are already so ingrained, it’s much more difficult.”

With \$137 billion in the bank, Microsoft can easily afford a cash deal, according to Bloomberg Intelligence. But it’s wary of overpaying, especially because the pressure from Trump makes TikTok look like a distressed asset. At the same time, Microsoft will want to avoid going so low that China feels ripped off, according to a person familiar with the matter who asked not to be named discussing internal deliberations. Microsoft has a delicate relationship with China: Although some of its products have been banned and the mainland makes up less than 2% of the company’s revenue, the government has allowed joint ventures selling the Xbox console and cloud services. Microsoft operates censored versions of LinkedIn and the Bing search engine there, and ►

▼ Monthly active users of the Android app in the U.S., by age group, in July



● Satya Nadella

◀ since the 1990s it's had a research lab in Beijing, which now has more than 200 scientists. Critics— notably including White House trade adviser Peter Navarro—say that's all evidence Microsoft is soft on China.

Under discussion is a deal in which Microsoft would own TikTok in the U.S., Canada, Australia, and New Zealand and ByteDance would retain the rest, which would create a host of concerns over technology transfer and branding, according to the person familiar with the company's thinking. Bridging the gap between two owners would make content moderation a major headache, as the two sides might have very different views of what should be allowed or banned, the person says. There are already multiple versions of TikTok for various regions, often employing code from Musical.ly, an app ByteDance acquired in 2017. With ByteDance engineers in China still working on TikTok, it's unclear how Microsoft could split the code and the underlying technology to ensure it's free from Chinese interference.

Since Satya Nadella became Microsoft's chief executive officer in 2014, shares have risen almost fivefold and the company has returned to the ranks of leading tech powerhouses. But while Nadella's strategy has been profitable, he has focused on relatively boring stuff such as enterprise applications and cloud computing—and besides the Xbox, there's little in the way of consumer business. Some previous attempts to move beyond stodgy corporate applications—Nokia and Skype come to mind—have been unmitigated disasters, leaving the impression that the company lacks the chops to succeed with consumers. TikTok could change that narrative, which spurred executives to begin exploring a purchase about a month ago, according to a person familiar with the situation.

Nadella has overseen three big acquisitions—the *Minecraft* computer game, LinkedIn, and GitHub, a collaboration platform for software developers. Each of those brought in large groups that Microsoft understood: gamers, white-collar workers, and coders, says S. Somasegar, a venture capitalist who worked at Microsoft for 27 years. The teens and young adults who make up the bulk of TikTok users are a less obvious fit—though Somasegar says a deal might nonetheless work. “Is it a risk? Absolutely,” he says. “But if you don't take risks, you turn into a mediocre company.”
—Dina Bass, Shelly Banjo, and Ben Brody

THE BOTTOM LINE Microsoft is wary of overpaying for TikTok because Trump's pressure makes it look like a distressed asset, but it must tread carefully to please the U.S. and Chinese governments.

How to Say Big Tech In Hindi

● Intense interest in Reliance's Jio Platforms unit heralds a global rush to invest in India

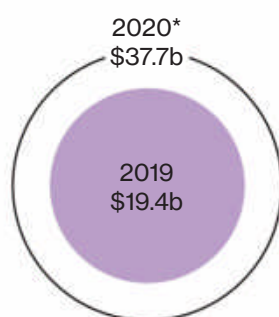
In May, Reliance Industries announced Facebook Inc. would pay almost \$6 billion for 9.9% of Jio Platforms, the Indian conglomerate's telecommunications and internet unit. The news unleashed a deluge of interest among global investors who sensed opportunity and began flooding the company with queries, spurring Reliance to impose what it called the “7-4-45” rule, strictly rationing access for even A-list companies such as Intel, KKR, Qualcomm, and Silver Lake Capital: seven days to examine the books on a secure website, four hours of virtual meetings with top executives, and—if a deal seemed close—a final 45-minute videoconference with Reliance Chairman Mukesh Ambani.

By mid-July a dozen companies had concluded deals with Reliance, which netted an additional \$14 billion and boosted total investment in India's tech sector so far this year to almost \$38 billion. With Jio, the immediate draw was the company's 388 million mobile subscribers. But just as important—for backers of Jio and other Indian tech outfits—was potential access to a market with more than half a billion mobile internet subscribers and hundreds of millions more on the way. “This is about the right to play in what promises to be the world's second-largest digital economy,” says Vijay Shekhar Sharma, founder and chief executive officer of One97 Communications, which runs Paytm, India's leading digital payments service.

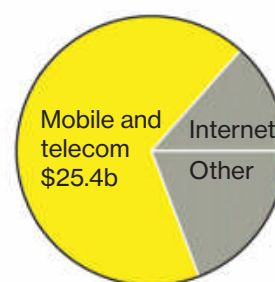
A Boost From Mobile

India-based startups that raised money through equity deals

Value of deals



Funds raised in 2020, by sector*



*THROUGH AUG. 5. DATA: CB INSIGHTS

As companies including Facebook, Google, Amazon, and Walmart see plateauing user numbers at home and escalating tensions between the U.S. and China's tech industry, they're looking more closely at India. Although the South Asian nation has long had more potential than payoff, its hundreds of millions of digital neophytes hunger for everything from streams of Bollywood films to boxes of breakfast cereal from online grocers. The coronavirus pandemic has hurt growth, but it's done little to slow global interest in a country that's on track to overtake Germany and Japan to become the world's No. 3 economy by 2039.

This year's investment rush began in January when Amazon.com Inc. founder Jeff Bezos, on a visit to Delhi, declared "the 21st century will be India's" and announced a \$1 billion investment to help small businesses there track inventory, sales, and accounts. In July, Sundar Pichai, CEO of Google parent Alphabet Inc., pledged \$10 billion to digitize India, including a \$4.5 billion investment in Jio. The next day, Walmart Inc. said it would spend \$1.2 billion on its Indian subsidiary, Flipkart, which faces growing competition from Amazon and, yes, Jio. All told, more than 800 deals totaling \$37.7 billion have been signed this year, according to researcher CB Insights. "The possibility of lighting up a billion ideas in a country deeply rooted in openness and free expression is making India an investor magnet," says Ajit Mohan, Facebook's managing director for the country.

One group no longer welcome at the party is the Chinese, whose companies had made rapid progress in India. TikTok, the video app facing opposition in the U.S., and the UC Browser from online marketplace Alibaba Group Holding Ltd. have each been installed almost 700 million times in India, researcher Sensor Tower estimates. And handset maker Xiaomi Corp. accounted for about a third of Indian smartphone sales in the first quarter, according to Counterpoint Research. Then, after 20 Indian soldiers were killed in fighting on the disputed Himalayan border in June, India banned dozens of Chinese apps, citing a security threat. Tensions with China have "created an opportunity of a lifetime for Indian entrepreneurs," says Mohanjit Jolly, a partner at venture capital firm Iron Pillar Capital.

Until the arrival of Jio, which means "live" in Hindi, foreigners dominated India's tech sector. The country is Facebook's biggest national market, with 328 million social network accounts and more than 400 million subscribers to its WhatsApp messaging service. Amazon controls almost a third of e-commerce there, with more than 500,000 small businesses using its platforms. Netflix Inc.



and Amazon Prime dominate video streaming.

Jio is poised to challenge those companies and more. Since its founding just four years ago, it's built a 4G network covering virtually every corner of India and become its leading mobile phone carrier. To keep customers glued to their handsets, it offers shopping, movie and music streaming, videoconferencing, and online news, and it's expanding into banking, e-learning, and apps for farmers. "Few companies have the potential to transform a country's digital ecosystem in the way Jio Platforms is doing in India," KKR & Co. boss Henry Kravis said in a note after committing \$1.5 billion.

Jio's rise worries some market watchers. Its cut-throat wireless data pricing and packages that offer free voice calls dramatically expanded internet access but helped drive a half-dozen rivals out of business. With its formidable bank account and ties to industry giants, Jio is ready to become a Big Tech player in its own right, says Urvashi Aneja, director of technology consultant Tandem Research. Jio's expansion, combined with economic fallout from the pandemic, could allow it to crowd out smaller players by giving preference to its own services, Aneja says. "Regulators need to ensure that Jio doesn't grow into a monopoly," she says.

Reliance boss Ambani hasn't publicly addressed those concerns, but he envisions a buoyant future for Jio. In recent years it has bought or invested in more than 20 startups in education, e-commerce, health care, and more. In May, Jio launched a grocery delivery service in 200 cities that it plans to link with millions of mom and pop stores, allowing customers to see what's in stock and place orders for speedy delivery. And with Google it's planning to produce smartphones that could retail for less than \$50, aimed at the 350 million Indians who still use basic handsets. "The time has come for a truly global digital product and services company to emerge from India," Ambani said at a July shareholder meeting. "This is Jio's ambition." —*Saritha Rai*

THE BOTTOM LINE Although India has long had more potential than payoff, tech companies have signed \$38 billion in deals this year to enter a market with more than half a billion mobile internet users.

▲ India has hundreds of millions of digital neophytes eager for content and services

● Jio's mobile subscribers

388m

The Streaming Wars Come to Real Estate

Studio lots are a hot property as Blackstone starts to write big checks

Stuck at home during the Covid-19 pandemic, Americans have been streaming movies and TV with abandon. They've plowed through *Tiger King* and the much-acclaimed production of the musical *Hamilton*. Millions have even made time for game shows as lowbrow as *Floor Is Lava* (pretty much what it sounds like), which turned into a hit for Netflix Inc. At the peak in late March and early April, people in the U.S. were devouring in excess of 160 billion minutes of streaming video per week—the equivalent of about eight hours per person, or twice what they watched a year prior, when a trip to the cineplex didn't run much risk of contracting a deadly virus.

Against this backdrop, Blackstone Group Inc. decided to buy a 49% stake in three Hollywood studio lots. Hard times have always been a boon for escapist entertainment, but the Blackstone deal, which the company said was completed on Aug. 3 and valued the properties at \$1.65 billion, was a long-term bet on streaming. Even after the pandemic, companies such as Amazon.com Inc., Netflix, and Walt Disney Co. will need stages to feed the world's bottomless appetite for video.

Blackstone and its partner, Hudson Pacific Properties Inc., are betting they can buy up more of the space in such key entertainment hubs as London, New York, and Vancouver in the coming years. "This is as strong a trend, as far as demand growth, as anything we see in the real estate business," says Nadeem Meghji, the head of real estate for the Americas at Blackstone. "If you look at the data, we've seen an almost doubling of total content spend globally over the last three years."

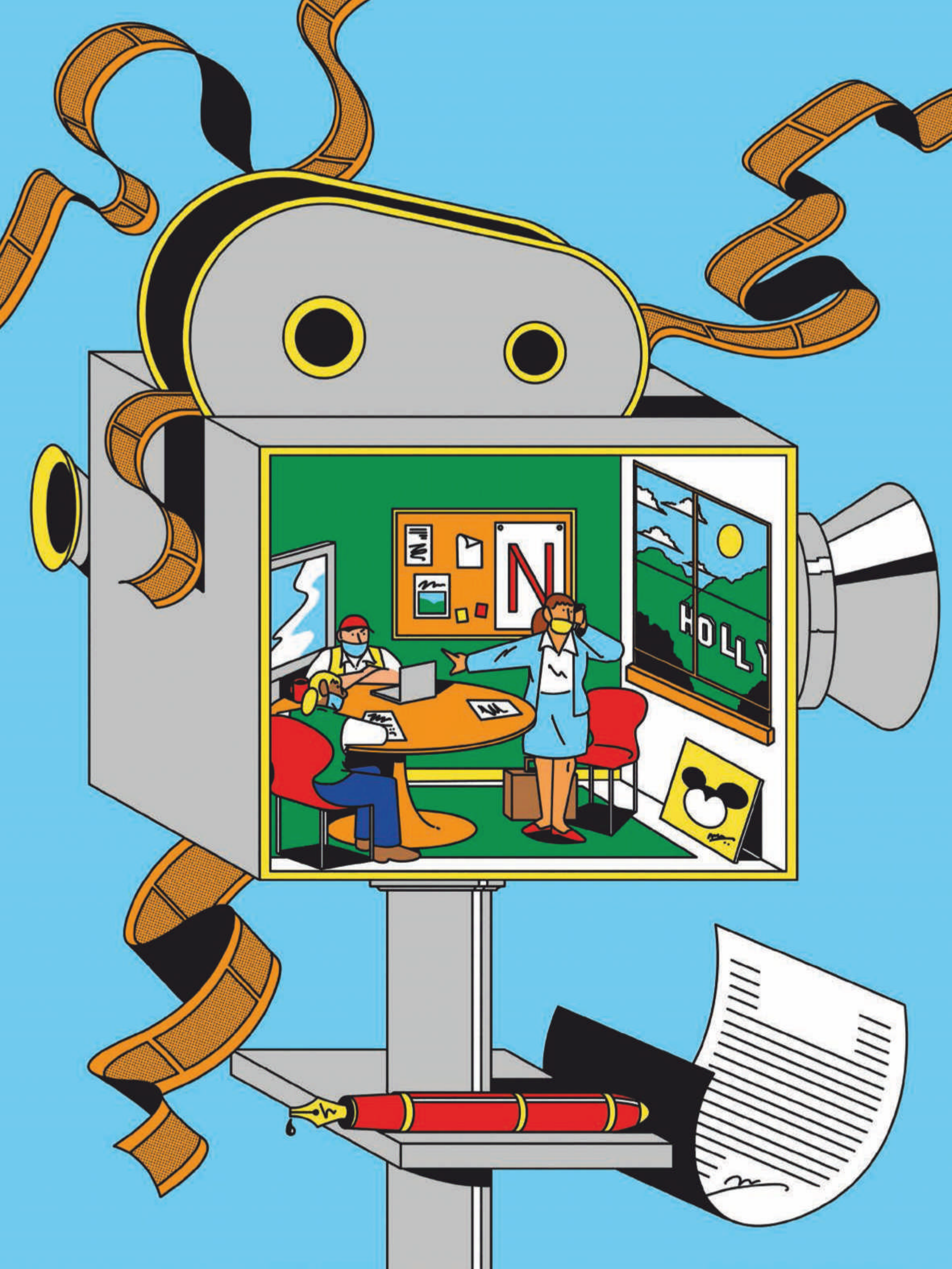
Commercial real estate investors have been puzzling over where to invest during the pandemic. Hotels and retail space look dicey as the virus curtails travel and trips to the mall. The future of offices is cloudy, too, as people telecommute from home. Even apartments, which have

long been viewed as recession-resistant, look like they're due for a couple of bad years with so many unemployed. That's left elephant-hunting real estate investors such as Blackstone with a narrower set of options. Owning studios is "pretty niche," says Danny Ismail, a senior analyst at Green Street Advisors. But "it checks many boxes that your average real estate investor would find very appealing."

Soundstages were seen for years as a ho-hum business for landlords. The norm in the industry was for production companies to sign short leases, because many shows got canceled after a season. But the rise of Netflix and other streaming services changed the equation. The new content creators wanted offices on-site and were willing to make longer-term commitments for space they could restage for show after show. The streaming wars have stoked demand, as binge-watchers expect a big menu of programs for their subscription. Meanwhile, very few new soundstages have been built, because it's hard to find enough land for the airplane hangar-size buildings in a city like Los Angeles.

Leading up to the pandemic, there was about a 1% vacancy rate for the space, according to Jennifer Frisk, senior managing director with broker Newmark Knight Frank's L.A. office. "Studios were able to pick and choose who they wanted on their lots, what kind of shows, what kind of terms," she says. "The market was incredibly strong." Even when the virus shut down production, landlords didn't have to provide rent relief or deal with tenants leaving, Frisk says: "Everyone's keeping their space, with plans to pick back up as soon as they can."

The tight market is forcing producers to consider lower-quality space, including a warehouse formerly used by retailer Forever 21, says Jeff Worthe, chairman of Worthe Real Estate Group, which has a partnership with Blackstone on offices and production facilities in Burbank, Calif. "People are going to ►





◀ make do with stuff they wouldn't have filmed in two or three years ago," he says.

It's all been a validation for a strategy that Hudson Pacific started pursuing more than a decade ago, when Netflix's big business was still mailing DVDs in red envelopes. Starting in 2007, the real estate investment trust began buying up some of Hollywood's historic lots, including the one where the first talkie was shot. Series as varied as *The Golden Girls* and *True Blood* have filmed or taped at the others. Hudson Pacific added creative offices to the properties, collectively called Sunset Studios, and leased space to tenants that included CBS, Netflix, and Disney.

Victor Coleman, Hudson Pacific's chief executive officer, began speaking with Blackstone President Jon Gray about a potential partnership late last year. Ultimately, Coleman says, he went with Blackstone in part because they had a shared commitment to be in the studio business for the long haul. The deal gives Hudson Pacific the capital to develop new office and production facilities. Blackstone is one of the deepest-pocketed investors in the world, with \$46 billion in "dry powder"—cash committed by investors—to spend on real estate.

Right now, though, there are some challenges to running studios. When California went into lockdown in March, filming halted. Even though production was allowed to resume in June, shows have been slow to restart as cast and crew figure out how to maintain social distancing while shooting fistfights and kisses. Even today, the lots look deserted. Hudson Pacific's Sunset Bronson property, which contains Netflix's main Hollywood office, has a billboard in the parking lot advertising *Spenser Confidential*, starring Mark Wahlberg. It premiered on March 6.

Hudson Pacific makes additional money by providing services, such as lighting, grips, and control room rentals, which can represent about a third of the revenue in normal times. A drop-off in filming caused income for that line item to plunge in the second quarter according to Coleman, even as the company's studios collected almost 100% of the rent.

A further challenge for studio owners could be lower demand for on-site office space, says Laura Martin, an L.A.-based entertainment industry analyst for Needham & Co. After having everyone work from home for months, companies such as Netflix may decide that back-office legal and accounting jobs can continue remotely. "The longer Covid goes on, the more likely some of the traditional habits of making TV and film change," Martin says. "And if they change, they're more likely to be more distributed and less centralized on lot space." Coleman is skeptical of a sea change. He says in-person collaboration will still be key for scriptwriting, editing, set design, and other production jobs.

There's also a long-running trend in the film and TV business of moving production to lower-cost locales that have generous tax breaks. Content creators may choose to own some facilities, rather than lease. Netflix, for instance, bought a studio in Albuquerque in 2018 that it's using as a U.S. production hub.

Still, Martin thinks L.A. will retain its leading role, because that's where the stars live. "The talent doesn't want to sign up for a series that's going to be in Wichita, Kansas, for 10 years," she says. "Remember Hawaii? The *Lost* people were there for 10 years. Lots of complaints. People don't even want to live in Hawaii for 10 years to do a series."

A widely anticipated shakeout among streaming players could also hurt demand over the long term. Right now, the space is crowded with companies that have billions to burn on new digital content, including Disney, Netflix, Amazon, and Apple Inc. But smaller players could end up getting absorbed or shutting down.

Which services make the cut won't affect Blackstone's bet much, says Meghji. "We're really not taking a view on who the winner will be," he says. "We're taking a view on aggregate demand growth." So far, the data are on his side. The Covid-19 bump for streaming video had subsided some by early June as the economy reopened, according to Nielsen. But it was still up about 50% from a year earlier. —Noah Buhayar and John Gittelsohn

THE BOTTOM LINE Streaming has changed how television producers think of studio space. Instead of short-term leases, they can reuse soundstages for multiple shows.

◀ Hudson Pacific's Sunset Bronson studio

▼ Square footage of soundstages in TV and film production centers, 2018

Los Angeles area
5.2m

U.K.
3.5m

Vancouver metro area
2.5m

Toronto metro area
2.3m

Georgia
2.0m

New York metro area
1.8m

The Year of the Everything Banker

● Faced with leaner times, dealmakers stretch to help their clients any way they can

Wall Street bankers feasted on mergers and acquisitions over the past five years, ringing up fees by the billions for a fairly straightforward task: combine two companies to make something bigger. Now the job is getting more complicated.

Although deals and stock offerings are starting to come back, the pandemic and a volatile market made them tougher to execute. In the absence of continuous, big-ticket takeovers, investment bankers found themselves providing more informal advice for clients and would-be clients on everything from supply chain disruptions to how to handle a trade war, or the best way to position a company for the outcome of the U.S. election. All of this to stay on top of the call list when a company starts looking for help with its next deal. In short, bankers have to know more and do more—including the occasional odd job. “The renaissance banker is back in vogue,” says Paul Taubman, chief executive officer of the investment bank PJT Partners Inc. “In a crisis, you need someone who can see the big picture.”

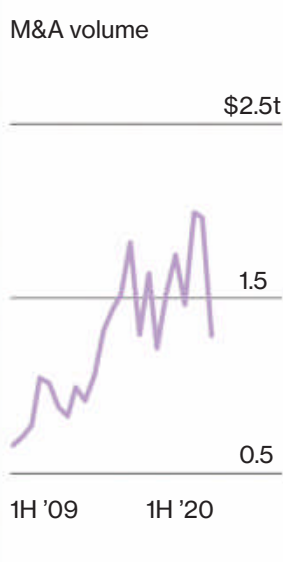
Dealmakers who were rustling up funding for WeWork just a year ago are now saddled with more mundane tasks. One Citigroup Inc. banker who works with governments trying to borrow money found herself trying to procure face masks for those clients. Others are helping troubled companies overhaul their finances. Restructuring specialists, often ex-lawyers who help companies navigate bankruptcy filings, haven’t been this busy since the last financial crisis. And bankers are arranging alternative forms of funding for clients from private equity firms, institutions, and billionaire investors.

Merger advisers such as Moelis & Co. and Perella Weinberg Partners have hired capital markets bankers after a spate of private investment in public equity, or PIPE, deals. These let large investors buy shares from a public company directly, often at a discount. They tend to happen when times are tough and companies need cash. Evercore Inc., meanwhile, has hired someone to oversee convertible securities, a hybrid of debt and equity that has seen a resurgence during the pandemic as investors look for safer bets.

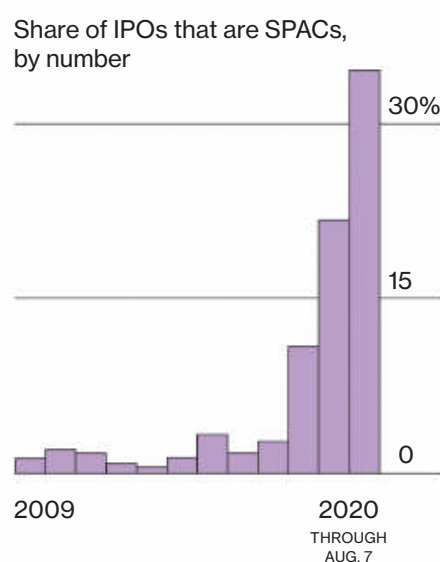
Bankers have also arranged billions of dollars this year for a once-unusual kind of initial public offering. Special purpose acquisition companies, or SPACs,

How the Job of a Banker Has Changed

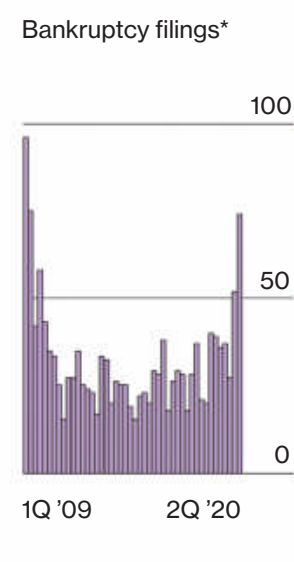
❶ Deal activity slowed. Mergers-and-acquisitions volume fell to its lowest point since the first half of 2017.



❷ The IPO market includes a lot of special purpose acquisition companies—empty shells that go public to seek a private company to merge with.



❸ Corporate bankruptcies have reached a level not seen since the global financial crisis.



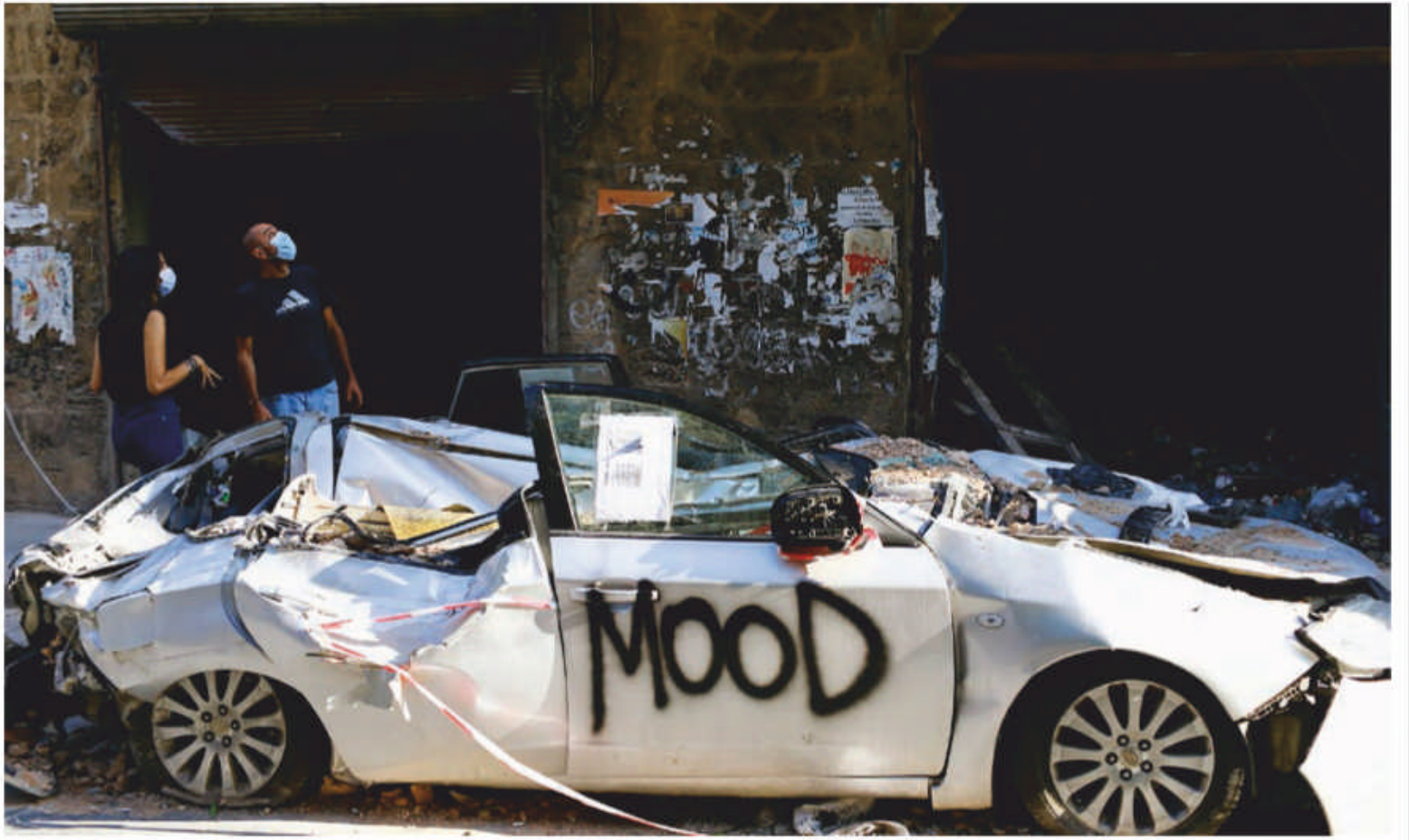
*CHAPTER 7 AND 11 FILINGS FOR PUBLIC AND PRIVATE COMPANIES WITH LIABILITIES OF MORE THAN \$50 MILLION
DATA: COMPILED BY BLOOMBERG

are businesses that have no real business yet. A prominent executive or money manager simply goes to the stock market to raise money for an unspecified takeover in the future. Investment bankers get to advise on those acquisitions, too.

Firms that deployed armies of bankers to service energy and industrial companies, which have been struggling, are reassigning them to focus on the remaining growth areas such as health and tech. So even as deals pick up, “what we do and how we do it may very well change,” says Elizabeth Crain, chief operating officer of Moelis.

Lazard, Evercore, and Perella have said they’re cutting more than 5% of their workforces. That’s a jarring change from the preceding half-decade, when dealmakers routinely left large firms to strike out on their own. Now bankers who kept their jobs are willing to fill any slot they can. “People are being repositioned into different roles,” says Noah Schwarz, a Korn Ferry recruiter who has worked with some of the biggest investment banks. “If you spent your career covering one industry, you should be prepared to cover another.” —*Sonali Basak and Crystal Tse*

THE BOTTOM LINE The lucrative and headline-grabbing business of arranging mergers has slowed down. So bankers are brushing up their skills in other niches.



When Worst Gets Worse

● The blast in Beirut laid bare the wreckage from decades of sectarian politics

When Dany Chakour reopens his four upscale Em Sherif restaurants after repairing the damage wrought by the devastating Aug. 4 blast in Beirut, he plans to turn over the 11% sales tax he collects on each transaction to the local charities that helped clean up the city—instead of giving it to the government. “It’s a form of civil disobedience to give to trusted organizations in this time of need rather than to the state, where I don’t know how it will be spent,” Chakour says. “What has the state ever done for us? The state can’t even provide us with electricity.”

Lebanon was already coming apart at the seams before a 2,750-ton cache of ammonium nitrate detonated at the Port of Beirut, killing at least 171 people and wounding thousands. As the realization sank in that the blast was neither a terrorist attack nor the start of a new war with Israel but the culmination of decades of corruption and mismanagement, the streets exploded with rage.

Protests promptly dispatched the 7-month-old government of Prime Minister Hassan Diab, who blamed his failure to prevent the disaster or lift the country out of a deepening financial crisis on a political elite so entrenched and so self-serving that it threatens to “destroy what’s left of the state.”

Haunted by a 15-year-long civil war that ended in 1990 leaving many grievances unresolved, the tiny nation straddling the Middle East’s political and sectarian fault lines is reckoning with a crisis of identity that was never far beneath the surface. Under a complex power-sharing arrangement that helped seal a peace between warring factions, Lebanon’s president must be a Maronite Christian, the prime minister a Sunni Muslim, and the speaker of parliament a Shi’ite Muslim. The system has engendered chronic paralysis, while sectarian leaders have carved out effective fiefdoms, playing on the fears of the myriad minorities and using their official positions to drive resources toward their own constituents in return for votes and loyalty.

Further complicating the situation is Hezbollah, an Iran-backed militia that has morphed into a powerful political force and is accused by critics of running a state within a state. It’s resisted

suggestions that it give up an arsenal believed to be more advanced than the army's.

Amid all of the political disfunction, Lebanon's 6.8 million inhabitants could at least count on two constants: a relatively sound banking system and the Lebanese pound's peg to the U.S. dollar. Both began disintegrating last year as the nation was engulfed in a financial crisis that sent the currency into free fall, prompting the central bank to restrict access to dollar deposits. Fearful of seeing their life savings wiped out, hundreds of thousands of Lebanese took part in weeks of protests that triggered the collapse of the government in October.

Diab, a career academic, took office in January, having assembled a cabinet composed mainly of technocrats billed as capable of averting a full-scale economic collapse. They quickly concluded that the country was bankrupt. Lebanon's habit of financing its perennial budget deficits through borrowing have made it the third-most-indebted nation after Japan and Greece, with a debt-to-GDP ratio of 178% as of the end of 2019. Deeming the debt-service burden unsustainable, Diab's government defaulted on \$30 billion in bonds in March, then turned to the International Monetary Fund for a \$10 billion bailout.

Negotiations with the fund never advanced as bankers, politicians, and other vested interests blocked a reform plan that would have forced them to pay for the country's economic calamity. With talks at an impasse and the nation locked out of international debt markets, Lebanon's central bank began printing money with abandon, causing the value of the currency to plunge further and igniting inflation, which neared an annualized 90% in June. "We are heading the way of Venezuela," says Nasser Saidi, a former economy minister.

Prices in the import-dependent nation—including those for food staples, which had soared 250% in the 12 months to June—are no doubt headed higher as a result of the blast, which damaged the country's main grain silo and other infrastructure vital to commerce. Saidi estimates the country's imports will drop by more than 70% this year.

The damage from the disaster exceeds \$15 billion, Lebanese President Michel Aoun said on Aug. 12, a figure that amounts to more than 28% of last year's gross domestic product. In an Aug. 9 report, Garbis Iradian, chief economist for Middle East and North Africa at the Institute of International Finance, wrote that he expects the economy to contract 24% this year.

A virtual conference of aid donors hosted by French President Emmanuel Macron on Aug. 9 drew almost \$300 million in pledges, a fraction of

the billions it will cost to rebuild the port and city.

It isn't the first time global powers have tried to throw the country a lifeline. In 2018 a meeting in Paris drummed up \$11 billion in commitments. But donors conditioned the release of funds on critical reforms, such as overhauling the electricity sector to put an end to the economically debilitating blackouts that force Beirut's residents to go as long as 20 hours at a stretch without power. Also high on the priority list: thinning the ranks of a public sector bloated by decades of political patronage. But the politicians ignored these calls, continuing to squabble over everything from jobs to power stations for their own region or religious sect.

Signs that Lebanon had become a failed state were everywhere, even before that reality was vividly rendered in the mushroom cloud over Beirut. Rubbish sits uncollected in the streets as officials fight about whose area it should be dumped in. Streetlights are on in the day and off at night, and traffic lights work only intermittently, leaving motorists to make their own luck on increasingly potholed streets, as they did during the darkest years of the civil war.

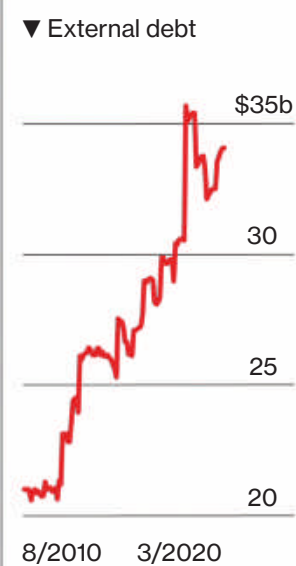
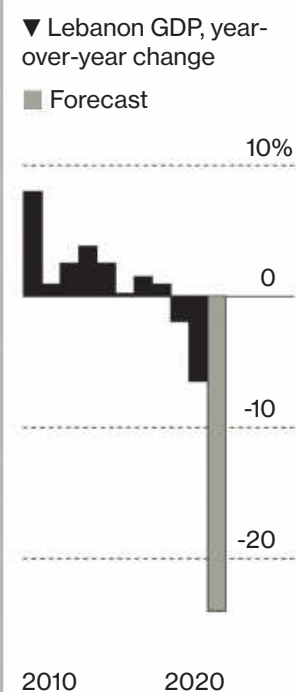
In short, government has abdicated its most basic function, which is to protect the citizenry from harm, whether from expired medicines, toxic pesticides, or, as in the most recent consumer scandal, spoiled chicken meat. "Vested interests are so entrenched we need a total mop-up, but that will take time we don't have," says Nafez Zouk, emerging-markets strategist at Oxford Economics and a Lebanese national. "Is this one of those pivotal moments in a nation's history where what was not possible before suddenly becomes possible? I'm cautiously optimistic, because if I'm dealing with a corrupt state where I need to pay a bribe, I can live with it, but if I'm dealing with corruption that kills my children, destroys my home, and robs me of my livelihood, then that's something else."

The population's frustration was evident in the hero's welcome for Macron when he toured some of the hardest-hit areas of Beirut in the aftermath of the blast. Some even drew up a petition inviting the French back to run the country, as they did from 1923 to 1943.

The ruling class "has to be removed. They have to resign and go away. If they don't go, we will get increasing violence in the street," says Saidi, the former economy minister. "To do this we need sustained international pressure, from Macron, from others, and if necessary sanctions—international sanctions at the personal level that hit these people where it hurts."

On his visit to Lebanon, Macron delivered ►

◀ The aftermath of the Aug. 4 explosion



◀ strongly worded messages to Lebanon's political leaders, demanding they come up with a new social contract and make specific changes that will unlock billions of dollars from international donors. In the meantime, to ensure humanitarian aid reaches those that most desperately need it—instead of lining the pockets of politicians and their cronies—France and other donor nations have said they will channel humanitarian assistance through private charities and international aid agencies.

There are indications that some political players, including Hezbollah, understand the gravity of the situation and are willing to contemplate compromise on sensitive issues, according to three diplomats with knowledge of the matter. Among those is demarcation of sea borders with Israel, which would make it easier for Lebanon to explore for offshore oil and gas deposits.

Saidi's comparison to Venezuela is apt. There, the divided opposition has been unable to unseat a government that's driven the economy of the petroleum-rich nation into the ground. In Lebanon, opposition forces have yet to conceive a viable alternative to the sectarian quota system.

"The issue is we never had a post-war reconciliation," says Mona Fawaz, an activist and professor of urban planning at the American University of Beirut. "There was no accountability for the warlords that now rule us and run this system. So we continue to live in that era with warlords and their cronies who led us into this financial crisis or into regional wars."

Many are now tempted to join waves of emigration dating back more than 160 years that have given rise to a globe-spanning diaspora. Rather than heading to the Persian Gulf for a spell to work, build up some savings, and then return to their homeland, more are now considering going for good, which could accelerate a brain drain at a time when Lebanon needs its most capable people to take part in reconstruction.

Janay Haidar had planned to go abroad to earn a Ph.D. and then return to Lebanon to start her career. Now, she's looking to start over in Germany or France. "Everything's polluted, you can't breathe clean air, you can't swim in the sea, you have no electricity, no streetlights, you don't know if your food will poison you. You can't get a job, you can't open a business. Nothing is stable. The blast was the last straw. I have nothing to stay for," she says. "It breaks my heart, but I need to raise my boys in a place where they can be safe. Where we can live, really live." —*Lin Noueihed*

THE BOTTOM LINE Lebanon's economy may contract by 24% or more in the aftermath of the Aug. 4 explosion, which damaged critical infrastructure and precipitated the government's ouster.

Captive Market

● International students marooned on U.S. campuses are helping keep local businesses afloat

When Regina Vaughn reopened her Freshii franchise in West Lafayette, Ind., in mid-April, after it had been closed for almost a month, orders started flowing back in from some of her old regulars. Among them was Nour Hendy, a computer engineering student at Purdue University, who hails from Alexandria, Egypt. "It's been part of my routine to go to Freshii, to get lunch there, for a very long time," says Hendy, 22, who, amid the pandemic, had to switch to mostly using an app to order his favorites, which include brown rice and vegetables with chicken or tofu.

College towns are struggling across the U.S. For many local businesses, revenue flows are dictated by the academic calendar: the arrival of students in late summer, prospective applicants and their parents touring campuses in fall and spring, families attending graduations in May, and then an influx of high schoolers enrolled in summer programs. Most of these customers have been absent since March, when universities sent students packing to avoid the spread of the coronavirus. It's unclear if many will return in the fall, and those who do may be directed not to leave campus to prevent infections.

Some businesses have been able to rely on a captive market of sorts. There were about 1.1 million foreign students enrolled at U.S. colleges in the 2018-19 school year, equal to more than 5% of the university population. Many have been essentially trapped in the U.S., because closed borders, mandated quarantines, or other restrictions on travel have prevented them from returning to their home countries. Or they worry that if they do, they may not be permitted to come back to the U.S.



◀ Vaughn

Adding to the climate of fear, a federal rule introduced last month would have exposed international students enrolled at schools opting for online-only instruction in the fall to the risk of deportation if they chose to remain in the U.S. It immediately ignited controversy and was quickly rescinded, but the cloud of uncertainty that's formed over U.S. immigration policy under the Trump administration hasn't dissipated.

International students attending American colleges and universities injected \$41 billion into the U.S. economy and supported almost 460,000 jobs during the 2018-19 academic year, according to the trade group Nafsa: Association of International Educators. Universities and their hometowns worry that the pandemic and uncertainty over visa rules could put that economic contribution in jeopardy at a time when it's sorely needed. "International students are really critically important to our community and Purdue," says Scott Walker, president and chief executive officer of the West Lafayette Chamber of Commerce. The nearly 30,000 foreign students Indiana welcomed in 2018-19 had an almost \$1 billion economic impact, according to Nafsa's figures.

After U.S. colleges told students to leave campus in March, about 92% of international students enrolled in the spring semester remained—that's almost 235,000, according to a May survey of 441 schools by the Institute of International Education, a trade group. In a follow-up study in July, 302 schools reported more than 40,000 international students were enrolled in classes on campus this summer. Upwards of 90% of the institutions polled said they expected a majority of those students would be staying on through the fall, according to Mirka Martel, head of research at the institute.

Purdue counted almost 9,100 students from abroad in the fall of 2019, including those in graduate programs. Of the 2,700 foreign undergrads who responded to a survey in late May, more than half said they hadn't departed the U.S., according to Michael Brzezinski, dean of international programs at the school.

Vaughn credits those students, along with about \$17,000 from the federal Paycheck Protection Program, with keeping her restaurant afloat despite a 75% reduction in sales. "I feel like they carried us through for a few months," says Vaughn, 50, whose franchise is a short walk from campus. "They kept coming in and supporting us. Even if they didn't come in, I could see them on the third-party apps like DoorDash."

At Mount Holyoke in South Hadley, Mass., international students make up 27% of the student body.

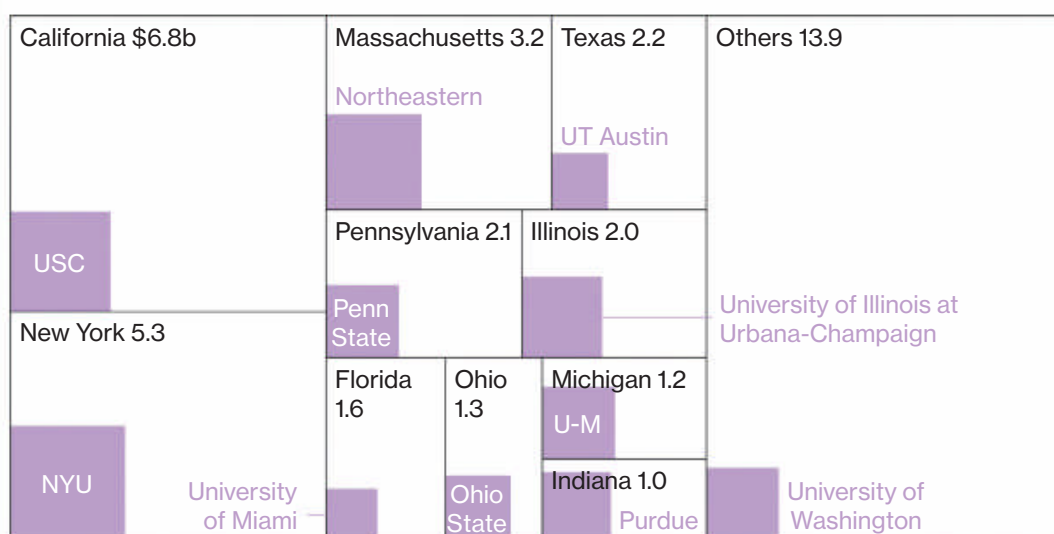
Of about 106 students still on campus now, 93 are international students, says Christian Feuerstein, a college spokeswoman.

Among them is Hiba Nawaid, 20, a rising sophomore from Karachi, Pakistan, who last saw her parents about a year ago. Nawaid lives on campus and mostly picks up her meals in a Styrofoam container from the dining hall. Once a week or so, she splits an order from a local restaurant with a friend and also uses apps to have groceries delivered. "More than 100 people like me order things every week for basic necessities," she says.

Miranda Ordynowicz, the manager at Johnny's Bar & Grille, one of the establishments that Nawaid patronizes, says international students who have stayed on campus have been ordering regularly from her restaurant and its sister sushi place, Iya: "I've noticed a few of the same names weekly."

Economic Contributions of International Students, by State

Top school in state by dollar amount, 2018-19 academic year



DATA: NAFSA: ASSOCIATION OF INTERNATIONAL EDUCATORS

Freshman and sophomore students at Mount Holyoke were to start classes on campus later this month, but the school recently opted for all virtual lessons because of health concerns. International students like Nawaid will be allowed to remain for the duration of the school year, says Feuerstein, the college spokeswoman.

Communities such as West Lafayette want to see the pipeline of international students remain intact. Walker, of the chamber of commerce, says U.S. immigration authorities should continue to welcome them, as they help boost local economies. "It's important that we figure this out for international students to keep coming to our universities." —Janet Lorin, with Yifan Feng

THE BOTTOM LINE Businesses near U.S. university campuses are increasingly dependent on international students, many of whom stayed behind after the rest of the student body left in March.

The Divided Post-Pandemic City

● American cities will survive Covid-19 as they've weathered past crises. But the gap between haves and have-nots will widen, experts say

There's a debate raging among urban experts over how much the Covid-19 pandemic and recession will hurt American cities. Some predict heavy damage, whereas others foresee minimal harm. But cities are really just people. The right question: What will happen to New Yorkers? Angelenos? Houstonians? Detroiters?

On that question, there's something closer to agreement: The virus and the economic slump are likely to worsen inequality, leaving the rich largely unscathed while crushing the poor and working classes of America's big and midsize cities. That's despite the efforts of Black Lives Matter and other movements that are devoted to fighting a winner-take-all urban economic system.

Since 2010 the population of 25- to 34-year-olds living within 3 miles of a city center has risen 30% nationwide, going up in every metro area with 1 million or more people, calculates Joe Cortright, an economist and the director of City Observatory, an urban policy think tank in Portland, Ore. "They're the dream demographic of an HR department of a fast-growing company," he says.

That trend is expected to continue. To narrow budget deficits, cities might have to cut back on social services that benefit mostly the poor and survive by enhancing their appeal to highly educated professionals, many of them young, say real estate executives, economists, and others who are tracking cities' response to Covid-19. Those less favored will either move out or hang on by their fingernails.

Cities were once escalators to opportunity, but changes in technology and other factors have reduced upward mobility. Edward Glaeser, a Harvard economist who studies cities, says the pandemic will make it harder for cities to generate the kinds of jobs that low- and middle-skilled workers are qualified to fill.

Richard Florida, an urban economist at the University of Toronto, says he hopes cities will become more equitable because of policy innovation and new multiracial coalitions for justice. But right now, he wrote in Bloomberg's CityLab in June, "we are experiencing a new urban crisis of 'success' marked by rampant unaffordability, third-world levels of inequality, and racial and economic segregation."

Municipal finances are the heart of the problem. Most cities are required to balance their operating budgets, borrowing only for long-term projects such as construction. With \$150 billion of federal aid through the Coronavirus Aid, Relief, and Economic Security Act set to expire at year's end and state governments unable to help much, mayors and councils are desperate to deal with shortfalls in sales taxes and user fees. Property tax revenues have held up so far, but they could drop once owners of real estate that's fallen in value challenge their assessments.

A third of cities have begun to cut municipal workers, and almost half plan hiring freezes, according to the National League of Cities, which estimates that the pandemic will leave cities with a \$360 billion budget shortfall through 2022. In June the city council of Nashville raised property taxes 34%. Seattle and the District of Columbia



have raised taxes on businesses. Chicago Mayor Lori Lightfoot and other Illinois mayors of both parties signed a letter in July to the state's congressional delegation saying, "We cannot continue to function and serve the people" without more federal aid. "The irony is that the person who will defund the police is Donald Trump," Dayton Mayor Nan Whaley told the Associated Press for an article published on Aug. 10.

Pressure from Wall Street is a factor. Rather than one-off budgetary gimmicks, bond investors and ratings companies want to see lasting, "structural" budget changes. That's often a euphemism for cuts in city jobs, many of which are held by residents of limited means. Investors appear confident that they'll get what they want, though: After a sharp decline in the spring, mutual fund flows into municipal bonds have been strong. According to data gathered by Bloomberg, the yield on AAA muni bonds is only 1 percentage point higher than the yield on U.S. Treasuries, down from as much as 3.5 percentage points in the spring. That's a sign investors are confident that cities—eager to avoid damage to their credit ratings—will find a way to keep paying, no matter how bad their situation.

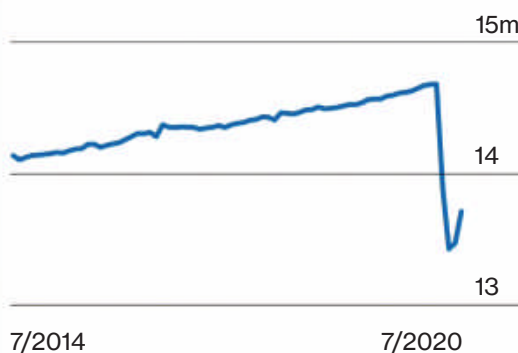
Tax increases are an alternative structural remedy, but city governments shy away from them because they're unpopular. Moreover, cities that

have income taxes, such as New York, worry that higher rates will drive away top earners.

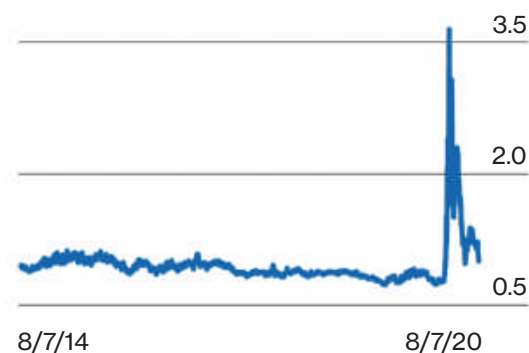
Telecommuting, which the pandemic necessitated, makes it easy for people to keep a city job while living in a cheaper suburban or rural home. Cities can overcome that disadvantage by continuing to make themselves attractive places to live for young, free-spending professionals, as they have

Wounded Cities

Local government employment



Yield spread of municipal bonds over Treasuries, in percentage points



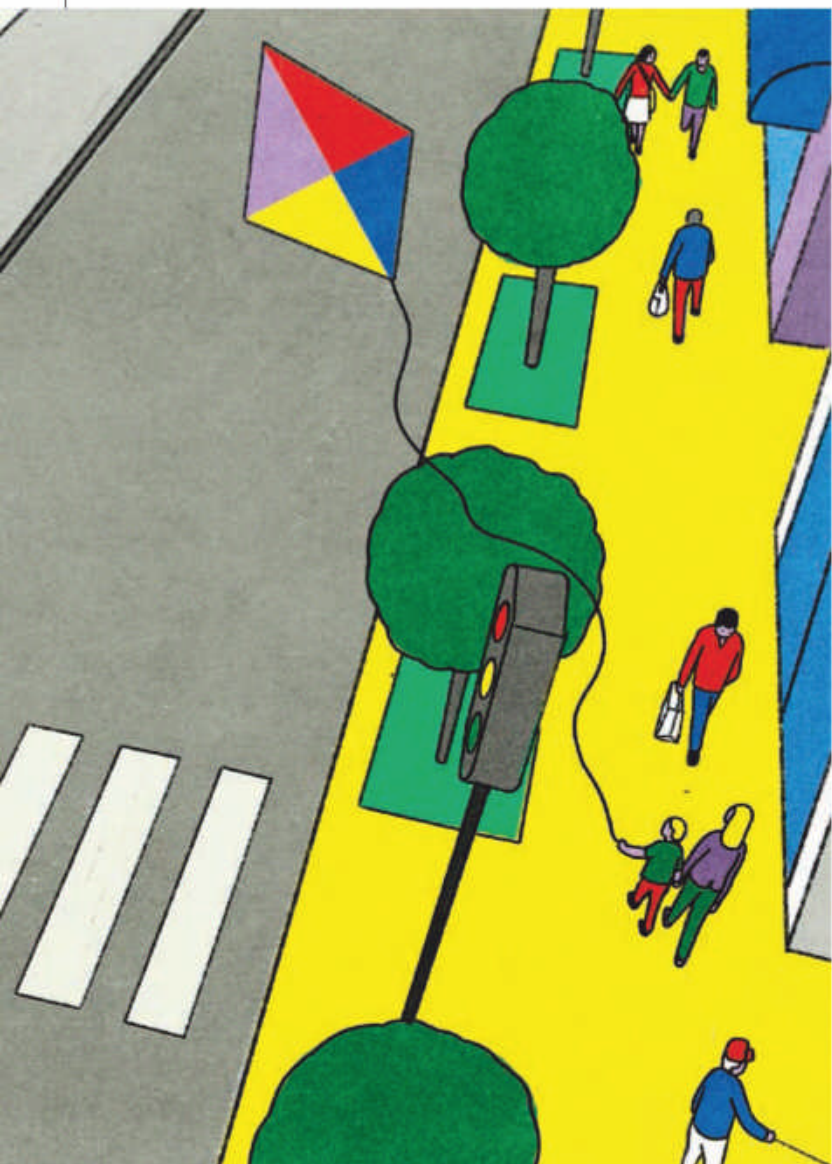
DATA: U.S. BUREAU OF LABOR STATISTICS, COMPILED BY BLOOMBERG

for decades. Issues that are liabilities to middle- and working-class families—such as deteriorating public schools and public transportation—are less of a problem for childless younger workers who have cars or get around by Uber or Lyft.

When maskless young people crowd into restaurants and clubs in U.S. cities, it's simultaneously a serious risk factor for spreading Covid-19 and strong evidence of the enduring appeal of the urban lifestyle. Cities snapped back quickly after the Spanish flu pandemic of 1918-20, and New York rebounded from the terror attack of Sept. 11. "I keep hearing about how cities are going to die because of one or another phenomenon, but it never happens," says former New York City Planning Commissioner Alex Garvin.

Tech companies continue to put offices in Manhattan because that's where their employees and potential recruits prefer to be: Facebook Inc. this month leased more than 700,000 square feet in an iconic building facing Penn Station, adding to other leases and making the company one of the city's biggest corporate tenants.

It's considerably less dreamy at the bottom of the income scale. About 29% of renters in households earning less than \$50,000 a year say that the pandemic has made them more likely to move and that they're "primarily motivated by a need to secure stable and affordable housing in the face of financial uncertainty," according to a study by Apartment List Inc. Consulting company Oliver Wyman, in its research for the Partnership for ►



◀ New York City, estimates that the shortage of affordable units in the city will rise 17%, to 760,000, by next April. A four-month federal moratorium on evictions expired in July, and Congress is deadlocked over how to renew it. That puts a fifth of the 110 million Americans in rental housing at risk of eviction by the end of September, according to the Colorado-based Covid-19 Eviction Defense Project.

“There really is a crisis under way in the rental market,” says Jeff Tucker, a senior economist at Zillow.com Inc. Owners are less stressed than renters on average, he says: Demand for purchases has stayed strong “because homebuyers think on a five-year scale”—that is, they’re focusing on a brighter post-pandemic future.

What’s new is not only the pandemic but a change in Washington’s attitude toward cities. Richard Ravitch, who was involved in the talks that

led to the Ford administration’s bailout of New York City in 1975, says, “What’s going on today is not in any way analogous to what happened then.” That’s partly because the problems are more serious, he says, and partly because “we have a total, incomprehensible lack of government leadership.” Although born a New Yorker, Trump draws most of his support from rural areas and suburbs. “It’s a shame to reward badly run, radical-left Democrats” who run cities, he told reporters on July 30.

With cities left pretty much on their own to cope with Covid-19 and double-digit unemployment, their financial survival is at stake—and lessening inequality and injustice may be falling down the list of priorities. —Peter Coy

THE BOTTOM LINE Covid-19 has gutted budgets, so many cities will cut jobs and services that lower-income residents depend on and will strive to remain attractive to high-income professionals.

A Progressive Woos Red Texas

● A Republican House incumbent faces surprisingly stiff competition from a Bernie Sanders-endorsed Democrat

Texas’ 10th Congressional District wraps around the northern fringes of Austin, sweeps through the small-town headquarters of Blue Bell ice cream and farm country, and reaches across the western suburbs of Houston. Since 2004 the district has voted eight times to send Republican Michael McCaul to the House of Representatives.

But the district is changing as the Austin and Houston areas grow, and its deep red politics are showing a purple tinge. McCaul faces a tough fight this November from Democrat Mike Siegel, a progressive who supports “Medicare for All” and was endorsed by Vermont Senator Bernie Sanders.

The fight is actually a rematch: Siegel and McCaul faced off in 2018, with Siegel losing by only a few percentage points. Last month, Siegel emerged the victor from a primary runoff against Pritesh Gandhi, a physician who told voters he’d be more electable than Siegel in the general contest.

To fend off Siegel a second time, McCaul is running what Corry Bliss, a top Republican strategist, calls the most “aggressive and sophisticated” House campaign in the country. Siegel, a civil rights attorney in Austin, says that’s proof that McCaul sees him as a real threat: “It shows how scared he is.”

McCaul has raised \$2.5 million and spent

\$1.2 million so far, according to campaign finance data from the Center for Responsive Politics. He acknowledges that he’s running “probably the most aggressive campaign of my career” but says he views the close result in 2018 as a one-off, driven by straight-ticket voting that won’t be a major factor this time around. (Democrat Beto O’Rourke, challenging Republican Senator Ted Cruz, won the district in 2018 despite losing to Cruz.)

“I think this district is still very much a Republican district,” McCaul says. “I know the people of Texas 10 really well. I don’t think they’re going to go for a candidate with very extreme ideology.” The district went for Trump by a nine-point margin in 2016.

McCaul has attacked Siegel as “the most radical liberal running for Congress anywhere in America.” Siegel rejects McCaul’s claims that his support for universal health care represents socialism and that the Green New Deal would be a job killer in Texas, instead saying his policies would restore access to health care at a time when the global pandemic is exposing vulnerabilities and create new jobs amid historic unemployment. “That’s not socialism, that’s democracy,” he says. He’s raised \$890,000, more than in 2018.



● McCaul



● Siegel

President Trump's low poll numbers are a hurdle for many Republican candidates this year. "The president's style is not mine," McCaul says, though he adds that Trump had a "good track record" on the economy until the pandemic and that he supports the president's desire to bolster the military.

Trump has alleged that his challenger, Joe Biden, will "destroy" suburban neighborhoods, and suburbs will be key in the race for the 10th—even though Republicans drew the district lines in 2011 to slice and dice liberal Austin and Houston. The demographics in areas such as Pflugerville and Katy are changing, with tech and energy workers moving in from out of state and former city dwellers drawn by affordability and good schools.

"There's been a lot of talk about Republican voters changing their minds and Trump souring Republicans," says Jim Henson, who teaches at the University of Texas at Austin and directs the Texas Politics Project. "But we're seeing less evidence of that in these races and more the changes of the demographic makeup in these districts that's driving what we've seen the last two cycles."

Still, Republicans who are down on Trump are a focus of GOP campaigners in places such as Cypress, an unincorporated community of Harris County about a half-hour northwest of downtown Houston. "Our guidance is, 'You don't like Trump, fine. But hopefully you don't vote for socialism,'" says Bill Ely, a director of the Cypress Texas Tea Party.

The largely rural stretch of the district between the fringes of the two big cities will almost certainly remain solidly behind McCaul. "What we would need in order to do better is a more ethnically diverse, a better educated, and younger population," says George Dillingham, chairman of the Washington County Democratic Party. "And, well, we don't have it."

Winning Washington County isn't the goal, Siegel says, but he hopes to pick up "hundreds and even thousands" of new votes there and in the surrounding counties between Houston and Austin.

The 10th District "is interesting in the fact that it really shows that urban-rural divide all in one spot," says Renée Cross, senior director at the Hobby School of Public Affairs at the University of Houston. In 2018 "it definitely took people by surprise that Siegel came out of nowhere and came within five points," she says. "You would think that this time around he should probably do just as well, or maybe better, because he does have some name recognition now." —*Rachel Adams-Heard*

THE BOTTOM LINE Demographic changes in metropolitan Houston and Austin could help a progressive Democrat unseat a longtime Republican incumbent in Texas.

Policy

Internet Speech

After social media sites blocked a misleading video posted by his campaign, President Trump said on a radio show on Aug. 6 that "of course" the companies are censoring him. Trump is far from the only U.S. politician to argue that social media platforms must be held accountable for how they handle user posts as their role in shaping public opinion grows. Democrats point to hate speech, election meddling, and misinformation online, whereas Republicans say tech companies censor their ideas and candidates.

Lawmakers on the right and left are calling to change the statute that shields the companies from liability for online speech: Section 230, a clause in the 1996 Communications Decency Act.

There are several efforts under way in Washington this summer to limit Section 230 and how the statute is interpreted.

Chipping Away at 230

● The PACT Act

Senators John Thune, a South Dakota Republican, and Brian Schatz, a Hawaii Democrat, introduced the PACT Act to require online platforms to explain their content moderation practices in a policy that's easily accessible for consumers. Their bill would also require the platforms to take down posts that courts have found to be illegal.

● The EARN IT Act

This legislation from Senators Lindsey Graham, a South Carolina Republican, and Connecticut Democrat Richard Blumenthal seeks to curb online sexual abuse of children. It would narrow Section 230 to allow for more lawsuits against companies that present or distribute material that exploits children.

● Executive order

Trump issued an executive order in May instructing government agencies to "clarify" the "narrow purpose" of the clause and ask the Federal Communications Commission to draft new rules around it.

● DOJ recommendations

The Department of Justice has outlined proposed changes to Section 230 and recommendations for how courts should interpret it more narrowly than before. These reforms would remove companies' protections if they promote illegal speech and would limit their discretion in taking down political posts.

What Comes Next

Major immediate action is unlikely because of the pandemic and the approaching election, but tech companies and free-speech advocates are alarmed. For the tech industry, policing content more carefully would probably mean bolstering its ranks of hired moderators and facing down far more lawsuits. Tech's clash with Washington over Section 230 "sets up a volatile 2021," says Paul Gallant, an analyst for Cowen Inc. —*Todd Shields and Ben Brody*



Small Business

Locking Out The Pirates

The maker of TSA-approved locks says trust-but-verify is the key to fighting counterfeiters



Tim Meade had known the owners of the Chinese suitcase manufacturer for years, well enough to have spent many late nights sharing shots of high-octane Moutai liquor and swapping stories of family, friends, and vacations. So it was tough when Meade, general manager of Travel Sentry SA—which licenses locks that can be opened by airport security officials—discovered that the luggage maker had been underreporting the number of bags it had produced with the locks, effectively stealing the technology. It was even tougher three months later when he discovered the company cheating a second time—a total of 4 million unlicensed locks.

On a cold January day in 2019, Meade marched into the factory 300 miles west of Shanghai, took the owners into a conference room, and showed them his evidence: locks from the factory with unauthorized copies of Travel Sentry's logo, a red diamond. Meade didn't like the idea of losing his fifth-largest client, with sales of almost 4 million licenses a year. But he couldn't let his now-former friends get away

with pirating millions more, so he canceled the contract and blacklisted the company. “We call it killing the chicken to scare the monkey,” says Meade, a 55-year-old American based in Hong Kong. “We have manufacturers who tell us, ‘We know you guys are serious about licensing removal. We’ve seen what you’ve done to others.’”

Travel Sentry’s business is entirely about trust. The company’s sole product is a license for locks that work with special keys available to agencies such as the U.S. Transportation Security Administration, which has the right to break locks it can’t open. Buyers of the locks—or suitcases with the locks built into them—have to trust that the keys are really available only to airport staff inspecting their luggage. And Travel Sentry must trust its licensees, almost all China-based manufacturers, to play by the rules, producing only the locks they pay for and not letting keys slip out the side door in the pocket of a wayward employee.

The company was formed in the wake of the Sept. 11 attacks in the U.S. Seeking a way to search luggage while reassuring passengers that their possessions would be safe, the newly created TSA contacted John Vermilye, at the time a top executive at the International Air Transport Association who’d spent decades in the airline business, starting as a baggage handler at Boston’s Logan International Airport. He suggested a secure system of master keys, which the TSA liked but felt it couldn’t do on its own for legal reasons. So Vermilye decided to do it himself. He soon signed an agreement with the agency to supply the keys and contacted luggage makers to ensure they were on board. The first products hit the market in November 2003 when 452 U.S. airports had keys for the locks.

Travel Sentry remains small, just 15 employees on three continents who work in marketing and oversee relations with manufacturers. But it has sold more than 600 million licenses, and the system is in use at more than 700 airports in 55 countries. Vermilye declines to disclose details but says revenue had been growing at 15% annually until the coronavirus pandemic shut down global travel this year, spurring a 75% plunge in sales of suitcases—and the locks needed to secure them. A major headache for Vermilye is legal fees, which he says eat up “too much” of the company’s profits: Since 2006 he has been fighting court battles with Safe Skies Locks LLC, a U.S. company that alleges Travel Sentry has infringed on its patents. Safe Skies didn’t respond to requests for comment.

Piracy remains Travel Sentry’s biggest concern, which Vermilye and Meade counter with incentives, vigilance in marketplaces, and close scrutiny of manufacturers. That approach is smart, says Yosh Wong, managing director of Suzzess Ltd., an intellectual-property investigator in Hong Kong that doesn’t work with Travel Sentry. Wong encourages brand owners to closely monitor factories and to develop difficult-to-replicate packaging and

tracking mechanisms such as holograms and bar codes, which make it hard for manufacturers to steal their ideas. Such measures are “effective and yield results,” Wong says. “Where raid actions take place, the counterfeiters often stop.”

For Travel Sentry, the first step is maintaining a strong brand, which allows producers to charge a premium for licensed locks and gives those who play by the rules an incentive to monitor competitors to ensure they’re not



Travel Sentry locks can be opened with a master key available only to airport security personnel

being undercut by pirated goods. And the company pays a bounty to those who discover cheating. Last year, Travel Sentry found some unlicensed locks and circulated them to trusted manufacturers, one of which “was able to trace it back to the lock supplier based on their relationship,” Vermilye says.

Those controls are backed up by Travel Sentry’s investigative team, which conducts unannounced factory visits and frequent searches for unauthorized goods online and in street markets. That team, based in Beijing, has filed 20 IP theft lawsuits in Chinese courts and won 14 judgments. And Travel Sentry tracks each manufacturer’s production via a microchip technology that must come from a single trusted supplier. That lets the company keep a tally of the number of logos various luggage makers should be reporting, which Travel Sentry compares with monthly sales reports provided by manufacturers and retailers. “We trust our partners,” Vermilye says. “But we go check in on them, and they know it.” —*Kari Soo Lindberg*

THE BOTTOM LINE Piracy remains Travel Sentry’s biggest concern, which the company counters with incentives, vigilance in marketplaces, and close scrutiny of manufacturers.

Sun, Sand, and Social Distancing



In the Spanish beach town of Benidorm, a family-run hotel chain is using the outbreak to rethink its business

Few places are as tied to mass tourism as the Spanish resort town of Benidorm. It's often dubbed the birthplace of package tours, and on a typical summer day its broad beaches, towering hotels, and palm-lined promenades are jammed with visitors seeking sun and surf. This year it's been more about silence and social distance.

So in mid-July, as Ramón Martínez watched the first mask-clad guests enter his 320-room Hotel Presidente after four months of lockdown, he was overwhelmed with emotion—akin to what he imagines locals felt when the first foreign tourists arrived in the 1950s. “I told the staff, ‘This is incredible,’” Martínez says. “It was a special moment.”

For Martínez and other hoteliers in the city, the coronavirus epidemic augurs change almost as dramatic as those early days, when Generalissimo Francisco Franco ruled the country and Benidorm was little more than a village. The city today gets about 4 million visitors a year, often flying in on packed budget airliners, sunbathing towel-to-towel, and filling clubs and bars to drink, dance, and flirt into the wee hours. That's not a business model that works during a pandemic, says Leire Bilbao, director of the city's tourist board. “If you don't do things right during a crisis,” she says, “when the crisis has passed, you might be a place where people don't want to go.”

The city of 70,000—whose population swells almost sixfold in August—has taken the measures it can, marking off squares on the beach, for instance, and allowing only four people in each. Police patrol the waterfront and order anyone without a mask to put one on, pronto. Some shops have thermoscanners at the door. More than a third of hotels remain closed, and occupancy at those that are open hovers at about 40%, vs. 90% in a normal summer.

People in the hospitality industry—which is to say pretty much everyone—are bracing for perhaps half of the restaurants and bars to go bust this year. Nuria Montes, secretary general of Hosbec, a hotel trade group, says Benidorm's businesses should seize the opportunity to “lay the groundwork” for an eventual economic recovery. “We are facing years with a lot of work and little revenue,” she says.

For hotel owner Martínez, the foundations were already being laid. He and his brother had been planning to revamp two of their four hotels when Spain went into lockdown in March. “The world changed, and we had to adjust,” Martínez says, surveying the lobby of the Presidente, with disinfectant-coated mats at the entrance and thermographic cameras discreetly scanning the reception area.

The brothers adapted their renovation project and are now planning to build only double rooms, getting rid of the triples, quads, and extra beds that appeal to families or groups of friends eager to cut down on the cost of a weekend getaway or bachelor party. “That's over, done,” Martínez says. Even when a vaccine is developed, he expects visitors will crave more space. “This is going to remain seared in our minds for a long time,” he says.

Those changes will result in a de facto price hike, though, as more guests will have to book an extra room. To avoid boosting rates, the brothers scrapped plans to apply for a fourth star even though the renovation will include four-star amenities such as larger rooms. Rates in the city had been rising—by almost a third from 2015 through last winter—

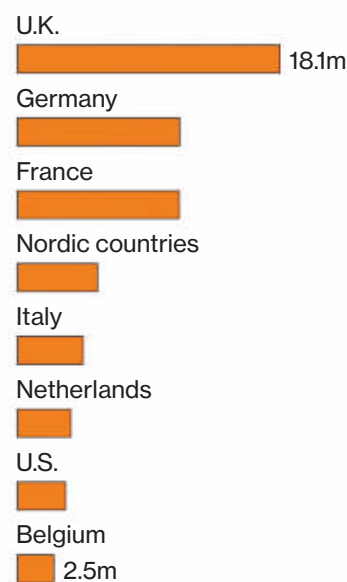
but the pandemic is likely to erase those gains, and it will take several years for them to recover, according to data company BedsRevenue. “This isn't the moment to increase prices by having a fourth star,” Martínez says.

About a week after the Presidente reopened, Spain's coronavirus cases began rising again. Some countries discouraged trips there, and the U.K. ordered a two-week quarantine for anyone arriving from Spain, a major disincentive to travel. As cancellations

flooded in, occupancy at the Presidente plummeted to 13%, and Martínez mulled shutting down. But it's expensive to start and stop a business, so he decided to take the optimistic view and hope the restrictions will soon be lifted, allowing him to salvage some shred of the summer season. He quickly tapped a text message into his phone telling a contact at a British package-tour operator that the lights are still on. “I've decided to keep my hotel open,” Martínez says. “In case you change your mind, I'm here.”

—*Jeannette Neumann*

Origin of tourists visiting Spain in 2019*



THE BOTTOM LINE The owners of the Presidente adapted their renovation project and now plan to build only double rooms, getting rid of the triples and extra beds that once appealed to groups looking for a cut-rate getaway.

City Jobs for Village People

A new app aims to connect migrant laborers from rural areas with work in India's megacities



India's cities are home to millions of low-skilled workers—drivers, masons, deliverymen, and others—who hail from villages hundreds of miles away. These people crowd into shantytowns and slums, scratching out a living on the margins with virtually no safety net. So when India went into lockdown in March, millions of migrant laborers found themselves out of work, penniless, and far from home. In the following weeks, these people hit the road en masse, often walking alongside highways for days with their children and meager possessions on their shoulders, backs, and heads, returning to their villages. Now, as India starts to reopen, those millions are reluctant to go back to cities until they can be certain there's work. Nirmitt Parikh says he can help.

Parikh, a 32-year-old Apple Inc. alum with an MBA from Stanford, has created Apna, which he envisions as a sort of LinkedIn for non-English-speaking, nonaffluent Indians. When these people move to the cities, they typically find work via small-time employment agencies or on street corners crowded with men and women waiting for someone to hire them for a few hundred rupees a day. With Apna, job seekers enter their name, age, and skills to generate a virtual "business card" that's passed out to employers in Bangalore, Delhi, Mumbai, and Pune, with more cities on the way. "A digital business card is a confidence booster for many who've only seen their super bosses carry business cards," Parikh says. "We want to give millions of bottom-of-pyramid workers a career path."

Apna says 1.25 million people have signed up since its launch in February, and big-name companies such as Amazon.com, online grocer BigBasket, and HDFC Bank, India's top lender, have hired workers via the app. It's divided into dozens of sections, from low-skilled jobs

such as carpentry, tailoring, and cooking, to higher-level positions in accounting, lab work, call centers, and nursing. The app is available in Hindi and Kannada, so English—a stretch for many poor Indians—isn't needed. So far, the company has no revenue, but Parikh envisions job seekers paying the equivalent of a few pennies for skills courses or English lessons, and he plans to charge companies for arranging interviews.

Apna ("Ours" in Hindi) faces a growing number of rivals. The Delhi city government set up an online marketplace for job seekers, who can call prospective employers via its app. Bollywood actor Sonu Sood is backing Pravasi Rojgar (Migrant Employment), used by more than 500 companies in construction, health care, logistics, and a dozen other fields to recruit workers from villages. And ad company Lowe Lintas in July introduced Kaam Wapasi (Return to Work) to connect rural candidates with urban jobs. "Migrant workers aren't ready to return to cities without a sense of clarity and control," says Prateek Bhardwaj, the ad agency's chief creative officer.

The idea for Apna grew out of Parikh's experience hiring a welder a decade ago, when he got hundreds of résumés in response to an ad on a job portal. He invited about 20 people in for interviews, but only five showed up and most of those knew little about welding. "The system was broken," he says. As he began developing the idea in earnest last year, he took a job as an electrician in a factory in Ahmedabad, 300 miles north of Mumbai, where he chatted with workers on chai breaks and spent evenings talking with people in nearby slums. "I tried to look at it from the candidate's point of view," he says. A key take-away: Low-skilled workers don't need résumés, an off-putting requirement on many job portals. Last summer he raised \$3 million from Lightspeed Venture Partners and Sequoia Capital. "Job startups need to start catering to the deep underbelly of the economy, about 250 million Indians doing nonfarming," low-skilled labor, says Lightspeed partner Vaibhav Agarwal.

Parikh spent the next six months with five coders, and by December Apna was ready. Shortly after the app went live, the pandemic hit and Parikh sensed that his idea was more relevant than ever. With millions of people out of work, traffic soared far beyond what he'd planned for, so he hired about 20 more coders working nights and weekends to bolster his technology, and he brought on scores of people to sign up companies and help build communities of job seekers. In July, he says, Apna facilitated 800,000 job interviews, and August is on track to double that. "People's lives are broken," he says. "We're helping them put things back together." —*Saritha Rai*

THE BOTTOM LINE Apna has raised \$3 million from venture capital backers, and since its February launch it has signed up 1.25 million laborers seeking jobs in four Indian cities.

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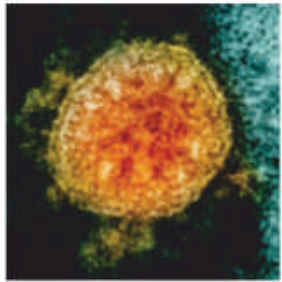
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We're more than a few steps away from an idiotproof answer to Covid-19. Our Vaccine Issue looks at the biggest challenges, the most promising solutions, and the weirdest science, from the molecular level on up.



answer to Covid-19.

You are here-ish

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Best Shots

By Peter Coy

The story of the war against Covid-19 begins half a billion years ago. That's when jawed fish—our scaly forebears—evolved an immune system capable of learning, adapting, and defeating invaders. The adaptive immune system, as it's called, was so massive an improvement over the slow-learning innate immune system of the day that some scientists now describe it as the Big Bang of immunology. In humans, only the brain rivals the immune system's sophistication, says Alice Huang, a senior faculty associate at the California Institute of Technology who has studied virus-host interactions for five decades. "It is a complex interplay between cells and their products."

As awesome as our immune system is, though, it doesn't win every time. Right now it's facing a stern challenge from a foe it doesn't always know how to fight. While some countries have managed to control the coronavirus through social measures such as mask-wearing, others—notably the U.S.—have manifestly failed. According to the World Health Organization, Covid-19 has killed almost 700,000 people and sickened some 18 million since its identification in Wuhan, China, last December.

That's where a vaccine comes in. It's the injectable answer, the *deus ex machina* that sets right the botch we've made of things. The scientists working in vaccine laboratories from Beijing to Ahmedabad, India, to Plymouth Meeting, Pa., are doing the most important work on the planet. If they succeed, some orator somewhere will surely say of them what British Prime Minister Winston Churchill said of Royal Air Force pilots during World War II: "Never in the field of human conflict was so much owed by so many to so few."

Failure, or at least partial failure, is very much a possibility. Experts warn

that the new vaccines may provide only some protection, and only temporarily—more like the annual influenza jab than, say, the knockout polio and measles vaccines. Old people whose immune systems can't handle the virus may get the smallest boost. Some vaccines that look good in the lab could fall short in clinical trials, and some anti-vaxxers will refuse to get shots. There could be side effects; a bad vaccine could harm people if it's authorized for emergency use before human trials are complete. (On Aug. 11, Russian President Vladimir Putin announced the world's first registration of a coronavirus vaccine for public use even though Phase III trials have just begun.) Vaccines that require refrigeration or multiple doses will be hard to administer in poor countries. Then there's vaccine nationalism: Countries are racing to find a vaccine and deliver it to their people first rather than pooling resources for a faster, better solution.

To appreciate how big the challenge is, consider that there's still no vaccine against HIV, the retrovirus that causes AIDS, even though it has been identified since 1983 and has killed more than 33 million people. The fallback for AIDS has been antiretroviral drugs, which keep HIV from spreading to other people and arrest its spread in the body. That could be the primary avenue of attack against Covid-19 if vaccines prove to be short-lived or only partly effective.

On the plus side, today's vaccine developers have better tools and a deeper understanding of viruses and the immune system than their predecessors who developed vaccines against smallpox, diphtheria, tetanus, whooping cough, polio, measles, mumps, and rubella. "It's a running start," says Stanley Plotkin, who played key roles in developing rubella and rotavirus vaccines and continues to consult for more than 40 companies from his perch as a professor emeritus of pediatrics at the University of Pennsylvania. "The end is not yet in sight, but I remain cautiously optimistic," the 88-year-old Plotkin says. "Underline cautiously."

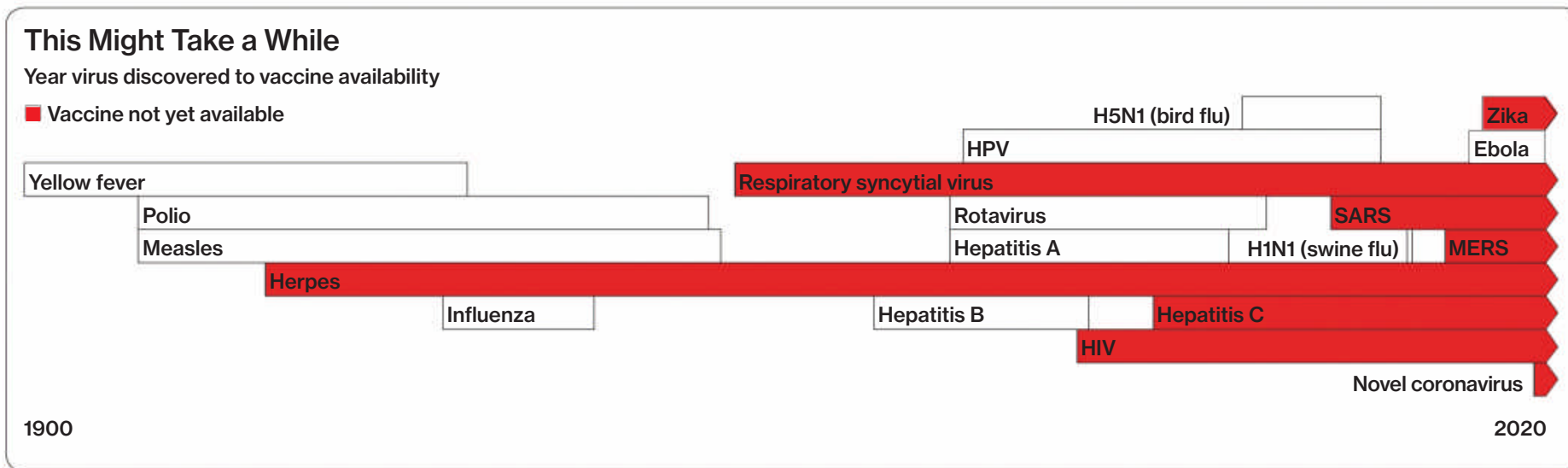
Distinguishing self from nonself, or friend from foe, is the immune system's first job. That's more easily said than done, considering that most cells found

in our bodies, though seen as self, aren't strictly human. The body is a "scaffold" for microbes, including bacteria and viruses, that outnumber human cells by a factor of 10. The innate immune system identifies foes approximately, by recognizing broad classes of pathogens. It existed before those jawed fish came along in the Ordovician Period, and it remains the first line of defense. Its weapons include macrophages, neutrophils, and dendritic cells that engulf viruses, and natural killer cells that destroy them. The gene for the proteins on those soldiers that detect the enemy—known as Toll-like receptors—was identified first in fruit flies, in 1985.

The adaptive immune system, the smart one, zeroes in on specific enemies using a strange, Darwinian process whose discovery won a Nobel Prize for Japanese-born Susumu Tonegawa in 1987. There aren't enough genes in our DNA to code for all the proteins specific to every possible foe, but the body finds a way using a trick called gene rearrangement. The genes in immature white blood cells mix and match segments of DNA to randomly spew out an immense variety of cells with different pathogen detectors. The vast majority are useless. The soldier who happens to have the right weapon for the occasion is then cloned on a massive scale, as in the *Star Wars* prequels.

Given this complexity, it takes a few days for the adaptive immune system to kick in after an infection. The defensive play consists of B cells, which emanate from bone marrow, and T cells, which start in the marrow but migrate to the thymus, a small organ beneath the breastplate. Some B cells become plasma cells that manufacture antibodies, the Y-shaped molecules that glom onto viruses and other invaders. Some T cells kill pathogens; others help other immune cells. A different set of B and T cells become memory cells that go into action rapidly if a vanquished enemy attempts to return.

Antibodies alone are a whole textbook. Some neutralize pathogens by clogging their binding sites, while others coat the pathogen (or "opsonize" it) to be recognized by other immune-system attackers. Scientists are still trying to figure out why some people fight



off the coronavirus better than others. Age, obesity, and chronic health conditions are clearly factors. Some people produce a lot of cytokines—small proteins that cause inflammation. While cytokines can aid healing, an oversupply can damage healthy tissue. Inflammation from a “cytokine storm” is the cause of death for many Covid-19 victims.

One realization every vaccinologist comes to early is that human beings have no hope of creating a defensive system better than the one our bodies already have. Their goal is more modest: to put the immune system on alert, the way a coach preps a team for a new opponent.

Preparing the body to fight by giving it a taste of the enemy is an old trick. Historians now believe that people in China and possibly Africa and India were inoculating one another against smallpox with bits of fresh matter from ripe pustules for a century or more before the practice came to Europe in the early 18th century. In 1796 the English physician Edward Jenner went a step beyond by proving, through an experiment on an 8-year-old boy (this was before institutional review boards existed), that exposure to cowpox generated immunity to smallpox, a more serious disease.

What’s new is that scientists can both view and simulate down to the molecular level how viruses infect cells, how the immune system reacts, and how vaccines bolster that reaction. “I was trained in the ’60s, when a lot of the things that we’re talking about in immunology were imaginary. Now, in my lifetime, they have become pure proteins that we can isolate and identify and work with,” says Caltech’s Huang.

The new tools have led to a profusion of creativity and potential pathways to

a vaccine. For example, a partnership between France’s Sanofi SA and Britain’s GlaxoSmithKline Plc uses armyworm moth cells as a factory to churn out copies of the virus’s spike protein—the tip of the spear—that are then injected into the body, triggering an immune response.

Several leading companies treat the coronavirus like software. They isolate the genetic code for the spike protein and put it into a segment of messenger ribonucleic acid, which then goes into the body. The cells that receive the mRNA carry out its instructions to make the spike protein and then show it on their surfaces, which puts the immune system on high alert for the actual virus.

The software development approach to vaccines moves incredibly fast. On Jan. 11, Chinese authorities shared the genetic sequence of what was then called the novel coronavirus. Just two days later, Massachusetts-based Moderna Inc. and researchers at the U.S. National Institutes of Health isolated the part of the sequence that codes for the virus’s spike protein, which gave them the makings of mRNA-1273, their entry in the vaccine race. Moderna shipped its first batch of mRNA-1273 for animal testing on Feb. 24 and dosed the first human volunteer on March 16. Shown to be effective and safe in early tests, it began Phase III clinical trials on July 27.

While Moderna delivers its mRNA inside microscopic blobs of fat, some competitors’ nucleic acid vaccines are being delivered via other viruses—such as measles or human or chimpanzee adenovirus—that have been weakened so they can infect cells but not spread. Once the weakened virus enters a cell, the mRNA spliced inside it pumps out spike proteins. There’s poetic justice

in pitting one virus against another.

The wave of investment has made this a golden age for vaccine development. Under Operation Warp Speed, the U.S. government has committed \$2 billion to the venture of Sanofi and GlaxoSmithKline and \$1.2 billion to the British-Swedish company AstraZeneca, as well as splashing out billions on U.S. companies: \$1.95 billion to Pfizer, \$1.6 billion to Novavax, \$483 million to Moderna, and \$456 million to Johnson & Johnson, among others.

The creativity extends to testing and distribution. In countries with poor recordkeeping, such as Bangladesh, organizations are experimenting with iris scans and other biometrics to make sure each person gets inoculated once, and only once. If a vaccine whose development was partly funded by the U.S. government gets snagged in a patent fight, the government has the right to seize control and let others use the patent.

Not long ago, vaccines weren’t even dreamed of for most diseases. Poliomyelitis, for example, was a vicious killer andcrippler of children until the 1950s. With World War II still raging in 1944, President Franklin Roosevelt, who used a wheelchair himself, devoted a radio address to raising money for the National Foundation for Infantile Paralysis, saying, “The dread disease that we battle at home, like the enemy we oppose abroad, shows no concern, no pity for the young.”

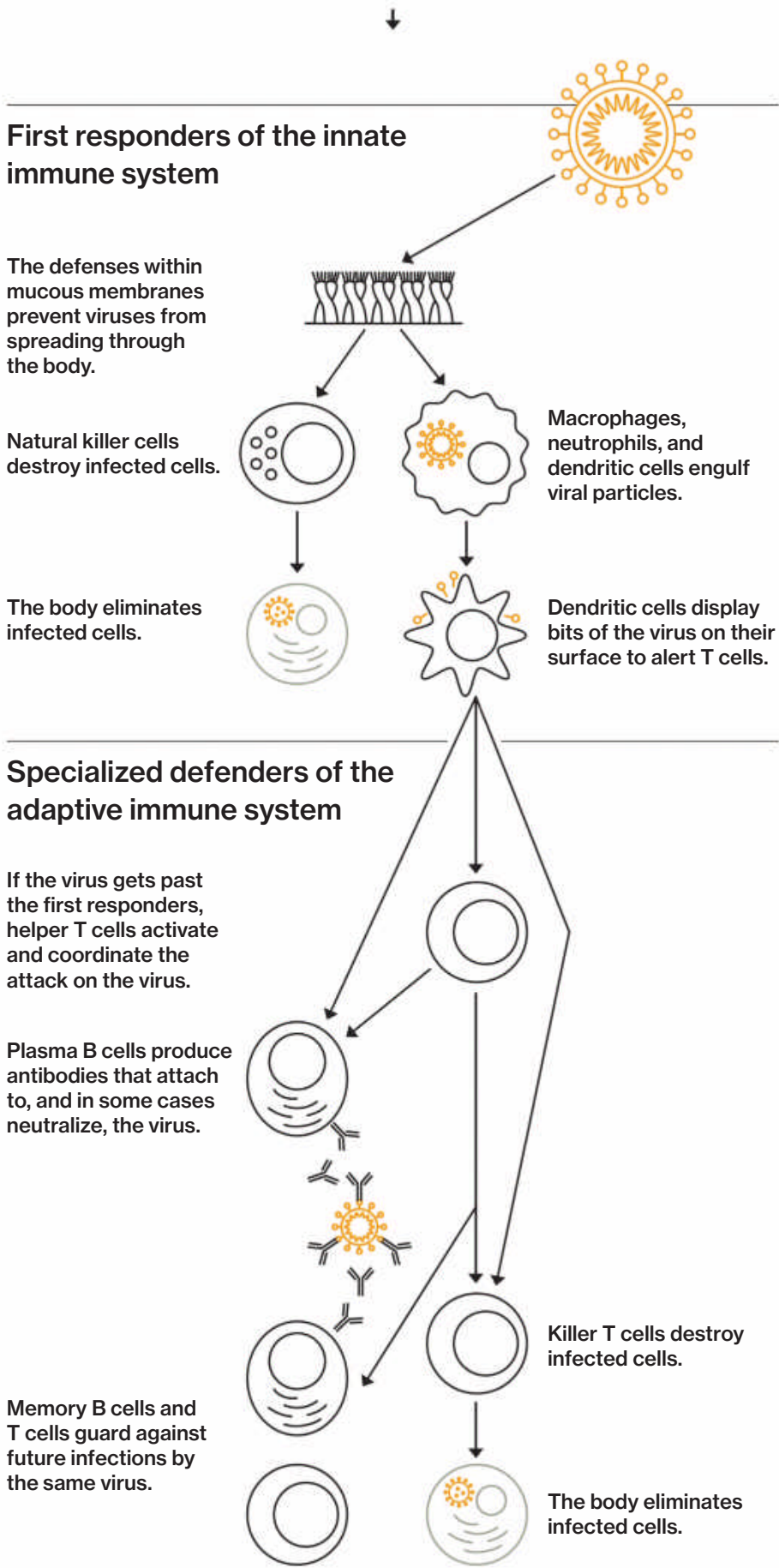
With Covid-19 it’s the old rather than the young who are most at risk, but the sense of being at war with a silent killer is just as strong. The best hope for humanity is a successful alliance between the immune system within us and the vaccine researchers among us. **B**

Basics and Battle Plans

By Peter Coy and Shawn Hasto

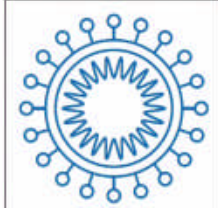
Coronavirus particles, or virions, attach to the surface of a cell with their spikes, then pierce the cell and release a strand of RNA. The genetic code it carries hijacks the cell's machinery to make more virions, which seek new targets.

Here are some of the approaches being tried by researchers working on coronavirus vaccines. Some of the more than 200 competitors are using techniques that have been honed over more than a century, but most are experimenting with far less proven tactics.



● Whole Pathogen

The killed or weakened virus is injected whole into the body, as in a typical vaccine.

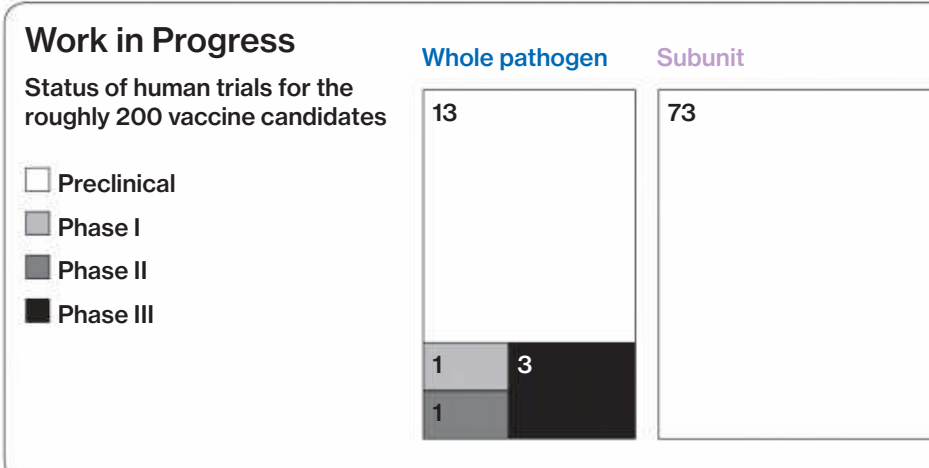


The Players

The Bandim Health Project, based in the West African nation of Guinea-Bissau, is testing whether a polio vaccine can work against SARS-CoV-2, the coronavirus that causes Covid-19, possibly by fortifying the innate immune system. Others are testing tuberculosis and measles shots.

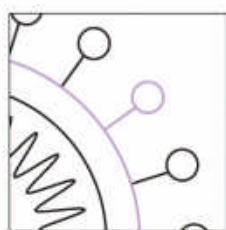
Codagenix Inc., of Farmingdale, N.Y., together with **Serum Institute of India Pvt. Ltd.**, is testing the safety of a live, carefully “deoptimized” version of the virus.

Beijing’s **Sinovac Biotech Ltd.** says its vaccine, based on inactivated virus particles, spurred the creation of neutralizing antibodies in more than 90% of people tested.



Subunit

The vaccine is made from a harmless fragment of SARS-CoV-2, usually a surface protein.



The Players

Sichuan Clover Biopharmaceuticals Inc., of Chengdu, China, in collaboration with **GlaxoSmithKline Plc**, grows proteins resembling the virus's spike protein in a mammalian cell culture and injects them into muscles to trigger an immune response.

Novavax Inc., of Gaithersburg, Md., grows synthetic spike proteins in armyworm moth cells. Supported by U.S. federal funding, it plans to make more of the proteins in the Czech Republic and other places.

Others to Watch

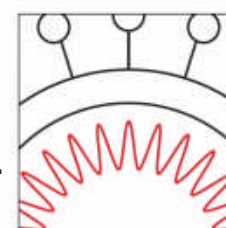
Medicago Inc., a Canadian company one-third-owned by tobacco giant Philip Morris International Inc., grows virus proteins in an Australian relative of the tobacco plant.

Sanofi Pasteur Inc. mass-produces bits of the virus using the method it developed for its influenza vaccine, Flublok.

The **University of Pittsburgh Medical Center** delivers viral particles using a Band-Aid-like patch with 400 tiny needles that dissolve into the skin.

Nucleic Acid

Genes from the virus are inserted into the body's cells, causing them to manufacture viral fragments.



The Players

The **University of Oxford**, teaming with **AstraZeneca Plc**, uses a weakened chimpanzee adenovirus as a vector to carry the genetic code for the spike protein into cells. It says its shot stimulates T cells and antibodies.

CanSino Biologics Inc., working with the People's Liberation Army, splices the virus's spike protein into a safe, nonreplicating version of a human adenovirus, which ordinarily causes colds and pinkeye. It's approved for military use in China.

German companies **BioNTech** (with **Pfizer**) and **CureVac** (with **GlaxoSmithKline**) package coronavirus-fighting messenger RNA in tiny particles that look to the body like cholesterol. So does **Moderna Inc.** of Cambridge, Mass., which is working with the U.S. National Institute of Allergy and Infectious Diseases.

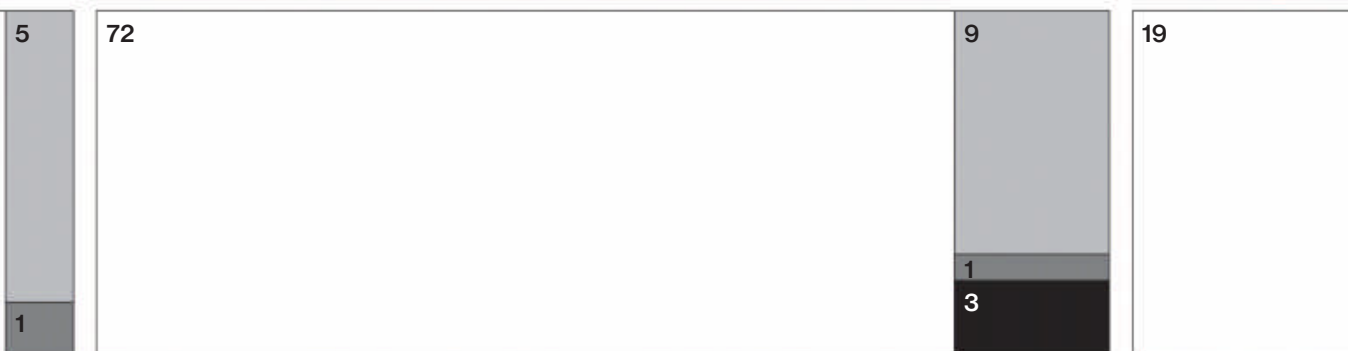
Others to Watch

Merck & Co. is splicing the spike protein into viruses for measles and vesicular stomatitis, which infects horses and cattle.

Inovio Pharmaceuticals Inc., of Plymouth Meeting, Pa., injects rings of DNA into the skin or muscle, then uses electrical pulses to briefly open tiny pores in the cells for the DNA to get in.

Nucleic acid

Unknown



Instructions

Vaccines from the U.S. company Moderna and its German rival BioNTech use RNA as a messenger inside cells. The message: Produce an immune reaction, stat

By Robert Langreth
and Naomi Kresge



Almost every antiviral vaccine ever sold works in a similar way: A dead or weakened virus, or a piece of one, is introduced into a healthy person. The weakened virus stimulates the immune system to generate antibodies, protecting the person when the real pathogen threatens to infect them.

Over the decades, this tried-and-true approach has vanquished polio, eradicated smallpox, and reined in chicken pox, measles, and mumps. But vaccine production has never been simple or fast. Many flu vaccines are still grown in chicken eggs. Newer approaches draw on genetic engineering to eliminate the need for whole viruses, but their viral proteins are still grown inside live cells.

The coronavirus vaccines from Moderna Inc., in Cambridge, Mass., and its German rival BioNTech SE propose to immunize people in a radically different way: by harnessing human cells to become miniature vaccine factories in their own right. Instead of virus proteins, the vaccines contain genetic instructions that prompt the body to produce them. Those instructions are carried via messenger RNA, or mRNA.

Moderna's mRNA-1273 consists of a strand of mRNA that tells the body to produce the spike protein the coronavirus uses to latch onto human cells. The strand is like one side of a zipper; the "teeth" are a sequence of chemical letters that cells read to produce the 1,273 amino acids that make up the spike protein. If the vaccine works as intended, the body will start producing the proteins soon after injection, prompting the immune system to react and build up protective antibodies against them.

The great advantages of mRNA vaccines are speed and flexibility. No finicky live cells or hard-to-handle viruses are needed, and the basic chemistry is straightforward. Moderna's vaccine

Included

reached Phase I human trials on March 16, only 63 days after the company began developing it. And at 6:43 a.m. on July 27, the first volunteer in Moderna's 30,000-person, final-stage efficacy trial in the U.S. received an injection. Less than 12 hours later, BioNTech and its partner, Pfizer Inc., said they, too, were beginning a late-stage trial, a study that will be conducted in the U.S., Brazil, and several other countries. They took advantage of mRNA's rapid-response capability to create four slightly different vaccines, which they compared in initial trials before selecting the best one for large-scale testing.

In Phase I trials, both the Moderna and BioNTech-Pfizer vaccines stimulated people's immune systems to produce antibodies that neutralized the virus in lab experiments, a positive initial sign. "This is a relatively new platform, but it is looking quite good," Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases, said after the results of Moderna's Phase I trial, sponsored by NIAID, were published. "Neutralizing antibodies are the gold standard of protection." Moderna, which has worked with NIAID for years, is receiving \$955 million from the U.S. government to support its coronavirus trials.

How well mRNA vaccines will actually prevent Covid-19 remains unknown. No vaccine based on messenger RNA has ever been approved for any disease, or even entered final-stage trials until now, so there's little published human data to compare how mRNA stacks up against older technologies. And the vaccines have hardly been free of side effects: In Moderna's Phase I trial, all 15 of the patients who received the median of three dose sizes reported at least one side effect, though none were severe. Three of the 15 patients at the highest dose had temporary severe reactions. That dosage won't be tested further.

Still, the accumulating data has some mRNA skeptics warming to the technology. "I don't see the reason for focusing on mRNA vaccines. I don't get that," Peter Jay Hotez, dean of the National School of Tropical Medicine at Baylor College of Medicine in Houston, said in an interview in early June. "The old-fashioned vaccines may do a better job." In late July he said his opinion had shifted based on encouraging monkey and human trial results. Moderna's vaccine "is showing promise," he said. "There is enough of a glimmer to warrant continuing its clinical development and progressing to larger clinical trials."

The possibility of a Covid-19 shot has led investors to more than triple the value of Moderna's shares this year, giving the company a market capitalization of about \$28 billion, an astonishing number for a company with no products. BioNTech shares have more than doubled. A third company with an mRNA-based Covid-19 shot, CureVac AG, has said it's considering an initial public offering. Both Stéphane Bancel, Moderna's chief executive officer, and Ugur Sahin, his less flashy counterpart at BioNTech, have become multibillionaires.

The excitement around mRNA goes beyond the pandemic. Proponents hope it can become a wide-ranging platform that will lead to vaccines for other difficult-to-treat infections, as well as customized cancer shots and even heart disease treatments. "It's a big moment for mRNA therapeutics in general, because now it's a household word and everybody knows about it," says

Derrick Rossi, a stem cell biologist who was a co-founder of Moderna in 2010 but is no longer affiliated with the company. "For Moderna, it's the first time on the global stage."

Interest in using genetic material to turn the body's cells into vaccine factories dates to a series of experiments in the early 1990s. In 1993 researchers at Merck & Co. injected lab mice with loops of DNA that contained instructions for influenza proteins. To the surprise of the scientists, the mice generated an immune response that protected against the flu. The concept, so elegant it seemed almost too simple to be true, produced a surge of excitement among vaccine experts.

But though DNA vaccines worked in animals, they weren't successful in initial human trials. It was difficult to get sufficient amounts of DNA into human cells, and when scientists overcame that, the vaccines turned out to be less potent than needed. (They were tried on the most challenging diseases, including HIV.) Over the years research into DNA vaccines has continued, but none has made it to market for humans. Inovio Pharmaceuticals Inc., a dark horse in the Covid-19 vaccine race, is testing a DNA-based approach. It uses a hand-held device to zap the skin with electric pulses after an injection, opening up holes in cell membranes to allow in more DNA.

For years most researchers gave little thought to using messenger RNA as a vaccine or therapeutic, despite its close relation with DNA. When the body needs more of a protein, mRNA transports the requisite genetic code from the DNA to protein-making factories throughout the cell. But unlike DNA, a stable molecule, mRNA is notoriously fragile. Numerous enzymes present throughout the body break it down. Making matters worse for vaccine researchers, the immune system is hyper-vigilant about foreign RNA, identifying and destroying it before it can spur the protein-manufacturing process. In the 1990s, "we couldn't envision it being feasible," says Barney Graham, deputy director of the Vaccine Research Center at NIAID.

A few lonely scientists pursued mRNA therapies for years. In 2005, University of Pennsylvania researchers Katalin Kariko and Drew Weissman found that a slight modification to the mRNA molecule could reduce the immune reaction, making it much more amenable for use in drugs or vaccines. (Since then, scientists have found ways to reduce mRNA's other vulnerability inside the body, protecting it from enzymes by encapsulating it in lipid nanoparticles.) They filed for a patent and formed a company, but the university, which had rights to the patent, licensed it to a third party. Moderna rose to prominence using a similar approach. The experience still rankles Kariko, who left Penn for a job at BioNTech in 2013. "My science and my work were not considered important, and I was not recognized," she says. "Nobody cared."

The idea started gaining more attention in 2010, when Rossi, then at Harvard Medical School, used modified mRNA to convert skin cells into stem cells. Sensing big commercial possibilities, he reached out to his Harvard colleague Timothy Springer, who'd made \$100 million in 1999 by selling the first biotech company he founded. Springer introduced Rossi to the venture capital company Flagship Pioneering, which founded ►

◀ Moderna in 2010 and began its operations the next year. He also brought in Robert Langer, a chemical engineer at MIT who'd co-founded many other companies. Langer became a co-founder and board member. (Springer, who put \$5 million of his own into Moderna, made \$400 million when the company went public in late 2018. His stake is now worth about \$1 billion; Langer's is worth about \$900 million.)

Bancel, the former CEO of French lab testing company BioMérieux SA, joined the board in March 2011 and became Moderna's CEO that October. He proved to be a prodigious fundraiser and a tireless proselytizer for the technology. In its eight years as a private company, Moderna raised \$2.5 billion in venture capital and drug-company money, leading to one of the biggest IPOs in biotech history.

Armed with so much funding, Moderna cast widely for possible targets for its technology, including rare diseases and cancer. In its early years it was an intense place with lots of turnover. Bancel "is very ambitious," Rossi says. "He drove it very, very hard and drove people that worked there very, very hard."

Moderna also gained a reputation for secrecy. For years it published few scientific papers, unusual for biotech companies, which typically like to brag about their credentials. Since 2017, though, it's published more frequently; the company says it now has more than 50 publications.

BioNTech, the company that's emerged as Moderna's biggest competitor, was founded quietly in 2008, based on the research of a husband-wife team of German medical researchers, Ugur Sahin and Ozlem Tureci. Tureci had spent her girlhood following her father, a surgeon, on his rounds at a Catholic hospital staffed by nuns. Sahin's parents worked for a Ford factory in Cologne. The pair met while they were finishing their medical training; in the 1990s they were hired by Christoph Huber, head of the hematology-oncology department at the University Medical Center of the Johannes Gutenberg University Mainz.

The three of them spent years pursuing immune-based treatments for cancer, eventually zeroing in on personalized vaccines that attempted to enlist the immune system to attack tumors. The researchers screened databases of gene sequences to find markers on cancer cells that could alert the immune system to targets. In 2000, Sahin started exploring mRNA as a delivery method for cancer vaccines. All of this was considered a crazy idea at the time, Tureci says.

So when Sahin, Tureci, and Huber started Ganymed Pharmaceuticals in 2001, they focused on more proven immunological approaches. Then, seven years later, Sahin persuaded two of Ganymed's investors, Thomas and Andreas Strüngmann, to spin out the mRNA cancer vaccine research into a new company—BioNTech. Sahin became CEO, and Tureci was on the scientific advisory board. In 2018, two years after Astellas Pharma Inc. bought Ganymed, she became BioNTech's chief medical officer.

If Moderna is polished and corporate, BioNTech has always had an academic vibe. The company has published its research from the beginning, putting out some 150 scientific papers in the past eight years alone. Sahin still uses his university email address. "Ugur is a scientist, and even though he

runs a multibillion-dollar business, he still is a scientist and he thinks like a scientist first," says Penn's Weissman, who receives research funding from the company.

For most of its history, BioNTech focused exclusively on cancer drugs. Its first big foray into infectious disease came in August 2018, when it signed a deal with Pfizer to work on a vaccine for seasonal flu. The idea was to use BioNTech's customization process to develop a better vaccine for the influenza pathogen, which morphs and mutates each winter season. Huber, a board member, says he never would have guessed its first product could be a pandemic vaccine.

Moderna was also initially focused on drugs. In 2014, Bancel recalls, a small group charged with finding uses for mRNA "were exploring new things, and they said, 'Hey, vaccines might be a great use of this technology.'" The potential was obvious. For any given vaccine, "we use the same process, in the same building, in the same rooms, with the same people. That gives you an incredible speed advantage," Bancel says. "It was very clear to me this technology could be deployed one day in a potential outbreak."

In 2017, Moderna started working with Graham's team at NIAID to design vaccines for several viruses, including MERS, a coronavirus that had hit Saudi Arabia and other countries starting in 2012. In the fall of 2019, Bancel briefed NIAID officials on a factory the company had built in Norwood, Mass., which could produce new vaccines in 60 days. They were skeptical at first, he says, because the company had never produced anything at scale, so he invited them to tour the facility and offered to do a test run for a hypothetical pandemic. The agency would send Moderna the genetic sequence for an emerging viral disease, and Moderna would see how fast it could have vials of a vaccine ready for clinical trials. NIAID was about to pick a virus to use when Covid-19 hit.

In early January, Bancel read a newspaper article about a mysterious virus going around China. He fired off an email to Graham asking if he knew what it was. Graham said he didn't, but if it was a SARS-like coronavirus, it might be a good time to run the pandemic vaccine drill they'd been discussing. Bancel forwarded the emails to Hamilton Bennett, who is now program leader for Moderna's Covid-19 vaccine effort. Bennett, a



Bancel at a March meeting of the White House Coronavirus Task Force

self-described “public-health nerd” with a master’s degree in environmental microbiology, had sought a job at the company after hearing it was working on mRNA-based vaccines for new viruses. “It’s one of the few technologies that could respond in real time and make a difference,” she says.

On the evening of Friday, Jan. 10, the gene sequence from the virus was posted online by Chinese researchers. Scientists at NIAID and Moderna worked all weekend to identify a viable mRNA sequence for the spike protein. By early the next week they had agreed on one and started trying to synthesize a vaccine.

Bennett coordinated almost daily calls with NIAID and, in later months, numerous other federal agencies as they became involved. Moderna scientists were highly motivated to show that mRNA technology could help, she says. “Everyone looked at this as, I’m going to do whatever I can to make this successful.” The company originally thought it could have a shot ready for trials in late April, but manufacturing went faster than expected, and by Feb. 24, 42 days after it started, Moderna was shipping the first batch of vaccine to NIAID. After a fast Food and Drug Administration review of the trial plan, the first healthy volunteer was injected on March 16.

BioNTech also started working on a vaccine in January, after Sahin read an article in the *Lancet* describing how the coronavirus had spread in a family that had visited Wuhan. “It showed a pattern which is absolutely critical for a dangerous pandemic disease,” he says. The virus was new, no one was immune, and at least one of the family members hadn’t shown symptoms of infection.

After Sahin discussed the article with Tureci, BioNTech assigned 25 people to start running experiments on mRNA vaccines for the novel coronavirus, setting up shifts that ran through evenings and weekends. By March 2 they’d come up with 20 vaccine candidates that could spur a strong immune response against the virus in lab animals and cell culture experiments. That day Sahin called Kathrin Jansen, head of vaccine research and development at Pfizer. “We had a very short conversation, and it was very clear that she and her team were very interested,” Sahin says.

The companies started working together almost immediately. They narrowed the field of vaccine candidates to four and on April 23 started testing on people in Germany. A U.S. trial began less than two weeks later. The four options used three different mRNA technologies—BioNTech’s trial, essentially, was a giant scientific experiment to identify the one most likely to make a potent vaccine.

The bragging rights associated with being among the first companies to have vaccines in trials are nice. But with numerous alternatives likely to go into Phase III trials over the next few months, they may not tell us much about the ultimate outcome of the hunt. To the extent that being first matters right now, it’s because of money.

“When these guys put their hands up and said, ‘We’ll be able to go into the clinic in a few weeks,’ you can see why people gave them money,” says Nikolai Petrovsky, a vaccine researcher at Flinders University in Australia. “But it doesn’t mean that they’re the best platform or the most reliable platform or

the platforms that will ultimately succeed.” Petrovsky, who founded a small company working on a competing Covid-19 vaccine that uses more established methods, says he hasn’t been particularly impressed by the immune responses generated by mRNA vaccines and worries about how well they’ll be tolerated. He suspects that when all is said and done they’ll prove inferior to vaccines produced using older technologies.

The hype surrounding mRNA vaccines has been lucrative for Moderna’s executives. This year, as share prices have soared on the whole and gyrated wildly on day-to-day vaccine news, Moderna insiders have sold more than \$250 million worth of stock, according to executive compensation data company Equilar Inc. Bancel has sold more than \$18 million since the Covid-19 vaccine program was announced, and investment companies he controls have sold \$11 million more. Moderna says sales by executives are triggered by preexisting share-sales plans, and Bancel says the vast majority of his fortune is still tied up in Moderna stock.

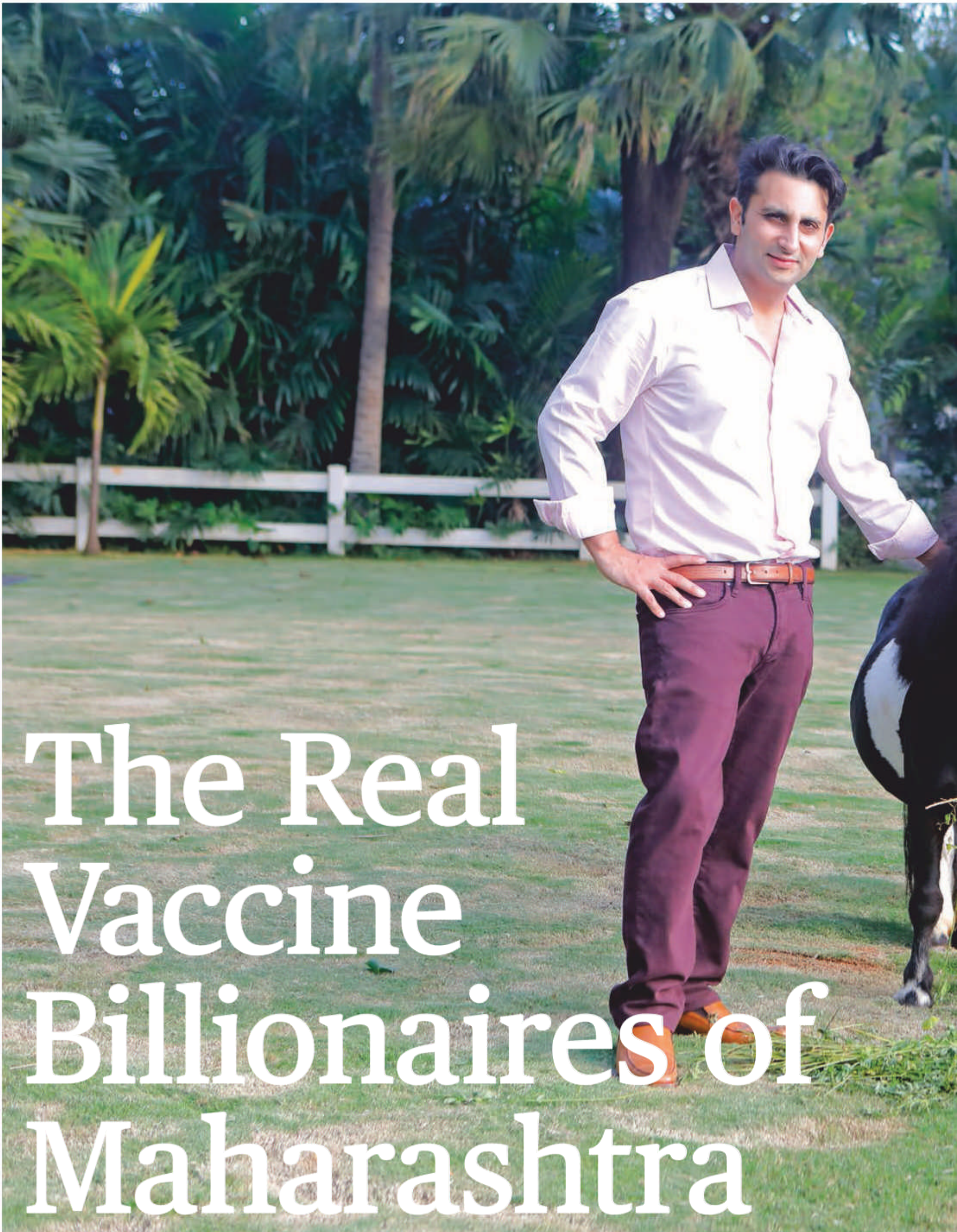
Some scientists were particularly annoyed about a press release on May 18 from Moderna announcing “positive interim clinical data.” Its vaccine had produced neutralizing antibodies in the first eight volunteers, but the company didn’t indicate what kind of numbers those antibodies were being produced in, making it hard to judge how promising the results actually were. Moderna’s shares went up 20% anyway, and the company raised \$1.3 billion in a secondary stock offering later that day.

Bancel says the company decided it had to put out a release because numerous government officials knew the results; it couldn’t take the risk they’d leak. “We were stuck between a rock and a hard place,” he says. When the full trial results were published on July 14, including all the numbers, they confirmed that the vaccine produced antibodies in all people who completed the trial.

Because the coronavirus is a respiratory pathogen that hits many parts of the airway, it’s possible we’ll end up with a partially effective vaccine. That’s as true for mRNA vaccines as for any other approaches, old and new. Patients may have to be revaccinated regularly if the shot’s effectiveness wanes over time. The FDA has indicated it will approve modestly effective vaccines as long as they are safe and prevent the disease or reduce its severity in at least half of those who are vaccinated.

Moderna is planning for success, one way or another. It cut a deal with contract manufacturer Lonza Group AG in May to add manufacturing capacity. Between its plant in Massachusetts and Lonza’s in New Hampshire, Moderna says it hopes to be able to make enough of the vaccine to cover the entire U.S. population. Lonza’s plants in Switzerland have capacity for another 300 million doses. Pfizer, for its part, has cut a deal to sell 100 million doses of any successful vaccine coming out of its collaboration with BioNTech to the U.S. government for \$1.95 billion.

Bancel says he’s confident Moderna’s vaccine will stimulate antibodies against the coronavirus, as it did in the first patients in the Phase I trial. But whether that prevents people from getting sick, he admits, “we cannot know until we see the Phase III data.” If the trials proceed as fast as Moderna hopes, we may know the answer by late fall. **B**



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The Real Vaccine Billionaires of Maharashtra



An Indian racehorse dynasty may be the world's best hope for producing enough vaccine to end the pandemic

By Ari Altstedter
Photographs by Subhash Sharma

NECESSITY →

SCIENCE →

R&D →

MANUFACTURING →

PRICING →

DISTRIBUTION →

EDUCATION ●

As chief executive officer of the Serum Institute of India, the largest manufacturer of vaccines in the world, Adar Poonawalla can produce about 1.5 billion doses a year of almost any inoculation. He has machines that fill 500 glass vials every minute, and gleaming steel bioreactors almost two stories high that can make more than 10 million shots a month. He can claim, credibly, that he helps inoculate 65% of the world's children, in more than 100 countries, against diseases such as measles and tuberculosis. And deep inside Serum's lushly landscaped, 50-acre campus, about three hours inland from Mumbai, he's already brewing the raw materials to make one of the leading experimental vaccines for the novel coronavirus at a scale that could make a serious difference to ending the pandemic.

But before getting into all that, the first thing Poonawalla wants to show me during a recent visit is his office, because it's brand-new—and it's a plane. Specifically, a converted Airbus A320. "This is kind of similar to Air Force One," he says as he leads me through an onboard lounge, a 10-person boardroom, and, finally, in what was once coach, a bedroom that could easily be found in a five-star hotel. It's all elegantly designed, vaguely art deco, and accessed through a luxe jetway with marble floors and carved wooden doors that's connected to ground level by a dedicated elevator. How much did the remodeling cost? "Oh, nothing," Poonawalla replies before revealing the figure: about \$1 million.

While his family fortune stands at about \$13 billion, that kind of spending—to say nothing of indulgences that include a collection of 35 rare cars (one of them a Mercedes converted into a replica Batmobile) and flying in Michelin-starred chefs to cater dinners with his glamorous wife, Natasha—might seem extravagant for someone in his business. Making basic vaccines, particularly for emerging markets, is such a low-margin proposition that manufacturers in the developed world largely abandoned it decades ago. But there's a case to be made that Poonawalla's immoderate ways put him in a better position than almost anyone to help get the world out of its present crisis. Since becoming CEO in 2011, he's habitually ignored projections for sluggish vaccine demand. Instead, buoyed by his family's money and a history of long-shot bets that went the Poonawallas' way, he's steadily increased Serum's production footprint, building manufacturing lines that doubled its capacity and then doubled it again.

The results are visible from the cockpit of Poonawalla's office. Just across a patch of tarmac—he uses it to land his helicopter—are two factory buildings and a giant concrete-and-glass warehouse, a brand-new campus that cost about \$700 million to construct. When Serum began planning it a little less than four years ago, the coronavirus pandemic was merely an epidemiologist's bad dream. Now the facilities are starting to be put into commission, boosting annual capacity



A Serum technician checks on coronavirus vaccine production

to about 2 billion doses. That will put Serum far ahead of the second-largest vaccine producer, Sanofi SA, which turns out a bit more than half that volume, largely from Indian factories.

Serum already has a deal to produce a billion doses of ChAdOx1 nCoV-19, the vaccine being developed by the University of Oxford and AstraZeneca Plc, which could win approval from U.S. and European regulators as soon as this autumn. But Poonawalla argues that whichever of the more than 100 vaccine candidates in development ends up being effective, Serum will have to be part of any global-scale manufacturing plan, and not just because of the size of its factories. The only shareholder Poonawalla has to answer to is his 79-year-old father, Cyrus—one of India's best-known bon vivants in his day and the man he credits for his own liberal attitudes toward money. That family ethos is what created Serum's massive capacity, and, in Poonawalla's view, it allows the company to move faster and take bigger risks manufacturing in the pandemic than any publicly listed pharmaceutical giant. After all, he can afford it. Have you seen the plane?

"People today are really puzzled why we are the only ones who can make Covid-19 at this scale, and that's because I had the vision, and we put in all the money, to just build," he says, with typical humility and restraint. "I don't see a choice. They're going to have to come here."

The Poonawallas trace their lineage to a migrant who, sometime in the mid-19th century, came from western India to Pune, about 90 miles from what was then Bombay. The migrant promptly set himself up as a "billiard marker" at the local British officers' club, keeping score and refreshing drinks. He parlayed his connections with the colonial military into a successful construction business and wound up owning so much land that people started calling him Poonawalla, which more or less means "the guy in Pune."

But his descendants had large families, which divided inheritances. By the time what was left of the fortune made it to Soli, Adar's grandfather, all he got was a house and

40 acres of undeveloped land. Soli used that spread to create the Poonawalla Stud Farms, which would eventually become the country's most successful breeder of racehorses. But the sport of kings had an uncertain future in newly independent, officially socialist India, and as he came of age, Soli's son Cyrus figured it would be wise to diversify into a business with more mass-market potential.

Casting around for ideas, Cyrus realized the Poonawallas had ample raw material for two lifesaving products that Indians desperately needed. Anti-venom for snake bites and tetanus antitoxin, which neutralizes tetanus in the bloodstream, are produced by injecting horses with small quantities of venom or bacteria, respectively. When the horses develop antibodies, their serum—the fluid part of blood—can be harvested and refined into treatments. The Poonawallas had been selling retired racehorses to a government institute in Mumbai for that purpose, but Cyrus decided he could do it more profitably himself. The Serum Institute of India Pvt. Ltd., which he founded in 1966, was soon working on vaccines, too, including one for tetanus.

It was a time of huge innovation in vaccines—the measles-mumps-rubella shot was introduced in 1971, while international efforts to eliminate smallpox and polio were in high gear—and Cyrus decided that was where the future lay. At the time, vaccine production in India occurred largely in sleepy government labs, and Serum's more nimble management and lower costs allowed it to win contract after contract from the national and state administrations. Earnings from that work gave Cyrus the capital to import manufacturing equipment from Europe and the U.S., which allowed him to add more products to Serum's lineup.

In 2001, Adar Poonawalla, newly graduated from university in the U.K., joined Serum's sales team. He found the experience frustrating. The company was at the mercy of India's all-powerful and emphatically glacial bureaucracy. He often brought stacks of books to meetings with ministers or civil servants, assuming he'd be kept waiting for hours in their anterooms no matter how early he arrived. "I found that not

The only solution was "building, building, building capacity, because I knew the demand for exports would be growing so fast"

only humiliating but also pointless," he recalls. "That's when I said, 'This is ridiculous.'"

Western manufacturers had spent much of the previous decade shifting to more complex vaccines that could command higher prices. But poorer countries often couldn't afford them, leaving much of the market open to anyone who could provide the same benefits at lower cost. Poonawalla believed that should be Serum, which at the time exported to only 35 countries. He began making regular drives from Pune to Mumbai, catching multileg flights to Egypt, Indonesia, and other countries, and found that compared with India, their governments worked at lightning speed. Soon Serum was adding as many as six countries a year to its list of importers. (Today the company sells to 140 countries, accounting for more than three-quarters of its roughly \$782 million in annual revenue.)

Production couldn't always keep up with the pace of new business. "Within two or three months of having the facilities commissioned, they were sold out," Poonawalla says. The growth became a virtuous circle. Serum's economies of scale allowed it to sell vaccines cheaper than anyone else and still turn a profit: One meningitis shot went for just 64¢ a dose. Those low prices spurred more demand from governments and organizations such as Gavi, the global vaccine provider backed by Bill Gates. For Poonawalla, the only solution was "building, building, building capacity, because I knew the demand for exports would be growing so fast that we'd never be able to catch up. And that's exactly what happened."

If Poonawalla has played his cards right, humanity's deliverance from its worst viral outbreak in a century may begin on a cramped second-floor landing on Serum's Pune campus. Usually used as a staging area for deliveries, its new purpose was declared by a piece of office paper slid into a plastic sign holder: "Covid-19 Vaccine Manufacturing Facility," it read. The vaccine it referred to is the one under development by Oxford scientists and AstraZeneca, which could be one of the first approved. It uses a harmless chimpanzee virus to mimic the so-called spike proteins that allow the coronavirus to breach human cells, hopefully training the body to recognize and destroy them.

Because the Oxford team, led by researcher Sarah Gilbert, had proved the same method was safe for humans with a previous experimental vaccine, its Covid-19 effort entered human trials at high speed. AstraZeneca, which agreed in April to back the effort with its financial muscle and distribution network, wanted to begin putting together the necessary factory capacity right away, so if the vaccine does prove effective, injections could begin immediately. Poonawalla says he and Pascal Soriot, AstraZeneca's CEO, were connected by a mutual friend in May. Over a couple of video calls, they negotiated a deal for Serum to manufacture about 1 billion doses over the course of a year, almost half the overall total, with 400 million due before the end of 2020. They'll be sold at cost until the end of the pandemic—in a recent deal to supply 100 million doses to low- and middle-income countries, Serum capped the price at \$3 per shot—though even after that Poonawalla estimates he won't charge much more than \$13. ▶

NECESSITY

SCIENCE

R&D

MANUFACTURING

PRICING

DISTRIBUTION

EDUCATION

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◀ When I visited in June, the company had already started preproduction. In a sterile room crammed with stainless-steel lab equipment, a technician in a white hooded jumpsuit attached an oversize plastic syringe to a tube sticking out of a 200-liter (53-gallon) bioreactor—essentially a still that grows cells instead of fermenting alcohol. Slowly pulling back on the syringe’s plunger, he drew a slug of pinkish goo from inside. A huge bag of the same substance was sitting on a heavy-duty steel shelving unit, feeding into the bioreactor through another tube, like a giant IV drip. The fluid, known as animal cell culture media, is a soup of nutrients and amino acids that the cells growing inside the reactor use for sustenance, and the technician was taking a sample to see how they were doing.

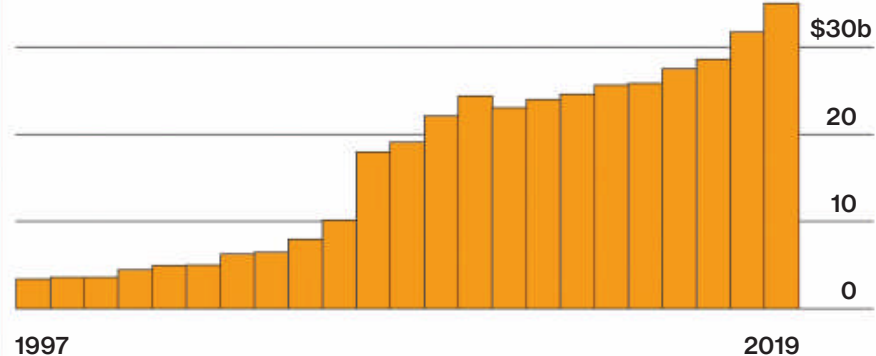
The goal was to create a “virus bank”—a large volume of human embryonic kidney cells that can be infected with the Oxford researchers’ modified virus. Once the virus had multiplied through these cells, they might be purified and processed to produce a modest quantity of vaccine, but in this case the Serum team was planning to bank them to infect even more cells, part of its plan to have enough for commercial manufacture. The company was in the process of ripping out the ceilings above another factory floor, creating room for 2,000-liter bioreactors suitable for pandemic-level production.

The Oxford team published promising data in a July article in the *Lancet*, showing its vaccine produced an immune response in almost everyone who received it in early tests. But it still has a long way to go before its safety and efficacy are proved in large-scale human trials, which are now under way. If the vaccine fails to prevent disease or turns out to have unacceptable side effects, Serum’s preparations will have been for nothing. That would incur a loss the company estimates could be as high as \$200 million—though the Bill & Melinda Gates Foundation has agreed to help share some of the production risk, and Serum hopes to repurpose its new equipment for other coronavirus vaccines.

That could require some significant retooling. Another leading candidate, from the U.S. biotech company Moderna Inc., relies on a never-before-used method that teaches the body to ward off the spike proteins by recruiting its own cells to produce and release them. This “messenger RNA” method—so called because the instructions for the spike protein are written in bits of genetic code that tell cells what proteins to produce—might be much easier to make at scale. Researchers at Imperial College London estimate that a single 5-liter bioreactor could produce as many as 50 million doses a year. But the technology is completely unproven, and Serum will have the capability to manufacture it only early next year, using techniques it’s never employed before.

The company is far more experienced producing vaccines of the oldest kind: inactive or weakened forms of an original virus, rendered harmless by heat or a chemical such as formaldehyde, or trained to infect a chicken embryo until they become inept at replicating in humans. At least two Chinese companies are developing coronavirus vaccines that employ the inactivated-virus approach, but it’s not clear where production would occur if they’re successful.

Global vaccine sales



The potential for complex problems, and even outright conflict, is obvious. The past several months have seen the emergence of a sort of vaccine nationalism, with governments around the world clamoring to make sure their citizens are at the front of the line. Sanofi CEO Paul Hudson prompted outrage in France when he said the U.S., which put up initial cash for manufacturing, would likely get the first shipments of the vaccine the Paris-based company is working on with GlaxoSmithKline Plc. The U.S. Department of Health and Human Services, meanwhile, recently bought up almost the entire short-term supply of remdesivir, an antiviral drug that’s been helpful for some Covid-19 patients.

Poonawalla says Serum has received no direct instructions from the government in Delhi to prioritize domestic use—only a general mandate to “make sure you have enough vaccine for India.” The plan for now is to devote half of Serum’s Oxford vaccine production to its home country—enough to cover the most vulnerable, plus a substantial chunk of the general population—and the rest to other developing nations, many with no meaningful production capacity of their own.

That would make Serum something of an outlier. If AstraZeneca’s manufacturing plans are any guide, most vaccine supplies are going to be national or regional, with American factories supplying the U.S., European ones responsible for Europe, and so on. But India, which already produces about 60% of the world’s vaccines, would make the shots for itself and anyone else who needs them. How much of that production comes from Serum, and not its many smaller but no less adept domestic competitors, will depend on Poonawalla’s abilities as a dealmaker and his production team’s ability to adjust to the needs of the winning formula.

No one can afford to wait long for a coronavirus vaccine, but time in poor countries is particularly short. India, where tens of millions of people live in densely packed slums, implemented one of the strictest lockdowns in the world but has failed to flatten the curve of infections, more than 2.1 million of which have been confirmed. The virus-fighting measures contributed to an economic collapse, throwing more than 100 million people at least temporarily out of work and creating a real risk of starvation among the poorest. So while some richer nations were able to maintain controls on movement until new cases fell to manageable levels, Prime Minister Narendra Modi had little choice but to open the economy back up, whatever the cost in viral

Serum's billion-dose vaccine factory, under construction



deaths. So far, more than 43,000 have been recorded, with the daily count regularly exceeding 800 in early August. Many more almost certainly have gone uncounted.

What worries some epidemiologists, though, is the possibility that humanity is entering a dangerous new age of infectious disease. There have been a half-dozen serious viral threats over the past 20 years, from the outbreak of severe acute respiratory syndrome (SARS) to the Ebola epidemic in West Africa, which shattered previous records for the spread of the terrifying pathogen. The odds of more emerging are arguably higher than ever. The destruction of natural habitats is putting people into much closer contact with animal viruses, while global travel networks make it possible for them to spread with ease. Many of these “zoonotic” viruses will be harmless to people, or not contagious enough to travel far, but some could have the right mix of attributes to create another catastrophe.

Shortly after the World Health Organization declared a pandemic in March, Poonawalla assembled 600 construction workers to build his biggest plant yet. Two months later the hulking concrete frame of the first and second stories was in place, with thickets of rebar pointing upward for the third. When the facility is complete in three years, it will add an additional 1 billion doses to Serum's annual capacity, at a cost of about \$400 million. With any luck, the coronavirus will be far less of a threat by then, and immunizations for it in only limited production. But Poonawalla plans to keep the new line ready for whatever comes next. “Maybe not in my lifetime, but at least in my children's lifetimes, there's going to be another global pandemic,” he says. “And I'm willing to bet anything that pandemic will be far worse than this.”

For much of the past two decades, proposing big, speculative investments in vaccine production would get you laughed out of many pharma company boardrooms. It still might. Vaccines are expensive and risky to develop but rarely have the payoff of, say, a new cancer therapy. A disproportionate share of the demand comes from developing countries with little ability to pay, and by definition each

patient receives just one or a few doses, rather than becoming a long-term customer. In a 2019 report on global vaccine development, McKinsey & Co. said “pipeline growth has been flat” among the so-called Big Four vaccine developers—GlaxoSmithKline, Merck, Pfizer, and Sanofi—with more lucrative products such as biologic medicines attracting a rising share of investment dollars.

Poonawalla's business model, by contrast, is built almost entirely on vaccines—and he's hopeful the experience of Covid-19 will spur a dramatic change in how governments, and investors, view his product. Politicians are going to “put huge priority and funding to vaccine procurement and distribution,” he says. That would benefit Serum enormously, though Poonawalla insists he won't cash in on the interest by going public or bringing in outside investors. But he is investigating the possibility of setting up some kind of dedicated unit to prepare for novel threats, and finding a philanthropic entity or sovereign wealth fund to help back his 1 billion-dose pandemic factory. Poonawalla is plenty rich and has the tolerance for long-term risk you might expect from a man who was to the stud farm born. But the burden of permanent vigilance against the next catastrophe is more than he can handle. “The endgame solution is to have some dedicated pandemic facility on standby forever,” he says. “Finding a financial model to keep that going is where I will need outside funding.”

In the meantime, Poonawalla's family is isolating at home, albeit with a vibe that's more *Lifestyles of the Rich and Famous* than *Contagion*. They've been riding out the virus in a spacious ranch house, surrounded by 190 acres of rolling hills and patches of woodland. In a glass-walled enclosure in the garden, Natasha, his wife, told me about how the virus scotched her tentative plan to send one of her two sons to a British boarding school, forcing her to take over his education personally. Meanwhile, a platoon of waiters in white shirts and black waistcoats laid out a teatime repast of cakes, cookies, and nuts. None of them wore masks; no one is allowed to get near the family without being tested. The last thing Poonawalla wants, as he tries to roll out a vaccine the world desperately needs, is to get sick. “I need to perform, and I'm focusing on that,” he says.

Natasha had barely had a chance to reach for a cookie before we were called out to the lawn. Two miniature Shetland ponies that Poonawalla wanted to show me had been fetched. Attendants led them to an artificial waterfall to pose for photos with the couple, Poonawalla in burgundy jeans and a light pink button-down and Natasha with a sleeveless Louis Vuitton hoodie hanging off her shoulders. They each held one of the tiny horses by a leash.

After the photos were taken, the Poonawallas retired to a nearby patio. As I left, the last thing I saw was the team of butlers racing across the lawn, the snacks we'd abandoned earlier balanced on silver trays. **B**

The Patent Problem



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Intellectual-property disputes throughout the drug supply chain could hold back a Covid-19 shot

By Cynthia Koons

Inside the race to develop a vaccine for the coronavirus is another contest worth keeping a close eye on: the rush to patent any discoveries. The frenzy to protect intellectual property brings with it the potential to impede access to what will likely be the world's most in-demand shots.

Dozens of companies and academic labs are working to find a vaccine. In early May the U.S. government waived fees for speedy Covid-related patent reviews, easing the research and development path for smaller teams that might not have been able to afford the extra charges, which average about \$2,100. All companies prize intellectual property, but for small ones it's

especially vital. IP gives them a way to value their inventions when seeking a development partner or buyer. And they almost always need help to finance the kind of large-scale trials required to seek approval for a drug.

When defending high drug prices, the industry has always argued that without generous rewards, there would be no innovation. But governments around the world know there's a risk in giving any one business veto power over a Covid cure. Canada and Germany have already threatened to override patents if necessary to get access to vaccines. In March, Israel issued an order to permit the import of a generic version of AbbVie Inc.'s antiviral Kaletra for use against the

disease. The government said AbbVie couldn't supply enough Kaletra, which is still under patent in Israel. After the order, AbbVie said it would "remove any potential barriers to alternate sources of supply." The drug hasn't been shown to be effective against Covid-19.

Seeing the potential pitfalls early on, the World Health Organization in May formed a patent pool—essentially asking researchers to share proprietary information, while not giving up royalties, to make it easier for vaccine researchers to replicate one another's work. As of July, many countries had signed on, but no drugmakers had, nor had the U.S.

A group of U.S. academics and engineers formed a patent coalition with a similar intent, and Amazon.com, Facebook, Microsoft, and other giants agreed to participate. No pharma companies joined. "Our guess is their position is, 'Covid-19 is a legitimate market—it could be a big market for us—so why give that up?'" says one of the pool's creators, Jorge Contreras, a patent law professor at the University of Utah.

In signing a \$2 billion deal to supply their experimental vaccine to the U.S., Pfizer Inc. and BioNTech SE set a price ceiling of less than \$20 a dose. During an early August conference call with investors, Moderna Inc. Chief Executive Officer Stéphane Bancel laid out the company's strategy. "During the pandemic, we are priced well below value with pre-approval supply agreements, mostly to governments...executed between \$32 and \$37 per dose," he said. While "larger volume agreements under discussion will be at a lower price," he said, after the worst phase of the pandemic ends, "pricing considerations will follow traditional dynamics and market forces."

Beyond price, complications could arise because drug companies often rely on outside manufacturers to produce medicines in large quantities. In this scenario, it might not be patents but trade secrets that create the headaches. There have been some signs of cooperation within the industry. In August, Pfizer Inc. said it had reached a multiyear agreement with Gilead Sciences Inc. to manufacture and supply its antiviral remdesivir. But one vaccine developer, Inovio

Pharmaceuticals Inc., has already sued its contract manufacturer for refusing to provide information about a manufacturing process. Inovio says it will need to scale up production of a theoretical vaccine. "You can't put up these roadblocks when public health, the greater good, is in play," CEO J. Joseph Kim said after suing in June. "It's appalling and shocking to me." The defendant says the information is protected as trade secrets, and the Pennsylvania courts have let those trade secrets stand while allowing the case to proceed.

"You can't put up these roadblocks when public health, the greater good, is in play"

Large pharma companies have also started adding manufacturing capacity before they've developed a viable vaccine, and it's possible one could build a plant but not succeed with its shot. In that scenario, governments would want that company to offer its facility to a competitor with a viable product. But both parties could easily refuse such an arrangement if it seems to put patents or trade secrets at risk. "If, for example, it turns out that AstraZeneca can't produce enough for the government," says Arti Rai, a law professor at Duke, "the question will become, will they license their intellectual property to other manufacturers? There could be patents or trade secrets, because manufacturing vaccines can be quite complex."

The U.S. government has some options. In instances in which it helped pay for research, it can exercise what are known as "march-in"

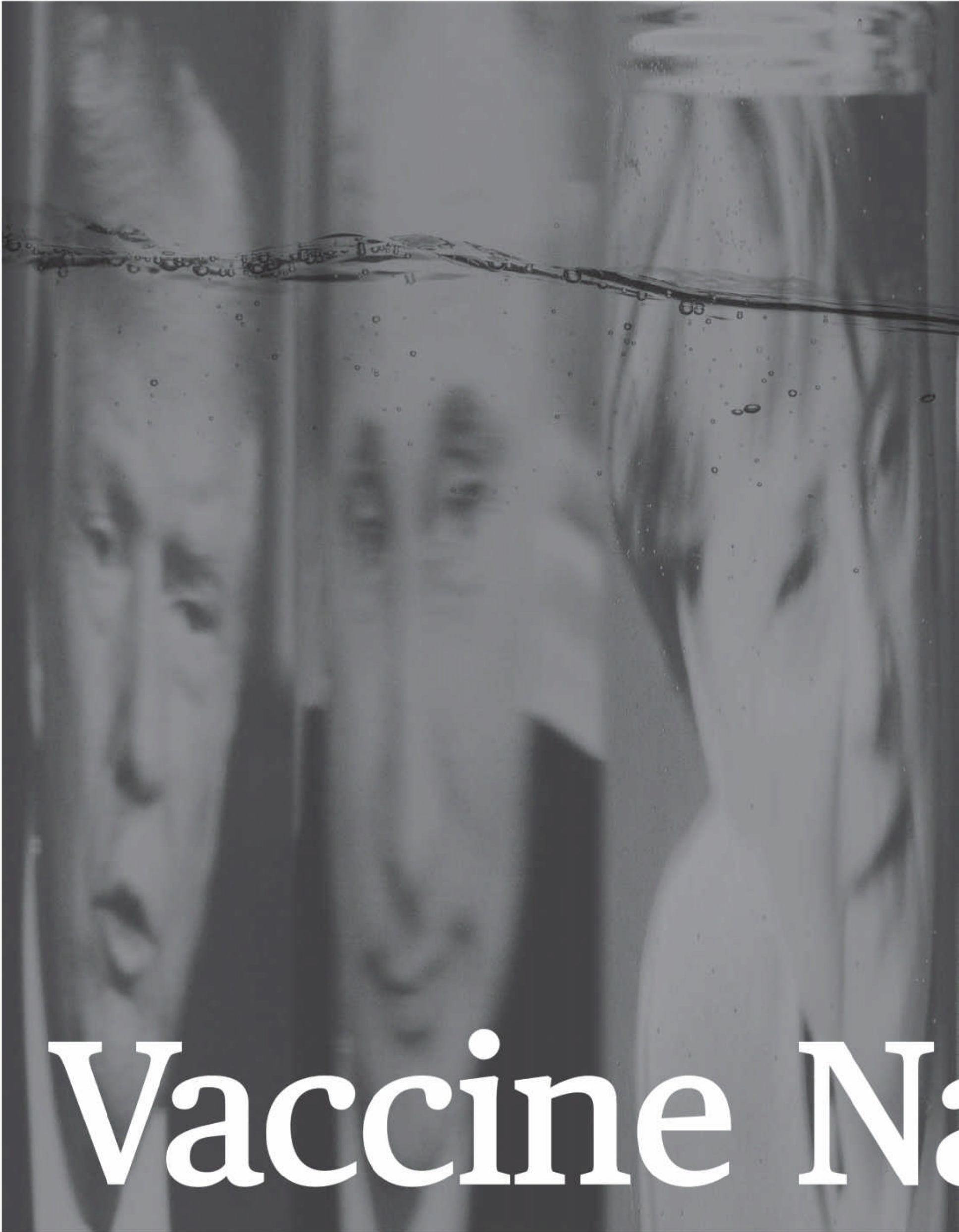
rights under the 1980 Bayh-Dole Act to wrest control of patented inventions and let others use them. Bayh-Dole hasn't been used on drugmakers. Even in instances where the government didn't fund research, it has the power to issue a compulsory license, letting others manufacture the drug. The patent owners would be entitled to a "reasonable royalty." The Pentagon regularly exercises such powers in defense contracts, such as for stealth technology in the F-22 fighter jet and helmet-mounted displays in the F-35 Joint Strike Fighter.

In a confrontation during the anthrax scare of 2001, the government threatened to override Bayer AG's exclusivity rights to the antibiotic ciprofloxacin. Bayer instead increased production and lowered prices on its own.

There are reasons to believe the government won't intervene directly this time. The nonprofit group Knowledge Ecology International, through a Freedom of Information Act request, uncovered industry-friendly details in government deals with drugmakers. In contracts with Johnson & Johnson for a vaccine and Regeneron Pharmaceuticals Inc. for a treatment, the U.S. government either narrowed or gave up its march-in rights.

"There's no rationale to say this should be outside of the Bayh-Dole Act," Contreras says. "This is why the Bayh-Dole Act was passed." J&J says that it's committed to making a vaccine available and that these kinds of contracts "strengthen" private-public engagement for research. A Regeneron spokeswoman says its contract "allows the government to access these technologies in order for us to work together to quickly address" the pandemic.

Patients Over Pharma and other consumer advocacy groups are urging the government to build some price guarantees into vaccine contracts or at least offer some transparency into what taxpayers are going to have to pay. "Any successful vaccine would be developed with taxpayer investments," says Eli Zupnick, spokesman for Patients Over Pharma. "There absolutely should be those kinds of protections baked into the contracts." **B** — *With Susan Decker*



Vaccine Na

WHAT IS AVAXHOME?

AVAXHOME-

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fresh magazines, hot games,
recent software, latest music releases.

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Cheap constant access to piping hot media

Protect your downloadings from Big brother

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The world's governments are vying to secure doses before their peers can. It's already getting ugly

By Vernon Silver

nationalism

NECESSITY →

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EDUCATION ●

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In a valley south of Rome where tourists rarely tread, the scene playing out on a recent morning was reminiscent of the climax of *Star Wars*, with the rebel pilots preparing for battle. Just past the vineyards, inside a sprawling modern pharmaceutical complex, clutches of young women and men marched down corridors in steel-toed boots, mint-green jumpsuits, and surgical masks. One group of cadets watched a training video. Another took turns assembling and disassembling equipment. Behind glass walls, droidlike robots rolled around performing automated tasks.

This Italian version of a rebel base is an outpost of an American company, Catalent Inc. The Death Star is Covid-19, which devastated this country in early spring. Catalent has a contract to fill tiny glass vials with as many as 450 million doses of the Oxford University-AstraZeneca Plc vaccine, which in late May became the first coronavirus candidate to enter large-scale human trials. The stakes, perils, and opportunities could hardly be higher for Italy: going from the West's first victim to, potentially, having within its borders almost a quarter of Earth's supply of a vaccine.

If the mission succeeds, the precious hoard will start piling up next month in a refrigerated warehouse at the Catalent plant. By early November, Italian regulators should be in a position to release the first doses to the international market, according to Mario Gargiulo, global head of biologics operations for Catalent, which is based in Somerset, N.J.

"The nation that was hardest hit—to be part of the solution—is a great story," Gargiulo says as he shows off the plant, located in the ancient town of Anagni. "The people here feel a strong responsibility. It will be the first, or one of the first, on the market. This is a race."

The competition has spurred a phenomenon known as vaccine nationalism—the jockeying of governments to secure doses of promising candidates for their citizens. The means of doing that are numerous, and the field of combat is vast: There are more than 160 efforts under way, with 26 in clinical evaluation as of July 31, according to the World Health Organization. Front-runners in final, Phase III trials include the Oxford vaccine; another from Moderna Inc., based in Cambridge, Mass.; and a third from Germany's BioNTech SE, which has partnered with Pfizer Inc. All of these have investments from or purchase agreements with the U.S. government and at least one other nation. China, Russia, and (starting this month) Italy are also among those with vaccine candidates being tested on humans.

With bragging rights and economies at stake, not everyone is playing nice. China and Russia have tried to hack various Western vaccine efforts, according to the intelligence services of the U.S. and its allies. Some nations and pharmaceutical companies are planning for the possibility that vaccines or their components might be blocked from crossing borders. The contest may also be putting medical safety at risk. It normally takes years to develop a vaccine, and the compressed timelines raise concerns about leaders' ambitions bending the judgment of regulators. Russia announced on Aug. 1 that it will start mass inoculations in October with a vaccine that hasn't yet finished clinical trials.

In the U.S. there are concerns, including those raised by members of Congress at a July hearing with pharmaceutical executives, that President Trump could pressure the Food and Drug Administration to cut corners as the November election nears.

Trump has embraced the competition with his Operation Warp Speed, which is spending as much as \$10 billion in the hope of having some 300 million doses of a winner available for Americans. As the deep-pocketed spoiler, Trump is placing bets on almost every major Western vaccine effort. "We will achieve a victory over the virus by unleashing America's scientific genius, which is what it is," Trump said during a July 27 visit to a biotech facility in North Carolina.

AstraZeneca has committed to creating autonomous supply chains for the Oxford shot on four continents—a frank acknowledgment that it isn't counting on a normal flow of goods. "Because of some of the politics, there's a risk of people ordering but not letting the vaccine across country borders," says Mene Pangalos, the company's head of research and development for biopharmaceuticals. "We've been looking at that pretty carefully and wondering what will happen if that moment comes. So we're being very careful about trying to create independent supply chains that will enable full access to the vaccine around the world." AstraZeneca is setting up production of its 2 billion initial doses in Europe, Brazil, India, Russia, and the U.S. India alone will account for half those doses, which are being made with an understanding reached with Prime Minister Narendra Modi's government that about 500 million will stay in the country.

Nations tend to flatter themselves in terms of how central they are to the action. Some Italian newspapers refer to the Oxford shot as the "Anglo-Italian vaccine" because of the support roles Italian companies have played in readying it for distribution. For months, Advent Srl, based in Pomezia, a 45-minute drive south of Rome, has been cranking out the doses AstraZeneca has been using for clinical trials in Brazil, South Africa, and the U.K. The production deal with Catalent was political gold for the government of Prime Minister Giuseppe Conte. It helped to abate the legal and political pressure that had been building around his administration's handling of the crisis, which has killed 35,000 Italians.

When he announced the deal in June, Conte was able to crow, "Italy, which was the first in Europe to get to know this virus closely, today has been recognized to be among the first countries to give an adequate response." Hopes for a vaccine replaced probes of the pandemic response on the nation's front pages. The moment provided a lesson in the power that even marginal victories in vaccine nationalism have right now. The moonshot race may determine not just who lives and dies, but which economies, and governments, rise and fall.

Countries are eyeing one another warily in part because of how they behaved during the first wave of outbreaks. Starting in March, governments blocked borders as they competed for masks, medicines, and ventilators, with at

least 90 jurisdictions putting restrictions on exports of protective equipment and other medical material, according to the Global Trade Alert project at Switzerland's University of St. Gallen.

The Trump administration, for example, asked 3M Co. to stop exporting N95 masks to Canada and Latin America as shortages mounted at U.S. hospitals. In March, Germany temporarily banned most exports of protective medical equipment. Italy then went tit-for-tat, seizing mask exports. China capitalized on Italy's moment of need (and perceived abandonment by its allies) and sent planeloads of Chinese Red Cross teams with ventilators, protective suits, and other gear. It was a classic use of soft power—be a friend and ally now, see how that might pay off later.

The West's next rude awakening to vaccine nationalism came on May 13, when the French drugmaker Sanofi SA said Americans would likely get its vaccine before the rest of the world, because the U.S. had financially backed early research.



Vials in Anagni...



...and the vial filling line

“The U.S. government has the right to the largest preorder because it's invested in taking the risk,” Chief Executive Officer Paul Hudson said in an interview with Bloomberg News. The company reversed course under pressure from its home country and others, but the message was plain: Put in your orders or wait in line.

A second shock followed days later, when the British government announced plans to spend £65.5 million (\$86 million) on the Oxford tieup with AstraZeneca. “This deal with AstraZeneca means that if the Oxford University vaccine works, people in the U.K. will get the first access to it,” said Alok Sharma, secretary of state for business, energy, and industrial strategy, in a news release, which promised that as many as 30 million doses would be available in the U.K. by September.

The moment was a wake-up call in Italy. The next morning's headline in *La Repubblica* framed the announcement as nearly a betrayal: “London Reserves 30 Million Doses of the Vaccine Born Between Oxford and Pomezia.” The first words of the story quoted Sharma saying the U.K. would get the shot first. “It is not clear what will go to Italy,” the article added. Behind the scenes, the Italian government began its own negotiations with European allies and AstraZeneca to put in an order.

Meanwhile, Trump's spending spree spurred fears in Germany that the U.S. was angling to buy CureVac AG, one of the country's leaders in the vaccine race, or its technology. To head off the Americans, Berlin agreed in June to buy about 23% of the company for €300 million (\$355 million). “Germany is not for sale,” Economy Minister Peter Altmaier said at a press conference. “We aren't selling off the family silver. I am a great supporter of a global free-market economy, but there are certain areas where our position must be very clear.”

Germany was right to understand Trump's government as putting allies second. In his July visit to the North Carolina plant, the president laid out a vaccine nationalism doctrine that boils down to this: America first, maybe some other countries later, and it's all China's fault. “We're mass-producing all of the most promising vaccine candidates in advance so that on the Day 1 that it's approved, it'll be available to the American people immediately,” he said. “And we'll probably have a lot for a lot of other people throughout the world. The world is suffering from this China virus.”

Brazil's plan to produce the Oxford vaccine for its own population could give a boost to President Jair Bolsonaro—himself recovering from Covid-19—as he presides over the world's second-worst outbreak while simultaneously downplaying its harm. The \$287 million deal the health ministry announced in June foresees Brazil taking delivery of 30.4 million doses in December and January, and then, following a technology transfer, making 70 million doses domestically.

Russia has taken some unorthodox shortcuts. The government's planned mass inoculations will use a vaccine developed by the state-run Gamaleya Institute of Epidemiology and Microbiology in Moscow, for which it used 50 military personnel as subjects for its first trial phase. ▶

◀ Scores of Russia's business and political elite have also been given early access to the experimental vaccine, Bloomberg News reported in July. As early as April, top executives at companies including aluminum giant United Co. Rusal Plc, as well as tycoons and government officials, began getting shots.

At the same time, Russia has denied the West's hacking allegations—in part saying it doesn't need to steal any technology because it's already signed with AstraZeneca to become a regional production hub for the Oxford vaccine. Under the deal, R-Pharm, one of Russia's largest pharmaceutical companies, will make and export doses of the Oxford shot to more than 30 countries, including in the Balkans, the Middle East, and some former Soviet republics.

Even the Canadian government is making sure it can make and keep an inoculation within its borders. It's spending C\$44 million (\$33 million) to upgrade a facility in Montreal so it can make vaccines and has set up partnerships with researchers at home and abroad, including China's CanSino Biologics Inc. "Canada is prioritizing domestic capacity to manufacture a vaccine candidate when one becomes available," the government's innovation, science, and economic development department said in a statement. Once fully operational, the Montreal facility will produce up to 100,000 doses a month. "This investment and research collaboration will help ensure that Canadians and frontline workers have access to potential vaccines as soon as possible."

In game theory, there's a puzzle called the prisoner's dilemma, which provides lessons on the choices people make as they weigh self-interest and cooperation. The premise is that two members of a gang are imprisoned in separate jail cells where they can't communicate with each other. A prosecutor who doesn't have evidence to convict either of a serious crime gives each prisoner the same deal: Snitch on your friend and you go free—unless he snitches on you, too. Of the various combinations, the best overall outcome is each prisoner staying mum and dealing with lesser charges.

What's happening now with the vaccine race is the prisoner's dilemma in action, says Thomas Bollyky, director of the Global Health Program at the Council on Foreign Relations, and Chad Bown, a senior fellow at the Peterson Institute for International Economics. Nations are eschewing the best case of cooperation for the risk of going it alone. "Vaccine nationalism is not just morally and ethically reprehensible: It is contrary to every country's economic, strategic, and health interests," Bollyky and Bown write in a *Foreign Affairs* article titled "The Tragedy of Vaccine Nationalism." As countries speed to secure their own early access to vaccines, the authors say, they're failing to slow the spread of the virus elsewhere, fostering supply chain disruptions, inefficiently spurring economies, and possibly sparking geopolitical conflict.

Rich countries are responding to these concerns by supporting the Covax Facility, a mechanism that's raising money to guarantee access to vaccines for some 90 lower-income



countries. At least 75 countries say they'll support the Covax Facility. But they're simultaneously putting their own interests first.

The European Union, for example, is supporting global initiatives for equitable vaccine access but isn't participating in such a program for its own purchases—it's taking its pool of money to place vaccine orders for member states. The U.K., in turn, has decided not to participate in an EU purchasing pool, because the government wants to be able to negotiate its own deals. Drill down further, and there's the deal that's leading Italy to bottle from 400 million to 450 million doses of the Oxford vaccine in its four-country pact with France, Germany, and the Netherlands. They're in it together, but exactly how and when those doses get distributed hasn't yet been announced.

Step back for a moment, though, and there's something to be said for a nation and its people working together to dig out of a crisis—especially if their efforts can help the rest of the world, too. That was the case with biochemist Stefania Di Marco, the scientific director at Advent. Di Marco became a crucial part of the Oxford effort in the earliest days of the outbreak, working out of a 1,000-square-meter production facility that was once a staff gym for pharma giant Merck & Co., the campus's previous owner.

In early February, a full month before Italy went into lockdown, Oxford's Jenner Institute signed a deal with Advent to produce doses of its vaccine. Having worked with the Oxford scientists on previous vaccines, Di Marco began familiar processes for the arrival of the "seed stock" that would allow her team to produce thousands of doses for Oxford's clinical trials. In the weeks that followed, Italy became the first coronavirus epicenter outside of China. Businesses around the country shuttered, but Di Marco's team of about 25 women and men kept working as part of a government-designated essential industry.

After weeks of preparation, Oxford shipped the precious seed stock. The arrival on March 23 of the samples, totaling just a few milliliters in fewer than 10 vials, packed in dry ice, set in motion a nonstop process. "There were no spare days," Di Marco says. They worked Saturdays and Sundays and nervously scanned headlines about small pockets of local

infections. During that time, Di Marco was in daily touch with colleagues at Oxford.

With that seed stock, Advent made about 3 liters of vaccine, yielding 13,000 doses. On May 20, the team sent its first shipment, in about 400 multidose vials, to Oxford in temperature-controlled Styrofoam boxes that kept them between 2C and 8C. Eight days later, British regulators released that first batch to the Oxford scientists. That evening, a Thursday, they began injecting the Advent doses into the arms of trial volunteers.

I met Di Marco the next morning during a visit to the Pomezia lab. She wore a surgical mask as she entered a conference room for the interview and squirted sanitizer from a dispenser onto her hands. She was practically giddy with the news that the vaccine candidate her team had made had started coursing through British veins just hours earlier.

For the next hour, Di Marco was all business—until I asked which moment in the months of work had meant the most to her. She paused. Because of the mask I couldn't see her whole expression, but her eyes turned glassy with tears. “The filling,” she said. That moment, at about 9 p.m. on May 4, when technicians began the semi-automated process of transferring the precious vaccine into glass vials, meant she and her team had threaded the needle at a sprint. “There was a lot of tension that something could go wrong,” Di Marco said. Italian politicians might be paying tribute to the national effort, but for Di Marco and her team, which includes scientists and technicians from all over the world, her story of Italian perseverance had been one of cooperation that she expects will save lives everywhere.

At Catalent's fill-and-finish facility, Gargiulo says he has no interest in promoting vaccine nationalism. The threat of cross-border hijinks is real enough, he says, that he's taken steps to mitigate possible disruptions.

Take the supply of glass vials. Globally, vaccine producers are braced for a potential shortage of the bottles, which

“Once the drug substance is available, there will be a supply chain in Italy, because everything after that will be done in Italy”

are made of a special glass. AstraZeneca has mitigated the risk, in part, by having contractors pack 10 doses into each multidose vial. For Gargiulo, that was just a first step. On the ground in Italy, allies' border-blocking of material in the pandemic's early days is still a fresh memory, so he reasoned he'd need to lock in a vial supply wholly within the country.

He turned to a company in Italy's northwest, Soffieria Bertolini SpA. But he had to be careful: The company obtains its specialty glass from a German glassmaker. Before he could assure AstraZeneca that Soffieria Bertolini could supply the vials, Gargiulo did due diligence on the bottle maker's hoard of raw German glass. “They told us their inventories,” he says. Only once he was assured there was enough on Italian soil was the vial-buying deal a go. Now, as he hires 100 employees and trains them on the bottling line, Catalent is awaiting the arrival, as soon as September, of massive bags of the vaccine “drug substance” being produced elsewhere in Europe. “Once the drug substance is available, there will be a supply chain in Italy, because everything after that will be done in Italy—formulation, filling, packaging,” he says.

Those are the processes Catalent's jumpsuit-clad workers are preparing for—adding final ingredients to the mix, pumping it into the filling line of sterilized bottles, moving the cargo into an inspection machine that scrutinizes each vial with nine cameras from different angles, and then racking the vials into boxes that are ready for transport. As Gargiulo gives a walk-through of the stages, two engineers at the end of a long corridor pore over poster-size flowcharts that map the steps the machines will go through. Once the machines start, they'll go almost nonstop, cranking out 24,000 vials per hour around the clock.

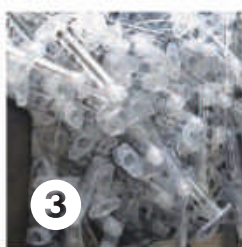
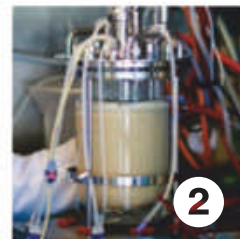
As batches are completed, they'll be moved to a refrigerated warehouse in the Catalent complex and stacked on aluminum and plastic pallets, ready for regulatory approvals and shipping. Gargiulo says he's sure the government will fast-track any bureaucratic steps. Among the last of those, the Superior Institute of Health will decide whether to release the finished product for export. While there are no signs this scientific process has been politicized, how it plays out could determine whether Italy is perceived as getting the vaccine first or, in the style of Chinese soft power, being a European hero for quickly distributing the supply.

In Italian politics, however, there are hints that the leadership expects its citizens to be first in line, even if all official statements about the deal portray it as being for Europeans and the EU has taken a role in managing the program. Health Minister Roberto Speranza has repeatedly said, including in a speech to Parliament, that if all goes well, some 60 million doses will be ready before the end of the year. That number is roughly equal to Catalent's capacity on the current schedule.

It also matches the population of Italy. Yes, these doses are meant for Europe. But Italians who are casual listeners to the news could be forgiven for assuming that the first batch is going entirely to them. **B** — *With Stephanie Baker*



Little Vaccine



Essentials

It's not just about the immunizing liquid

When you're planning a large vaccine drive, predictability is vital. The immunization campaign that allowed India to eradicate polio in 2014, for example, worked methodically through the country's populace of hundreds of millions of children, backed by a bank of knowledge about how the virus behaved, what the vaccine's properties were, and where new cases could be found. Such factors dictate not only how much vaccine is manufactured but also the production of a host of ancillaries: chemical additives such as adjuvants; hypodermics, glass vials, rubber stoppers, and other parts of an injection kit; and storage equipment such as deep freezers. Without this gear, a vaccine is just a fine formula, a cure in search of its disease.

Nothing about Covid-19 has been predictable, though. When the quest for a vaccine began early this year, moments after the new coronavirus's genes were sequenced and posted online, the prospects were so unclear that some governments postponed preparations for vaccine delivery. In a whistleblower complaint, Rick Bright, then the director of the U.S. Biomedical Advanced Research and Development Authority (Barda), wrote that his agency had estimated as far

By Samantha Subramanian

back as January that the country would need from 650 million to 850 million needles and syringes for a Covid-19 vaccination drive. The Strategic National Stockpile held just 15 million at the time, and Bright kept hearing that other countries, aware that scientists were predicting a 12- to 18-month timeline for the release of a vaccine, were buying up stocks of syringes and needles from the U.S. Yet the American government didn't place its first order for needles and syringes until May 1, he told Congress.

When a vaccine is finally approved for manufacture, the rush to stock up on ancillary products will be unprecedented. Across the world, according to Simone Blayer, who oversees vaccine process development for Path, a public health nonprofit based in Seattle, "we're looking at probably 2 to 4 billion doses to be deployed in the first quarter." No one knows what kind of vaccine will succeed, how it will need to be stored, where it will be administered first, how many doses a person will need—or, indeed, whether we'll even have a vaccine at all. If and when we do, manufacturers of vaccine ancillaries, accustomed to sedate and reliable cycles of demand, will have to meet a near-instantaneous clamor for their products.

1 Vials

A brief appreciation of borosilicate glass



The invention of borosilicate glass is part of corporate lore at Schott AG. In 1880 the German chemist Otto Schott, a window maker's son, set about experimenting with glass, trying to fulfill the stringent needs of a telescope observatory in the town of Jena. Methodically he worked his way through the then-new periodic table, adding one element after another to glass mixes and testing the results. Boron, until then, had been used mostly in detergent, but it turned out to make glass containers more resistant to temperature changes and far less reactive to the chemicals they held.

I asked Fabian Stöcker, Schott's vice president for global strategy and innovation, what makes borosilicate glass so different from the glass out of which I've just taken a sip of water. "That glass of water you're holding—it's a soda-lime glass," he says. If it held a more potent chemical, he explains, small particles of glass would gradually leach into the liquid. That doesn't happen with borosilicate glass, making it ideal for containing drugs and vaccines, which must avoid contamination. Schott makes long glass tubes out of borosilicate mixes—7% to 13% boron, the rest mostly silicon dioxide—at four melting facilities: two in Germany and one each in India and Brazil. The company is the world's largest manufacturer of medical borosilicate. "Around the world, roughly 25 billion injections every year—or 1,200 a second—are drawn out of vials made with our borosilicate glass," Stöcker says. About 11 billion of these are vials made by Schott itself; the rest are made by other vial manufacturers to whom Schott sells its borosilicate tubes.

In the early weeks of the pandemic, vaccine developers still couldn't forecast the kind of vials they'd need, but as prospects grew brighter and clearer, a tide of inquiries came Schott's way. To commission and test all-new factories, Stöcker says, would have taken a couple of years. Instead, Schott freed up manufacturing capacity in its existing factories, giving over more and more production lines to vials. The company had already planned to invest €320 million (\$376 million) across its operations, including for plant machinery; it ordered still more machines as vaccine development progressed. "We can supply vials for 2 billion vaccine doses, when the time comes," Stöcker says.

Several challenges of physics and logistics remain. The final step in the process of vaccine manufacturing is known as the

"fill and finish," in which vaccines and other chemicals are piped into vials, which are then sealed and checked. Many plants today can fill and finish tens of thousands of vaccine doses per hour, but when the immediate need is for billions of doses, even the fastest robotic filling arm can be too slow. For this reason, says Blayer at Path, the first wave of vaccines will likely have multiple doses in each vial. And the urgency of the demand may mean these multiple-dose vials won't contain preservatives, which normally have to undergo extensive testing to ensure the chemicals don't react adversely. In that case, Blayer says, "all the doses in a vial will have to be used up six or so hours after the vial has been opened, according to WHO [World Health Organization] requirements." An analyst at investment adviser Evercore Inc. also warned in April that the glass industry will face shortages of the kind of high-purity sand that goes into borosilicate glass, though Stöcker insists Schott isn't expecting a sand crunch.

Bright warned the U.S. government early in the pandemic that all the borosilicate tubes on the global market were either sold out or spoken for. It wasn't until May, when the U.S. government finally began to prepare for a vaccine, that it tried to secure a supply. Barda has invested \$204 million in Corning Inc. to expand its production of glass vials, and the government is also trying to secure alternatives to the classic vial in its attempt to make up for lost time. A company in Connecticut, Apiject Systems Corp., has received \$138 million to make 100 million prefillable plastic syringes by the end of the year. Another company, SiO2 Materials Science in Auburn, Ala., manufactures a patented vial out of plastic coated with a thin layer of glass. It looks just like a glass vial but is stronger and won't be affected by sand shortages, according to Lawrence Ganti, the company's chief business officer. In June, after extensive presentations to Barda and the U.S. Department of Defense, SiO2 won a \$143 million investment to accelerate its production—from 14 million vials to 120 million by December. "Basically they've called dibs on our entire production, should they need it," Ganti says.

If you went to the SiO2 campus in Auburn, he adds, you'd see "our first 165,000-square-foot plant, with people running around in cleanrooms, wearing PPE bunny suits, and just down the road, diggers and machinery that are building a second plant. We're having to hire like crazy." (By July, SiO2 had started work on a third plant.) Every kind of vial has to undergo stability testing with vaccine candidates to make certain the container and its contents don't react with each other. Ganti says SiO2 has been conducting this testing with Moderna Inc. and three other vaccine developers.

In June, Schott's chairman, Frank Heinrich, told Reuters he'd rejected requests from pharma companies to reserve stocks of vials in advance, lest Schott end up committing a major supply to a vaccine developer that fails to bring its product to market. The company has instead forged agreements with a number of big companies—"hot tickets," as Stöcker calls them—that are working on Covid-19 vaccines, so its newly added capacity can best support production. "Then, in case one of them gets to make the successful vaccine," Stöcker says, "we are ready and there."

2 Adjuvants

Moving beyond soapbark to target the coronavirus



On a Zoom call, Garo Armen playacts with his hands the role of an adjuvant in a vaccine. “Say you have a gun, a very accurate gun, and you point it at the target you want to hit,” says Armen, CEO of the biotechnology company Agenus Inc., based near Boston. He mimes cocking a pistol with the fingers of one hand and aims it at the other. The gun is a vaccine, and the target is a particular kind of immune response roused by the vaccine. “Now, maybe your bullet doesn’t have enough energy to reach the target, and it drops away before the target. That extra energy needed is provided by the adjuvant.”

More precisely, the adjuvant is a secondary chemical that acts alongside the vaccine to provoke the right kind of immune response and ensure the response has “memory”—that it can be stirred up again even if a pathogen invades the body years down the line. The first adjuvant was discovered by accident, by a French veterinarian named Gaston Ramon who gave horses diphtheria shots in which he’d mixed one or the other of a range of substances: breadcrumbs, tapioca, agar. For decades thereafter, the only notable adjuvants licensed for human vaccines were salts of aluminum, which could be produced cheaply and plentifully; they goosed inoculations against hepatitis, tetanus, and diphtheria. Only in the 1990s did biotech labs such as Agenus find and develop complex new approaches. Agenus’s flagship adjuvant, QS-21, rides

inside GlaxoSmithKline Plc’s shingles vaccine. The addition helps make the vaccine effective in more people and for longer periods of time, Armen says. “Even eight or nine years out, we haven’t seen any decline in efficacy.”

Not every vaccine requires an adjuvant, but many of the Covid-19 vaccines under development are using one in trials. In theory, adjuvants can shrink the volume of vaccine needed in each dose, which would ease the pressure on manufacturers. They can also boost the effects of vaccines in older adults, who’ve been disproportionately affected by Covid-19 and whose immune systems are difficult to stimulate. The effectiveness of flu vaccines, for comparison, wanes in people over age 65, even though these shots frequently come “adjuvanted”; in 2018-19 they were effective in just 12% of this age group, vs. 25% for people 18 to 49. In May, GlaxoSmithKline announced it would manufacture 1 billion units of its AS03 adjuvant, which has worked with pandemic flu vaccines, to supply multiple developers of Covid vaccines around the world.

Twenty years ago, a sudden demand for adjuvants could only have been filled by aluminum salts. The newer options are more refined and take better aim at the immune system, according to Armen. To demonstrate, he pulls open a drawer in his desk and takes out a flip phone. “Would you use one of these today?” he says. “No. So why would you use aluminum salts?”

The new adjuvants, however, until very recently had to be distilled from natural sources, which took time, patience, and abundant supplies. The active ingredient in QS-21 comes from the soapbark tree, which grows in the mountains of Chile; its bark has to be harvested in the southern summer, turned into a slurry, and processed. Squalene, another new adjuvant, is derived from shark liver oil. To obtain 1 billion doses “would take a lot of sharks, and a lot of hunting, for a long time,” says John Melo, CEO of Amyris Inc., a biotech company based in Emeryville, Calif.

Now, biotechs are finding ways to synthesize these compounds. Armen says that Agenus has been working on multiplying cells in bioreactors and that in a couple of years he expects to be able to turn out vast quantities of QS-21 without needing a steady harvest of Chilean bark. Amyris has been testing and validating its version of squalene, made by fermenting raw sugarcane in Brazil and then processing that product in American factories, for the past two years. When the pandemic started, it was “close to market-ready,” Melo says. In July, Amyris had already committed to deliver 10 tons of squalene adjuvant—1 billion 10-milligram doses—by the end of the year to a major pharmaceutical company for its coronavirus vaccine candidate.

I ask Melo what would happen to all that squalene if the search for a vaccine failed. He’s sure it would still be used—if not in a coronavirus vaccine, then in a flu shot. “It’ll have a home, definitely,” he says. The real issue is to have more squalene ready to go if a compatible coronavirus vaccine made by another company proves successful. “What makes it hard is that, right now, I don’t think anyone can predict which the winning vaccine will be.”

3 Hypodermics

Building toward billions of ouchies



The world's largest manufacturer of injection devices is Becton, Dickinson & Co., which sold its first syringe in 1897. Imported from France and costing \$2.50, the original was an all-glass model at a time when others were made either of hard rubber or of glass and metal combined. Today, Becton Dickinson factories are spread across the U.S., Europe, and Asia, helping the company earn revenue last year of \$17.3 billion. In the U.S., the largest manufacturer of Becton Dickinson's syringes is a plant in Columbus, Neb., and its needles chiefly come from a factory in Canaan, Conn. Troy Kirkpatrick, a spokesperson for the company, won't specify how many of each the company makes in a typical year but says it's "in the billions in the U.S. alone."

When I spoke with Kirkpatrick on the phone in June, he was at home; Becton Dickinson's headquarters in Franklin Lakes, N.J., hadn't reopened yet. But the company's plants were all running, by and large. It helped, he says, that Becton Dickinson has factories in China, which saw the coronavirus first; as the pandemic spread westward, its factories in Europe and America were able to implement the lessons the

company had learned. Employees had their temperature taken when they arrived; the shop floor was cleaned even more than usual. Some product lines, such as for catheters and artery balloons, had to be put on hiatus, Kirkpatrick says, because hospitals were so focused on Covid-19 they'd stopped performing elective surgeries and nonemergency procedures.

Most modern syringes are extrusion-molded out of polypropylene resin and then packed in blister film and medical-grade paper. Needles are milled from stainless steel—the hollow tubes sealed along their sides by lasers, pressed to thinness in a die, and then ground to a sharp point. The raw materials for both products are common and widely available, according to Kirkpatrick. "We haven't seen any issues in these supply chains, so we aren't worried about that currently," he says. "The bigger risk, I think, is, do we have enough of an understanding of the kinds of volumes that are going to be needed six or seven months from now?"

If the Trump administration were to order 300 million hypodermic injection sets, Becton Dickinson could do that. "Obviously it helps that our baseline is in the billions," Kirkpatrick says. "But it isn't like we can flip a switch and do it overnight." He expresses concern that some officials haven't been planning ahead. "One government that has thought about this already is the Canadian government, which has ordered 38 million needles and syringes from us. That's enough to inoculate their entire population with one dose," he says. "But others seem to be thinking that this is down the road a bit, and that they have the luxury of waiting. We're talking to them and trying to break that myth."

At the time Kirkpatrick and I spoke, Becton Dickinson was in talks with the U.S. government. "We're trying to say: 'Look, if you're looking at potential vaccines that may be ready, say, at the beginning of next year, you need to place your orders now,'" he says. "Otherwise, even we can't make hundreds of millions or billions of syringes in a matter of months without sacrificing all sorts of other products that are used for non-Covid purposes." On July 8, Barda agreed to invest \$42 million in ramping up Becton Dickinson's manufacturing in Nebraska and to purchase 50 million needles and syringes; two weeks later, the U.S. ordered an additional 140 million, and Canada an additional 37 million.

These orders notwithstanding, Becton Dickinson could well set about expanding its production capacity only for no vaccine to materialize. Purely from a business perspective, this scenario doesn't trouble Kirkpatrick much; the U.S. government will pay for the equipment well in advance, and if no vaccine materializes, the needles and syringes will go into the national stockpile for future use. The priority is for manufacturers to get involved early in the planning process. Not all hypodermics are the same, and syringe and needle makers need to know the nature of the vaccine before they begin production. "Do you need 1 milliliter, or 10 milliliters, or something in between?" Kirkpatrick asks. This is why companies are pressing for quick decisions. "Cranking up production is fine, but cranking up production of what, specifically?" he says. "We can't guess what types of syringes you'll need at the last minute." **B**

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The Anti- Anti-Vaxxers

Web-savvy doctors like Zubin Damania (aka ZDoggMD) are fighting vaccine pseudoscience, one viral clip at a time

By Thomas Buckley
Photograph by
Demetrius Philp

In January, as the first cases of Covid-19 were gaining global attention, Nicole Baldwin, a pediatrician in Cincinnati, posted a playful 15-second clip on TikTok, listing the diseases that inoculation prevents and rebuking the conspiracy theory that vaccines cause developmental disorders. After accruing a dozen or so views, she posted it to her Facebook, Instagram, and Twitter accounts in the hope it would reach a wider audience. Almost overnight, it did, but not the audience she intended.

“Come near me or my child with a needle and I will put it in your jugular,” one comment read. “Dead doctors don’t lie,” read another. A militia of vaccine opponents, thousands strong, was conducting a coordinated attack. Not content to keep it to social media, they threatened Baldwin’s practice, leaving false reviews meant to incriminate her on Google and Yelp. Some made threats to her life that were repeated and credible enough to land a police detail outside her home.

As the fervor grew, Todd Wolynn, a fellow doctor and a co-founder of Shots Heard Round the World, an informal group that seeks to protect vaccine advocates from online abuse, enlisted 16 volunteers to help get hateful posts removed and some of their 6,000 authors banned. Wolynn also thought a counterattack might be in order—so he called in Zubin Damania.

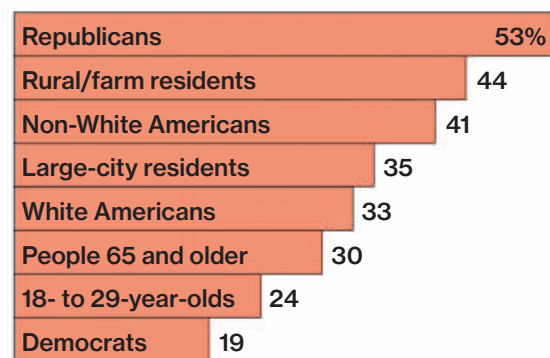
Damania is something of a healthcare avenger. His YouTube videos, in which he raps in costume or rants about the anti-vaccine movement and wider problems with the medical system, have been viewed tens of millions of times. He’s one of a growing number of physicians turned online influencers able to communicate compellingly to viewers who might otherwise fall prey to pseudoscience. After getting the call from Wolynn, he organized a virtual rally, calling on health workers of all stripes to post videos, statements, and evidence to discredit Baldwin’s aggressors alongside the hashtag #DoctorsSpeakUp. The resulting campaign trended nationally on Twitter.

Damania’s ambition to vanquish the so-called anti-vax movement was born out of a conversation he had about a

decade ago with a pediatrician friend who said enough parents were declining to vaccinate their children that a resurgence of potentially fatal diseases could result. Anti-vaccine sentiment has continued to spread since then, as opponents gather on Facebook, Reddit, and other forums, swelling their numbers with catchy, (literally) viral clips, sensationalistic rhetoric, and a litany of hashtags designed to draw viewers down social media’s algorithmic rabbit holes. Such is their reach that last year the World Health Organization named growing hesitation toward common vaccines as one of the top 10 threats to human health. In the U.S., the vaccination rate among kindergartners has fallen below the targeted 90% in a majority of states, a decline that last

No Vaccines, Please

Share of Americans from different demographic groups who say they’d decline a free, government-approved Covid-19 shot



year led to the country’s most severe measles outbreak in a quarter century.

The fight against vaccine misinformation has taken on new urgency during the current pandemic. Life won’t return to normal unless an overwhelming majority of people develop some measure of immunity to the novel coronavirus, which essentially means either sufficient numbers get a vaccine or get the disease and develop antibodies, even as many more victims die along the way. Yet a poll published by Gallup in early August found that 35% of surveyed Americans would decline a government-approved Covid-19 shot offered to them at no cost.

Some of those seeking to combat vaccine misinformation stick to staid recitations of scientific fact. Damania does do serious interviews with leading medical

professionals, but more than most, he hits anti-vaxxers where they lurk. His videos are often goofy, profane, or outraged; one fitting the latter two descriptions, *A Doctor Reacts to “Plandemic,”* posted in response to the widely circulated pseudoscientific documentary claiming the flu shot contains coronaviruses, has attracted 3 million views.

To mitigate the influence of anti-vaxxers, Damania argues, more of his colleagues will have to find imaginative ways to connect with an audience prone to getting its diagnostics from Facebook groups. “We’re probably a good three years of hard work behind in terms of cultural influence, and we just have to fight fire with fire,” he says. “If the anti-vaxxers are weaponizing social media and using the algorithms to their advantage, then why shouldn’t we?”

In the 1990s, Andrew Wakefield, a doctor at the Royal Free Hospital in London, published a pair of papers in the prestigious medical journal the *Lancet*, positing links between vaccination and disease. The first, from 1995, claimed that 3,545 people who’d received a live measles vaccine for a 1964 trial had experienced higher prevalence of Crohn’s disease and other digestive disorders than an unvaccinated control group. The second, published in 1998, sought to establish a link between autism and the measles, mumps, and rubella vaccine, based on a study in which the parents of 8 of 12 autistic children described the onset of behavioral symptoms associated with the disorder within two weeks of receiving an MMR vaccination.

The papers brought Wakefield international fame, despite comprehensive epidemiological studies subsequently carried out by the U.K. National Health Service, the U.S. National Academy of Sciences, the American Academy of Pediatrics, and the Centers for Disease Control and Prevention showing that no link existed between the MMR vaccine and autism. In 2000, Wakefield appeared on *60 Minutes*, where he falsely claimed during a heated debate that the MMR vaccine’s cumulative strength made it more likely to adversely affect children than separate doses for the three target viruses. A year later, he resigned from ►

◀ the Royal Free Hospital and decamped to the U.S., where he became one of the most prominent promoters of anti-vaccination conspiracy theories and medically unsubstantiated cures for autism.

In 2010, Wakefield was struck from the U.K.'s medical register following the longest ethics investigation in the history of Britain's General Medical Council. The council found that, among other breaches, he'd once paid children at his son's birthday party to let him draw their blood. It also said that he'd failed to disclose glaring conflicts of interest, such as his application to patent a rival vaccine to the common MMR shot, and that he'd been paid almost \$1 million to carry out his research by lawyers representing families seeking to sue vaccine manufacturers. The *Lancet's* editor-in-chief subsequently retracted the 1998 paper, calling it "utterly false." The following year, the *British Medical Journal* published an editorial showing that Wakefield had manipulated evidence to reach his conclusions.

As his stature declined in respectable circles, Wakefield went after a fringier and more impressionable segment of the American populace. His notoriety spiked in 2016, when a film he'd produced, *Vaxxed*, was released and he spoke at a seven-day "Conspira-Sea" cruise off the coast of Mexico, alongside fellow guests such as a self-described alchemist who claimed to have visited secret colonies on Mars. In the runup to that year's U.S. election, Wakefield and two other noted anti-vaxxers also had an audience in Florida with Donald Trump, who'd repeatedly proclaimed a link between the MMR vaccine and autism prior to running for president.

Throughout the decade, millions of anti-vax sympathizers were banding together online to craft and spread propaganda, coordinate conferences and demonstrations, and mount guerrilla efforts to abuse vaccination advocates. They exploited gaps in social media oversight, often working anonymously and adopting tactics such as sharing the same video hundreds of times to hike its chances of going viral. Occasionally, their aversion to evidence-based medicine hurt one of their own. Earlier this year, for example, a 4-year-old boy

died of influenza in Colorado after his mother, one of 148,000 followers of a Facebook group called Stop Mandatory Vaccination, decided to treat him with a concoction of breast milk, elderberry, and thyme recommended by a fellow member, rather than with the antiviral flu drug the child's pediatrician had prescribed.

Although hardcore anti-vaxxers are still fewer in number than proponents, they appear to be succeeding in growing the ranks of agnostics. A study published in *Nature* in May assessed almost 100 million people who'd expressed views on vaccines on Facebook and estimated, based on the pages they followed, that 4.2 million were anti-vaccine and 6.9 million were pro-vaccine, while a staggering 74.1 million were undecided. The authors raised the prospect that people holding anti-vaccination views would be the majority within a decade.

That same month, Wakefield appeared at the virtual Health Freedom Summit, where he suggested that the reported number of Covid-19 deaths—more than 735,000, so far—was "greatly exaggerated." He also compared the vaccine industry to the slave trade and said the refusal to be immunized was worth dying for. Wakefield didn't return phone calls or respond to voicemails and text messages seeking comment for this article.

The media and the medical profession have tried to challenge Wakefield and his followers. In the past decade, he's topped Medscape's annual list of the world's worst doctors and been named one of science's great frauds by *Time* magazine. He was also awarded a Golden Duck for "lifetime achievement in quackery" by the nonprofit Good Thinking Society. But Wakefield's opponents have failed to match his followers' energy and tech-forward methods.

That's where Damania, who grew up in California, the child of two physicians, came in. In 2010 he uploaded his first video to YouTube, of his commencement speech at the University of California at San Francisco School of Medicine. From there he began to experiment, rapping about ulcers and crooning ballads such as *Pull and Pray—The Safe Sex Song* under his online moniker, ZDogMD. As his

channel grew in popularity, he became convinced that it could be an important platform for sound health information.

The following year, while Damania was working at Stanford University Medical Center and the Washington Hospital Healthcare System in Fremont, he uploaded *Immunize*, a parody of the Travie McCoy and Bruno Mars song *Billionaire*, which included the lyrics "Everywhere I turn my eyes/ The internet is spreading lies/ So many parents scared by fairy tales and hate/ I need to educate so I can vaccinate." The video featured a fellow doctor as a scrub-wearing, sword- and nunchuck-wielding "immu-ninja." "It was my first foray into that sort of counterprogramming, and it came from a place of just abject disgust," says Damania, who's 47, with excitable, deep-set brown eyes and a wide smile.

The video quickly racked up more than 200,000 views, accompanied by praise and disdain in equal measure. His critics questioned his credentials, posted his private information online, and even called Stanford to accuse him of ridiculing parents with "vaccine injured" children. Damania found the onslaught terrifying but fascinating. He learned that the more views and comments the video received, the more likely YouTube would suggest it to people searching for vaccine-related terms. Encouraged, he began spending more time on anti-vax Facebook groups, looking for insight into how their members created and shared viral content.

As he read, he came across a loose "anti-anti-vax" movement that had begun to form. Its leading lights included David Gorski, an American surgical oncologist who also served as managing editor of *Science-Based Medicine*, an informational website. Such work was honorable, in Damania's view, but too dry. The groups "spent a lot of time countering all of the misinformation but doing it in a very unemotional, Spock-like way that I didn't find particularly compelling for the average Joe," he says. His attitude was, "Let's get into the emotion of it, because that's what really sways people."

In 2012, Damania left Stanford to start a network of preventive-care clinics in Las Vegas, backed by Tony Hsieh, the

chief executive officer of online clothier Zappos.com LLC. When the initiative foundered five years later, Damania moved his family back to California and began vlogging and public speaking full time, dubbing himself “Healthcare’s Unfiltered Voice” and traveling the world to lecture before institutions such as Doctors Without Borders. On his social media channels he kept staging satirical scenarios alongside grounded conversations with pro-vaccine figures, including one with the physician Paul Offit that was interrupted by anti-vaxxers violently pounding the studio walls. These days, Damania works out of a gated complex at an undisclosed Bay Area location, to ensure his safety. He regularly receives death threats—some, he says, peppered with the additional threat of castration.

The hundreds of videos he’s posted since 2010 have now cumulatively attracted about 60 million views—enough to gain the notice of social media executives, who’ve long been criticized for their inaction on misinformation. “Facebook and YouTube are well aware of what we do,” he says. “I’ve had calls with their highest folks, where we talk about how it’s possible to cut through the haze of misinformation and promote the information that’s actually positive.”

Damania isn’t seeking censorship of anti-vax content. His preferred approach is tagging, along the lines of the disclaimers Twitter has started to affix to troublesome tweets. On YouTube, he says, this might consist of banners linking to channels like his, reading, “Hey, by the way, this is total

BS—here’s a video that tells you why.”

Despite his online stardom, Damania started worrying earlier this year that his work wasn’t helping bring about some of the larger changes he’d had in mind when he set out—grand goals such as galvanizing U.S. health care to reform with an emphasis on preventive care. In some videos he solemnly asked viewers whether his work mattered and whether he should quit. Hundreds of people wrote in saying he’d changed their minds about vaccines. He also got supportive notes from some of the U.S.’s most accomplished health-care figures. And one junior doctor said Damania’s videos about coping with burnout had pulled him back from the brink of suicide.

When the pandemic took hold, Damania swiftly gained tens of thousands of new followers on YouTube and Instagram. His Facebook page jumped by 400,000 followers, to 1.8 million. Americans were hungry for reliable information on the virus, on immunity, on whether *Plandemic* was real, on whether President Trump was on to something when he mused about injecting bleach. The attention reinvigorated Damania and got him thinking ahead to the showdown that’s all but sure to take place if a vaccine becomes available. “The anti-vaxxers will activate en masse and try to sow enough doubt and dissension that you will not get the critical vaccination levels and it will fail,” he says.

The anti-vax movement has long since popularized the belief that Big Pharma and the CDC are conspiring

to profit from medicine they know to be unsafe. Damania foresees a distinct challenge with Covid-19 in the unprecedented pace at which large pharmaceutical companies are racing to develop vaccines, gain regulatory approval, and build out their supply chains. The scientific consensus around the safety of current vaccines exists in part because they were tested over a time frame that’s typically three to four years and because they ultimately went on to decades of harmless use in large populations. Damania is concerned that, if a Covid-19 shot becomes available, anti-vaxxers will accuse manufacturers and regulators of rushing out a dangerous product, regardless of how thorough the trial process has actually been.

Medical workers should be prepared, he says, to mount a major communication effort to get the vaccination rate where it needs to be. Others share his thinking. A working group at Johns Hopkins University, for example, published a report last month that includes recommendations to U.S. policymakers and doctors for persuading the public to accept a future vaccine to prevent Covid-19. The report emphasizes continuously sharing data about its benefits, risks, and supply.

In June, after a flurry of anti-vax sites falsely claimed Bill Gates had said a coronavirus vaccine could kill 1 million people, Damania uploaded his most ambitious music video to date. Set to Eminem’s *Stan*—in which the rapper imagines getting letters from an obsessive, increasingly aggrieved fan—the parody version, *Dan*, has ZDoggMD receiving pleas for attention from an anti-vaxxer who has, among other afflictions, been bitten by his service weasel, which he’s fed a measles-laced burrito in an attempt to confer immunity without a vaccine. ZDoggMD ultimately replies in a firm but compassionate tone: “I know you’re mad, Dan/ I’m sad you don’t feel heard/ But I get mad when kids get hurt/ Because damn, these vaccines work.” Dan, like Stan, dies before he can hear the rapper’s message, but he was never the target audience, anyway. As long as viewers get it, Damania says, it’s one more step toward turning the anti-vax tide. **B**



So How Does This End, Bill?



Bill Gates, the Microsoft Corp. co-founder and billionaire philanthropist, has become, for better and worse, a central character in the story of Covid-19. The good news: The Bill & Melinda Gates Foundation has pledged more than \$350 million to fight the disease, including funds for vaccine manufacturing efforts at AstraZeneca, Johnson & Johnson, and Novavax. The bad news: Gates has been vilified by anti-vaxxers and other conspiracy theorists who claim he seeded the virus for his own nefarious purposes.

Gates says he's optimistic about the world's chances of seeing through the wilder theories and of beating the coronavirus, too. His remarks have been condensed and edited for clarity.

How confident are you we'll have a working vaccine that can be widely distributed by the end of 2020?

Well, the initial vaccine won't be ideal in terms of its effectiveness against sickness and transmission. It may not have a long duration,

and it will mainly be used in rich countries as a stopgap measure.

We'd be lucky to have much before the end of the year. But then, in 2021, a number of other vaccines are very likely to get approved. The strongest response will probably come from the protein subunit. With so many companies working on it, we can afford quite a few failures and still have something with low cost and long duration.

For years, people have said if anti-vaxxers had lived through a pandemic, the way their grandparents did, they'd think differently. Whoops.

The two times I've been to the White House [since 2016], I was told I had to go listen to anti-vaxxers like Robert Kennedy Jr. So, yes, it's ironic that people are questioning vaccines and we're actually having to say, "Oh, my God, how else can you get out of a tragic pandemic?"

Given the skepticism, should a Covid vaccine be mandatory?

Making something mandatory can often backfire. But you might say that if you're going to work in an old-folks home or have any exposure to elderly people, it would be required.

What do you make of the conspiracy theories that you're pursuing vaccine research to control people's minds using 5G radio waves and so on?

It's strange. They take the fact that I'm involved with vaccines and they just reverse it, so instead of giving

money to save lives, I'm making money to get rid of lives. If that stops people from taking a vaccine or looking at the latest data about wearing a mask, then it's a big problem.

What about the conversation around hydroxychloroquine, which the White House has promoted despite its repeatedly being shown to be ineffective and, in fact, to cause heart problems in some patients?

This is an age of science, but sometimes it doesn't feel that way. In the test tube, hydroxychloroquine looked good. On the other hand, there are lots of good therapeutic drugs coming that are proven to work without the severe side effects.

We've seen the U.S. and other countries buying up vaccine supplies even before they're approved. Is that harmful?

We need cooperation within countries and between countries. The U.S. as yet has not helped come up with procurement money for poor countries. We've funded more research and development than any country, but on factories and procurement, we've only taken care of ourselves. Every call I'm on with the pharma leaders and the leaders of countries is with the goal of, "Hey, we need everybody to be protected."

How do you think this all ends?

The innovations in therapeutics will start to cut the death rate, but the true end will come from the spread of natural infections and the vaccine giving us herd immunity. For rich countries, that will be sometime next year, ideally in the first half. We'll get out of this by the end of 2021.

So we're going to be OK?

Certainly. We're lucky this one wasn't a more fatal disease. **B** — *Dina Bass and Candy Cheng*

How long has it been since you hugged someone who doesn't live in your home?

Less than a week	One to four weeks	One to four months	More than four months	Unsure or not a hugger
21%	14%	15%	31%	18%



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