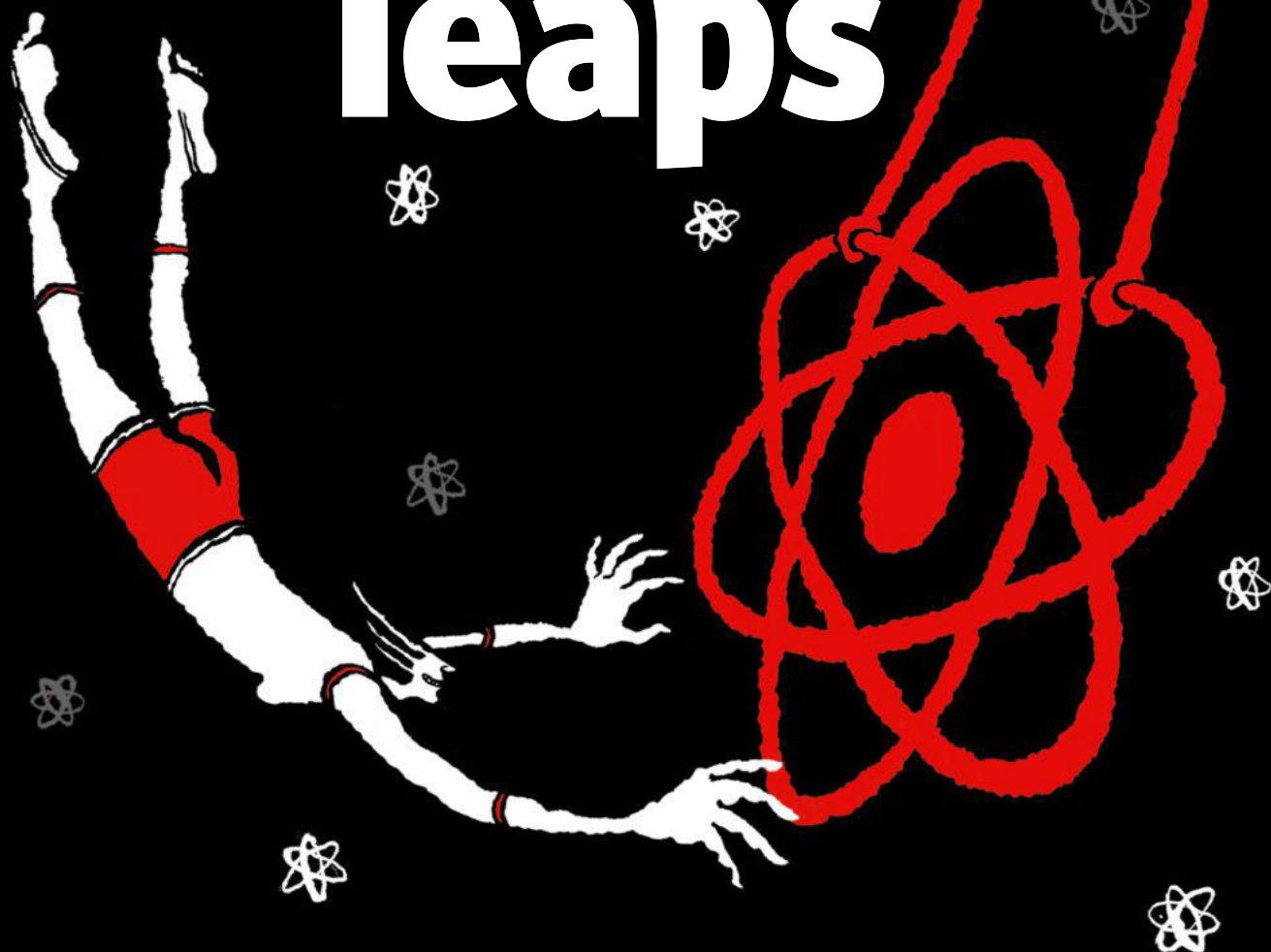


The Economist

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Quantum leaps



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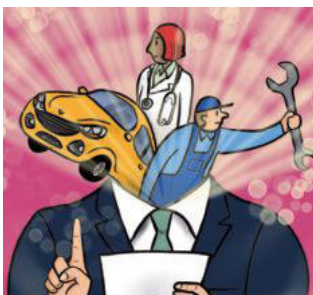
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Politics



Donald Trump signed a revised executive order to implement a **travel ban** on citizens from six Muslim-majority countries. Iraqis were taken off the list, as the administration conceded that they have been crucial in the fight against terror. Republicans who had condemned the original order fell in line to support the new ban, which comes into force on March 16th.

Jeff Sessions, the attorney-general, recused himself from an investigation into **Russian attempts** to influence last year's election, after admitting that he had spoken to the Russian ambassador during the campaign. As allegations swirled about Russian links to his team, Mr Trump said that Barack Obama had ordered his phones to be tapped, but offered no evidence.

Republicans in the House of Representatives unveiled a bill to replace Obamacare. Among other things, it would drop the requirement for people to have **health insurance**, but it allows for a penalty on those who let their insurance expire. The bill's passage is far from assured. Conservatives have griped that the new system would retain too many subsidies. Some Republican senators have raised concerns that the plan to roll back the expansion of Medicaid adversely affects their states.

Diminished circumstances
Brazil's economy shrank by 3.6% in 2016, according to new data. This follows a contraction of 3.8% in 2015. The two-year slump is the country's

most severe recession on record. But inflation and interest rates are falling, which should spur a recovery.

Bolivia's president, Evo Morales, signed a law to expand the area on which the cultivation of coca, the raw material for cocaine, is allowed. Under the new law, farmers may now grow coca on 22,000 hectares, up from 12,000 hectares previously. Mr Morales, a former leader of a coca-growers' union, defends the crop as a traditional stimulant. Coca leaves can be chewed or used in hot drinks. Critics contend that much of it is used to make cocaine.

See you in court

South Africa formally revoked its notification that it was withdrawing from the International Criminal Court, after a domestic court ruled in February that its decision to do so was unconstitutional. The government has not said whether it intends to try again.

Iraq's armed forces made rapid advances in west Mosul. Optimists predict that the city will be liberated from Islamic State within weeks.

Groundbreaking

An election was held in **Northern Ireland**. The unionists, led by the Democratic Unionist Party, lost their overall majority of seats for the first time in the province since its partition from the south in 1921. Turnout was well up and all the big parties increased their total vote. But a reduction in the number of seats from 108 to 90 contributed to lowering the DUP's tally by ten and the Ulster Unionists' by six. The vote for Sinn Fein, the biggest

Irish nationalist party, surged by 34%, provoked by the DUP's hardline campaign. Talks now begin to create a new power-sharing executive.

Authorities in several **German** cities blocked visiting Turkish ministers from speaking at rallies that were held to encourage local Turkish citizens to vote for constitutional changes granting more power to Recep Tayyip Erdogan, **Turkey's** president. The authorities said the rallies violated safety rules. Mr Erdogan denounced what he called "Nazi practices". Separately, the Council of Europe warned that the referendum for the constitutional changes threatened to make Turkey more like an "authoritarian" regime.

Poland nominated its own candidate for president of the European Council to oppose Donald Tusk, the current president and a former Polish prime minister, who is seeking re-election. Poland's populist government has accused Mr Tusk, who was widely popular when he headed the previous centrist government, of a range of unsubstantiated misdemeanours.

In **France** Alain Juppé, a former prime minister, said he would not step in as the Republican candidate for president if the current candidate, François Fillon, pulls out. Mr Fillon has been under increasing pressure over charges that he paid his family nearly €1m of public money for work they barely did. He insists he will stay in the race.

It's complicated

North Korea said it would not allow nine Malaysians in the country to leave until it had settled a row with **Malaysia** over the killing of the half-brother of the North Korean dictator, Kim Jong Un. Malaysia responded by barring the departure of the 1,000-odd North Koreans in Malaysia. North Korea also tested four missiles simultaneously, prompting America and South Korea to accelerate the deployment of an American anti-

missile system in South Korea, which annoyed China.

A special prosecutor in **South Korea** said that the president, Park Geun-hye, should be charged with corruption and abuse of office. The constitutional court is weighing whether to remove Ms Park from office on similar grounds. It is due to rule on March 10th.

Police in the **Philippines** said they were resuming their controversial war on drugs, after a month's hiatus. Perhaps 7,000 people have died during the campaign. The police have blamed many of the killings on unknown assailants.

Japan's Liberal Democratic Party approved a change to its rules allowing its leader to serve three three-year terms. That would allow Shinzo Abe, the prime minister, to remain in office until 2021, provided he can win another election.



The annual session of **China's** rubber-stamp parliament, the National People's Congress, opened in Beijing. The prime minister, Li Keqiang, told the meeting that China's GDP should grow by "about 6.5%" this year. In 2016 it expanded by 6.7%. Mr Li warned of financial risks arising from previous years of debt-fuelled growth. He also said demands for Hong Kong's independence from China would "lead nowhere".

China said spending on its armed forces would grow by 7% this year, the lowest rate in this decade. The **defence budget** would be equivalent to 1.3% of GDP, an official said. Many Western analysts believe it is much bigger than China claims.

Business

After weeks of speculation, **PSA Group**, which produces Peugeot and Citroën cars, struck a deal to buy **General Motors'** European operations for €1.3bn (\$1.4bn). The addition of the Opel and Vauxhall brands to its range makes PSA the second-largest motor company in Europe, behind Volkswagen. GM has not turned a profit in Europe since 1999, losing some \$8bn since 2010. It was so keen to ditch the business that it agreed to retain liability for most workers' pensions. PSA has said it won't immediately close factories, but it will eventually have to if it is to realise its projected cost savings.

Fed-speak

Janet Yellen, the chairwoman of the Federal Reserve, said a "further adjustment" to **interest rates** would probably "be appropriate" this month, meaning a rise is on the cards for March. It was an unusually frank statement by a Fed official ahead of a policy meeting.

Deutsche Bank announced plans to raise €8bn (\$8.5bn) through a rights issue to bolster its balance-sheet. The German bank also scrapped the proposed sale of its Postbank business; said it would sell a stake in its asset-management division; and announced that it would reunite the corporate and markets units of its investment bank. Deutsche made a €1.4bn loss last year.

Aberdeen Asset Management and **Standard Life** agreed to merge. Based in Britain, the combined company will have £660bn (\$800bn) in assets under management, making it Europe's second-biggest asset manager.

China racked up a trade deficit in February, its first in three years, as imports soared by 38% compared with the same month in 2016. Exports unexpectedly fell. The lunar new year, which fell in February, would have affected trade. Higher prices for imported iron

ore, oil and other commodities also played a part.

Peter Navarro, the controversial head of Donald Trump's new National Trade Council, said that the administration wanted bilateral talks with **Germany** over its trade surplus with America. Angela Merkel, Germany's chancellor, will meet Mr Trump in Washington on March 14th.

AkzoNobel, a Dutch multinational making paint and coatings that owns the Dulux brand, rejected a takeover from **PPG**, an American rival, saying that its €21bn (\$22bn) offer undervalued the company. Foreign bids for Dutch firms are an issue in the country's election campaign.

Heebie-jeebies on H-1Bs

A way of fast-tracking **H-1B visas** in America is to be suspended for at least six months from April 3rd. Skilled foreign workers can pay \$1,225 to get a response to an application within 15 days, but America's immigration agency wants to halt this service temporarily so that it can quicken the processing time for H-1Bs overall.

A final reading of the **Greek economy** for the last three months of 2016 reckoned that

GDP shrank by 1.2%, much worse than the 0.4% contraction that had been estimated in an initial government report. It was the worst quarterly performance since mid-2015, and creates another wrinkle in the wrangling over Greece's bail-out.

Communication breakdown

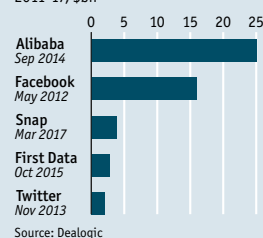
Responding to more bad publicity about its business ethics, **Uber's** chief executive, Travis Kalanick, said he was looking for a chief operating officer to help him run the firm. Uber also lost its legal case against new rules in London requiring minicab drivers to speak and write basic English. Those without a school certificate in English will have to sit a test. Uber says 33,000 of its drivers would either fail the test or put off applying for a licence, but a court found that being able to communicate in English is essential for passenger safety.

In a rare rebuke to the EU's antitrust body, a court quashed the European Commission's decision in 2013 to block a merger between **UPS** and **TNT**, two logistics firms, finding that it had based its conclusion on an econometric model which it did not give UPS a chance to argue against. TNT was eventually bought by FedEx.

America's Justice Department announced that **ZTE**, a big Chinese supplier of network equipment, had pleaded guilty to violating American sanctions against Iran and North Korea and also to obstructing a federal investigation. It will pay a penalty of \$892m and a further \$300m if it does not obey the terms of the settlement. It is the biggest fine to date levied on a Chinese company for sanctions busting.

Top five US-listed technology IPOs

2011-17, \$bn



Snap's share price whipsawed. Having surged by 44% on its stockmarket debut, the share price fell back sharply in subsequent trading. The initial enthusiasm was dampened by short-sellers and concerns that the potential for growth is as ephemeral as the social-media firm's messages.

Other economic data and news can be found on pages 80-81



Quantum leaps

After a century stuck in textbooks, mind-bending quantum effects are about to power mainstream innovation



A BATHING cap that can watch individual neurons, allowing others to monitor the wearer's mind. A sensor that can spot hidden nuclear submarines. A computer that can discover new drugs, revolutionise securities trading and design new materials. A global network of communication links whose security is underwritten by unbreakable physical laws. Such—and more—is the promise of quantum technology.

All this potential arises from improvements in scientists' ability to trap, poke and prod single atoms and wispy particles of light called photons. Today's computer chips get cheaper and faster as their features get smaller, but quantum mechanics says that at tiny enough scales, particles sail through solids, short-circuiting the chip's innards. Quantum technologies come at the problem from the other direction. Rather than scale devices down, quantum technologies employ the unusual behaviours of single atoms and particles and scale them up. Like computerisation before it, this unlocks a world of possibilities, with applications in nearly every existing industry—and the potential to spark entirely new ones.

Strange but true

Quantum mechanics—a theory of the behaviour at the atomic level put together in the early 20th century—has a well-earned reputation for weirdness. That is because the world as humanity sees it is not, in fact, how the world works. Quantum mechanics replaced wholesale the centuries-old notion of a clockwork, deterministic universe with a reality that deals in probabilities rather than certainties—one where the very act of measurement affects what is measured. Along with that upheaval came a few truly mind-bending implications, such as the fact that particles are fundamentally neither here nor there but, until pinned down, both here and there at the same time: they are in a “superposition” of here-there-ness. The theory also suggested that particles can be spookily linked: do something to one and the change is felt instantaneously by the other, even across vast reaches of space. This “entanglement” confounded even the theory's originators.

It is exactly these effects that show such promise now: the techniques that were refined in a bid to learn more about the quantum world are now being harnessed to put it to good use. Gizmos that exploit superposition and entanglement can vastly outperform existing ones—and accomplish things once thought to be impossible.

Improving atomic clocks by incorporating entanglement, for example, makes them more accurate than those used today in satellite positioning. That could improve navigational precision by orders of magnitude, which would make self-driving cars safer and more reliable. And because the strength of the local gravitational field affects the flow of time (according to general relativity, another immensely successful but counter-intuitive theory), such clocks would also be able to measure tiny variations in gravity. That could be used to spot under-

ground pipes without having to dig up the road, or track submarines far below the waves.

Other aspects of quantum theory permit messaging without worries about eavesdroppers. Signals encoded using either superposed or entangled particles cannot be intercepted, duplicated and passed on. That has obvious appeal to companies and governments the world over. China has already launched a satellite that can receive and reroute such signals; a global, unhackable network could eventually follow.

The advantageous interplay between odd quantum effects reaches its zenith in quantum computers. Rather than the 0s and 1s of standard computing, a quantum computer's bits are in superpositions of both, and each “qubit” is entangled with every other. Using algorithms that recast problems in quantum-amenable forms, such computers will be able to chomp their way through calculations that would take today's best supercomputers millennia. Even as high-security quantum networks are being developed, a countervailing worry is that quantum computers will eventually render obsolete today's cryptographic techniques, which are based on hard mathematical problems.

Long before that happens, however, smaller quantum computers will make other contributions in industries from energy and logistics to drug design and finance. Even simple quantum computers should be able to tackle classes of problems that choke conventional machines, such as optimising trading strategies or plucking promising drug candidates from scientific literature. Google said last week that such machines are only five years from commercial exploitability. This week IBM, which already runs a publicly accessible, rudimentary quantum computer, announced expansion plans. As our Technology Quarterly in this issue explains, big tech firms and startups alike are developing software to exploit these devices' curious abilities. A new ecosystem of middlemen is emerging to match new hardware to industries that might benefit.

The solace of quantum

This landscape has much in common with the state of the internet in the early 1990s: a largely laboratory-based affair that had occupied scientists for decades, but in which industry was starting to see broader potential. Blue-chip firms are buying into it, or developing their own research efforts. Startups are multiplying. Governments are investing “strategically”, having paid for the underlying research for many years—a reminder that there are some goods, such as blue-sky scientific work, that markets cannot be relied upon to provide.

Fortunately for quantum technologists, the remaining challenges are mostly engineering ones, rather than scientific. And today's quantum-enhanced gizmos are just the beginning. What is most exciting about quantum technology is its as yet untapped potential. Experts at the frontier of any transformative technology have a spotty record of foreseeing many of the uses it will find; Thomas Edison thought his phonograph's strength would lie in elocution lessons. For much of the 20th century “quantum” has, in the popular consciousness, simply signified “weird”. In the 21st, it will come to mean “better”. ■

Britain's budget

Spreadsheets v politics

Philip Hammond's budget was prudent and, in parts, brave. But the government ducks too many big questions



AT JUST 68 pages, the spring budget Philip Hammond published on March 8th was less than half the length of last year's. Blessedly short on the gimmicks favoured by many of his predecessors in the Treasury, its most significant chapter was on official forecasts. The economy has done much better than expected since the Brexit referendum last June (see page 49): it is forecast to grow by 2% this year, up from the 1.4% predicted in November and well ahead of the recession many feared.

Yet the modest, good-news budget got a dreadful reception. Mr Hammond announced higher taxes for self-employed people, which broke a manifesto pledge and infuriated an important Conservative constituency. The criticism is unjustified. The tax plan makes economic sense, and with Brexit on the horizon it is right to fund any spending increases with tax rather than more borrowing. The bigger worry was the chancellor's repeated refrain that urgent questions, from housing to health care, were still under review—a reminder of how many matters the government has yet to tackle.

Revenge of the white van man

With Labour in steep decline under an unpopular leader—Mr Hammond aptly compared the party to a driverless vehicle—the Tories enjoy unusual freedom. The chancellor used this to raise the national-insurance contributions (NICs) paid by self-employed people, who pay less than employees (see page 50). Businessfolk pointed out that they lack benefits such as sick pay and parental leave that employees enjoy. They have less than half a point: the main reason for the discount was their worse state-pension entitlement, which was fixed last year. Mr Hammond has promised to improve their other benefits. And

employees will continue to pay even more NICs via their employers. Equalising their tax treatment will slow the slide towards self-employment for tax purposes. It should go further.

Amid the outrage it was easy to forget that the tax raid was worth less than 0.1% of public spending. It is on the big questions that the government looks less convincing. Eight months into Theresa May's term, urgent matters that were crying out for answers last summer are still being put off. The question of how to treat the "gig economy" and other new forms of work is under review until the summer. The social-care system, which is close to breakdown, will feature in a green paper later in the year. The touchy matter of how to set business rates, a tax on firms that is in need of reform, is out for consultation. On sustaining the creaking National Health Service the budget threw only crumbs. Because the government lacks answers, the budget resorted to emergency cash instead: extra money for social care; a fund for local authorities to help out firms struggling with rates.

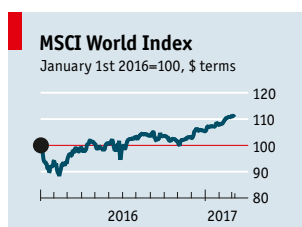
It is better to get big reforms right than to rush in. By the end of the year the government may have come up with good answers to Britain's problems. But policy reviews under Mrs May have so far been anticlimactic. Last month a long-delayed white paper on the chronic shortage of housing, an area with plenty of good, but unpopular, solutions, failed to endorse the big ideas needed to boost housebuilding. In January a document outlining a new "industrial strategy", which Mrs May flagged as a signature policy in the first days of her premiership, amounted to little. So did earlier promises of revolutions in railways, prisons and more.

A good test will be how the government responds to the future over self-employment. It is a sound idea which means only minor pain for a small number of mainly Tory voters. If Mrs May flinches at the unjustified outrage it has caused, it is hard to see her taking on bigger challenges. ■

Stockmarkets

Bubble-spotting

Markets are booming. Their underpinnings are fragile



HAVE investors become irrationally exuberant? That is the biggest question hanging over global stockmarkets. Despite tumultuous politics across much of the rich world, share prices are reaching ever loftier heights. After breaking the

20,000 barrier in January, the Dow Jones Industrial Average swiftly passed 21,000 earlier this month. In Britain the FTSE 100 has been notching up fresh records, too. The MSCI World Index has hit an all-time high.

At first sight, the warning signals are flashing. The recent flo-

tation of Snap, an internet firm that is yet to make a profit, brought back memories of the dotcom boom; its shares soared by 44% on their first day of trading (although they have fallen back since). By historical standards, valuations in the American market are worryingly dear. The cyclically adjusted price-earnings ratio, which averages profits over ten years, is just under 30, according to Robert Shiller of Yale University. Only twice has it been higher—in the late 1990s, during the internet boom, and just before the crash of 1929.

There are three reasons why investors are ignoring the alarm bells, each of them reasonable. First, investors' exuberance comes after a long period of restraint. The S&P 500 index is up by 5.5% so far this year. But in 2016 it returned less than ▶▶

▶ 10%. In 2015 it fell. Contrast that with the late 1990s, when the S&P 500 returned 20% or more in five successive years. Nor have investors bet the farm on shares. After suffering net outflows for the previous 12 months, equity mutual funds in America recorded their first week of net inflows in February. That same month a Bank of America Merrill Lynch survey of fund managers found that they held more cash than usual. Investors have a negative view on government bonds: ten-year Treasuries yield 2.5%, compared with 1.8% before Donald Trump's election. Equities look attractive in comparison.

Second, there are indications of a pickup in the global economy. That is a big change from the start of 2016, when investors were preoccupied by the state of the Chinese economy and the threat of deflation. After a feeble performance over the past few years, with annual growth in trade volumes barely keeping pace with GDP, the signs are that global trade is picking up again. The volume of South Korean exports rose by 20% in the year to February, the fastest growth rate in five years. Commodity prices are 10% higher than a year ago (see page 55). Even European growth forecasts have been revised higher.

Third, expectations of tax cuts, infrastructure spending and deregulation from the Trump administration have invigorated animal spirits in America. In December American small-business confidence saw its biggest rise in nearly 40 years, according to the National Federation of Independent Business. Profits for firms in the S&P 500 index are expected to rise by 12% in 2017 after being squeezed during the past couple of years, partly because a low oil price hit the energy industry.

The risks to this happy prospect are manifold, however. Despite the strong tone of surveys, the recent economic data in

America have been mixed: consumer spending and industrial production both fell in January. After eight years, this recovery is already long in the tooth. Mr Trump's fiscal-stimulus programme could take till next year to get through Congress and will be watered down along the way. Some of Mr Trump's proposals—cracking down on immigration, say, and threatening trade sanctions—would harm growth.

Meanwhile, monetary policy, which has played a big role in supporting stockmarkets since 2009, is becoming less accommodating. The Federal Reserve is widely expected to raise interest rates this month (see Free exchange). The European Central Bank will scale back the volume of its monthly bond purchases in April. Around 80% of all global private-sector credit creation happens in China, according to Citigroup; the authorities there are already starting to tighten policy.

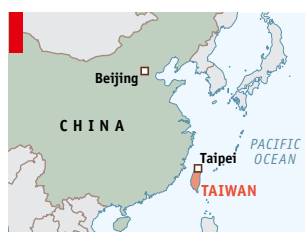
Parties weren't meant to last

A deeper problem lies in a contradiction between politics and economics. Elections in the Netherlands, France and Germany this year will give voters the chance to hammer established parties. Just as with Mr Trump in America, workers are backing insurgent candidates because they want a bigger slice of the economic pie. But mathematics cannot square a surge in real wages with a market rally based on the hope that profits will rise faster than GDP. As a movement that rejects globalisation, populism is a menace to companies that thrive on the free movement of goods, labour and capital. So it will be hard to keep both populist voters and the equity markets happy. Stocks may fly high for some time yet, but investors should keep a parachute handy. ■

Geopolitics

One China, many meanings

The one-China policy is a preposterous fib—but America should stick to it



FEW diplomatic sophisms are as skilfully worded as America's "one-China policy". Mere repetition by American officials that their country sticks to it has helped more than anything else to keep the peace between two nuclear-armed powers. Were

America to reject the policy, mainland China would be enraged. Anti-American riots would erupt. The government in Beijing might even respond by launching a military attack on Taiwan, or American forces in the region. The global economy would shudder. Millions of lives would be threatened.

Small wonder, then, that pulses quickened on both sides of the Pacific when Donald Trump, as president-elect, questioned the policy. ("I don't know why we have to be bound by a one-China policy unless we make a deal with China having to do with other things, including trade," he said.) Last month he changed his mind and reassured China's president, Xi Jinping, that he would, in fact, uphold it. Yet the one-China policy is in a fragile state. Far from casting doubt on it, Mr Trump needs to make America's support for the status quo clearer than ever.

The one-China policy is a fudge. At the time it was devised, the governments in Beijing and Taipei both claimed to be the

rightful rulers of all China. (Chiang Kai-shek, Taiwan's leader until 1975, had fled from the mainland in 1949 after losing a civil war against Mao Zedong.) Until the 1970s, America recognised only "Free China", ie Taiwan. Under the new policy, it acknowledged that both sides believed there was only one China while tactfully not saying who was the rightful ruler of Taiwan. The aim was to butter up Red China, which Richard Nixon wanted as an ally in the cold war against the Soviet Union. The communists would have preferred America to accept what they call the "one-China principle"—namely that Taiwan is a renegade province of China, and ought to bow to the Communist Party. But they were content that America was prepared to switch diplomatic recognition from Taiwan to the People's Republic and withdraw American troops from the island (both of which it did in 1979). So the fudge stuck.

The result has been an extraordinary relationship between two great powers. They were divided by ideology but united initially by their common hatred of the Soviets and later by their common pursuit of wealth by trading with each other.

However, Taiwan remains a flashpoint (see page 17). Communist China has not given up its dream of taking control of the island, by force if necessary. America has kept on selling weapons to Taiwan. The "Taiwan Relations Act" requires it to view an attack as a matter of "grave concern" to America: a hint ▶▶

▶ that it might come to Taiwan's aid. China has often made clear its outrage at this. Its rapid military build-up in recent years has been aimed, not least, at deterring America from trying to defend Taiwan. If it could keep America out, it could, in all probability, inflict a crushing defeat on the island.

One China, one Taiwan

This tinderbox has now been exposed to the spark of Taiwanese democracy. In the 1990s the island began to cast off authoritarianism. The Taiwanese are pragmatic. Last year they elected an independence-leaning president, but one who prefers not to antagonise the communists. Most believe that the island is already autonomous enough. Few want to enrage China by formally declaring independence. But they have also started to question the idea of "one China". They see the mainland as a different country, and abhor the idea of being swallowed by

the giant dictatorship next door. Taiwan has never been ruled by the communists. Since 1895 it has been under the mainland's control for less than five years.

Most are happy to let the one-China fudge persist. But will it? Having stirred up nationalist feelings for so long, the Communist Party can never abandon its claim. Some day, to shore up its popularity, it may be tempted to invade Taiwan.

America's ability and willingness to deter China is not only vital to Taiwan but also a measure of its role in the world more broadly. The arms that America sells to Taiwan would not enable the island to hold out for long against a Chinese onslaught, but they are a token that America has a stake in Taiwan's fate, and that China should beware. Rather than using Taiwan as a bargaining chip, America should maintain its military support for the island. If repeating a misleading mantra is the price of peace, it is worth it. ■

Food snobbery and economics

In praise of quinoa

The spread of exotic grains is evidence that globalisation works



PEOPLE are funny about food. Throughout history they have mocked others for eating strange things. In 1755 Samuel Johnson's dictionary defined oats as "a grain, which in England is generally given to horses, but in Scotland supports the people". Nineteenth-century Japanese nationalists dismissed Western culture as *bata kusai*, or "stinking of butter". Unkind people today deride Brits as "limeys", Mexicans as "beaners" and French people as "frogs". And food-related insults often have a political tinge. George Orwell complained that socialism was unpopular because it attracted "every fruit-juice drinker, nudist, sandal-wearer [and] sex-maniac... in England". In many countries today, politicians who wish to imply that their rivals have lost touch with ordinary voters sneer that they are latte-drinkers, muesli-munchers or partial to quinoa.

This South American grain gets a particularly bad rap. To its fans, it is a superfood. To its detractors, it is like the erotic sci-fi murals found in Saddam Hussein's palaces—pretentious and tasteless. An advertisement for Big Macs once riffed on this prejudice. "Foodies and gastronomists kindly avert your eyes. You can't get juiciness like this from soy or quinoa," it said, adding that "while [a Big Mac] is massive, its ego is not." Even those who love quinoa sometimes fret that scarfing it may not be ethical. What if rising hipster demand pushes the price up, forcing Andeans to eat less of their beloved grain? Or what if the price falls, making Andean farmers poorer? A headline from *Mother Jones*, a left-wing magazine, perfectly captured the confusion of well-meaning Western foodies: "Quinoa: good, evil or just really complicated?"

This newspaper takes no view as to whether quinoa tastes nice. But its spread is a symptom of a happy trend. More and more people are chomping unfamiliar grains (see page 53). Rich Westerners are eating less wheat and more of the cereals that people in poor countries traditionally grow, such as millet, sorghum, teff and yes, quinoa. Middle-class Asians are eating

more wheat, in the form of noodles or bread, instead of rice. West Africans are eating 25% more rice per head than in 2006; millet consumption has fallen by the same share.

All this is to be celebrated, for it is a symptom of rising prosperity and expanding choice. The spread of better farming techniques has raised yields, helping humanity feed itself despite a rising population. Rapid urbanisation means that fewer people grow their own grain, and more have the cash to try new varieties. Globalisation has allowed food and farming techniques to cross borders, meaning that people on every continent can experience new flavours and textures. Migration and tourism have broadened people's culinary horizons: Chinese visitors to France return home craving baguettes; Americans who live near Ethiopian immigrants learn to love *injera* (a soft teff flatbread that doubles as an edible plate).

Food for thought

The globalisation and modernisation of agriculture have contributed to a stunning reduction in hunger. Between 1990 and 2015, the proportion of children under five who were malnourished fell from 25% to 14%. People who are still underfed are less severely so: their average shortfall in calories fell from 170 a day to 88 by 2016. And between 1990 and 2012 the proportion of their income that poor people worldwide had to spend on food fell from 79% to 54%. As for those quinoa farmers, don't worry. A study by Marc Bellemare of the University of Minnesota found that Peruvian households became better-off because of the quinoa boom, even if they didn't grow the stuff, because newly prosperous quinoa farmers bought more goods and services from their neighbours.

Granted, rising prosperity has allowed an increasing number of people to become unhealthily fat. But the solution to that is not to make them poorer, which is what the backlash against globalisation will do if it succeeds. Rather than sniping snootily about Donald Trump's taste for well-done steaks slathered with ketchup, liberals should worry about the administration's plans to erect trade barriers and possibly start a trade war. That would make the world poorer and hungrier. ■

Renewing energy markets

You succinctly described the conundrum faced by electricity markets adapting to renewable energy (“A world turned upside down”, February 25th). Existing renewable-energy plants with zero marginal generation costs will price any fossil-fuel power plant out of the market.

Today’s liberalised electricity markets, where prices are set by the marginal cost of generation, were concocted in the 1990s. These markets are not determined by physical laws; we should question established orthodoxies and design more effective alternatives. The current system neither guarantees that there are sufficient price signals to maintain the high availability of electricity we are used to, nor achieves the deep levels of decarbonisation required to keep the planet inhabitable.

We need to look at the cost of the “package deal” for a reliable, low-carbon electricity system, as Simon Müller of the International Energy Agency poignantly puts it, without assigning the derogatory term “subsidies” to individual components of that package. By all means, market principles should rule the new regime, for example through large-scale competitive tendering of renewable-energy plants. Recent results demonstrate that such tenders can achieve extremely competitive pricing for carbon-free electricity. Visionary policies are what’s called for, not patches on a colossal market failure.

MORITZ BORGMANN

Partner
Apricum—The Cleantech
Advisory
Berlin

By 2040 global electricity demand is forecast to rise by 70% thanks to its decarbonisation potential and the electrification of industries such as transport. Energy storage will become increasingly important as intermittent renewable power increases: pumped storage hydro is the economically viable technology that is proven to work and can be

delivered on a large scale. Other storage technologies such as batteries will also play an important role as part of the grid, to balance fluctuations.

But we need new market frameworks to support this change. This means stronger carbon-price signals to incentivise clean-energy investment and technology rather than subsidies for polluting fuels. As you point out, it also requires spending to enhance and digitise electricity networks. Networks are more important than ever in a smart energy world, to manage localised multidirectional power flows and to ensure the stable supply of electricity.

Many utilities are already adapting to deliver this transformation. But policymakers also need to meet their side of the bargain.

IGNACIO GALÁN
Chief executive officer
Iberdrola
Madrid

Energy policies are increasingly and mistakenly geared towards expanding renewable energy as an end in itself, rather than achieving carbon reductions and maintaining reliability. The cost of providing system backup power or storage is not reflected in the wind and solar “levelised cost of energy” or the market price. With more renewable production, these shadow costs escalate because a full-sized system of on-demand power or over-size seasonal storage (which does not practically exist today) is needed to cover multiple days and weeks when there is little wind or sun. If it existed, this storage system would face the same challenge that capacity markets face in a high-renewables world: large capital costs and low usage. High renewable penetration makes all forms of energy production “intermittent” and therefore costly.

Most studies suggest that achieving a low carbon grid at a manageable cost will require a mixture of nuclear, gas with carbon capture or other zero carbon on-demand sources in addition to renewables. To redesign markets to facilitate

very high uptake of renewable energy for its own sake is indeed a way to turn the world, and economic logic, upside down.

JANE LONG
Lawrence Livermore Laboratory
(ret.)
Oakland, California
ARMOND COHEN
Clean Air Task Force
Boston

In New York state we are modernising the regulatory regime and electric grid. These reforms include allowing utilities to earn returns for their shareholders by advancing clean-energy solutions, rather than only by investing more capital in the expansion of the grid’s capacity. This is one way of solving the “utility death spiral”. New York’s utilities now have a clear business motive to improve the energy and financial efficiency of the state’s entire grid. For example, by using transparent price signals in retail energy markets, utilities will be able to deploy more renewable generation and energy-efficiency projects where they can help with grid congestion in high-use areas, which will reduce the need for capacity payments to dirty and expensive “peaker” plants. As a result, these clean-energy deployments will benefit all users of the grid, not just those homes and businesses that have the opportunity to implement clean-energy projects. We want to provide customers with what they want, instead of what regulators and utilities think they want.

RICHARD KAUFFMAN
Chairman
Energy and Finance, New York
state
Albany, New York

I agree with your analysis. We expect that by 2030, half of the electricity in the European Union will come from renewables. Upgrading the design of outdated electricity markets is thus an urgent matter. The European Commission has published wide-ranging proposals, such as allowing price spikes at moments of scarcity and deregulating prices at the

retail level, measures to prevent blackouts and clearer rules on cyber-security and the smartening of power grids, and more interconnection between EU states. This renewables revolution is only possible with the buy-in of consumers, who need to be empowered as part of this energy democratisation. The role of providers and innovators is indispensable for enabling active consumers and providing them with new state-of-the-art services.

MAROS SEFCOVIC
Vice-president of the European
Commission in charge of the
Energy Union
Brussels

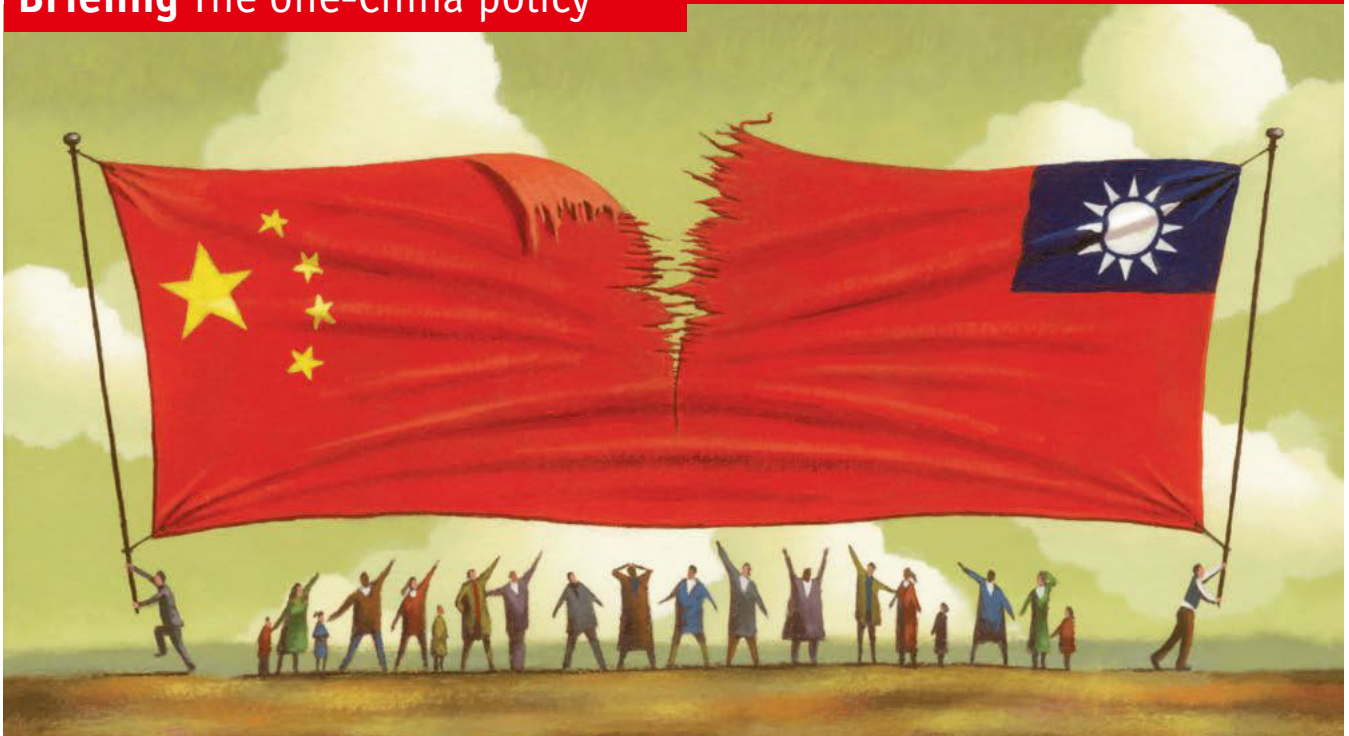
Cross-border power markets can significantly alleviate some of the problems you mentioned. Through a well-integrated Nordic electricity market, Denmark avoids curtailed power because of fluctuating wind energy by exporting excess capacity to Norway and Sweden when the wind blows and importing hydro power when it doesn’t. In this way, the Nordic power market provides flexibility across renewable-energy types, ensuring that electricity generated everywhere and through every source enters the grid and reaches consumers.

LARS CHRISTIAN LILLEHOLT
Danish minister of energy
Copenhagen

It is said that the shift to renewable energy will reduce profitability. However, when considering “The Coal Question” in 1865, William Stanley Jevons found that as the efficiency of energy generation increases, the quantity of energy consumed goes up by a disproportionate amount. With the switch to abundant, cheap renewable energy, consumption, and profits, will rise.

JAMES SHERWIN-SMITH
London ■

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The great brawl of China

BEIJING AND TAIPEI

The polite fiction that there is only one China has helped keep the peace in East Asia. But it is becoming harder to sustain

WHEN Donald Trump, then America's president-elect, said on December 11th that "I don't know why we have to be bound by a one-China policy" he ripped aside one of the oldest sticking-plasters in the world of diplomacy. That he stuck it back on again two months later, telling Xi Jinping, China's president, that he would honour the one-China policy "at President Xi's request", does not alter the fact that an American leader had questioned a basic feature of Asian security. Nor does Mr Trump's reversal solve problems with the one-China formula, on which peace between Taiwan and China has depended, that were evident well before his election. If they worsen, the two sides' frozen conflict could heat up.

The one-China formula is not so much fraught with ambiguities as composed of them. China itself does not actually have a one-China policy. It has what it calls a one-China principle, which is that there is only one China, with its government in Beijing. It regards Taiwan as a renegade Chinese province and refuses diplomatic recognition to any country that recognises Taiwan as a state. Yet this rigid principle can be bent. In 2015 President Xi met the island's then-president, Ma Ying-jeou, for what would have looked to innocent eyes very much like a bilateral summit of heads of

state. And China looks the other way, albeit with some fulmination, when America sells arms to Taiwan—a traffic which, in 1982, America said it would phase out, but continues to this day.

America does not accept the one-China principle. Instead it has the one-China policy, which acknowledges that China has such a principle—not quite the same thing. America does not recognise Chinese sovereignty over Taiwan, nor does it recognise Taiwan as an independent state. It does plenty of trade with it, though. Small as it is, Taiwan is the ninth-largest buyer of American exports, outstripping Italy and India. America's unofficial ties with the island are closer than many countries' diplomatic links. The American Institute in Taiwan, a private not-for-profit institution with headquarters in Washington, DC, looks like an embassy and acts like one, too. The Taiwan Relations Act of 1979 commits America to helping Taiwan defend itself against invasion and embargoes, deeming any coercion of the island to be "of grave concern to the United States".

In Taiwan itself the one-China formula has an even stranger history. It is rooted in the fiction that the island's first president, Chiang Kai-shek, who fled there in 1949 after losing a civil war to Mao Zedong's communists, would one day recapture the

whole of China. Hence Taiwan's official name, the Republic of China. Thus the party that Chiang led, the Kuomintang (KMT), and the Chinese government can both subscribe to an agreement called the "1992 consensus", which says that there is only one China but recognises that the two sides disagree about what that means in practice, thus piling fudge upon ambiguity. Taiwan's other major political party, the Democratic Progressive Party (DPP), rejects both the 1992 consensus and the one-China principle more generally. But its leader, Tsai Ing-wen, who succeeded the KMT's Mr Ma as president last year, prefers not to do so openly.

In most areas of politics this surfeit of uncertainty would be worrying. Yet the agreement not to look too closely at the contradiction of "one China" has kept an uneasy peace across the Taiwan Strait. There have been political crises—most recently in the mid 2000s—and in 1996 China fired missiles towards the island while Chinese leaders scowled for the cameras. But by and large it has worked well enough for all three sides to want to maintain it.

Their reasons differ, just as their reading of the formula does. China believes that time is on its side. As the motherland becomes ever wealthier and more powerful, its leaders seem genuinely to hope that Taiwan's people will want to rejoin it. Taiwan's leaders think the opposite; that with time the island's people will see themselves as having less and less in common with the mainland. Since the 1992 consensus, the proportion of people on the island who identify themselves simply as Taiwanese has more than tripled to almost 60%; the share of those who call them- ▶▶

elves Chinese has plunged to just 3% (see chart). Among people between 20 and 30, 85% say they are Taiwanese. In America the attitude is a simpler ain't-broke-don't-fix-it one. The status quo enables the country to have diplomatic ties with China without breaking off links with Taiwan, and that is good enough.

But this equilibrium of incommensurable interests depends on certain conditions being right: that China continues to get richer, confirming its leaders' optimism; that people on each side of the strait do not come to see each other as enemies; that Asia remains more or less stable, so the sides do not get caught up in other conflicts; and that, if the worst comes to the worst, America's armed forces will step in to keep the peace.

All these conditions are now changing. China's economy has been slowing. And Asia is no longer so stable. Mr Trump has threatened to impose tariffs on Chinese exports, risking a trade war. Chinese territorial claims over various islands are heightening tensions: America's secretary of state, Rex Tillerson, told the Senate that America must be able to limit Chinese access to disputed islands in the South China Sea. Mr Trump confirmed to Shinzo Abe, Japan's prime minister, that their two countries' defence treaty covers the Senkaku islands, which China calls the Diaoyu.

And while Mr Trump and Mr Abe were meeting, North Korea conducted its first post-Trump missile test. A month before, North Korea's leader, Kim Jong Un, had claimed his country would soon test its first intercontinental ballistic missile, which could hit the American mainland, though that was not what was tested. In response to Mr Kim's threats America is fielding a missile-defence system in South Korea—to which China vociferously objects.

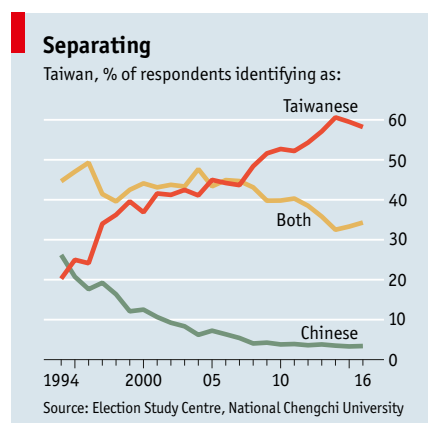
Taiwan might seem like the eye of the

storm. Yet China still holds a threat of invasion, or blockade, over the island, and it sometimes shows signs of wanting to bring things towards a head. In 2013 Mr Xi sent a tremor across the strait when he told Vincent Siew, Taiwan's vice-president, that their conflict "cannot be passed on from generation to generation". It sounded as if the president's patience was starting to wear thin. On March 6th the head of the Taiwan Relations Office, a government department, said to the National People's Congress (NPC), China's rubber-stamp parliament, that "I have to emphasise that Taiwan's independence...will lead nowhere. I hope the Taiwan government will think about this sentence carefully." All this is in the context of a military balance that has been shifted by a decade of double-digit increases in Chinese spending. Ten years ago Pentagon planners dismissed the idea of an invasion as "the million-man swim". You don't hear such non-chalance much these days.

Strait and narrow

America might no longer be able to dispatch two aircraft-carrier groups to the Taiwan Strait to force China to back down, as it did in 1996. But if hostilities were to break out America would almost surely be drawn in. The Taiwan Relations Act does not fully oblige it to, but to refrain would be a mortal blow to its position and prestige as a superpower. There would also be economic considerations: Taiwan makes more than a fifth of the world's semiconductors; a Chinese blockade could cripple the computer industry.

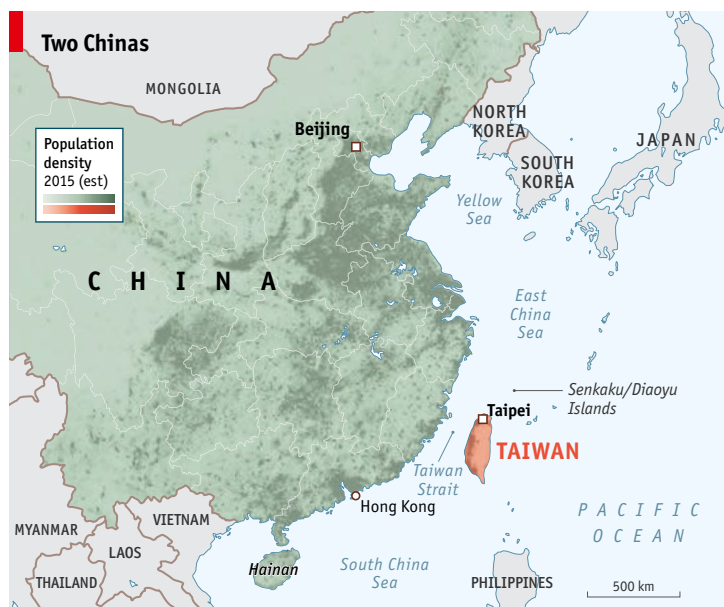
Against such a backdrop, the election of Ms Tsai of the independence-minded DPP was always likely to ratchet up tension. Soon after her inauguration last May the government in Beijing cut off communications between China's Taiwan Affairs Of-



fice and Taiwan's Mainland Affairs Council, increasing the chances of misunderstanding and miscalculation.

On November 25th China flew a pair of Xi'an H-6K bombers round the island, along with some escorts. Two weeks later another Xi'an bomber and three fighter jets again circled Taiwan. Then in January China's aircraft-carrier, the *Liaoning*, sailed round the southern tip of Taiwan and into the Taiwan Strait. "It shows they mean business," says Andrew Yang, a former Taiwanese deputy defence minister.

Chinese pressure on Taiwan could increase further. The five-yearly Communist Party congress is due near the end of this year and Mr Xi may be tempted to burnish his hawkish credentials by holding several sabre-rattling military exercises in the run up. He could deplete Taiwan's tally of 21 diplomatic partners. There have also been reports that China is considering amending its "anti-secession" law. At the moment it says that China would consider taking "non-peaceful methods to defend the nation's sovereignty" only if Taiwan formally declared independence or if there is no hope of a peaceful resolution. On Febru- ▶▶



	CHINA*	TAIWAN
2016 or latest		
Area km ²	9,596,960	35,980
Population	1.38bn	23.5m
GDP	\$11.4trn	\$529bn
Income per person at PPP	\$15,424	\$47,790
Military budget total	\$214.7bn	\$9.8bn
as % of government spending	6.3%	10.6%
Imports from US	\$135.1bn	\$28.6bn
Exports to US	\$389.1bn	\$33.5bn
Fortune 500 number of firms	99	7
Largest firm annual revenues	State Grid \$330bn	Hon Hai \$141bn
Infant mortality deaths per 1,000 live births	9.2	4.4
Life expectancy years	76	80
Population below national poverty line	6.1%	1.5%
Gini coefficient 1=most unequal	0.46	0.34
Corruption index (ranking/176)	40 (79th)	61 (31st)
Press freedom index (ranking/180)	80.96 (176th)	24.37 (51st)
Economic Freedom index higher=better	52	74.7

Sources: CIA; CEIC; EIU; IMF; SIPRI; Fortune; Transparency International; RSF; The Heritage Foundation

*Not including Hong Kong and Macau

ary 7th *Yomiuri Shimbun*, a Japanese newspaper, reported that China is thinking about amending this to say it could invade if Taiwan's leader refuses to endorse the 1992 consensus—a refusal to which the DPP has so far stuck. During the NPC, a Chinese admiral, Yin Zhuo, said China should use the anti-secession law to make it clear to Taiwan that “independence means war.”

Relations between China and Taiwan have been through fraught times before, though, without breaking down completely. And there are three reasons for thinking that, in the short term at least, things will not go horribly wrong this time.

Both Mr Xi and Ms Tsai have strong domestic reasons for setting aside their differences for a while. Mr Xi is consumed by the party congress, and though he may want to make himself appear tough with a few bellicose gestures he does not want a distracting crisis. As for Ms Tsai, she knows that her chances of re-election in 2020 depend on her handling of the economy, not on her handling of China. Taiwanese GDP growth and wages are flat. Her opinion-poll ratings are dismal. She is about to launch a politically risky reform of the bankrupt state-run pensions system. The last thing she wants is a fight with a superpower.

A second reason for guarded optimism is that Ms Tsai has taken the DPP further towards China's position than ever before. At her inauguration she said that she recognised the “historical fact” of the 1992 negotiations, which is as near as she can get to accepting the consensus without actually doing so. In a speech in October she reassured the communist government that she “will, of course, not revert to the old path of confrontation”. Ms Tsai is a trade lawyer, cautious, predictable and restrained—everything her risk-taking DPP predecessor, Chen Shui-bian, the president from 2000 to 2008, was not. China's condescension towards her—the Taiwan Affairs Office called her inaugural address “an incomplete examination answer” as if she were a stupid schoolgirl—has been mild compared with the invective levelled against previous DPP leaders, whom they have called “insane”, “evil” and “scum”. That may mean Mr Xi wants to keep open the door for future negotiations.

Third, the military balance in the Taiwan Strait has not swung far enough for China's high command to be confident of swift victory. If the country could sweep into Taiwan so fast the world did not have time to react (as when Russia invaded Crimea) other countries might conceivably treat an invasion as a *fait accompli*. But Taiwan is no Crimea. Only 10% of the population wants unification and less than 2% wants it as soon as possible. The island has a vibrant civil society capable of putting millions of protesters onto the streets against a Taiwanese government, let alone a Chinese occupying force.

The mainland has around 1,400 land-based missiles aimed at Taiwan, plus an unknown number of air- and sea-launched ones. Despite the presence of anti-missile defences—both American Patriot missiles and Taiwan's own systems—the island's air bases and many of its other defences might be quickly destroyed by all that firepower. But an invasion requires troops on the ground—ground which, in this case, lies the other side of 180km of open water. And Taiwan's surviving forces could make that voyage very unpleasant. Mr Yang says that, for an invasion to succeed, China would need promptly to destroy 85% or more of Taiwan's own missiles; if half of Taiwan's missiles survived the first wave of attacks, China's invasion force would be vulnerable.

Ex uno, plures

If the invasion could be slowed down, other countries would have time to react. At that point, any Chinese leader would have to decide whether to stop the invasion or risk a wider conflict. He would surely push on for fear of what might happen at home if he backed down. But he would just as surely prefer to avoid such a choice altogether. And that is where Taiwan's real deterrence lies: it does not need to be able to turn back an invasion; it only needs to be able to buy enough time to force on China the choice between a coup at home and a regional war abroad.

Without the assurance of a quick victory, cleaving to the familiar ambiguities of “one China” will make the most sense to China's leader. But those ambiguities will become ever more difficult to maintain. Mr Trump may yet return to his doubts about American support for the policy; it would hardly be the first time he has changed his mind. And popular attitudes across the strait are hardening. It is not just that is-

landers increasingly see themselves as Taiwanese; mainlanders, who used to regard the Taiwanese as brothers, have started taking a chillier attitude. They still see the islanders as part of the same culture, but they are now imposing loyalty tests, demanding (for example) a boycott of Taiwanese entertainers who last year did not condemn an international tribunal's ruling against Chinese claims in the South China Sea. The Communist Youth League, long a training ground for ruling party officials, waged a social-media campaign against one well-known Taiwanese performer in China, Leon Dai, and got him blacklisted.

Chinese officials are encouraging suspicion. The number of Chinese tourists to Taiwan has fallen by more than a third in the past year, largely because bureaucrats have made it harder to travel. Chinese universities have also asked Shih Hsin University, in Taiwan, not to discuss “sensitive political subjects” (such as the one-China principle) with exchange students from the mainland. A senior KMT official fears the days of pro-Taiwan sentiment on the mainland may be over.

Political attitudes are hardening, too. Taiwan used to have a one-China party, the KMT, and a party that preferred independence, the DPP. But the KMT is in free fall after its defeat in last year's election. The fastest rising force is the New Power Party, which has its roots in student demonstrations against close ties with China; it is at least as anti-one-China as the DPP. Mr Xi's crackdown on dissent and civil society is leading the political system ever further from Taiwan's vibrant democracy. The Beijing government's interference in Hong Kong's local politics is taken to show that “one country, two systems”, a formula devised for Hong Kong and once offered to Taiwan, is a fraud.

In the face of these realities, both sides want the option of continuing to say that the one-China framework holds, and looking for fresh obfuscations to that end—new helpings of fudge to put on top of that served up in the 1992 consensus. In 2011 Wang Yi, now China's foreign minister, then head of the Taiwan Affairs Office, said privately during a visit to Washington that China might consider replacing the 1992 formula, and there have been some signs that this could still be on the cards. Every two weeks Taiwanese officials meet to sift through new forms of words. A new formula might conceivably provide the basis of future talks.

The simple and natural solution is to admit there are two Chinas. But the communist government is not ready to do that. Instead, it is forcing the Taiwanese and Americans to deal with the fraying ambiguities of a one-China policy, as all three move slowly towards a new, more dangerous endgame. ■





Australia's economy

On a chiko roll

CHARTERS TOWERS

The end of a mining boom leaves the economy surprisingly intact

A GOLD rush in the late 19th century so enriched Charters Towers, an outback town in the state of Queensland, that it opened its own stock exchange. Trading ceased long ago. But the grand building still stands, its barrel-vaulted portico supported by eight slim pillars. Over a century later, Queensland is reeling from the demise of another mining boom. "There was a perception it would go on forever," says Liz Schmidt, mayor of Charters Towers. But unlike so many other booms, this one has not ended in a national bust. Australia's multi-pillared economy is still standing.

Given the violence of the commodity cycle, Australia's resilience is remarkable. At its height, mining investment accounted for 9% of GDP (see chart). As the economy scrambled to meet China's demand for iron ore and coal, Australia's terms of trade spiked. The price of its exports, relative to its imports, reached the highest level since the gold rushes of the 1850s, according to Philip Lowe, governor of the Reserve Bank of Australia, the central bank.

Like those 19th-century scrambles, the China "rush" brought sudden prosperity to far-flung places. Townsville, a coastal city in north Queensland, hosted thousands of fly-in-fly-out workers (or "fifos"), who served the Bowen Basin's coal mines and Mt Isa's copper and zinc mines. Their six-figure salaries boosted the local economy and inflated the housing market, which attracted speculative investors from faraway Sydney, Melbourne and Brisbane. "There

was so much money around," says Peter Wheeler, a Townsville estate agent.

Similar booms elsewhere have ended in horrible busts. The turn in the commodity cycle helped condemn Brazil and Russia to brutal recessions. In China a sharp downturn in mining and metals prompted fears of a hard landing that still linger. Many argue that economic rebalancing and steady economic growth are incompatible goals.

That worry also gnawed at Australia. As commodity prices started falling, mining companies stopped investing in big projects. Fewer fifos landed in places like Townsville, depressing local spending and employment. Townsville's house prices fell and its unemployment rate rose above 11%, almost double the national figure.

A big hole

Australia, business investment in mining
As % of GDP



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South of Townsville, around Gladstone, about 30,000 workers once had jobs building the state's liquefied natural gas (LNG) industry; last year, the industry employed just 5,000. Similar stories can be found on the other side of the country. In Western Australia, where iron ore is a mainstay, the sinking economy appears to be pulling down the conservative government. It is likely to lose a state election on March 11th (see next story).

These local difficulties could have added up to a national danger. When Australia's economy registered a negative growth rate in the third quarter of 2016, some feared the worst: Australia might at last fall into recession (commonly defined as two consecutive quarters of negative growth), a fate it had avoided for 25 years.

But the wobble quickly passed. In the fourth quarter the economy regained momentum, growing by 2.4% compared with a year earlier. Australia's GDP is now almost as big as Russia's (if the two are compared at market exchange rates) and the Reserve Bank forecasts growth of about 3% this year and next. "We show that openness can deliver both prosperity and resilience," argues Mr Lowe.

Given how many economies succumbed to the global financial crisis or the commodity supercycle, Australia's resilience may seem miraculous, another example of the luck for which the country is famous. But from another perspective, its performance should not be surprising at all. "It's a textbook example of how a more open, flexible economy can handle these things," argues Saul Eslake, an economist.

As the mining boom petered out, the Reserve Bank cut its benchmark "cash" rate from 4.75% in 2011 to 1.5%. The Australian dollar fell steeply (it is now worth \$0.76, compared with a peak of \$1.10 six years ago). The cheaper currency and lower interest rates have allowed the older and ▶▶

▶ more populous states of New South Wales and Victoria to keep the economy bustling. Property developers are building more houses, farmers are exporting more food, and foreigners (both students and tourists) are paying more visits: Australia welcomed 1.2m Chinese last year, a record.

Just as Australia's extractive industries benefited from China's appetites, its property market has benefited from China's anxieties: Australian homes are a popular investment for wealthy Chinese eager to move money somewhere safer. The fifos have also changed direction. Whereas people from Sydney and Melbourne once flew to Townsville seeking work, locals are now setting off to Australia's two biggest cities in search of jobs, says Jenny Hill, Townsville's mayor.

As well as rebalancing away from resources, Australia has also benefited from a rebalancing within the industry. Mining investment has given way to mining exports. Shipments of coal and iron ore helped Australia post a record trade surplus in the fourth quarter. The price of both has rebounded as China's growth has stabilised. But investment is likely to remain subdued. Resource firms will use any improvement in revenues to "repair balance-sheets rather than invest in new capacity," says Michael Roche, a consultant.

Townsville and Charters Towers have pinned their hopes on another rebalancing, from China to India. Adani, a firm based in the Indian state of Gujarat, wants to build what could be Australia's biggest coal mine in the Galilee Basin, south-west of Townsville. It has spent about A\$3.2bn (\$2.4bn) buying leases and fighting court petitions against the project from environmental and indigenous groups.

The state and federal governments support the scheme because of the jobs it would bring. Adani has applied for a federal loan to help build a 380km railway line across the outback to a port at Abbot Point, near the Great Barrier Reef, from where coal would be shipped to India. Matt Canavan, the federal resources minister, is "open to suggestions of a subsidy". He predicts a "devastating impact on Queensland's confidence" if the project does not go ahead.

In Charters Towers the old stock-exchange building is itself an elegant monument to economic reversals and renewal. It was restored in the 1970s and added to Queensland's "heritage register", partly because it "evokes the rise and fall of fortunes typically connected with goldfield towns". The building is now home to an art gallery, a museum and the office of a local politician. At one point it even hosted a beauty parlour offering "microdermabrasion" to smooth out pockmarked skin. Thanks in part to this capacity for reinvention, Australia's economic record remains remarkably unblemished. ■

Elections in Western Australia

Western values

PERTH

An anti-immigrant party takes advantage of an economic slump

BY THE standards of Australian politicians, Colin Barnett has lasted several lifetimes. Four prime ministers and several of state premiers have come and gone since he first took the reins in Western Australia in 2008. But his winning streak is expected to end on March 11th, when his right-of-centre Liberal party is likely to be trounced in a state election. Polling suggests that 57% of the vote will go to the opposition Labor party.

In a normal year the rest of Australia would barely notice. Western Australia is the source of much natural gas and iron ore, but is sparsely populated and three time zones removed from Sydney and Canberra. The election is drawing national attention, however, thanks to the resurgence of One Nation, a nativist party that briefly flourished in Queensland in the 1990s. It won four seats in the Senate at last year's federal election. Since then its leader, Pauline Hanson, a former fish-and-chip-shop owner, has seen her popularity soar. In Western Australia she is fielding almost 50 candidates (there are 95 seats in the two chambers of the state parliament) and has struck a deal with the Liberals that is likely to benefit her more than them.

Conditions suit her anti-immigration agenda well. The state's economy, which is heavily dependent on natural resources, has struggled since a massive mining boom ended three years ago. Economic growth fell to 1% in 2015, a fifth of the rate of the preceding decade, and unemployment

has doubled, to 6.5%. Falling property prices are hurting miners who bought McMansions with big mortgages when the gravy train was chugging. Mr Barnett's coalition government, meanwhile, splurged on salaries and showy infrastructure, including a big stadium and a much-derided waterfront development in Perth, Elizabeth Quay, or Betty's Jetty, as locals have it. The state faces a budget deficit this fiscal year of A\$3.4bn (\$2.6bn) and debt which is projected to top \$41bn by 2020.

Cashing in on the growing disillusionment, One Nation has polled as high as 13%, although recent counts put its share at 8-9% of the vote. It is unlikely to win any seats in the lower house. However, in the upper chamber, where members are elected by proportional representation, the party should win at least three seats, says William Bowe, an analyst in Perth. It will probably hold the balance of power in the upper house, forcing the state government to haggle with it.

The next test will come in Ms Hanson's home, Queensland, another boom-and-bust state which may go to the polls this year. Perhaps a quarter of voters there will opt for One Nation. Yet the party has shown itself capable of imploding: internal squabbling reduced it to irrelevance after it won 23% of the vote in state elections in Queensland in 1998. Mr Barnett, to justify the Liberals' alliance with One Nation, claims that the party has changed. Certainly, where once Ms Hanson feared that Australia was "in danger of being swamped by Asians", she now frets that it is "in danger of being swamped by Muslims". Bad organisation and infighting, however, appear not to have abated. In December one of One Nation's four federal senators quit the party; he was subsequently replaced by the courts with a colleague. Ms Hanson may find that her biggest challenge comes after election day. ■



My other car is in arrears



Free speech in Singapore

Grumble and be damned

SINGAPORE

The government says it welcomes criticism, but its critics still suffer

LIKE most constitutions, Singapore's promises freedom of speech. Unlike most, it allows the government to limit that freedom with "such restrictions as it considers necessary or expedient" to maintain national security, friendly relations with other countries or public order and morality, as well as to protect "the privileges of Parliament" and to prevent "contempt of court" or "incitement to any offence". Officials have not hesitated to quell their critics. Opponents of the People's Action Party (PAP), which has ruled Singapore without interruption since independence, have often found themselves on the losing end of defamation suits regarding accusations that American or European politicians would have shrugged or laughed off.

Singapore's government has long insisted that such measures are essential to safeguard the country's hard-won racial harmony and public order. Recently, however, the country's rulers have begun expounding the virtues of thick skins. In late February Lee Hsien Loong, the prime minister, said leaders need to be challenged: "If all you have are people who say, 'Three bags full, sir', then soon you start to believe them, and that is disastrous." On the very same day Kishore Mahbubani, a former diplomat who runs a public-policy institute at the National University of Singapore, said that Singapore needed "more naysayers [who] attack and challenge ev-

North Korea and Malaysia

A despot takes hostages

SINGAPORE

Call Kim Jong Un a killer and he'll kidnap your people

GOVERNMENTS often expel foreigners who enrage them. North Korea offers a worse fate: not being allowed to leave. On March 7th authorities in Pyongyang, the capital, said that 11 Malaysian citizens living in North Korea would be prevented from flying home until the two countries had resolved their differences over the murder of Kim Jong Nam—the half-brother of Kim Jong Un, the North's dictator. Kim Jong Nam was assassinated last month at Kuala Lumpur's main airport using vx, a nerve agent renounced by nearly all governments except North Korea's. The North later released two of the hostages, but continued to hold the other nine.

Najib Razak, Malaysia's prime minister, condemned North Korea's decision to detain its citizens as "abhorrent". He announced that North Koreans in Malaysia—of whom there are perhaps as many as 1,000, many doing dirty jobs such as mining—would in turn be prevented from leaving until the regime backed down. Malaysian authorities are watching who enters and leaves North Korea's embassy in Kuala Lumpur. The chief of police believes that at least two North Koreans wanted for questioning about Kim Jong Nam's murder are hiding inside; he has said that his men will stand guard for "five years" if it takes that long for them to come out.

The stand-off caps a week of dip-

lomatic drama. On March 6th Malaysia kicked out the North Korean ambassador, Kang Chol, who denies that North Korean spies were responsible for the murder or that the victim was Kim Jong Nam; he accused Malaysia of cooking up the story with America and South Korea to blacken the North's reputation. The North Korean government formally expelled Malaysia's ambassador the same day, though by then his bosses had already called him back to Kuala Lumpur.

In a further display of recalcitrance, North Korea tested four missiles simultaneously on March 6th, in defiance of UN sanctions. In response to the North's frequent tests, America and South Korea are accelerating the deployment in South Korea of THAAD, an American anti-missile system. That, in turn, has riled China, which fears THAAD could render its missiles less potent, too.

Meanwhile, on March 8th, a previously unknown outfit called Cheollima Civil Defence posted a video it said was of Kim Han Sol, the son of Kim Jong Nam. It claimed to have responded to a request to "extract and protect" him from his home in Macau, along with his mother and sister. The group said it had received help from China, America and the Netherlands. Whether Kim Han Sol will become a vocal critic of the regime that murdered his father, or choose to vanish from sight, remains unclear.

ery sacred cow". Tommy Koh, another diplomat, urged his countrymen to prize "challengers who are subversive and who have alternate points of view".

These comments were presumably not intended as a criticism of the Supreme Court. Just two days before it had upheld the conviction and fining of three activists who took part in a protest about the management of the Central Provident Fund, a compulsory savings scheme administered by the government. The three had been marching in Hong Lim Park, home to Speakers' Corner (pictured), a spot set up for Singaporeans to exercise their freedom of speech without any restriction whatsoever, beyond the obligation to apply for permission to speak and to comply with the 13 pages of terms and conditions upon which such permissions are predicated, as well as all the relevant laws and constitutional clauses.

The three protesters were convicted of creating a public nuisance, for disrupting a public event being held in the park. One of

them, Han Hui Hui, who ran for parliament as an independent in 2015, was also convicted of organising a public protest without approval (the authorities said she had applied to give a speech rather than a demonstration). The courts fined Ms Han S\$3,100 (\$2,199). Anyone convicted and fined more than S\$2,000 is barred from becoming a member of parliament for five years—another restriction the authorities must still deem necessary or expedient for the maintenance of something or other.

The upholding of Ms Han's conviction comes six months after Singapore's parliament enacted a law stiffening the penalties for contempt of court, to as much as three years' imprisonment or a fine of up to S\$100,000. The law defines contempt broadly: any comment that, in the court's judgment, "poses a risk that public confidence in the administration of justice would be undermined". If the prime minister wants to encourage criticism of the government, making more of it legal would be a good first step. ■

Pakistan

Pak on track?

ISLAMABAD

An unfamiliar hope infiltrates a country more used to pessimism

THE first thing to come back was the prime minister. Having twice held Pakistan's highest office before the army toppled him in 1999, Nawaz Sharif returned from exile to win it back in 2013. This was a personal triumph but also a historic moment, marking the only time since Pakistan's founding that one elected government has completed its term and passed power to another. It also turned out to be the first of a heartening series of signs that Pakistan itself seems to be returning, slowly and haltingly, to a more stable and prosperous state.

For the eight years since terrorists attacked a visiting Sri Lankan team, Pakistan's cricket-mad citizens have forfeited the joy of watching top international matches on Pakistani soil. But on March 5th Lahore, the capital of the province of Punjab and site of the attack in 2009, hosted the final match of the Pakistan Super League, a lucrative franchise with many foreign players. For safety reasons the PSL's matches had until now, embarrassingly, been staged in the United Arab Emirates. In February Pakistan also held its first international skiing competition since 2007, when Taliban militants overran its biggest ski resort, at Malam Jabba in the Swat Valley, and smashed the "heathen" lifts.

More broadly indicative is that Pakistan's stockmarket has risen faster than any other in Asia over the past 12 months, by a heady 50%. Perhaps this is because annual GDP growth, having languished below 4% from 2008 until 2013, is now back to the long-term average of around 5%. Poverty has fallen and the urban middle class is growing. Nestlé, a giant maker of processed foods, says its sales in Pakistan have doubled in the past five years, to over \$1bn.

Across much of the country, too, lights are coming on again. When Mr Sharif resumed office four years ago Pakistanis rarely enjoyed more than 12 hours of electricity a day. "It was so acute that private backup generators could not recharge the batteries that start them up," says Ahsan Iqbal, the minister of planning. Big investments in power infrastructure mean that power cuts are now down to a more manageable 6-8 hours a day. The government hopes to eliminate them entirely in time for national elections next year.

That deadline has prompted another important step: over the next two months Pakistan is due to hold its first national census since 1998. Some 90,000 civilians and



200,000 soldiers are being mobilised to count the country's 200m-odd inhabitants. The results will be used, among other useful things, to reapportion parliamentary districts. Until a recent revision, Pakistan's constitution stipulated that a census should be taken every ten years. The fact that there have been only two in the past 45 years says much about the tragic drift under both military and civilian rulers.

Of anywhere in Pakistan, the part that may have got the shortest shrift is the Federally Administered Tribal Areas (FATA). British imperialists regarded this rugged re-

**Euphoria in the bunker**

gion along the Afghan border as so untameable that its tribal chieftains were left to impose their own laws, a dispensation that has continued to this day. One result is backwardness: in one district the proportion of girls enrolled in school in 2011 was a shocking 1%. Across FATA as a whole, female literacy in 2014 was estimated at just 13%. This contrasts with national literacy rates of 43% for women and 70% for men.

Another result has been insecurity. The endless war in Afghanistan flooded FATA with guns, refugees and radicalism, all of which Pakistan's armed services unwisely sought to harness in pursuit of their own murky agenda, both in Afghanistan and at home. Having slipped completely out of control in the late 2000s, FATA has been pacified in recent years only by a mix of American drone strikes and Pakistani offensives on the ground. As many as a third of the region's 4.5m people are believed to have fled. A government report in 2016 estimated that military operations over the previous decade had destroyed 67,000 houses and left 27,000 dead.

Given all this, the government's recent announcement that it plans to normalise the administration of FATA is welcome. It will be absorbed into the neighbouring province of Khyber Pakhtunkhwa, giving it elected leaders rather than tribal elders, regular courts that apply national laws and ordinary police instead of tribal militias. Locals seem pleased: a recent survey found hefty majorities backing all these changes.

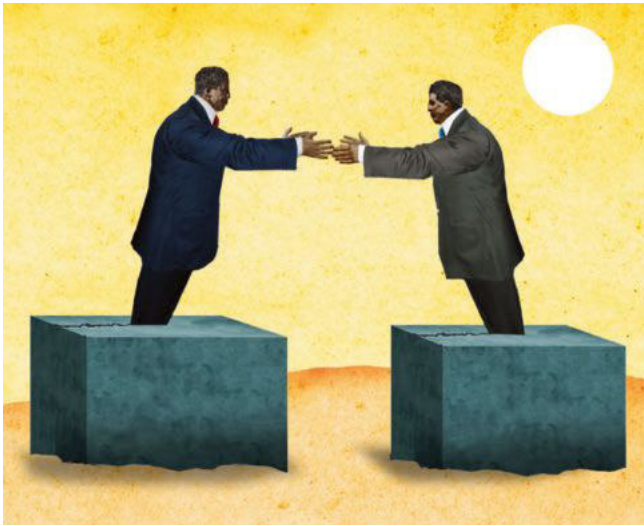
Despite all the good news, however, Pakistan's progress remains unsure. Terrorist attacks, bombings, murders, kidnappings and brutal state retaliation continue at a brisk pace. Pakistan's powerful military remains dominant and its secret services opaque. Take the case of the vanishing bloggers. Over three days in January, five obscure social-media commentators who had dared to criticise the army vanished from different parts of Punjab. The army denied any involvement, but pro-military social media sites were quick to label the abductees blasphemers, apostates and traitors—in a country where blasphemy remains punishable by death. "Their crimes are so heinous that no one should say...that they suffered injustice," tweeted one notoriously craven television host. Four of the men were eventually released, but have refused to talk about their ordeals.

Some Pakistanis question how much has really changed. Commenting on the elaborate security for the PSL final, Anjum Altaf, a columnist for the *Dawn* newspaper, harrumphed: "I fail to understand how spending hundreds of thousands of dollars to bribe a handful of foreigners to play a game in a nuclear bunker can be convincing proof that the country is back to normal...This is self-delusion carried to absurdity." For Pakistan, however, even to be debating the subject is encouraging. ■

Banyan | A tale of two statues

TSUSHIMA

South Korea and Japan are at loggerheads, but the ports of Busan and Fukuoka remain close



FOR centuries the *wako*, dastardly Japanese pirates, skulked in the countless coves of Tsushima island, roughly halfway between the Japanese archipelago and the Korean peninsula, frequently raiding the coast of Korea. In 1592 General Toyotomi Hideyoshi and his 200,000 men launched the seven-year Imjin invasion from the island, landing in Busan, on Korea's southern coast. Centuries earlier *sueki* ceramics, a new form of pottery, had been transmitted from Korea to Japan via Tsushima.

Today it is mainly leisure-seekers who take the hour-long ferry ride from Busan to Tsushima: fishermen, hikers and day-tripping teens. Once a year, however, a delegation of South Koreans dressed in the colourful garb of 17th-century envoys makes the crossing. They are re-enacting the *Joseon tongsinsa* missions, or "sharing of good faith from Joseon" (an ancient name for Korea), which began in the aftermath of the Imjin war to reaffirm friendly ties between the Korean king and the Japanese shogun.

The envoys travelled along a 2,000km route, from Hanyang, as Seoul was then known, to Edo, present-day Tokyo, via Busan and Tsushima. The emissaries carried notes of friendship, and a dazzling assortment of Korean artwork. Over two centuries, a dozen such expeditions sent poets, painters, acrobats and calligraphers from Korea to Japan; by the time the delegations embarked from Busan, they had about 400 artists in tow. Another 1,800 joined them on the Japanese side. Villagers lined the streets to greet them, waiting up all night to receive a poem or painting.

The two governments are a long way from such cordial exchanges today. In the open sea north-east of Tsushima, they squabble over a group of rocks (Dokdo to South Koreans and Takeshima to the Japanese), and bicker with each other about history. Japan annexed Korea in 1910 and exploited it ruthlessly until 1945; many South Koreans feel Japan has done too little to atone for its colonial atrocities.

Among the most painful incidents for South Koreans is the corralling of tens of thousands of women into Japanese military brothels. South Korean civic groups erected a bronze statue of a "comfort woman" outside the Japanese embassy in Seoul in 2011, to serve as a daily rebuke to the diplomats inside. In December a similar statue was installed outside the Japanese consulate in Busan. In a huff, Japan's government, which thought it had put the

matter to rest by agreeing to compensate the surviving comfort women in 2015, recalled its ambassador to Seoul as well as its consul-general in Busan. Neither has yet returned to his post.

The spat also threatened to upset the centuries-long exchange between Busan and its Japanese sister city, Fukuoka, which lies roughly 200km across the Tsushima strait. Both cities are closer to each other than to their respective capitals. In the 1960s the people of Busan found it easier to receive Japanese TV signals than those broadcast from Seoul. Karaoke machines, now a staple in both nations, first came to South Korea via Busan, in the 1980s.

Last year a record 1.2m South Koreans travelled by ferry to Kyushu, the island of which Fukuoka is the main city, for its shopping, food and *onsen* (hot springs). Flights between Busan and Fukuoka have doubled since 2010, to eight round-trips a day. Akihiko Fukushima of the government of Fukuoka prefecture says that Busan is *geta-baki de iku*: close enough to visit in casual wooden slippers, as if popping round to see the neighbour.

Exchanges have remained remarkably resilient, despite the visit in 2012 of Lee Myung-bak, the president of South Korea at the time, to Dokdo, which sent diplomatic relations into a tailspin. That year the Fukuoka Asia Collection, an annual fashion show, invited designers from Busan, and still does (Busan returns the favour at an equivalent event). Foundations on both sides have worked on a joint submission of historical documents chronicling the *Joseon tongsinsa* for UNESCO. Journalists at *Busan Daily* and *Nishinippon Shimbun* in Fukuoka participate in an exchange programme—remarkable in countries where the media routinely peddle a nationalist line.

Idol threats

In 2013 it was a local stand-off that threatened to end for good the raucous jamboree on Tsushima that honours the missions. The previous year South Korean thieves had stolen a small 14th-century statue, thought to have been made in Korea, from the tiny temple of Kannonji on the island. The South Korean police recovered it soon afterwards. But a local court blocked the statue's return to Tsushima, on the grounds that it had probably been pillaged centuries ago by the *wako* from a South Korean temple that was suddenly demanding its return. Incensed, the islanders told the Korean contingent to the festival not to bother coming. But the Japanese went ahead with the commemorations by themselves; one participant was Akie Abe, Japan's First Lady, who claims to keep a special fridge just for *kimchi*, the pickled cabbage that is Korea's national dish. And in 2014, when the visitors from Busan called for the statue's return, Tsushima allowed the festival to go ahead again, despite protests from Japanese nationalists.

Last year the Bokchon museum in Busan celebrated two decades of exchanging artefacts with museums in Fukuoka, free of charge. A curator says such swaps would be impossible without personal friendships and trust. Sekko Tanaka, the retired chief monk of Kannonji, says he feels "betrayed" by the court. Still, he welcomes South Korean tourists to the temple's guesthouse.

Japanese diplomats say they watch such exchanges as a more accurate measure of popular sentiment towards South Korea than strident press clippings and noisy protests organised by nationalist groups. The islanders of Tsushima, unlike other Japanese, use *chingu*, a word borrowed from Korean, to mean a close friend. South Korean visitors are charmed to hear that, on the clearest of days, the shoreline of Busan can be spotted; only a few spoilsports insist the sightings are, in fact, just a mirage. ■



The national legislature

Caretaker of the chrysalis

SHANGHAI

Bold talk conceals a much simpler economic agenda: don't mess up

LI KEQIANG is a master of metaphors for a painful economic reform. In 2013, his first year as prime minister, he told the National People's Congress (NPC), China's rubber-stamp parliament, that reform required the courage of a "warrior cutting his own wrist". At the NPC's annual gathering in 2015, he described it as "taking a knife to one's own flesh". On March 5th, at the opening in Beijing of this year's 11-day meeting of the legislature, he was less gory, calling it "the struggle from chrysalis to butterfly". Mr Li (pictured, right) deserves full marks for his range of imagery, but reforms on his watch have been less impressive. This year's parliamentary session has highlighted one big reason for Mr Li's limited accomplishments: his limited power.

For the past three decades, China's prime ministers have presided over the country's economic affairs. But the 3,000 delegates who are meeting in Beijing know that President Xi Jinping (pictured, left) calls the shots on the economy these days. At news conferences, many officials have praised Mr Xi as the "core" of the Communist Party, a title that was granted to him last year in recognition of his primacy (though he still has critics; see story on next page). Mr Li paid tribute to the president's "sound leadership".

Mr Xi's status as China's most powerful leader since Deng Xiaoping has given this year's NPC meeting a feeling of the unreal. More ceremonial than substantive at the

best of times, it now seems even more of a sideshow to what truly matters in Chinese politics. The big event in 2017 will be a quinquennial party congress towards the end of this year, when Mr Xi is expected to solidify his power by giving important jobs to his allies. Whether he will support Mr Li for a second term as prime minister is a subject of much speculation.

The approaching party event is casting a shadow over policymakers. Mr Li clearly sees it as his mission to ensure nothing goes wrong in the run-up. The economic targets he announced suggested his preoccupation with stability, even if that were to mean slightly lower growth. After aiming for, and achieving, 6.5-7% growth last year, Mr Li said China would shoot for "about 6.5%" this year. While that might sound like a tiny tweak, it sends a message that the central government wants restraint. It does not want to encourage local authorities to splurge on wasteful investments (as they are wont to do given the slightest of signals from Beijing). Mr Li is wary of overheating and a further build-up of already massive levels of debt.

Other targets revealed at the NPC were similarly conservative. After a widening of the budget deficit for three straight years, the finance ministry wants to keep it to 3% of GDP in 2017, the same as last year. The central bank called for slower growth in the money supply. And most strikingly for a government accustomed to spending

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ever more on infrastructure, the amount of money it plans to spend on building railways and roads in 2017 is the same as last year. It helps that, after a big dose of fiscal and monetary stimulus in 2016, the economy is growing strongly. The stockmarket is also rallying and the currency, long under pressure to devalue, is holding steady.

But Mr Li was candid about dangers that still lurk after a decade of debt-fuelled growth. He sprinkled his report with references to financial risk. In recent weeks, the government has started to devote more attention to curbing it. A mild increase of short-term interest rates by the central bank has rippled through the bond market, forcing investors to pare back risky bets. In February Guo Shuqing, a blunt-talking official, took over as bank regulator. It was a sign that the government is getting more serious about cleaning up the debt-entangled financial system.

Behind the rhetoric

Yet on how to proceed with reform, Mr Li had little new to offer. He said state-owned enterprises should be more competitive, but shied away from suggesting they be privatised. He promised that China would improve the market for rural land, but said nothing about letting farmers own it. He did not even raise the idea of levying a property tax, which officials have previously touted as a possible way of patching up local budgets (such taxes would be bound to anger middle-class Chinese).

This is the kind of painful change that China needs if its economic transformation is to continue successfully. But it is not the stuff of this year's parliament. Mr Li's job is simply to ensure that the chrysalis stays healthy. Mr Xi and the party congress in a few months' time will have much more say over how to transform the pupa into a butterfly. ■

Politics

Any colour, so long as it's red

BEIJING

China has a clutch of tame political parties. Has one of them broken ranks?

HOW many parties does it take to run a one-party state? Although the Communist Party is in sole charge, China also has eight other legally registered ones. It calls this a system of “multiparty co-operation”, which involves “sharing weal or woe”. The role of the non-Communist groups is to add a veneer of democracy. Ordinary people dismiss them as “flower vases”—pure decoration.

On March 1st Luo Fuhe, a senior leader of one such misleadingly named party, the Chinese Association for Promoting Democracy, challenged that description. He told reporters that his party had a proposal to make. Amid a sweeping crackdown on dissent, it was a remarkable one. Mr Luo said China’s “strict” controls on the internet should be relaxed to avoid hampering the country’s scientific and economic development. Rarely has a prominent member of the establishment taken such aim at China’s “great firewall”, which blocks access to many foreign websites (including this newspaper’s). Even more strikingly, some official newspapers reported his views. The delight of China’s long-suffering netizens was palpable.

Like the other “democratic” parties, as the non-Communist ones are officially described, Mr Luo’s was founded before 1949 when the Communists seized power. One of them is called the Revolutionary Committee of the Chinese Kuomintang, a pro-Communist spin-off of the party that ruled China before Mao Zedong took over and which then fled to Taiwan. At first, Mao kept these groups alive as a way to win over people who were not hard-core Communists yet who sympathised with Mao’s goals. But he lost patience with them during the Cultural Revolution of the 1960s and 1970s. Many of their members were jailed. Deng Xiaoping revived the parties in the 1980s to show that China was becoming more tolerant again.

As Mr Luo is doubtless aware, that tolerance is extremely limited. A Communist Party website says the eight parties are “neither parties out of office nor opposition parties”, and all of them support the Communists. They are funded by the Communist Party and do not contest any elections. New members must be recommended by existing ones and there is no open recruitment. In some cases they also belong to the Communist Party. They often speak with even greater caution than Communists, says a member of the Peasants

and Workers Democratic Party, because they know their groups exist only with the Communist Party’s assent.

It was not until 2007 that people from non-Communist parties were chosen to serve as ministers—one was put in charge of health, another science and technology. Loyal to the Communists though the non-Communists are, they are only trusted with jobs that do not have a direct bearing on the Communists’ grip on power.

Mr Luo is one of many people from the eight parties who are rewarded for their subservience with memberships of advisory bodies (just as much flower vases as the parties themselves, many Chinese grumble). He is a vice-chairman of the

most prestigious of these, the Chinese People’s Political Consultative Conference (CPPCC), which is holding its annual meeting to make polite suggestions to the rubber-stamp parliament (see previous story). On March 5th he attended a meeting of around 45 fellow party members who are delegates to the CPPCC. They sat around a square table declaring “great satisfaction” with the Communist Party’s achievements—albeit without obvious enthusiasm. Many of them tapped away on their phones; one read a newspaper.

Mr Luo drank tea and remained silent. He had reason to be subdued. Censors had begun their work online, deleting much of the discussion of his party’s proposal. ■

Dodging censorship

Xi, the traitor

BEIJING

A prank on state television shows dissidents’ cunning

ACCORDING to a programme on China Central Television, a state-run broadcaster, the following are the names of traitors: Xi Jinping, Li Keqiang, Hu Jintao and Wen Jiabao. Well, sort of. The broadcaster itself was clearly not claiming the president of that name, or his prime minister, or their immediate predecessors, were enemies of the people. Rather, it aired a historical drama called “The Qin Empire” and someone slipped the names into the latest episode. Their extraordinary, if fleeting, appearance was a glimpse of the dissent that still lurks in China, and that can sometimes outwit its army of censors.

The Qin was the first unified Chinese state (and gave China its name). Its founder was buried with an army of terracotta warriors. In the episode an earlier Qin leader, who is fighting a rival state,

discovers he has been betrayed. An underling is shown reading the traitors’ names, inscribed on a bamboo scroll in an ancient script (see picture). The scene lasted only a second or two but that was long enough for eagle-eyed viewers to read the names. The censors were equally quick, deleting screen shots, blocking online versions of the episode and leaving behind comments on what would happen to the show’s producer (“He is going to be so dead,” wrote one blogger).

There is a second, coded layer of dissent involved. The state the Qin is fighting is called the Zhao, and the “Zhao family” is internet code for the Communist elite. The epithet derives from a short story of the early 20th century in which an aristocrat called Zhao humiliates a sort of Chinese Everyman. So Xi Jinping, a spy for the hated Zhao family, is a traitor to the first Chinese state.

To call the president a traitor, even obliquely, is shocking in China. The harshest recent criticism seems to have been an anonymous letter of mock concern, published online last March, urging Mr Xi to step down for his own safety. The timing of the latest gesture—just before an annual meeting of the legislature—adds to its potency. Loyalty to Mr Xi is a theme of the gathering: at the opening session, the *Wall Street Journal* counted eight mentions of Mr Xi in the prime minister’s state-of-the-nation speech, the most references to a leader by name in such an oration since Mao’s time.

Officials are always on high alert to prevent shows of political discord during parliamentary meetings. Yet this time a small act of *lèse-majesté* slipped through. The more effective the censorship, it seems, the more inventive the dissent.



Curiously familiar names



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Everything-gate

WASHINGTON, DC

Donald Trump accuses his predecessor; Republican congressmen shiver

IT WAS almost as if Donald Trump was taunting his Republican colleagues. After tweeting an explosive and wholly unsubstantiated claim against Barack Obama on March 4th—“How low has President Obama gone to tapp [sic] my phones...Bad (or sick) guy!”—the president said it was up to Congress to investigate the matter. “Neither the White House nor the president will comment further,” primly declared his spokesman, Sean Spicer, “until such oversight is conducted.”

Some sort of follow-up is necessary. Mr Trump is the president, 47% of Americans trust him more than they trust the media (according to a Quinnipiac poll), and his charge against Mr Obama was grave. If it were shown that his administration illegally snooped on Mr Trump, Mr Obama’s legacy would be disgraced. Alternatively, if it secured a warrant to bug Mr Trump’s phones, that would mean it had sufficient cause to believe Mr Trump or his associates were involved with terrorists or foreign spies to convince a judge on the Foreign Intelligence Surveillance Court. On the other hand, if Mr Trump, an inveterate conspiracy theorist, was peddling inflammatory nonsense about his predecessor and America’s intelligence agencies, that would also be serious. And it is probably the case.

Mr Obama’s director of national intelligence, James Clapper, said there was no warrant against Mr Trump. James Comey, the head of the FBI, upset that the president

appears to have accused his agency of a serious crime, reportedly asked the Justice Department to repudiate his claim outright. Mr Trump’s aides have meanwhile put up such a valiant but hapless defence of it that, if the issue were not so serious, it would be comical. Asked why Mr Trump wanted Congress to investigate a crime the president claimed to have proof of, Mr Spicer lost the power of spin. It was because of the “separation of powers”, he fluffed. It would be good, he explained, to get Congress “as a separate body to look into something, and add credibility to the look, adds an element that wouldn’t necessarily be there.”

Mr Trump, who launched his political career by claiming Mr Obama was born in Africa and last year suggested the father of his main Republican rival had a role in the murder of John F. Kennedy, appears to have based his claims on a rant by a talk-radio host, Mark Levin, which was reported on Breitbart News, a Trumpish website. To support the president’s contention, White House aides referred to Breitbart and to separate reports, by the BBC and others, that the FBI had obtained a warrant to investigate individuals linked to the Trump campaign over their Russia ties. None of the reports mentioned wiretapping.

Mr Trump’s motive for turning these unproven scraps into perhaps the most serious charge by a serving president against his predecessor appears straightforward, given his history. He is enraged by suspi-

cions that his campaign was, to some degree, in cahoots with Russians who—in the view of America’s intelligence agencies—interfered with the election. The latest piece of circumstantial evidence came on March 2nd, when it was revealed that Mr Trump’s attorney-general, Jeff Sessions, had twice met with the Russian ambassador to Washington, Sergey Kislyak, during the campaign, despite denying during his Senate confirmation hearing having had “communications with the Russians”. Mr Sessions recused himself from any investigation touching on the campaign—which would include an ongoing FBI probe into Russia’s role in the election—even though Mr Trump had said he should not make such a concession. By smearing Mr Obama, the president may have hoped not only to deflect attention from talk of Russia, but also to arm his supporters with a made-up counter-scandal to set against it.

Warp-speed

Many Republicans are alarmed by Mr Trump’s latest haymaker against Mr Obama. His half-dozen somewhat vocal critics, who are mostly senators and include moderates such as Susan Collins of Maine, old warhorses such as John McCain of Arizona, and, in Ben Sasse of Nebraska, a principled conservative, have politely cast doubt on Mr Trump’s allegations. “We are in the midst of a civilisation-warping crisis of public trust, and the president’s allegations today demand the thorough and dispassionate attention of serious patriots,” wrote Mr Sasse. There are also signs that shyer critics of Mr Trump may be, if not breaking ranks, at least emitting distress signals. “I’ve got to believe—I think he might have something there, but if not, we’re going to find out,” said Representative Jason Chaffetz of Utah when asked about the president’s allegations.

Together with Mr Sessions’s embarrass- ►►

ment, the episode has at least increased the pressure on the House and Senate intelligence committees to pursue seriously the investigations each has launched into Russia's meddling. Both are in the process of launching their inquiries. The House committee agreed on the scope of its investigation last week; most members of the Senate committee, including the Republican chairman, Richard Burr of North Carolina, and the ranking Democrat, Mark Warner of Virginia, were due in Langley to receive a preliminary CIA briefing this week. Yet there are doubts about how zealously the committee's Republican members will quest for the truth.

It was recently revealed that Mr Burr and his counterpart in the House committee, Devin Nunes, a Republican from California, were both asked by the administration to try to convince journalists that there was no incriminating link between the Trump campaign and Russia—a surreptitious arrangement that made a mockery of Congress's responsibility to hold the executive to account. The House committee

seems unlikely to pursue its task with great diligence. Mr Nunes, has suggested that what needs investigating is the leaks to journalists that have embarrassed the White House, a nod to an idea newly popular among the president's most ardent supporters that a "deep state" is thwarting a democratically elected leader, a conspiratorial notion borrowed from semi-democracies that casts Mr Trump as a victim.

There is greater hope for the Senate committee, which has a history of bipartisanship and includes several independent-minded Republicans, including Ms Collins. "We are going to have unprecedented access to all the intelligence," said Mr Warner. "I am confident we're going to find out the truth."

The trouble is, the committee may be bipartisan, but America is not—and therein lies Mr Trump's abiding opportunity. Though his approval ratings are poor generally, among Republicans they are dandy. Any Republican who defies the president therefore risks serious damage to his career—so most will not. ■

have little incentive to control costs. Amazingly, several studies have found that Medicaid does not improve the health of those enrolled in it. Republicans also reckon that letting states decide how to run the programme will unleash innovation and experimentation, and hence better coverage.

Critics scoff at that. In most states that did not go along with the Obamacare expansion, Medicaid is a bare-bones programme. In only one, Wisconsin, are childless adults eligible, according to the Kaiser Family Foundation, a think-tank. In Texas and Alabama parents cease to qualify at just 18% of the poverty line (an annual income of about \$3,600 for a family of three). The left worries that states like these have no interest in experimenting with the best ways to help the poor.

In any case, states that did expand Medicaid would gradually lose the extra cash Obamacare gives them. This will alienate some Republican governors. House Republicans probably hoped the slow pace of change would ease worries. But on March 7th John Kasich, governor of Ohio, called the plan "counter-productive".

Medicaid reform, then, is stoking internal opposition among moderates in the party. Proposed changes to the individual market are causing ire on the right.

Obamacare established exchanges, government-run marketplaces where people can buy insurance. Those earning less than 400% of the poverty line, or \$47,550 in 2017 for an individual, get tax credits to help pay the premiums. These are more generous at lower incomes. They are also pegged to the cost of insurance, which varies widely by age and place. To stop insurers designing plans so as to attract only healthy people, a thicket of regulations guarantees minimum standards. To ensure healthy people buy the pricier plans that result, the "individual mandate" fines all those who do not buy insurance.

Republicans have spent years promising to tear down most of this edifice. But without 60 votes in the Senate, they can get at only bits of it. The AHCA would change the tax credits so that they vary with age, but not income or geography (although they would taper out at high incomes—see chart). Previously, Republicans had argued that insurance would remain affordable because deregulation would bring down costs. But under the AHCA, most of Obamacare's rules would remain.

In many places, the funding cuts would be dramatic. In Alaska the average tax credit would fall by over 70%, according to Kaiser. The bill's right-wing critics, however, want to abolish the subsidies entirely. Campaign groups like the Club for Growth have joined the House "freedom caucus" and Senator Rand Paul in slamming a "new entitlement programme".

The bill does scrap one crucial regulation: the individual mandate. In its stead, ▶▶

Ryancare

Medicine or poison?

WASHINGTON, DC

The House proposal to amend Obamacare may break parts of America's health-insurance market

FOR such an important bill, it has an unusually simple name. On March 6th Republicans in the House unveiled—and President Donald Trump endorsed—the American Health Care Act (AHCA). The bill would overhaul Obamacare, which Republicans have decried since its passage in 2010. Its nickname is "Ryancare" after Paul Ryan, the Speaker of the House.

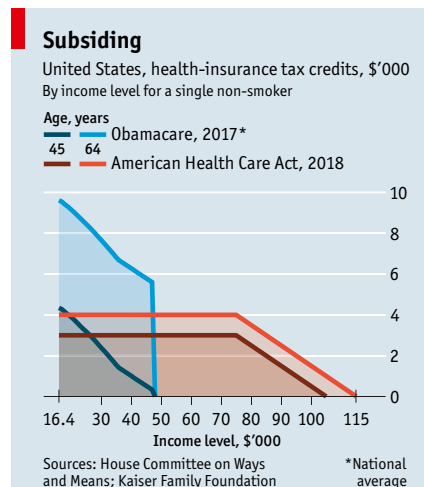
Obamacare had two main ingredients: an expansion of Medicaid (health insurance for the poor); and a reform of the so-called "individual" health-insurance market, which serves those who are not covered through an employer. Republicans say both bits are failing. Their proposed fixes may not fare much better.

First, Medicaid. In compliant states, Obamacare expanded eligibility for the programme to all those earning less than 138% of the federal poverty line, or \$16,400 for an individual in 2017. So far, this has boosted Medicaid's rolls by 12m, which accounts for nearly three-fifths of the improvement in health-insurance coverage since 2010. (Then, 16% of Americans went uninsured; today, only 8.8% do.)

The new bill would, in stages, remove federal funding for Medicaid's expansion after 2020. At the same time, it would change how the federal government funds

health care for those left in the programme. Currently, Washington helps pick up the tab for the medical expenses of those enrolled, chipping in a little more than half the total bill. The AHCA would instead give states a fixed payment for each person, and link it to medical inflation. States could choose how to spend the money.

Republicans say these changes are necessary because Medicaid is inefficient and provides nearly worthless coverage. States



Lobbying for refugees

That's awesome

ATLANTA

Some who arrived in time and the others left behind

BEFORE he arrived in America in 2013, aged 22, Nur Abdi spent five “very hard” years in India, sustained by the generosity of Somali compatriots. He applied for asylum through the United Nations’ refugee agency, and after a series of “very tough” interviews, he was resettled in Clarkston, just outside Atlanta. Now he works for a Lutheran relief agency, helping other newcomers. Some in his family, who like him fled violence in Mogadishu, are stuck in Ethiopia. Donald Trump’s ban on new Somali visitors threatens his hopes of a reunion.

On March 7th—the day after the president signed the new version of his travel restrictions—Mr Abdi attended a celebration of “new Americans” at Georgia’s state capitol. Troupes from the Andes and Laos danced in resplendent costumes. A technicolour choir of refugee girls sang “This Land is Your Land”. For a finale, a clutch of refugees took the oath of allegiance and became American citizens. The anthem was performed by a former Syrian refugee, and another, Dr Heval Kelli, now a cardiology researcher at Emory University, gave an exhortatory address. “Watering down a bad idea doesn’t make it a good idea,” Dr Kelli says of the revised edict. He would like to sponsor his widowed aunt and cousins to join him from war-ravaged Kobani, but the ban now means he cannot.

The serious purpose of the event, organised by the Coalition of Refugee Service Agencies (CRSA), was to lobby legislators. Georgia, like other states, enacts its own immigration-related measures to complement the federal ones. On the roster for the current session are a Trumpesque register of foreign criminals, and punishments for so-called “sanctuary” campuses. Next year’s session may be more demagogic, says Stephanie Ali of New American Pathways, part of the CRSA, because state elections follow it. Volunteers were dispatched to talk to the politicians; Mr Abdi teamed up with Craig Storlie, a Lutheran pastor.



Liberty print hijab

Some of their targets were absent, busy or pretending to be. But Scott Hilton, a freshman Republican, was willing to chat. Mr Storlie told him that 91% of refugees are self-sufficient within six months of arriving in Georgia. (Their economic contribution involves not just ethnic cafés and shops but labour in unappetising industries such as poultry processing.) Then Mr Abdi chimed in. He said he was Somali but had “found a home here, I found a job, I found a dream.” “That’s awesome,” said Mr Hilton.

Now, Mr Abdi went on, it “feels like refugees are no longer welcome.” After all, “they are human beings and deserve a second chance.” Pressed on Mr Trump’s initiative, Mr Hilton cited the need to protect America from “bad guys”. Mr Abdi countered that refugees are themselves “running from the bad guys”. If the embargo endures, he “will not be able to bring [his relatives] here.” “It’s tough,” Mr Hilton conceded. Still, he was “generally supportive” of a temporary ban.

▶ anyone who goes without insurance would have to pay 30% more in premiums, for one year, if they change their mind. Some worry this is not a sharp enough stick to keep healthy people in the market. Mario Molina, chief executive of one insurer, told the *Wall Street Journal* that premiums could rise by 30% next year as a result. Because the tax credits do not rise along with premiums, big price increases would

force people out of the market, increasing the risk of a so-called “death spiral”.

The AHCA’s total likely effect on coverage, and on the budget, is uncertain. Analysts have not yet scored the proposal (other than its \$594bn in tax cuts over a decade). Republicans think their short, simple-sounding bill is clearing up a mess. But in insurance markets, even the smallest changes can have huge effects. ■

The updated travel ban

Improved, unjust

NEW YORK

Donald Trump’s revised order may face more trouble in court

NEARLY a month after promising the Ninth Circuit Court of Appeals that he would “SEE YOU IN COURT”, Donald Trump has staged a lawyerly retreat from his executive order of January 27th. On March 6th the president revealed a fresh attempt at “protecting the nation from foreign terrorist entry”. The new order retains the original one’s core, limiting access to America’s shores for people from several Muslim-majority countries, and putting the refugee programme on hold—but has been softened in four ways.

First, the order exempts lawful permanent residents—those with a “green card”—from any travel restrictions. Second, whereas the first travel ban was implemented at the stroke of the presidential pen—causing chaos and confusion for people on flights to America when Mr Trump signed the order—the revision will not take effect until March 16th. Third, the revised order applies only to future visa applications, not to people already holding valid visas, or who manage to secure one before the deadline. Fourth, the list of seven banned countries has been whittled down to six: Iran, Libya, Somalia, Sudan, Syria and Yemen. Iraq was removed after its prime minister asked the White House why Iraqis fighting against Isis in Mosul should be considered potential terrorists.

One of the legal troubles with the first travel ban seems to evaporate with this edited edition: the complaint that the order violates the due-process clause of the Fifth Amendment. This apparent constitutional infirmity played a central role in the Ninth Circuit’s refusal to lift an injunction against the ban. By keeping lawful permanent residents out of America just because they happened to be travelling in a targeted country, the Ninth Circuit reasoned, the administration may have denied a class of people “notice and a hearing”. By giving ten days’ notice and lifting restrictions on green-card holders, the administration has probably immunised the new executive order from a due-process challenge.

Another potential constitutional roadblock is likely to plague Mr Trump’s new release, however: the claim of religious discrimination. The First Amendment prohibits the government from favouring one religion over another, and the equal-protection clause of the 14th Amendment bars it from discriminating on religious grounds. In its February ruling, the Ninth Circuit noted that “numerous statements ▶▶

► by the president about his intent to implement a ‘Muslim ban,’ and evidence that the first order “was intended to be that ban” constituted a plausible case against the travel rules. “[E]vidence of purpose beyond the face of the challenged law” is fair game, the Ninth Circuit noted.

Mr Trump’s lawyers, in a clear sign that they recognise this embarrassing pedigree as a stumbling block, struck a key line from the January 27th order: a sentence permitting refugee applications from minorities (that is, Christians) who have been subject to “religious-based persecution”. The new executive order contains language insisting that this conspicuous deletion should not be misinterpreted. The original line “did not provide a basis for discriminating for or against members of any particular religion”, the order reads, and “was not motivated by animus toward any reli-

gion.” This has the flavour of protesting too much. The thumbprint of Mr Trump’s campaign promise to ban Muslims from America (a call that remains on his website) will continue to mar this order and is certain to give rise to new lawsuits.

The original travel ban had a related problem: no lucid explanation of how the restrictions enhance national security. The new order does include a few sentences for each country (drawn from a State Department report of June 2016), purporting to “demonstrate why their nationals continue to present heightened risks to the security of the United States.” But the edit has the flavour of a student essay which, in its first version, contained no support for its thesis and has been patched up with a visit to a couple of websites. The logic behind categorical bans from particular countries remains as dubious as before. ■

e-mails, declaring: “I love WikiLeaks!” Days before taking office in January, Mr Trump accused American spy agencies of leaking against him, though he finally conceded that Russia might have been behind the hacking of Democratic e-mails.

The new CIA leaks are a fresh blow to an intelligence community still suffering the after-effects of the release of National Security Agency documents by a former contractor, Edward Snowden, in 2013. The leaks once again highlight the trade-offs underlying espionage in the digital age. Governments want good computer security because they fear cyber-crime and hacking. Yet they also value security flaws because computers and smartphones are excellent spying tools, even in an age of strong, private-sector encryption. If spies can read files directly off a target’s screen, they need not care if it is later transmitted by WhatsApp or similar services.

In another trade-off, governments rely on close co-operation with technology companies. That is why in 2010 the Obama administration undertook to alert firms to security flaws when they found them. WikiLeaks appears to show government agents still buying and hoarding so-called “zero-day” vulnerabilities from hackers, meaning coding flaws not known to a technology product’s creators. The files show agents discussing how to break into such operating systems as Apple’s iOS and Google’s Android, to extract a target’s location, audio and text messages, and secretly take over control of a smartphone’s microphone and camera. Apple said it had already patched many of the newly revealed flaws and would “rapidly” address others.

One of the more lurid files describes “Weeping Angel”, a program that can turn Samsung internet-connected televisions into listening devices, sending conversations back to the CIA. Other documents describe bids to penetrate vehicle control systems in cars. A WikiLeaks commentary suggested this would allow “nearly undetectable assassinations”.

If politicians are incensed that spy agencies seem unable to keep secrets, spooks can point to still another trade-off: the tension between employing hackers with the skills and cunning to design cyber-weapons, and the trickiness of enforcing discipline among workers who may not share the CIA’s culture. The newly leaked files detail codenames that refer to the Harry Potter books, whisky brands and a drug used to treat hyperactivity.

The FBI will now hunt for moles and leakers. The CIA must patch up its systems and meanwhile brace itself for fresh disclosures. That would be bad enough, but trust is low between those agencies and close supporters of Mr Trump, who charge intelligence services with acting as a “deep state” disloyal to the president. Foreign foes have much to cheer. ■



WikiLeaks, again

The spy who came in for the code

WASHINGTON, DC

The CIA, which exists to find out secrets, fails to keep them

A GRIM year for American spy agencies took a turn for the worse with the leaking, on March 7th, of what appeared to be a lengthy, detailed catalogue of the CIA’s secret hacking tools for turning computers, internet routers, telephones and even web-enabled televisions into remote spying devices, and for bypassing encrypted messaging services by penetrating individual Apple and Android smartphones. The WikiLeaks anti-secrecy organisation posted nearly 9,000 documents and files dated 2013-16 in what it said was a first taste of a “vault” of CIA secrets. WikiLeaks claimed that the archive was provided by a former American government hacker or contractor eager to “initiate a public debate” about the security and democratic control of

cyber-weapons, viruses and malware. The group said it had redacted computer code that could be used to launch attacks, pending such a debate.

That self-justification by WikiLeaks will only further strain relations between the intelligence community, the administration of President Donald Trump and technology firms in Silicon Valley. In the final days of the Obama era, American spy chiefs assessed “with high confidence” that a trove of embarrassing e-mails stolen from officials at the Democratic Party and Hillary Clinton’s presidential campaign were “relayed” to WikiLeaks by Russia, in a bid to sway the election of 2016. A month before that election Mr Trump had gleefully hailed the leaking of Clinton campaign

Chicago

This American carnage

CHICAGO

Sending in the Feds is not the answer

“I AM sick of President Trump denigrating Chicago,” said Bill de Blasio, the mayor of New York, during a trip to the Windy City on March 3rd, lamenting Mr Trump’s “particularly painful stereotyping” of the place. In January Mr Trump tweeted that he would “send in the Feds!” if the city did not fix the horrible “carnage” of gun violence. In his recent speech to a joint session of Congress, Mr Trump said it was not acceptable that more than 4,000 people were shot in Chicago last year.

With 764 murders in 2016, more people were killed in Chicago, America’s third-largest city, than in its biggest city, New York (334), and its second-biggest, Los Angeles (294), combined (see chart). Three children were killed in four days in February. Sending in the Feds, whatever it means, may sound appealing, but it would be unlikely to help. Though Mr Trump said that “very top police” in Chicago had told him that the city’s crime problem could be stopped in a week with tougher tactics, there is no single explanation for the rise in violent crime. Nor is there any quick fix. Many of the reasons frequently discussed, such as splintered gangs, an influx of guns from states surrounding Illinois, the demolition of public housing, concentrated poverty or even the weather, are things that have been around for years.

One thing is certain, says John Pfaff at Fordham University in New York: sending in the National Guard, as Mr Trump seemed to suggest, would send the wrong signal and would probably worsen the already sour relations between the police and black Chicagoans. Deploying troops—when local police are unable to contain unrest and the mayor of a city appeals to the governor, who oversees the state National Guard—should be a last resort.

Some things have changed, though. Gangs are using high-powered rifles that can tear through cars and even bulletproof vests. And the Chicago Police Department (CPD) made over 80% fewer street stops in January 2016 than it did in November 2015. The officers’ retreat was related to a public outcry after the release of video footage in November 2015 showing the execution-style killing of a black teenager by a white policeman. The furore resulted in the firing of the then-police chief, Garry McCarthy, as well as an investigation of CPD practices by the Department of Justice. A few months after that steep reduction in street stops, gun violence raced up.

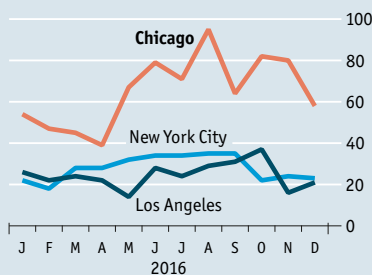
This coincided with a sharp decline in the clearance rate for gun crimes in 2016. Last year 26% of murders resulted in an arrest, down from 36% in 2015, and arrests for shootings fell to 5% from 7%. Many assume the fall is related to black Chicagoans’ lack of trust in police officers, which in turn stems the flow of information needed to solve a crime. It meant that more than three-quarters of last year’s murderers walked free. That may have encouraged revenge killings, as the likelihood of getting caught was so low.

A long-running stand-off between the governor of Illinois, Bruce Rauner, and the state legislature, which has resulted in the disruption or end of many social programmes for Chicago’s poorest residents, is also a factor. Since March 2015 the funding of CeaseFire, which employs former felons and others with insight into local crime as community messengers to prevent violence, has been cut to almost nothing. The one district on the South Side where CeaseFire was not slashed was the only one that saw a drop in shootings. Spokesmen for the programme, known in other cities as “Cure Violence”, claim that if it were fully funded, murders in Chicago could be reduced to fewer than 350 a year; possibly even fewer than 200.

If that sounds self-serving, consider New York’s experience. After bolstering its police force, the Big Apple had success with community policing, which involves officers getting to know not just the criminals on their beat but also the business-owners, teachers and local families, in order to build trust. In Chicago, the vast majority of shootings and murders happen in four or five poor black or Latino neighbourhoods where unemployment is high, schools dreadful and urban blight omnipresent. In January almost half of the city’s 51 murders occurred in Englewood on the South Side and Harrison and Austin on the West Side. This lopsided number contains a hopeful sign: a concentrated problem is easier to tackle than one that is diffuse. Nor is Chicago fated to suffer: six days passed last week without a murder, the first time that has happened for four years. ■

Windy and dangerous

United States, number of homicides



Sources: Chicago, Los Angeles, New York City Police Departments

Campus free speech

Blue on blue

Another student protest descends into violence

“PART of the job of an intellectual community,” said Laurie Patton, president of Middlebury College in Vermont, “is to argue.” Introducing Charles Murray, a controversial author, on March 2nd, she emphasised the audience’s right to non-disruptive protest. Excitable students who thought Mr Murray unacceptably prejudiced—one of his books touches on the relationship of race to intelligence, though he also written on the white working class—evidently considered that offer insufficient.

Their protests quickly escalated from jovial catcalling to prohibitive heckling and then—after Mr Murray was interviewed on camera by Allison Stanger, a Middlebury professor, in a separate room—into violence. Ms Stanger’s hair was yanked; the car in which the pair departed was mobbed. “I feared for my life,” she subsequently wrote.

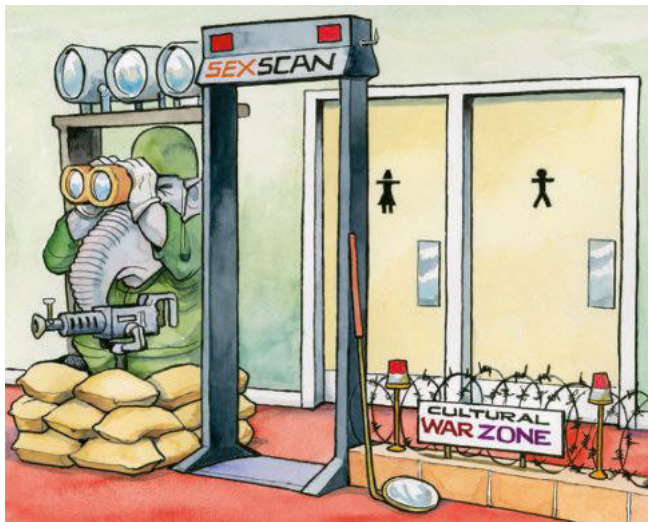
In this latest tussle between campus advocates of free expression and those seeking to banish views they think lie beyond that concept’s ambit, there is some cause for optimism. Ms Patton turned up to the talk, organised by a student club, and afterwards apologised. The college ensured Mr Murray could be heard; it is investigating the scuffle. Still, like the trouble that erupted recently over an offensive speaker in Berkeley, California, the violence at Middlebury—real violence, not the imaginary sort some hotheads think Mr Murray’s beliefs inflict—is an ominous turn.

Ominous for the left, in particular. As with previous incidents, this was as much a clash between different generations of liberals as between left and right. Ms Stanger made clear that she sympathised with Mr Murray’s critics: “We have got to do better by those who feel and are marginalised,” she wrote, adding a sideswipe at Donald Trump. But, as elsewhere, the dust-up pitted her old sense of openness against students’ moral certitude and tightly circumscribed idea of proper discourse.

Meanwhile, Mr Murray was left to worry about academic freedom and to note that many of his assailants resembled figures from “a film of brownshirt rallies”. Middlebury’s agitators might ask themselves how a man whose work they decry as racist acquired the right to compare them to fascists. Students everywhere should wonder how free speech, a central liberal value, is instead becoming the banner of conservatives.

Lexington | Fear and loathing everywhere

Increasingly, culture wars are presented as fights with real casualties



IN THE annals of political intransigence, few beat Senator Jesse Helms of North Carolina. On abortion or gay rights Helms was unyielding, insisting that God's laws pre-empted debate. As AIDS ravaged gay America in the 1980s and 1990s, Helms fought to block funds for research and treatment, blaming the disease on "perverts" whose conduct the Bible deemed an "abomination".

Today, not quite a decade after Helms's death, it is harder to stifle debate by citing the Scriptures or other eternal verities. Gay Americans may marry and join the army; an openly gay person sits in Helms's beloved Senate. Yet culture wars continue.

In 2016 North Carolina's Republican-dominated state legislature passed the "Public Facilities Privacy and Security Act", one of several "bathroom bills" debated nationwide. Notably, the act overturned a local ordinance passed by racially diverse, fast-growing Charlotte, the state's largest city. Charlotte had banned discrimination on the basis of sexual orientation or gender identity in a range of public places. Opponents paid special heed to the seemingly arcane question of transgender lavatory-access, and whether women and young girls might be ambushed in bathrooms or changing rooms by males claiming to be transgender women. Franklin Graham, a prominent evangelical pastor, called transgender bathroom-rights a boon to "paedophiles and predators". Strikingly often, culture wars sound like that today: less an appeal to abstract principles than a claim that opponents are—out of naivety or wickedness—exposing innocents to harm.

The Texas state legislature meets only every other year, reflecting Texan disdain for government. Despite the scant time available for lawmaking, arguably the state's most powerful Republican, Lieutenant-Governor Dan Patrick, calls it a priority to oblige transgender Texans to use lavatories and changing rooms in public schools and buildings that correspond to the "biological sex" on their birth certificates. Anything else is a "free pass to sexual predators", he says. A University of Texas/*Texas Tribune* poll shows that only 39% of Texans consider it important to pass Mr Patrick's bathroom bill. Many business bosses are hostile to it, lest Texas seem unwelcoming. North Carolina's bathroom bill prompted such firms as PayPal to scrap planned investments and led the NBA to move the 2017 All-Star basketball game from Charlotte. Still, as a way of rallying socially conservative voters, bath-

room bills are good politics. The lieutenant-governor of North Carolina, Dan Forest, joined Mr Patrick at the Texas state capitol on March 6th to insist that damage to his state's economy has been exaggerated. Mr Patrick, a former talk-radio host, compared the bathroom bill to the siege of the Alamo, urging colleagues to be as "courageous" as the doomed defenders of that Texan fort.

Presenting culture wars as a fight about safety can be exceedingly effective. In 2015 voters in Houston, though a diverse bunch who have elected a lesbian mayor three times, overwhelmingly rejected an equal-rights ordinance banning discrimination on more than a dozen grounds, among them sexual orientation and gender identity. The ordinance was beaten by a one-theme campaign headlined "No Men in Women's Bathrooms", backed by TV ads showing a young girl cornered in a lavatory. In vain, ordinance defenders noted that city and state laws already ban lewd or disturbing behaviour in public lavatories, and would continue to do so. Nor were voters swayed by arguments that, to obey conservative bathroom bills, bearded transgender men in lumberjack shirts must use women's loos if they were born female.

To be sure, as transgender Americans become more visible, new puzzles emerge. Mack Beggs, a 17-year-old Texan, began testosterone injections in 2015 and now identifies as a boy. In February, to the rage of rivals' parents (one father filed a lawsuit), he won a girls' state wrestling championship after his bid to compete with boys was rejected. Transgender rights in prisons or women's shelters raise hard public policy questions.

But bathroom use has been going on quietly and harmlessly for years. And a cynical focus on harm makes it hard for all sides to be pragmatic. In 2016 the Obama administration instructed schools to let pupils use facilities corresponding to their gender identity, as a question of civil rights. That was once the position of Donald Trump, who as a candidate for president correctly observed that transgender bathroom-users cause "so little trouble". On February 22nd the Trump administration withdrew that federal guidance—a move reflecting the influence of Jeff Sessions, the Alabama-born conservative who heads the Justice Department.

Transgender advocates have hardened their line, too. An early debate took place in Vermont, where in 2009 young gay activists asked schools to provide one gender-neutral (if need be, single-occupancy) loo for students, to avoid bullying in communal bathrooms. The American Civil Liberties Union, representing a transgender Virginia teenager in a case that the Supreme Court sent back to lower courts this week, argued that making him use a private loo left him feeling a "walking freak show" at school.

The NRA model of politics

All manner of culture wars are becoming an argument between two camps, each demanding: "Why are you trying to hurt my children?" Go back 30 years and the National Rifle Association (NRA) thundered about gun ownership as a constitutional right and a bulwark against government tyranny. Modern NRA ads present America as a dystopia of violent crime and terrorism, urging citizens to arm themselves to keep loved ones safe.

Fear resonates. Between 1999 and 2013 the proportion of Americans who said they owned a gun for protection almost doubled, overtaking hunting as the top reason cited. Donald Trump, a man who is not in thrall to abstract principles, justified his plans for a border wall by accusing Mexico of sending "rapists". Clashes of morality can cause nasty intransigence. Clashes over safety leave no room for compromise. ■



Brazil

An accidental, consequential president

BRASÍLIA

Michel Temer would rather be unpopular than populist

MOST presidents in Michel Temer's situation would be called "embattled". Brazil has yet to recover from its worst recession on record. Some of the president's closest associates face accusations in the country's biggest-ever scandal. His approval rating is below 30%; many Brazilians regard his presidency as illegitimate.

Yet, in an interview with *The Economist*, on a Saturday in a nearly deserted presidential palace, Mr Temer seemed anything but embattled. Collar unbuttoned, sleeves rolled to his elbows, the energetic 76-year-old was untroubled by the scorn that Brazilians heap upon him. Asked about the slogan "Temer out!", spray-painted on a fly-over that he passes on his commute between his official residence and his office, Mr Temer called it "proof of democracy's vibrancy". He could arrange to have it painted over, but would not dream of it.

He was not expecting to become president. Until last May, he was the largely powerless vice-president under Dilma Rousseff, of the left-wing Workers' Party (PT). He took over when she was impeached for manipulating government accounts. To her allies, Mr Temer is a *golpista* (coup-monger). To many other Brazilians, he is a typical member of the corrupt political class responsible for a vast bribery scheme centred on Petrobras, the state oil firm. Ms Rousseff was driven out of office by anger about that scandal, though she was not directly implicated, rather than by the technical offence with which she was

charged. Some think Mr Temer's presidency will also come to a premature end.

His jauntiness comes from his confidence that history will vindicate him. A member of the centrist Party of the Brazilian Democracy Movement, he is piloting reforms through congress to clear away obstacles that have blocked Brazil's progress for decades. Although Mr Temer will have been president for less than three years by the time he is due to leave office in early 2019, he says he will hand on to his successor a country that is "back on track".

As if to persuade his audience that what seems fantastic is real, he emphasises his points with the gestures of a stage magician. His government has passed a constitutional amendment to freeze federal spending in real terms for 20 years. It will soon reform the pension system. Those measures will help contain the increase in Brazil's massive public debt, one of the main threats to its long-term prosperity.

They face fierce opposition, especially from the PT and from trade unions, which contend that the government is balancing its accounts on the backs of the poor. Mr Temer retorts that without such action the federal government will suffer the fate of states like Rio de Janeiro and Minas Gerais, "which are virtually bankrupt because of public pensions". He points to himself as a "clear example of premature retirement": he has been drawing a generous pension since he stopped working as a prosecutor in São Paulo more than two decades ago.

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Far from hurting the poor, the reforms will protect "the future of all our social programmes", he insists. He would "rather be unpopular now than a populist".

So far, congress has largely gone along with his plans. The government has "an extremely solid parliamentary base", Mr Temer says. Emboldened by that support, he intends to begin an assault on the Mussolini-era labour laws. He is pushing a bill that would relax restrictions on employing temporary workers and let agreements between unions and employers override some rules in the labour code. On March 7th he presented a plan to simplify the tax law, whose complexity discourages enterprise, and to put out to tender 45bn reais (\$14bn) in infrastructure projects.

A better class of politician

A constitutional lawyer by training, Mr Temer dreams of reforming Brazil's dysfunctional political system. Despite his success in congress, he, like other presidents, has found it hard to manage a legislature composed of 28 parties, many of them machines for extracting patronage. "Brazil has no parties, only acronyms," he complains. The number could be cut by introducing a British-style first-past-the-post electoral system or voting by party lists rather than for individual candidates, he muses. Congress is considering the introduction of a 3% nationwide vote threshold for parties to enter the legislature and a ban on coalitions that bring in small parties. Both would be significant reforms.

Many Brazilians scoff at the idea that Mr Temer could be part of the solution. The prosecutor-general, Rodrigo Janot, will soon present a list of politicians he wants investigated as part of the *Lava Jato* (Car Wash) investigations into the Petrobras scandal. They are expected to include people close to Mr Temer, as well as figures from rival parties, including the PT. Sepa- ►

rately, the electoral tribunal is investigating whether the re-election campaign of Mr Temer and Ms Rousseff in 2014 benefited from dodgy donations. An executive jailed in the *Lava Jato* investigation testified that he and Mr Temer had discussed campaign donations.

Voters suspect that the president would like nothing more than to thwart investigations that could threaten him. Perhaps, but

he gives a good impression of being their biggest fan. *Lava Jato*, he says, is the “best example” of a process that is strengthening Brazil’s national institutions. As for the case against his re-election campaign, he has “full peace of mind”; all the donations were registered legally. If so, there is little to stop Mr Temer from serving out his term. This accidental president could end up being a pretty consequential one. ■

Ethnicity in the Caribbean

Favouring curry

PORT OF SPAIN

The flow of indentured workers ended 100 years ago. It still shapes the region in surprising ways

WHEN Anthony Carmona, the president of Trinidad and Tobago, showed up in a Carnival parade last month wearing a head cloth, white shorts and beads like those worn by Hindu pandits, he was not expecting trouble. Nothing seems more Trinidadian than a mixed-race president joining a festival that has African and European roots. But some Hindus were outraged. “[O]ur dress code has never been associated with this foolish and self-degrading season,” huffed a priest. Trinidad’s cultures blend easily most of the time; occasionally, they strike sparks.

The Hindu-bead controversy is not the only one ruffling feelings among Indo-Trinidadians. Another is caused by a proposal in parliament to raise the minimum age for marriage to 18 for all citizens. Currently, Muslim girls can marry at 12, girls of other faiths at 14. Muslim and Hindu traditionalists want to keep it that way.

Another argument has been provoked by the disproportionate number of Trini-

dadians who have joined Islamic State (IS). About 130 of the country’s 1.3m people are thought to have fought for the “caliphate” or accompanied people who have. That is a bigger share of the population than in any country outside the Middle East. The government wants a new law to crack down on home-grown jihadists, which some Muslim groups denounce as discriminatory. The attorney-general, Faris Al-Rawi, is guiding both measures through the legislature.

Both debates are causing unease in the communities that trace their origins to the influx of indentured workers in the 19th century. This month marks the 100th anniversary of the end of that flow. By bringing in large numbers of Indians, mostly Hindus and Muslims, the migration did much to shape the character of the Caribbean today (see chart). The arguments about marriage and terrorism are part of its legacy.

The migration from India began in 1838 as a way of replacing slavery, banned by

Britain’s parliament five years earlier. Recruiters based in Calcutta trawled impoverished villages for workers willing to sign up for at least five years of labour—and usually ten—on plantations growing sugar, coconut and other crops in Trinidad, British Guiana (now Guyana), the Dutch colony of Suriname and elsewhere.

Workers were housed in fetid “coolie” barracks, many of which had served as slave quarters, and were paid a pittance of 25 cents a day, from which the cost of rations was deducted. Diseases like hookworm, caused by an intestinal parasite, were common.

But the labourers’ lot was better than that of enslaved Africans. Colonial governments in India and the Caribbean tried to prevent the worst abuses. Workers received some medical care and were not subject to the harsh punishments meted out to slaves, notes Radica Mahase, a historian. In some periods the colonial government offered workers inducements to stay at the end of a contract: five acres of land or five pounds in cash.

Opposition from Indian nationalists and shortages of shipping during the first world war prompted the British government of India to shut down the traffic on March 12th 1917. By then, more than half a million people had come to the Caribbean. Today, just over a third of Trinidad and Tobago’s people say they are of Indian origin, slightly more than the number of Afro-Trinidadians; the share is higher in Guyana, lower in Suriname. Hindus outnumber Muslims. Many, especially those whose forebears were educated at Presbyterian schools, are Christians.

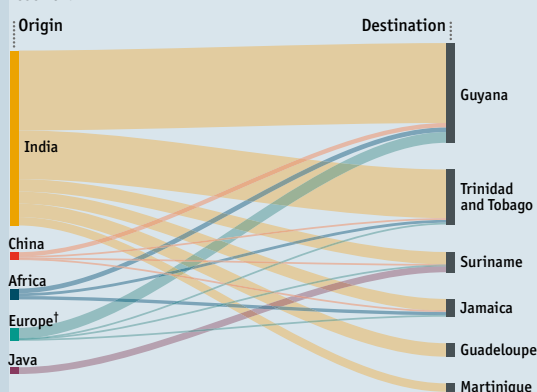
Caribbean people of Indian origin are as successful and well-integrated as any social group. Many of Trinidad and Tobago’s state schools have religious affiliations but are ethnically mixed; the government pays most of their costs regardless of denomination. Eid al-Fitr, which celebrates the end of Ramadan, and Diwali are public holidays. Many Hindus celebrate the religious festival of Shivaratri, then join in Carnival parades. “An individual can have multiple identities,” says Ms Mahase.

Politics still has ethnic contours. In Trinidad and Tobago, most voters of African origin support the People’s National Movement, which is now in power. Indo-Trinidadians tend to back the opposition United National Congress. Guyana’s president, David Granger, is from a predominantly Afro-Guyanese party.

But these distinctions are blurring. A growing number of Caribbean people identify with neither group. Nearly 40% of teenagers in Trinidad and a quarter in Guyana call themselves mixed-race or “other”, or do not state their ethnicity in census surveys. When both countries hold elections in 2020, these young people are likely to vote less tribally than their parents do. ▶▶

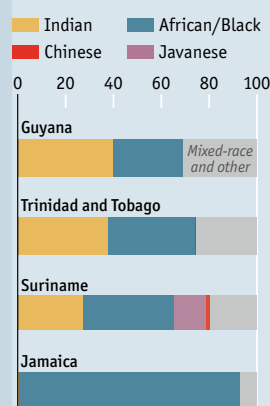
Routes

Indentured migration* to the Caribbean
By origin and selected destination countries, estimates
1838–1917



Ethnic composition

2012 or latest available, %



Sources: National census data; *The Economist*

*System of unfree labour. Workers are bound to an employer for a specified period of time †Almost exclusively from Madeira, starting 1835

▶ Trinidad's jihadist problem is in part caused by the choice of new identities rather than by the embrace of established ones. Many of its recruits are Afro-Trinidadian converts to Islam. Mr Al-Rawi, who is leading the fight to stop them, claims descent from the Prophet Muhammad through his Iraqi father, but has a more relaxed view of religion. His mother is Presbyterian, his wife is a Catholic of Syrian origin and one of his grandfathers was a Hindu.

The anti-terrorist and child-marriage laws he is promoting, though seemingly unrelated, are rebukes to rigid forms of identity. The anti-terrorist law would make

it a criminal offence within Trinidad to join or finance a terrorist organisation or commit a terrorist act overseas. People travelling to designated areas, such as Raqqa in Syria, would have to inform security agencies before they go and when they come back. Imtiaz Mohammed of the Islamic Missionaries Guild denounces the proposed law as "draconian".

The proposal to end child marriage affects few families; just 3,500 adolescents married between 1996 and 2016, about 2% of all marriages. But it has been just as contentious as the anti-terrorism law. The winning calypso at this year's Carnival, per-

formed by Hollis "Chalkdust" Liverpool, a former teacher, was called "Learn from Arithmetic". Its refrain, "75 can't go into 14", mocked Hindu marriage customs and implicitly backed the legislation to raise the marriage age. Satnarayan Maharaj, an 85-year-old Hindu leader, called it an insult.

The government has enough votes in parliament to pass the law in its current form, but opponents may challenge it in the courts. Traditionalists may thus hold on to an anachronism imported from India, at least for a while. The bead-wearing, calypso-dancing president is probably a better guide to what the future holds. ■

Bello | How to steal a country

Will Venezuela's dictatorship get away with it?

HUGO CHÁVEZ owed much to Raúl Baduel. When in 2002 Chávez was forced to step down as Venezuela's president following a massacre of protesters in Caracas, it was General Baduel, an old political ally, who restored him to power after an opposition junta had illegally suspended the constitution. In gratitude, Chávez made General Baduel defence minister. But in retirement the general dared to oppose Chávez's drive to abolish term limits. He was accused of stealing \$10m and jailed. Two days before completing his sentence, this month General Baduel was charged with treason.

His treatment shows how cornered the government of Nicolás Maduro, Chávez's chosen successor, feels. Mr Maduro has an approval rating of just 18% according to Datanálisis, a pollster. The economy is in freefall because of mismanagement and lower oil prices. To service its foreign debt, the government slashed imports to a third of their level in 2012.

Venezuelans are suffering privation previously unheard of in what was once South America's richest country. According to a study by three universities, 82% of households now live in poverty. That compares with 48% in 1998, when Chávez came to power. The rise in poverty follows Venezuela's biggest-ever oil windfall. Of the \$1trn the regime received in oil revenue, perhaps a quarter was stolen by insiders, according to the International Crisis Group, a think-tank. Infant mortality is rising, and Venezuelans are needlessly dying because of the shortage of medicines. Those who can, leave; perhaps 2m Venezuelans now live abroad.

To remain in power, Mr Maduro's state-socialist regime is extinguishing democracy. The opposition won a big majority in a legislative election in 2015. Since then, the government has used its



hand-picked supreme court to nullify parliament. The similarly tame electoral authority blocked the opposition's drive for a recall referendum. It failed to call an election for mayors and regional governors, due last year. The authority is now requiring the re-registration of opposition parties, a process whose rules are so impractical that it appears designed to abolish many of them.

Talks between the opposition and the government, brokered by the Vatican and the South American Union, collapsed in January because Mr Maduro showed little interest in freeing political prisoners or restoring constitutional rule. Instead he is becoming more repressive. His new hardline vice-president, Tareck El Aissami, heads a "national anti-coup command". This has kept General Baduel in prison and jailed several other army officers along with members of Popular Will, an opposition party whose leader, Leopoldo López, has been a prisoner since 2014. It is one of the regime's fantasies that it faces constant coup plots. Another is the quasi-religious official cult of Chávez, who died of cancer four years ago this week.

What can be done to halt Venezuela's implosion, organise a humanitarian rescue and achieve a return to democracy? Radicals in the opposition trusted in a popular uprising. But repression has worked: people seem too scared and preoccupied with survival to sustain mass protests. A negotiated solution remains the most plausible option. But it will take pressure from both within and without.

The United States has tightened the screws a little. Donald Trump met Lilian Tintori, Mr López's wife, at the White House last month, and called for his release. The United States Treasury has blacklisted Mr El Aissami, accusing him of drug-trafficking (which he denies). But sanctions are of doubtful effect and are likely to make officials even less willing to yield power. Some Republicans would like the United States to stop buying Venezuelan oil; that would cause disruption but provide a pretext for repression.

The best option is for the United States to join other Latin American countries in pressing the regime to accept talks. Last year Luis Almagro, the secretary-general of the Organisation of American States, invoked the group's democracy clause to call for Venezuela's suspension. He failed to get sufficient backing. Now he may try again. Political change in South America, combined with Venezuela's move to open dictatorship, has left Mr Maduro more isolated than in the past.

Diplomatic pressure alone will not be enough to shift him. But it will help. Needed, too, is a more effective opposition: it is high time that its squabbling groupuscules united in a single party with one leader. The alternatives are stark: the consolidation of a Latin American dictatorship, or the possibility of large-scale bloodshed. The region should do its utmost to avoid both.



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The war against Islamic State

Caliphate at bay

MOSUL

The Iraqi army is on the brink of defeating Islamic State. But the government must move fast if it is not to squander its victory

IN A series of lightning advances over the past few days, Iraq's army has seized control of most of western Mosul, the last redoubt of Islamic State (IS) in the country. On March 7th, a day that may have marked a turning point, army units took Mosul's main government complex, as well as the city's famous antiquities museum and about half of the old city. The airport had fallen a week or so earlier, and all roads in and out of the city in which the leader of IS, Abu Bakr al-Baghdadi, declared his "caliphate" in June 2014 are firmly in government hands.

In the command centre responsible for the eastern half of the city, which was liberated in December, Brigadier Qais Yaaqoub was jubilant. "They are in full collapse now," he said. "When an army breaks it happens very quickly. Within a week or two, this will all be over." He may be speaking prematurely, but probably not by much. The liberation of west Mosul, which started only last month, has proceeded much faster than expected. That said, the last of the fighting could be a lot more difficult. IS clings on in the oldest parts of the city, where streets are narrow, making it hard to manoeuvre vehicles and increasing the risk of ambushes and civilian casualties. However, tens of thousands have been able to make their way to safety.

American officers working closely with the Iraqi army estimate that as few as 500 IS fighters now remain in the city, the others having fled or been killed in a devastating campaign of well-targeted air strikes. The evidence is clear from a tour of east Mosul, on the left bank of the Tigris river, which has split the city in two since IS blew up all its five bridges as it fell back.

Residents point out building after wrecked building that had been used by jihadists, only to be knocked out from above. "This was a shopping centre, but Daesh [IS] took it over," says Muammar Yunnis, an English teacher. "Then the planes destroyed it." The liberation, he reckons, "could not have been handled better. Some have died. That happens in a war. But the government and the Americans have been careful."

Driving IS out of the city may come to be seen as the straightforward part, however. Judging by what has happened in east Mosul, rebuilding will be a slow process. Three months after their liberation, east Mosulites are getting fed up. They are still without running water, and the only electricity comes from private generators.

"We have security now, but no services at all," complains Muhammad Ahmed, a pharmacist. "There is no government here." The provincial governor lives in Er-

bil, a couple of hours' drive away, partly along roads ploughed up by IS that show no sign of being repaired. No international agencies are to be seen in the recaptured city, bar a few clinics and some empty school satchels donated by UNICEF. The central government has failed to provide it with an emergency civilian administration, leaving it either to the army, which is otherwise occupied, or to the local government, which barely functions.

Mr Ahmed probably speaks for many when he recalls that in the days immediately after IS took control of Mosul, the jihadists were rather popular. The previous elected authorities had been corrupt and incompetent, and unable to deliver the basics. Electricity, he recalls, was available for just three hours a day. Under the caliphate the lights stayed on, at least until coalition air strikes began and then, shortly before losing control of east Mosul, IS blew up the city's main power station and its water-pumping station.

At least they kept the lights on

If squabbling and corruption on the part of the politicians hinder the provision of services, citizens will once again consider supporting alternative groups. "What can we do?" laments the brigadier. "The government does not have the resources to fix all this. It will take 12 years or more. We need a lot of help from outside."

Many will blame the inaction on insecurity. But this is overblown. Although the chatter of machineguns and the crump of mortar rounds can be heard from across the Tigris, east Mosul already looks and feels reasonably safe. The Shia militias have been kept out of the city to avoid sectarian killings, as have the Kurdish pesh- ▶▶



► *merga* fighters. There is no curfew; policemen guard many street corners, and the “sleeper cells” that some warn of seem to be soundly asleep, if indeed they exist. The last incident in the city was a month ago, when a terrorist blew himself up in a restaurant, killing three people.

Children are back at school, to the delight of parents who had kept them at home after the city fell to IS rather than send them off to be indoctrinated by homicidal zealots. But even though restaurants and shops are open, business is slow. Muhammad Attar, who runs a falafel restaurant, says this is because no one has any money. Iraq’s economy is dominated by the state and most people with regular jobs work for the government. Amazingly, it kept paying salaries for about a year after IS conquered Mosul. But even so, most of the city’s workers have not been paid for more than a year. Pensions, somehow, are still getting through, and families are managing on those and on debt.

With Mosul recaptured, the rout of IS in Iraq will be complete. Undoubtedly, though, some of its surviving fighters will revert to suicide-bomb attacks. And, for a while, the group will live on in Syria. But there too it is surrounded and shrinking back to its “capital”, Raqqa. The caliphate’s short, brutal life is drawing to a close.

In the longer term, huge problems remain for Mosul. Many of its people undoubtedly collaborated with the occupiers, and scores will be settled. Sunnis will want to be sure that they are given a full share of power in the city and its surrounding province of Nineveh, even though it is a Shia-dominated army that liberated them. The Kurds will want some sort of reward for their part in beating IS back. Much of the city will need to be rebuilt. Getting the power back on and the water running as the roasting Iraqi summer approaches would be a good place to start. ■

Egypt’s economy Green shoots

CAIRO

Some good signs for Egypt’s beleaguered economy

AT TIMES last year it looked as if Abdel-Fattah al-Sisi, Egypt’s authoritarian president, was losing his grip. Faced with a faltering economy, he told Egyptians that they needed to sacrifice—by not eating or sleeping, if necessary. Perhaps they could send him their spare change too, he said.

Rummaging behind the cushions hardly seemed enough to turn around an economy plagued by political instability, and by terrorism that had scared off tourists and foreign investors. Moreover, while exhorting his countrymen to tighten their belts, Mr Sisi was squandering billions of dollars of aid from Gulf states on wasteful subsidies and on defending Egypt’s overvalued currency. The futility of these policies can be seen in a handful of figures: a gaping fiscal deficit that hit 12% of GDP last year; ballooning public debt (101% of GDP) and high unemployment (over 12%).

Yet there are signs that Mr Sisi is starting to put Egypt back on a more sensible economic track. In order to obtain a \$12bn loan from the IMF last year, his government has raised the price of subsidised fuel and electricity, brought in new taxes and allowed the Egyptian pound to float.

The currency float was promptly followed by a sickening lurch in which it lost 50% of its value. It bounced back sharply in February, then retreated again (see chart). Though the medicine was bitter, it seems to have been just what was needed to lure foreign investors back into the Egyptian market. A sale of \$4bn-worth of government bonds in January was more than three times oversubscribed, and foreign purchases of Egyptian treasury notes doubled in the same month. This appetite for investing in Egypt partly reflects a broader demand for emerging-market debt. But it is also a clear sign of growing confidence in the Egyptian economy.

That change in mood is also felt by Egyptians working abroad. Remittances, which accounted for as much as 7% of GDP in 2012, slumped by a fifth last year as people held onto foreign currency rather than send it home to be converted into overvalued pounds. Since the currency has floated, remittances are rising once more.

A weaker currency is also spurring growth, albeit gradual, in trade and tourism. Non-petroleum exports increased by 25% in January compared with the year before. Earnings from exports, along with new loans from the IMF and other sources, are plumping up the country’s foreign-cur-

rency reserves. In February they hit their highest level since 2011, promising to ease a shortage of dollars that has hindered Egyptian business. To be sure, businessmen gripe that it is still difficult to get the dollars that they need, and the government is still clearing a backlog of payments to oil firms and other multinationals.

Yet even as exporters celebrate, firms serving the domestic market are struggling. One measure of the health of the domestic economy comes from a purchasing managers’ index (PMI) compiled by Emirates NBD, a bank. Its figures suggest that private, non-oil economic activity has contracted for 17 consecutive months, even though official figures show that the economy as a whole (including oil and the state) has been growing. One reason is that the government’s efforts to cut subsidies mean Egyptians are spending more of their income on fuel and electricity, and have less left over for other things. A weaker currency has also led to higher prices for imports and fuelled consumer inflation. Red tape continues to tie firms in knots, although the government has promised to make it easier to do business, for example by smoothing the process for getting licences and permits to open factories.

The struggles of Juhayna, a big juice and dairy producer, are typical. Its profits declined by 34% in the third quarter of 2016 compared with the same period in 2015. Now it plans to raise prices and cut investment. Seif El Din Thabet, its CEO, blames its troubles on “the recession and low consumer purchasing-power”.

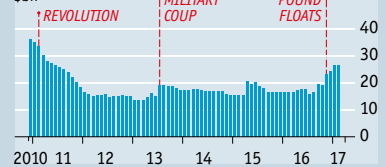
Yet there are signs that a broader recovery ►►

A river of troubles

Egypt

Foreign reserves

\$bn



Egyptian pounds per \$

Inverted scale



Consumer prices

% increase on a year earlier



Sources: Haver Analytics; Thomson Reuters

ery may come soon. The weaker currency is proving a fillip to some manufacturers, as consumers switch from expensive imports to cheaper domestic alternatives. Egypt's trade deficit in January was 44% smaller than it had been a year earlier.

These benefits are yet to trickle down to the average Egyptian. "We hear about the improvement on TV and read about it in the newspapers, but on the ground, nothing is getting better," says Ashraf Muhammad, a barber in Agouza. Inflation climbed to 28% in January. It will probably remain high if the government cuts subsidies and

raises taxes this year, as planned. Prices for staples have skyrocketed; other products are no longer available. "Some medicines I use disappeared for a while," says Mr Muhammad, who suffers from diabetes. "Now they are available, but at higher prices than before."

The protesters who toppled Hosni Mubarak, the strongman who ruled Egypt from 1981 to 2011, demanded social justice. So Mr Sisi may be wary of imposing too much pain on Egyptians. His government has backed away from reforms in the past and may lose any sense of urgency when

Zohr, a lucrative gasfield, starts production at the end of the year. But international investors and institutions are watching closely for any sign of backtracking. The IMF will review matters before sending Egypt more cash later this year. "We are seeing good progress," said Christine Lagarde, the head of the fund, last month.

Egyptians are more circumspect. "I don't blame the government for taking the hard way, but, at the same time, they should have considered the poor people," says Mr Muhammad. Still, he is sure that things will get better, albeit slowly. ■

A port for Gaza

Preventing the next war

NAHAL OZ, ISRAEL-GAZA BORDER

If you build it, will they trade?

ISRAEL'S border with the Gaza Strip is tense at the best of times. But tempers are especially frayed after weeks punctuated by sporadic exchanges of fire. Israeli security chiefs are wondering how they can avert another conflict in an area that has seen, on average, a big one every two to three years.

Much of Israel's introspection has been prompted by the release of a report by the State Comptroller on the decisions leading up to and during the war between Israel and Gaza in the summer of 2014, in which some 2,100 Palestinians and 73 Israelis died. Although much of the report dealt with the mayhem that summer, it also underscored long-standing complaints by senior officials that Israel's government had failed to seek a long-term solution to the whole Israeli-Palestinian dispute. It noted, for instance, that although military and intelligence officers had been warning for some time that life for the 1.8m Palestinians living in Gaza was getting much worse, the cabinet was presented only with military options for confronting Hamas, a militant Islamist group, without any diplomatic alternatives.

The report has revived talk within Israeli security circles of finding ways to ease a blockade of Gaza that contributes to its economic stagnation and the frustrations that prompt some Gazans to pick up stones, knives or rockets.

Although Israel withdrew from the territory in August 2005, it continues to control access, along with Egypt, to the 365 sq km coastal enclave. Following a civil war in 2007 in which Hamas wrested power from the Palestinian Authority, Israel and Egypt have enforced a blockade of varying degrees of severity.

Surprisingly, the loudest voice within Israel's government is that of Yisrael Katz, the transport minister and a hardliner in

the ruling Likud Party. He has proposed building an artificial island three miles off Gaza's shores. This could house a port and airport that would give Gaza much-needed access to the world, as well as power and desalination plants that would alleviate acute shortages of electricity and water. Putting the port offshore could allow an international security force to inspect imports and prevent the smuggling of arms to Hamas and other militant groups. Mr Katz adds that it would also entail "creating land which no side in the conflict has claim to". (This is what passes for a joke in Israeli-Palestinian diplomacy.)

Mr Katz argues that the \$5bn price would be paid by private investors and foreign donors interested in boosting Gaza's dire economy. Building it would provide jobs for unemployed Gazans. Above all, he argues, the gateway would relieve Israel of any responsibility for Gaza. "I have no illusions regarding Hamas and its murderous ideology," he says. "But our current policy allows them to imprison their population without any hope of development."

Mr Katz's proposal has widespread support within Israel's security establishment and the tacit support of many of his cabinet colleagues, even if they are wary of saying so in public. The main obstacles remain political. Israel and Hamas, which raises most of its revenue from taxing imports to the strip, both refuse to negotiate directly. And Hamas's testy ties with the Palestinian Authority and Egypt would further complicate efforts to reach an agreement.

Ultimately, though, the decision over whether to try rests with Binyamin Netanyahu, Israel's prime minister—and he is reluctant to act. His instinct, when it comes to Gaza, is to procrastinate until there is no choice but war.

Cameroon

Lingua fracas

DOUALA

Clamping down on the web and English

THE images beaming from the screens of Cameroon's state television channel, CRTV, show a country riding on a wave of glory. In February the national football team, "The Indomitable Lions", beat Egypt to win the Africa Cup of Nations trophy for the first time in 15 years. In January a Cameroonian teenager became the first ever African winner of the Google coding challenge, an international programming competition.

But turn away from the goggle box and the country is troubled. When the footballing trophy was brought to Bamenda, Cameroon's third-biggest city, placard-carrying protesters joined the crowds of onlookers. And for almost two months the country's young Google prodigy, along with hundreds of thousands of others, has been unable to surf the web because the government has shut it down in two English-speaking regions (see map). The plug was pulled as part of a clampdown on ▶▶



▶ Anglophone activists in which more than a hundred people have been arrested and pressure groups have been outlawed. At least six people have been killed and scores more injured since December by policemen and soldiers who have opened fire on demonstrators.

The protests initially began as a series of strikes by the country's English-speaking lawyers, who took to the streets in their wigs and gowns in October 2016 demanding English translations of the country's key legal texts and better treatment by the authorities. Since then many others have joined in, including teachers. The conflict between the government and the Anglophone minority is escalating.

The roots of Cameroon's linguistic rift date back to 1919, when Britain and France divided the country between them, having taken it from Germany after the first world war. After both parts gained their independence in 1960 and 1961, they reunited to form a bilingual, federal republic. But English speakers, who are less than fifth of the population, feel hard done by. They say that their regions get less than their share of public money and that it is too hard to interact with the state in English.

President Paul Biya, who has been in power since 1982, is sub-Saharan Africa's second-oldest ruler, after Robert Mugabe of Zimbabwe. Yet despite his age, he has mastered social media, in the sense of figuring out how to silence digital dissent. After young Arabs used smartphones to organise the uprisings of the Arab Spring, despots everywhere grew nervous. But then they found the off-switch. Last year 11 African governments, including Zimbabwe and the inaptly named Democratic Republic of Congo, interfered with the internet during elections or protests.

The government cut off the internet to a part of the country known for its technology start-ups, which probably hasn't done much for economic growth. Before the crackdown internet usage in Cameroon had been soaring, with penetration rising to 18% in 2016, from 4.3% in 2010. Phones are also ubiquitous, which may be why the communications ministry has been sending text messages, sometimes several times a day, warning of prison sentences of up to 20 years for anyone "found guilty of slander or propagating false declarations on social media".

Journalists have been arrested and a popular radio station has been taken off the air. Although the conflict in Cameroon has mainly affected the English-speaking minority, the government's heavy-handedness suggests that worse may lie ahead. Next year the country's 84-year-old leader is expected to run for a seventh term. With no clear successor or challenger in sight, Mr Biya probably has no need to ratchet up repression. But meddling with the internet can be addictive, like the internet itself. ■

South Africa

Disgrace

DIEPSLOOT

A survey reveals staggering levels of sexual violence

BBROWN LEKEKELA dreads the end of the month. Payday means binge drinking. Violence follows. Women turn up battered and distraught at his gate, usually with small children in tow. They have nowhere else to go: Mr Lekekela's emergency shelter, Green Door, is the only one in all of Diepsloot, a hardscrabble township north of Johannesburg that is home to an estimated half a million souls. The shelter, built in the yard of his humble house, can fit two women and their children, plus maybe one more family on the couch in his office. He runs it on donations and sheer willpower.

Mr Lekekela has a first-aid kit and some training to treat minor injuries. For more serious ones, it can take hours for an ambulance to arrive. Sometimes the women (or their children) have been raped. But with no other income or support, they often end up returning to their abusive partners. "It's hard," says the soft-spoken Mr Lekekela. "But if I don't do it, who will?"

Rape and domestic violence are hard to measure, since victims often suffer in silence. And headline-writers overuse the word "epidemic". But in South Africa it clearly applies. For a study published in November by the University of the Witwatersrand and Sonke Gender Justice, a non-profit group, 2,600 men in Diepsloot were surveyed anonymously. An aston-

ishing 38% admitted to having used force or threats to obtain sex in the preceding year. Add those who said they had beaten, hurt or threatened to use a weapon against a woman, and the share jumps to 54%. Of those men, more than half said they had committed such crimes more than once.

Many men in Diepsloot, as in many other parts of South Africa, do not think they are doing anything wrong. They think they have a right to use force against their partners. In addition, many of the men interviewed had themselves experienced childhood abuse or trauma. Some were mentally ill. Those who abuse others suffer few consequences, whether from the law or neighbours. Diepsloot, a warren of shacks with pockets of small houses, did not exist until the mid-1990s, so everyone comes from somewhere else. "These men think they can do whatever they like," says Precious Moeketsi, a 28-year-old with two young children who shares a shack with her sister's family. "I feel worried living here."

Although South Africa has strict laws against violence, they are spottily enforced. Researchers found that of 500 sexual-assault cases reported to the police in Diepsloot since 2013, only one resulted in a conviction. Small wonder rape is so rarely reported. (Researchers guess that police are informed about only one of every nine sexual assaults in South Africa.) Women worry about what friends and family will think. Some fear reprisals. Policemen are sometimes sceptical and tell women to go home and smooth things over. Even officers who take the issue seriously are hamstrung. Diepsloot's police station has no specialist unit for rape and sexual-assault cases; the nearest one takes an hour to get to. The closest state hospital that can examine victims is 30km away.

Simply getting to court can be steep barrier. To get a restraining order, for example, a woman in Diepsloot will have to pay 26 rand (\$2) for a round trip by minibus-taxi to the nearest magistrates' court—a lot of money for a woman with no job. Lawyers Against Abuse, a non-profit group, supports women with free legal and psychological services offered from a refurbished shipping container near the police station.

The cycle of abuse "will become the culture of how we live", frets Mr Lekekela. "But this is not how we are supposed to live."

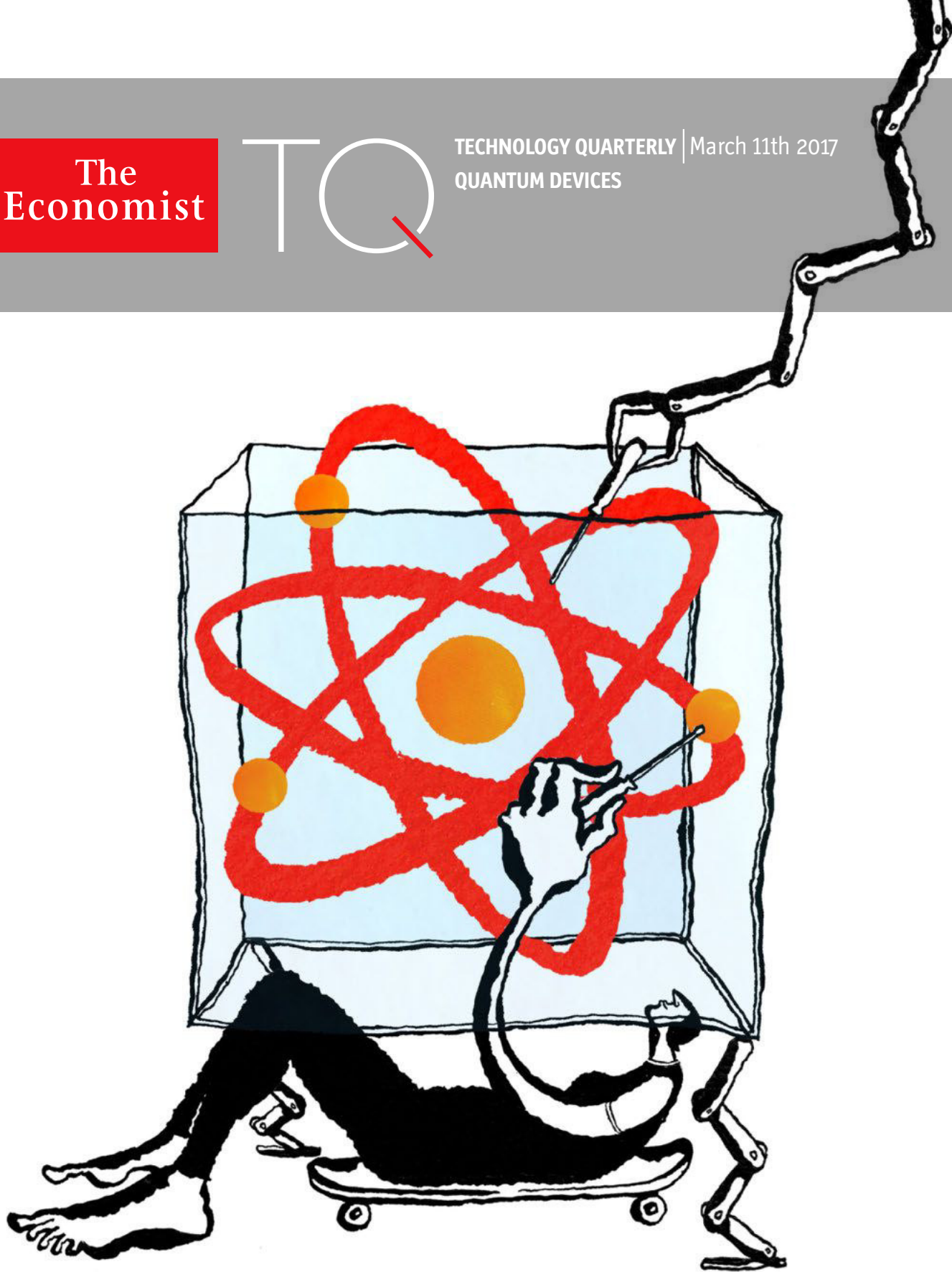


The message isn't getting through

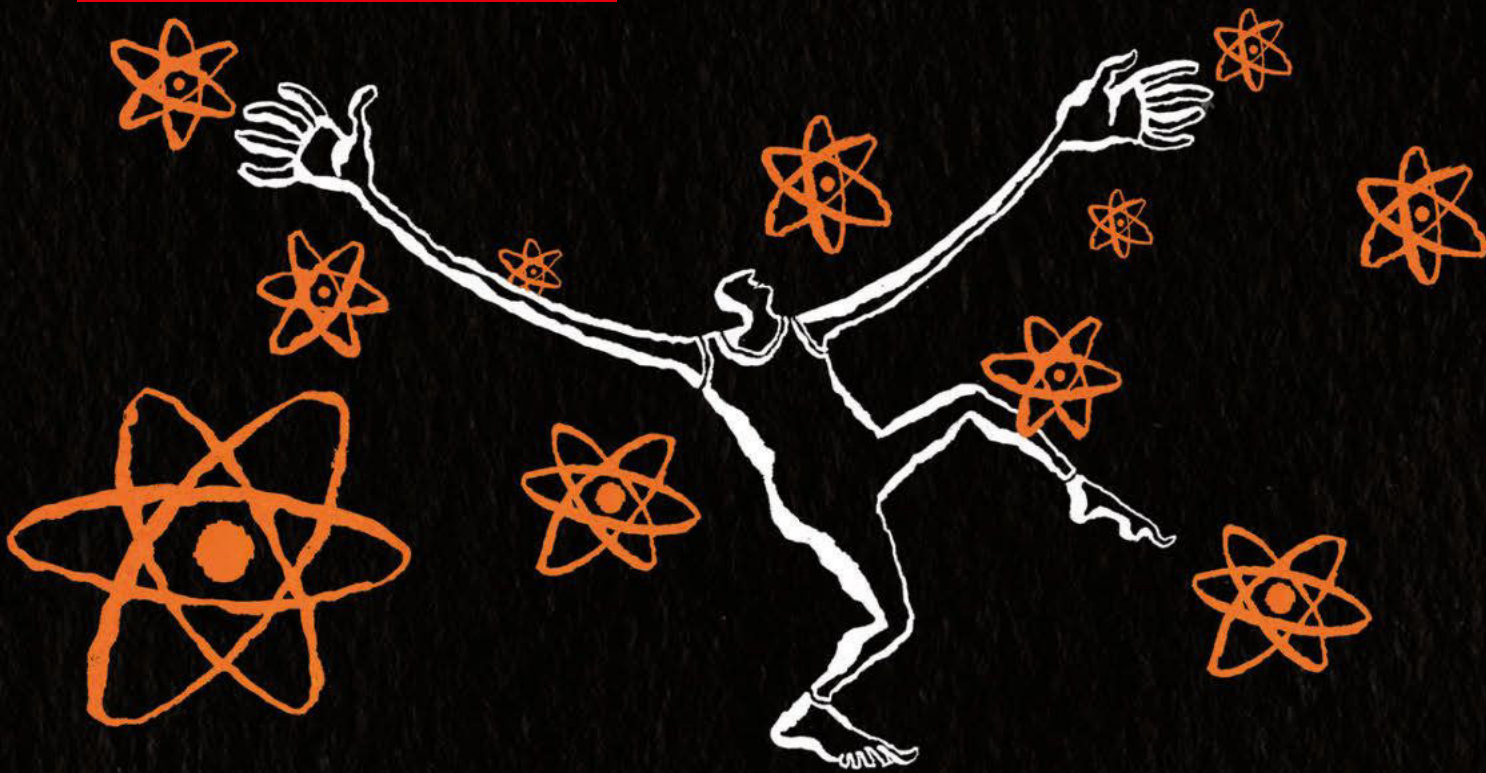
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TQ

TECHNOLOGY QUARTERLY | March 11th 2017
QUANTUM DEVICES



Here, there and everywhere



Here, there and everywhere

After decades as laboratory curiosities, some of quantum physics' oddest effects are beginning to be put to use, says Jason Palmer

PATRICK GILL, a director of the new Quantum Metrology Institute at Britain's National Physical Laboratory (NPL) in south-west London and an expert in atomic clocks, points to a large table full of lenses and mirrors, vacuum chambers and electronics. "And there's a smaller one over there," he says.

NPL is part of a consortium of the planet's official timekeepers. In all its atomic-clock laboratories, each of the flagship devices—some of which are huge—is flanked by a smaller one under construction. Miniaturisation is the name of the game. Here is one that fits into a standard electronics rack, 19 inches wide. Over there is a fist-sized gizmo designed to hold an atomic clock's precious innards safe within a satellite.

The caesium atomic clock, developed at NPL, was arguably the world's first quantum technology, though it was not labelled as such. The most common approach, first used in 1950, works by putting energy into atoms to create a "superposition" in which they are, in a measurable way, in more than one energy state at the same time—both excited and relaxed. Probing this strange condition reveals the "clock frequency" of those atoms—a constant for clocks on every continent, and the basis for a precise, internationally agreed definition of the second.

After decades of work in the laboratory, a raft of dif-

ferent devices and approaches relying on quantum-mechanical effects are now nearing market-readiness. It has taken so long mainly because the components that make them up had to be developed first: ever-better lasers, semiconductors, control electronics and techniques to achieve the low temperatures at which many quantum systems perform best.

Britain did not exploit the atomic clock's discovery in the market. Instead, a year after the device was invented, it was commercialised by the National Company, an American firm. Given the potential of these new quantum technologies, this time commercialisation is on many minds. The NPL's ever-smaller clocks are just one step towards marketable products that could vastly outdo GPS (which itself is an application of atomic timekeeping) in navigation, or help spot what lies underground. The era of quantum technology is almost here.

The odds are good; the goods, odd

Everything in the natural world can be described by quantum mechanics. Born a century ago, this theory is the rule book for what happens at atomic scales, providing explanations for everything from the layout of the periodic table to the zoo of particles spraying out of atom-smashers. It has guided the development of everyday technologies from lasers to MRI machines ►►

ALSO IN THIS TQ

METROLOGY
Sensing sensibility

COMMUNICATIONS
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Cue bits

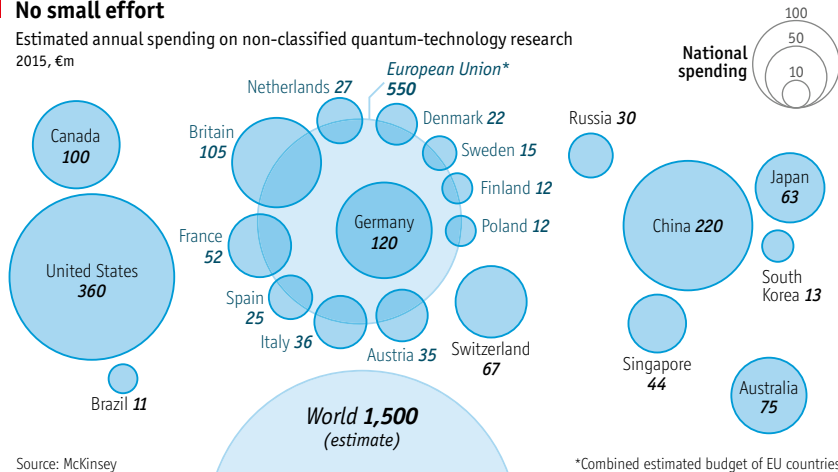
BRAIN SCAN
David Deutsch

SOFTWARE
Program management

USES
Commercial breaks

No small effort

Estimated annual spending on non-classified quantum-technology research 2015, €m



Source: McKinsey

*Combined estimated budget of EU countries

amplify and route quantum-communications signals; and for more robust “qubits” (of which more later) for quantum computing. Startups are embracing the technology with gusto, and tech giants have already planted their flags. There is wide agreement that Google is furthest along in quantum-computer technology and that Microsoft has the most comprehensive plan to make the software required.

Public money is flowing in, too. National and supranational funding bodies are backing increasingly ambitious quantum-technology efforts. Britain has a programme worth £270m (\$337m) and the European Union has set aside €1bn (\$1.08bn) for a pan-European programme. Many quantum technologies have security implications, so defence departments are also providing funding.

Many firms are already preparing for a quantum-technology future. In 2015 IBM set up its Research Frontiers Institute, inviting corporate participants to share ideas about growth areas in technology, the quantum kind being one. The research fund of AXA, a big insurer, has endowed a professorship in quantum information at the Institute of Photonic Sciences in Barcelona to consider the data-privacy risks presented by the coming quantum boom.

Quantum technology looks set quickly to find its way into all manner of products and services—mostly behind the scenes, as artificial intelligence has recently done. It may be weird, but it promises to be wonderful too. ■

Metrology

Sensing sensibility

Quantum technology’s supersensitivity makes it great for measuring

SINCE its inception a century ago, quantum physics has faced something of an experimental problem. The theory promises all manner of interesting and perhaps useful behaviours of particles in isolation, under rigidly controlled conditions. But on the lab bench particles and atoms are never fully isolated, so quantum experiments can be damnably difficult.

However, that difficulty also presents an opportunity for quantum technology: sensing. “We turn that on its head,” says Sir Peter Knight, a British quantum expert. “If it couples to the outside world so effectively, it’s sensing the outside world really effectively.” Take the first quantum technology to make it to market, the atomic clock. Most designs work by tapping into the energy levels of atoms that are prodded with microwaves. Some of those atoms absorb the light in such a way that they are neither in their unperturbed, lowest-energy state nor in an elevated-energy state but in both at the same time, an effect that is central to quantum mechanics. An improved design “entangles” these microwave levels in one atom with different energy levels in another—levels that correspond to visible light, which has a much higher frequency. Such entanglement, another quantum effect, links the fates of two atoms, temporarily but inextricably, so that experiments on one yield information about the other. Entangling microwave levels ►►

► and put a solid foundation under astrophysicists’ musings about unknowables such as the interiors of black holes and the dawn of the universe. Revealed by a few surprising discoveries, such as that atoms absorb and emit energy only in packets of discrete sizes (quanta), and that light and matter can act as both waves and particles, it is modern physics’ greatest triumph.

It has a weird side, though, and it is this that has captured interest in what is now being called the second quantum revolution. The first one was about physics: about understanding how the world worked at the tiny scales where quantum mechanics rules. Not only can particles be in two states at once, as with the atoms in an atomic clock; sometimes two of them, separated by a great distance, seemingly sense something about each other’s condition, a situation called entanglement. A particle’s exact position or state is never certain until a measurement is made; there are only higher or lower likelihoods of a given outcome, and the measurement changes the situation irrevocably. All this has been clear from the mathematics since the mid-1920s but was made manifest in laboratory experiments only later in the 20th century. As the theory’s more straightforward predictions were put to use, for instance in electronics, quantum mechanics gained a reputation for being counterintuitive, even downright spooky.

The expertise gained during those years is now paying dividends. The most counterintuitive quantum-mechanical predictions are being harnessed to make measurements of staggering precision, to generate uncrackable codes and to form the basis of impenetrable communications networks. Quantum computers may eventually crunch through currently unapproachable problems, improving the transmission of electric power or the manufacture of energy-intensive fertiliser, or simply sifting through impractically large data sets. However, long before then computing systems that still fall far short of a general-purpose machine are likely to start providing solutions in industries such as finance, energy and aerospace, and even help with things as mundane as recommendation engines.

From small beginnings

Much work remains to be done. Although a handful of quantum-enabled sensors, modest quantum networks and rudimentary quantum computers are already in use, they still fall short of fully exploiting quantum advantages, and few of them are ready to be widely deployed. According to McKinsey, a consulting firm, in 2015 about 7,000 people worldwide, with a combined budget of about \$1.5bn, were working on quantum-technology research (see chart). Industrialisation will boost those numbers.

What is notable about the effort now is that the challenges are no longer scientific but have become matters of engineering. The search is on for smaller atomic clocks, for example; for a means to

▶ with higher-frequency ones associated with visible light allows the clock to access the higher precision that goes with them. In 2012 David Wineland, of NIST, the American national metrology facility, received a Nobel prize for working out how to do this. For some years, his clock was the most accurate measuring device on Earth: had it been set ticking at the time of the Big Bang, 13.8bn years ago, it would still be accurate to within a second.

Precise timing, particularly from the small, cheap devices that are now being developed, has a wealth of uses, from time-stamping high-frequency market trades to quickly changing settings within a dynamic energy grid. Even lifting an atomic clock up can change how long a tick appears to take: according to the general theory of relativity, time moves ever so slightly more slowly closer to the Earth than further away. Nuisance or opportunity? It's all relative. A well-calibrated atomic clock could use this discrepancy to make an ultra-precise height measurement. Or, at a fixed height, it could sense the gravitational attraction of what is below; solid bedrock would give a different reading from an oil-and-gas pocket.

Laws of attraction

Clocks are not the only means to get a handle on gravity. At the microscopic scales where quantum mechanics rules, streams of matter particles can behave like waves. Like those on a pond's surface, those waves can interfere, adding to and subtracting from one another—in the quantum description, altering the probability of finding a particle here or there. In a device called an atom interferometer, two particle streams are sent at differing heights and then brought back together to interfere with each other. The degree to which the two paths are different, indicating the relative strength of the gravitational tug from below, measurably alters the degree of addition and subtraction.

Such devices have a multitude of uses. In Britain, for example, 4m holes are dug every year in the course of roadworks and construction, but two-thirds of the time the diggers have no idea what they will find beneath the surface. Test boreholes cover only a small area, and ground-penetrating radar does not reach deep enough. A gravity sensor that could tell pipework from pebbles would save a lot of trouble.

RSK, an environmental consultancy involved in cleaning up brownfield sites and the like, reckons that a third of construction projects overrun by up to a month, and another third by two months or more, and that half of these delays arise because of underground surprises. The company is collaborating with the University of Birmingham in Britain on fieldworthy quantum gravity sensors, in the hope of deploying them in big infrastructure projects. Other efforts to develop cheap sensors have drawn interest from companies such as Schlumberger, an oilfield-services giant, and Bridgeport, a surveying firm.

Military types are interested, too. "You can't shield gravity," says David Delpy, who leads the Defence Scientific Advisory Council in Britain's defence ministry. Improved gravity sensors would be able to spot moving masses under water, such as submarines or torpedoes, which could wipe out the deterrent effect of French and British nuclear submarines. Quantum gravimeters could precisely map geological features from the gravitational force they induce. That would help with getting around in places where satellite-navigation signals are not available—"a kind of Google Maps for gravitation", as Dr Delpy puts it.

And gravity, the theory of relativity also says, is just one manifestation of acceleration: a good gravimeter is a good accelerometer. And a good accelerometer is a good vibration sensor. Once they are small enough and good enough, all these high-precision devices will be of great interest to carmakers, and in particular to the autonomous-vehicle industry, the success of which will depend on accurate sensing of the movements of cars and their surroundings. Bosch, a German firm that is the world's largest maker of automotive components and a supplier to many other industries, already has its eye on quantum-technological enhance-



Precise timing has a wealth of uses

ments to its products.

Michael Bolle, the firm's head of research and development, believes sensors will be quantum technology's first market success. "I'm not talking about niche markets," he says. "I'm interested in the trigger point where things really go into mass production." Quantum technologists the world over are preparing for this market explosion by patenting their findings. In some countries, such as Japan and Australia, quantum sensors make up a large part of national patent portfolios (see chart).

Mr Bolle and others are also interested in sensors based on "nitrogen vacancies"—places where a diamond's all-carbon network has been disrupted by one nitrogen atom next to a missing carbon atom. This is a quantum physicist's playground: mostly isolated by its rigid cage of carbon neighbours from the bumpy, fluctuating world

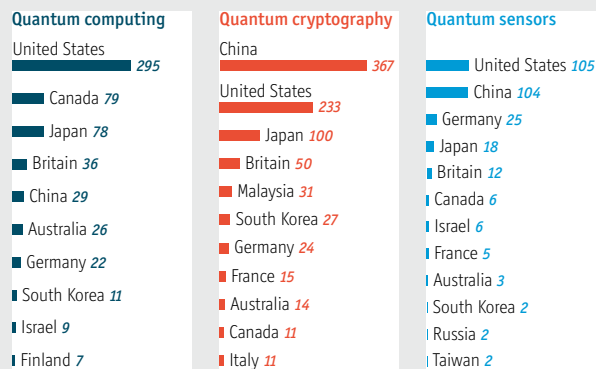
outside, electrons from the nitrogen atoms can be easily manipulated and measured, placed in superpositions and even entangled with one another. Just like the hypersensitive clock, these systems are extraordinarily responsive to their environment and can act as precise sensors of pressure, temperature and electric current.

Where they have shown the most promise is in measuring magnetic fields. Recent studies show that nitrogen vacancies can detect the on-and-off magnetic field of single nerve cells. The same principles can work inside the human body, too. Nanoscale diamonds with nitrogen vacancies have been used to spot chemical changes in living cells, and researchers from the Institute of Theoretical Physics and the Institute of Quantum Physics in Ulm, Germany, have formed NVision, a startup that uses such nanodiamonds to match the current best magnetically enhanced MRI techniques, but 40 times faster and at a quarter of the cost.

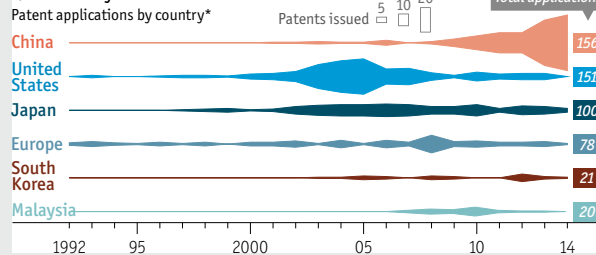
High performance in these applications depends on well-un-▶

Excited states

Patent applications to 2015, in:



Quantum-key distribution



Sources: UK Intellectual Property Office; European Commission *By location of corporate headquarters

► derstood nitrogen vacancies, which occur sporadically in natural diamonds but whose positions and number must be known for precision measurement. Enter Element Six (a subsidiary of De Beers, the world's largest diamond producer), which manufactures diamonds with precision-engineered nitrogen vacancies.

Capture the friendly ghost

Quantum-enhanced approaches may also supplement other biological imaging techniques, such as positron emission tomography (PET), which takes pictures of the high-energy gamma-ray light flying out of injected radioactive tracers. Each tracer molecule's interaction with tissue spits out two photons in opposite directions. Quantum-entanglement tomography aims to make use of the fact that those photons are entangled when they are created. In PET, the photons can be hard to track because they bounce off body tissues. The entanglement of each pair makes it easier to work out which came from where, so scans take less time and radioactive material.

Ghost imaging is another promising way of making use of light's quantum nature. The technique involves splitting a beam of light in two and aiming the resulting two beams at two detectors, one directly and one through a somewhat opaque medium, such as turbulent air rising from hot ground or a smoke-filled room. Because the photons making up the beam are correlated, a rigorous accounting of what the two detectors can see yields images of what the eye cannot. In 2013 researchers from America's army showed that the technique worked over more than 2km.

The technique points to a fascinating debate that underpins many discussions in the broader quantum-technology community about exactly how quantum effects confer an advantage. Though ghost imaging was predicted in the 1990s, arguments still rage about whether entanglement is playing a role or whether it works simply because light comes in discrete, countable photons. "There are plenty of physicists that don't understand the distinction," says Miles Padgett of the University of Glasgow, a quantum-imaging expert. "And I don't think it matters. What matters is, are we using our knowledge in the quantum world to bring competitive advantage?" With hand-held detectors that can sense height differences down to a millimetre, magnetometers that can in principle watch your every neuron and imaging kit that can see across a smoky battlefield, the answer is ever more clearly yes. ■

Communications

Oh what entangled web we weave

Quantum networks could underpin unhackable communications links

IN 2004 the Bank of Austria and Vienna's city hall notched up the first quantum-encrypted bank transfer. Anton Zeilinger, a quantum-cryptography pioneer whose lab facilitated the transfer, expressed his hope that "all problems of implementation will be solved within three years." They were not.

The technology was put to the test again in 2007 when quantum-encrypted vote tallies from the Swiss federal election were sent from polling stations to the Geneva state government. Engineers insisted that the transmission was utterly impervious to eavesdropping or tampering; a company called ID Quantique had developed a system that harnessed one of the rules of quantum mechanics to offer total security.



That claim, too, turned out to be premature. Hackers have since demonstrated that equipment used in such transfers could be vulnerable to attack. What is more, such quantum encryption also required a single, dedicated fibre between sender and receiver, which limited the technique to high-profile transactions, and precluded the cross-linking of many senders and receivers that has made networking and the internet so successful.

Key findings

That is now changing. In response to hackers' attacks, the kit has become markedly more secure. Field trials have shown that delicate quantum light signals can be sent through the same fibres that bring the internet to homes and businesses. And efforts to make quantum-enhanced versions of the equipment that amplifies and distributes standard optical signals are bearing fruit. Quantum networks are springing up or expanding. And quantum communications, just like their conventional counterparts, will soon be whizzing through space, too.

The most discussed and deployed technique is called quantum-key distribution (QKD). In one set-up, a sender launches single photons toward a receiver, randomly choosing one of four planes along which the light particles are polarised, two of them associated with a 0 and the other two with a 1. The receiver likewise randomly chooses which kind of polarisation to check for. After sending a string of these bit-associated photons, the pair can publicly compare notes on which polarisations they employed; whenever they happen to have chosen the same one, the 0 or 1 associated with that polarisation can be used as a bit in a cryptographic key.

What contributes to the system's security is Heisenberg's uncertainty principle, a much-touted quantum rule which, in this case, guarantees that an eavesdropper would disrupt the system's randomness, because intercepting and measuring a given photon forces it into a given polarisation. That disturbance to the system would reduce the number of coincidences the pair sees; if there are too few (they should be seen about half the time), they know someone is on the line.

Physics textbooks will tell you that a sufficiently long cipher, randomly generated this way and used only once, is absolutely secure. But Vlatko Vedral, of the Centre for Quantum Technologies in Singapore, says that hackers who have been invited to try to ►►

► break into the centre's quantum-communications experiments have often succeeded—not by beating quantum rules but by ruthlessly exploiting shortcomings of the kit itself. For example, storing a digital 0 generates a slightly different amount of heat from storing a 1, so careful observation of the heat being generated can expose the string of digits being received. Once discovered, such hacks are easily prevented. As time has gone on, such shortcomings have narrowed in scope, and have driven innovation.

Thanks to the development of ever more secure links, quantum cryptography has recently been deployed more widely. ID Quantique has installed quantum links between data centres of KPN, a Dutch telecoms firm; of Battelle, an American non-profit research firm; and of Hyposwiss and Notenstein, two Swiss private banks. It offers links between financial institutions in Geneva and a disaster-recovery centre 50km away. In 2015 researchers at Toshiba in Japan began sending quantum-encrypted genomic data from a research facility in Sendai to Tohoku University, 7km away.

But the future of the technology lies in quantum networks—the infrastructure required to connect many senders and receivers. These are springing up within and between major metropolitan areas. South Korea's government is funding a 250km link to join existing metro quantum networks. In Britain a network of similar length will be deployed between the cities of Bristol and Cambridge, via London. Australia is building a closed government network in the capital, Canberra.

No quantum network is more ambitious than the one completed in China at the end of last year. Funded by the central government, it links Beijing and Shanghai via Jinan, which already has a metro network over 70 square kilometres, made up of 50 “nodes”—switchboards connecting senders and receivers—and Hefei, which has a 46-node network. Its customers include China Industrial and Commercial Bank, the China Banking Regulatory Commission and the Xinhua news agency.

Distance presents a problem. As the meticulously prepared photons with their delicate quantum states bounce along lengths of fibre, those states eventually get scrambled and their information is lost. To ensure fidelity and security, the fibre link should be no longer than about 200km. Standard fibre-optical signals suffer from the same weakening of the signal, so “repeaters” to boost it are placed at regular intervals along their path. But under the quantum rule book, unknown quantum states cannot be copied, so quantum data would need to be temporarily decrypted before receiving a boost, creating a security loophole.

There are two ways to get round this, one by land and one by air. The land-based solution is to develop quantum analogues of the repeater. That will require a quantum memory that can store incoming information, and a means of sending them on that does not compromise quantum security. That last part requires another bit of quantum trickery: teleportation. This is a way of projecting the quantum state of one particle (not, it should be stressed, the particle itself) onto another, distant one. Last year two research groups showed the benefits of teleportation across two metropolitan networks, in Calgary and Hefei. Crucially, they carried out their experiment using the same wavelengths as those used in existing telecoms networks, to ensure that the new technique can be used with existing fibre infrastructure. It did the trick.

Spooks reacting at a distance

Another tack is to take to the air, over similar distances but without the need for a particular fibre link. The current record for teleportation of quantum states in this way was set in 2012, when researchers sent a quantum-encrypted message between two of the Canary islands, 143km apart. A long-standing ambition is to apply the idea to space: for a photon, the disturbance caused by the whole thickness of the Earth's atmosphere is equivalent to that caused by just a few kilometres of air at the surface.

Last August China launched Micius, a quantum-key-distribution-enabled satellite backed by tech companies including Hua-

The future of the technology lies in quantum networks

wei and Lenovo. The goal at this stage is to link the Beijing-to-Shanghai network to another in Urumqi, in Xinjiang province, some 3,000km away. Efforts to develop satellite communications are also under way in Singapore, Canada, Japan, Italy and America. Once the challenges of getting quantum signals into space—through turbulent air, clouds and so on—are overcome, a global network could easily follow.

With country-spanning networks and quantum-enabled satellites, it is easy to envisage a global “quantum internet” in which each link offers quantum-enhanced security. But the kind of innovation that will allow the development of such networks will also be of use, for example, in shuttling information within, and between, future quantum-computing devices: think quantum distributed computing and quantum cloud computing. Just as the internet has demonstrated the power of linking many standard computers, says Seth Lloyd, a theorist at the Massachusetts Institute of Technology, “the quantum internet has the potential to change the way in which people and organisations collaborate and compete, establishing trust while protecting privacy.”

Not everyone is convinced yet. The defence establishment seems to have been put off by some of the early setbacks to quantum links. Quantum-communications efforts are under way, for example in the research arms of America's army and navy, but an analysis by the air force's Scientific Advisory Board suggested that QKD had “little advantage over the best classical alternatives”. And doubters rightly point out that encryption is not the weakest link in many security chains.

Yet as the hardware improves and heavy investment continues, quantum networks may begin to look like a strategic must-have; if so, consumer applications are likely to proliferate. The European Telecommunications Standards Institute (ETSI), which sets global benchmarks for the industry, is working to define quantum-cryptography standards. ETSI scientists want to ensure that kit from multiple vendors can work together, and to create a certification so that consumers (including spooks) are guaranteed a widely agreed level of security. Miniaturisation efforts are well under way too, so before long the equipment may fit in the palm of your hand—or in your phone. ■

Quantum computers

Cue bits

Tech giants and upstarts alike are piling into a technology with huge potential

IN 1981 Richard Feynman, a visionary physicist, had a clever idea. Could the odd properties of quantum mechanics, he wondered aloud in a lecture, be used to carry out simulations of physical systems that computers of the time could not cope with? Others took up the question. In 1985, David Deutsch, now at Oxford University, showed how quantum systems could be set up as a “universal” computer—that is, like current computers, able to run any program. Though fascinating, at that point it was all rather theoretical, involving hardware that no one knew how to build.

What made the world sit up and take notice was a paper published in 1994 by Peter Shor, then at Bell Labs. Dr Shor showed that ►►

▶ a quantum computer would be capable of working out the prime numbers that, multiplied together, make up an exceedingly large number. The fact that this “decomposition” is mathematically very hard is the basis of cryptographic protocols still used today.

Since then, researchers have come up with a rich variety of problems for which quantum computers should be superior to the best supercomputers—and a number of algorithms, or sets of steps, to break down problems in such a way that quantum computers can crunch through them. This evident utility started an international competition to build one that was, for many years, confined to quiet labs and the academic literature. These days, big business is seriously interested, and blue-chip companies including Intel, Hewlett-Packard, Google and Microsoft all have research programmes. Last year IBM released Quantum Experience, which lets all comers play around with a crude quantum computer over the internet. Governments too are putting money into academic efforts, both directly and via defence contractors, and a growing band of startup companies are striking out on their own.

A computer big enough to do what Dr Shor envisaged would also be useful for all manner of currently intractable problems. Although that remains a distant prospect, steps towards developing one could have big benefits; for many applications, a much simpler or special-purpose computer will do.

Bit by bit

What makes the idea of quantum computers so attractive is not so much that they will work faster than traditional computers—they may for some applications but not for others—but that they will work fundamentally differently. Three intuition-defying concepts play a role. The first is superposition. Today’s computers depend on bits taking one of two values, 0 or 1. Qubits, their quantum analogues, can be arranged in “states” that are best thought of as some mixture of both 0 and 1. To carry out a computation using one of these strange beasts is to act on both the 0 and the 1, in a sense to create within the calculation the potential outcome of either at the same time.

The power of this indeterminate state is unleashed through the second quantum-mechanical effect, entanglement. A standard computer depends on the complete isolation of one bit from the next to prevent a computation from going awry or a document from getting corrupted. For a quantum computer, the entangling of multiple qubits is paramount; in the best case, all of a given device’s bits are entangled with one another. Again, to operate on one qubit is to operate, to varying degrees, on all the entangled ones. It is therefore impossible to describe such a machine in strict terms of its constituent parts. There is a need to consider how one qubit is connected to its neighbour, and to the next-but-one, and so on through all the cross-correlations. To describe all the states of a 50-bit standard computer requires 50 bits of digital memory; a description of a 50-qubit computer would require a quadrillion.

It gets weirder. Whereas it is easy to imagine an equation that predicts a low or even zero probability of a given event, it is much harder to reckon with what are called probability amplitudes in quantum

mechanics, which can actually be negative. In the course of a quantum computer’s crunching, these amplitudes can (again like waves) interfere, positive with positive and negative with negative—in essence, to reduce the probability of the wrong answer and boost that of the right one.

Posing a question starts with choosing an algorithm suitable for the problem. This algorithm is actually manifest as the starting states of the qubits: 0 here, 1 there, a bit of a mix over there. The calculation is then just a matter of letting quantum-mechanical laws play out on this system of superposed and entangled qubits. Changing states, shifting qubit couplings and so on represent a vast cross-multiplication of all those states and combinations, with probability amplitudes reinforcing and diminishing until the system settles into a final state that represents the answer. It is a matter of setting up the problem, and the machine, so that all the possibilities are sifted through at lightning speed.

Efforts to make qubits often centre on the use of tiny loops of superconducting wire, arranged like the “gates” of standard computers. Single charged atoms, trapped by electric or magnetic fields, can also do the job; in February an international consortium of researchers published an open-source blueprint for a trapped-ion machine. Several groups use single photons as qubits—an approach that looks easy to integrate with existing semiconductor-fabrication techniques. Microsoft’s planned “topological” quantum computer uses something else entirely: “anyons”, particles that would be more easily tamed than other qubit candidates but which have never been seen outside the pages of theoretical physics textbooks.

Setting up a qubit is no longer difficult. The problem is looking after it. Quantum states are notoriously delicate, requiring complete isolation from the actual stuff of the experiment. But isolation can never be complete, and errors creep in; for a calculation to succeed these must be noticed and corrected. It has become clear that as computers scale up, the number of logical qubits (the ones actually doing the calculation) will be dwarfed by an “overhead” of perhaps thousands of times as many error-correcting and command-and-control qubits. The kind of machine required to implement Shor’s famed algorithm on the sort of large numbers used in encryption will need to contain something like a million qubits.

Such machines will, to put it mildly, be an engineering challenge. But in a clear indication that quantum computing is getting closer, names familiar from traditional computing are increasingly getting involved. Hewlett-Packard is trying to build its own machine. Intel’s global quantum investments include \$50m going into work at QuTech, the Netherlands’ national quantum-technology hub. Microsoft’s topological quantum approach, if it works, will be much less error-prone. The quantum-computing startup scene is also becoming increasingly vibrant. Researchers from Yale and the University of Maryland have spun off companies, and physicists who had worked at IBM and America’s Department of Energy have started their own firms.

Governments are getting in on the ac-▶



tion too. Australia's has invested A\$26m (\$20m) in a laboratory at the University of New South Wales in Sydney (and the Commonwealth Bank of Australia and Telstra, a telecoms firm, have together chipped in about the same amount). A lab at the University of Sydney down the road is being funded as part of LogiQ, a programme of the Intelligence Advanced Research Projects Activity, an American government defence outfit. Leaked documents have revealed that America's National Security Agency has been exploring "if a cryptologically useful quantum computer can be built". Experts now reckon it can. But when?

Simulating discussion

Very few in the field think it will take less than a decade, and many say far longer. But the time for investment, all agree, is now—because even the smaller and less capable machines that will soon be engineered will have the potential to earn revenue. Already, startups and consulting firms are springing up to match prospective small quantum computers to problems faced in sectors including quantitative finance, drug discovery and oil and gas.

Perhaps the most interesting early applications will take the form of "quantum simulators": computers that mimic real physical systems. This is what Feynman had in mind, imagining in his lecture "that the computer will do exactly the same as nature". Quantum simulators might help in the design of room-tempera-

ture superconductors allowing electricity to be transmitted without losses, or with investigating the nitrogenase reaction used to make most of the world's fertiliser.

Quantum simulation has its fans in industry, too. Michael Bolle at Bosch foresees using simulators to design batteries that will supersede the current lithium-ion technology. Paolo Bianco, who heads the quantum-technology research team at Airbus, a big European aerospace firm, says that quantum-simulating a new material such as a stiffer or lighter alloy for use in aeroplanes or satellites would be much faster and cheaper than manufacturing and then testing the material itself. "The promise of quantum technologies", he says, "is in engineering terms a step up in performance—not of 20%, but of a couple of orders of magnitude."

For some applications and classes of problems that may well be true. But the experience of D-Wave Systems, a Canadian company that began selling the first commercially available quantum computer in 2011, shows how little is known about what future machines will be able to do. D-Wave makes what is known as a quantum annealer, a special-purpose quantum computer (as opposed to a universal one) that works best on "optimisation" problems, such as finding the shortest possible route for a travelling salesman. The firm's customers include Lockheed Martin and a consortium including Google and NASA. In January Temporal Defense Systems, a cyber-security firm, bought one. ▶▶

Brain scan | David Deutsch

The father of quantum computing sees it as a fundamentally new way of harnessing nature

"I OCCASIONALLY go down and look at the experiments being done in the basement of the Clarendon Lab, and it's incredible." David Deutsch, of the University of Oxford, is the sort of theoretical physicist who comes up with ideas that shock and confound his experimentalist colleagues—and then seems rather endearingly shocked and confounded by what they are doing. "Last year I saw their ion-trap experiment, where they were experimenting on a single calcium atom," he says. "The idea of not just accessing but manipulating it, in incredibly subtle ways, is something I totally assumed would never happen. Now they do it routinely."

Such trapped ions are candidates for the innards of eventual powerful quantum computers. These will be the crowning glory of the quantum theory of computation, a field founded on a 1985 paper by Dr Deutsch. He thinks the widely predicted "quantum supremacy" that eventually puts a quantum computation incontrovertibly ahead of a classical one will be momentous for scientists and laymen alike. He brushes off the fervent debate about whether the commercially available D-Wave computer offers a speed advantage. "If it works, it works in a completely different way that cannot be expressed classically. This is a fundamentally new way of harnessing nature. To



me, it's secondary how fast it is."

Still, these are steps towards a powerful, universal quantum computer that could solve a lot of thorny problems. To describe such a device properly is to account not only for the states of each of its constituent bits but also for all the couplings between them, for each is entangled with every other. A good-sized one would maintain and manipulate a number of these states that is greater than the number of atoms in the known universe. For that reason, Dr Deutsch has long maintained that a quantum comput-

er would serve as proof positive of universes beyond the known: the "many-worlds interpretation". This controversial hypothesis suggests that every time an event can have multiple quantum outcomes, all of them occur, each "made real" in its own, separate world.

At the same time, quantum computation, and the quantum-mechanical theory from which it springs, are all subsumed in a newer idea that Dr Deutsch is pursuing. He contends that what he calls his "constructor theory" provides a perspective that will lead to the rewriting of physics altogether. As with classical computer science, quantum computation and even genetics, it is based on the role of information. But rather than letting physical laws define what is and is not possible, as science does now, constructor theory asserts that those laws actually arise from what is and is not possible.

From observed possibilities, a mathematical object called a constructor can be fashioned. Operating with and on these constructors gives rise to what Dr Deutsch reckons is a theory even more fundamental than quantum mechanics. He is enthusiastic about the theory's potential to upend the very foundations of science, but concedes that testing it experimentally remains a distant possibility. Then again, a few decades ago he would have said the same thing about quantum computers.

► For years experts questioned whether the devices were actually exploiting quantum mechanics and whether they worked better than traditional computers. Those questions have since been conclusively answered—yes, and sometimes—but only by exhaustively testing the machines’ mettle directly. The current best supercomputers are able to simulate only what more general-purpose quantum computers of about 50 qubits can do. Tantalisingly, it is difficult to tell at what problems bigger machines will excel.

Google is aiming to use its own machinery, a so-called gate-model quantum computer of the sort most groups are pursuing, to achieve “quantum supremacy”, whereby a quantum computer performs a calculation faster than any known computer could. Google researchers have laid out an ambitious plan which may let them achieve that feat this year. D-Wave has hinted it has already done so, but has made similar claims in the past; their current numbers are still to be checked.

Whenever, and by whomever, this is accomplished, it will launch an era of small-scale machines offering quantum-enhanced solutions and services. The first publicly accessible one, IBM’s Quantum Experience, may be an indication that the machines’ future will be in the cloud. Most users have no more need for one at home than they have for a supercomputer.

But some do. In 1982, a year after Feynman gave his quantum-computing lecture, he was touring the supercomputer facility at Los Alamos National Laboratory, where he had worked on the first atomic bomb. Talking to Bo Ewald, then in charge of the lab’s computing efforts and now running D-Wave, Feynman said, “You know, young man, one day all of these will be replaced by quantum computers.” One has already moved in. ■

Software

Program management

Quantum-computer code could do wonders—but also unravel well-kept secrets

“IT DOESN’T help to have a quantum computer if no one knows how to program it,” says Tim Polk, of the White House Office of Science and Technology Policy in Washington. Although academic efforts to build quantum-computer hardware have been going on for two decades, comparatively little has been done to develop the software needed to run the machines when they come.

That is changing, because in the past few years it has become clear that those machines are getting closer. Two parallel efforts are under way. One is to create software as generally understood—the graphical interfaces, programming languages and so on, a kind of “Windows for quantum”. The other is to develop novel algorithms, step-by-step instructions that break down problems into discrete parts amenable to quantum computing.

Innovation abounds in both camps, and among big tech firms as well as plucky startups. Some big players are working on both sides of the problem, and a growing ecosystem of quantum-friendly consultancies advises companies on what quantum computing might do for them.

“Machine” language for quantum computers, which actually tells the computer what to do, is fairly well understood. It is not so different from the logic gates of standard computing, except that it allows for “superpositions” of qubits in which they can be both 0 and 1 at the same time. But how to write computer code to interact with such a machine, or to simulate what it can do? Options are



multiplying, including open-source software packages such as QuTip, funded by a number of research outfits in Asia. On March 6th IBM released the first commercial program for universal quantum computers (the general-purpose kind). And various startups have released their own quantum software.

One of the most ambitious, LIQVI (whose name plays on a symbol in quantum mechanics), comes from Microsoft. It aims to tackle the whole “software stack”, from the user interface to code-compilers and ultimately to a machine language suitable for Microsoft’s planned hardware, and that of others.

Krysta Svore, who leads Microsoft’s quantum-software team, says that the group is also working on reducing the total number of qubits and operations required for quantum calculations, known as “overhead”, and on making standard computers better at emulating quantum ones (the group recently hired a world expert in that field, Matthias Troyer). The team’s full-scale simulation of a 32-qubit computer requires 32 gigabytes of memory, more than the average desktop can muster but still manageable.

Dr Svore and her colleagues are also making estimates of how many qubits, and minutes, would be needed to crack specific problems. She says the numbers are “down dramatically”, thanks to recent improvements in keeping qubits under tighter control. For example, she reckons that a thorough analysis of the energy-intensive nitrogenase reaction to make fertiliser would take a 100-logical-qubit quantum computer hours or perhaps days, whereas a conventional supercomputer would need billions of years. The prize might be a cut of 1-2% in global natural-gas consumption.

But the key to getting the most out of quantum computers are the algorithms that these various software packages implement. The first of them, including the one by Peter Shor that showed how quantum computers could crack global encryption systems, tested the theoretical idea by aiming at the most intractable problems on the biggest notional machines.

Even deeper learning

These days, says Aram Harrow of the Massachusetts Institute of Technology, the focus has shifted to algorithms that smaller machines can make use of, because that kind of hardware will soon be widely available. “We’re still interested in what you can do with a million or a billion qubits, but it’s interesting to see if you can figure out what you can do with 100,” he says.

A lot, it seems. One of the most promising areas is in machine learning and deep learning, two facets of artificial intelligence that have attracted much attention recently. Applications include searching through vast swathes of data to find patterns, such as in image recognition, cyber-security and, more prosaically, recommendation engines that suggest products consumers might like. But there are all manner of other algorithms, from those that crunch numbers to those that mimic atoms.

All these quantum recipes call for some means of cataloguing them. Stephen Jordan heads the Quantum Algorithm Zoo at the ►►



► National Institute of Standards and Technology in Maryland, a comprehensive collection of known algorithms. He has devised a taxonomy of 59 mathematical families they fit into, each suited to particular kinds of problems or breaking down problems in a particular, quantum-friendly way.

Many such algorithms, when run on existing special-purpose machines or as emulations on standard computers, fail to beat their “classical” counterparts. Vlatko Vedral, of the National University of Singapore’s Centre for Quantum Technologies, stresses that traditional techniques, particularly for quantum-chemistry problems like the nitrogenase reaction, are already quite sophisticated. The trouble is that no beefy general-purpose quantum computer exists as yet, so no one knows whether a given algorithm run on one would beat its classical counterpart. At the same time, astonishingly efficient algorithms suited to quantum computing are waiting to be discovered.

Those 59 families of algorithms, and ever-better emulators for eventual machines, are an excellent starting point for planning the quantum-computing future, and nowhere is interest greater than in finance. Commonwealth Bank of Australia is getting in early, collaborating closely with a research group led by Michelle Simmons at the University of New South Wales. D-Wave has partnered with 1Qbit, a startup, to develop “Quantum for Quants”, a forum for the quantitative-finance industry. Its editors include Michael Sotiropoulos, head of global equities at Deutsche Bank. UBS, a big Swiss bank, is working with QxBranch, another startup, on using quantum algorithms in foreign-exchange trading and arbitrage. Hyder Jaffrey, head of Strategic Investments and Fintech Innovation at UBS, says he puts quantum computing in the same category as artificial intelligence and blockchains, “all stuff with the potential to change markets”.

Banking on it

Companies such as QxBranch and 1Qbit play a new role of middleman between the quantum experts and industry, examining whether and how a given firm’s business might be improved by quantum methods, for example optimising trading strategies or supply chains, or monitoring network activity to spot cyber-attacks. Landon Downs, a co-founder of 1Qbit, says that can lead to solutions which can already be put to use. “By taking the lens of how you would formulate an algorithm on a quantum computer you often find very good improvements on classical algorithms,” he says. “That’s where lots of our successes come from.”

The biggest benefit is expected to come from quantum-computing hardware once it arrives, so much of this business depends on simulating that hardware on standard machines as accurately as possible. Michael Brett, chief executive of QxBranch, says the idea is that “some Tuesday morning when one becomes available we just swap out our simulation for the real hardware.”

Even as all these computer scientists and consultants are working on software for the quantum future, a handful of others are

working on software to combat it. After all, what got researchers going in the first place was the fear that global encryption standards would crumble in the face of quantum computing. That remains a danger for the future, and retrospectively perhaps even for the present, if encrypted communications filed away now are analysed by powerful quantum computers later. That is the idea behind post-quantum cryptography, an effort to create ciphers that even future quantum computers will be unable to crack.

PQCRYPTO is a three-year, European-funded project to develop post-quantum ciphers. Its goal is not to find the most mathematically gnarly way of encrypting data, but rather to identify one that is sufficiently difficult to break without needing too much memory or computation to implement. RSA, a current global standard, could be made hard enough to break, but the cryptographic keys would have to be a terabyte long—an impracticable option. Keys for elliptic-curve cryptography, another current standard, are just 32 bytes long; any post-quantum solution needs to aim for a similar ratio of brevity to security.

Tanja Lange, who leads the project, says that post-quantum efforts are now attracting a lot of attention, particularly from nervous Silicon Valley outfits. In 2015 America’s National Security Agency said it would be updating all its cryptography to make it quantum-computer-proof. Last year Google quietly ran its own post-quantum cryptography test in Chrome, its web browser. Some of its users’ communications were protected both with elliptic-curve encryption and New Hope, a post-quantum protocol developed as part of PQCRYPTO. The median delay added to those communications turned out to be just a millisecond.

“The power of quantum computing is rediscovering all the problems that computers cannot solve, and having a path to solving them,” says Dario Gil, vice-president of science and solutions at IBM. “It’s a reorientation of what we think about computers.” But a device capable of solving big problems will create new ones if it can unravel protocols that have protected secrets for decades. ■

Uses

Commercial breaks

The most exciting thing about a quantum-enhanced world is the promise of what it may yet bring

WHEN the first atomic clocks were built and swiftly commercialised, no one used the term “quantum technology”. The clocks simply harnessed the power of quantum mechanics to improve results. At the time there were no other examples of how the odd predictions of quantum mechanics such as entanglement and superposition could be put to practical use. Mostly they informed fundamental science, yielding an ever-subtler view of the world at the tiniest scales.

Here and there, quantum weirdness did escape the lab, as in the case of the superconducting quantum interference device, an exquisitely sensitive magnetic-field sensor. The first of these was developed in 1964 at Ford Research Laboratory, the American car-maker’s blue-skies research facility. Now they are widely used, for example in MRI machines. In the early 1980s researchers at IBM turned the quantum effect of tunnelling, in which particles seem to pass straight through impenetrable barriers, into a way to see the microscopic world with staggering resolution.

The current quantum-technology push is on a far grander scale, with multiple research efforts being funded by national gov- ►►

ernments and supranational bodies, sometimes for strategic reasons. Freeke Heijman has led efforts to build QuTech, the quantum-technology institute of the Netherlands. “We don’t want to risk the scenario that we have invested all this money for years and in the end the money is going to be made in the us or China,” she says. And in the case of defence applications, she says security plays a role too: “If you have to buy it off the shelf, it’s not just an economic disadvantage, it’s also dangerous.”

But quantum technologies will not pass into the wider world in the same way as the global positioning system, which was developed with copious government funding behind closed doors and then handed over as a public good. “It’s just not like that today,” says Neil Stansfield, formerly of the British government’s Defence Science and Technology Laboratory. “We’re not the big kid on the government block, and certainly not on the global block.”

That leaves business to step into the breach. But Trevor Cross, chief technology officer of e2v, a British company whose detectors brought the world pictures from the Hubble Space Telescope and which is now doing pioneering work for quantum devices, says that quantum technologies are still viewed by many industries as risky. That may be because many of the approaches are technologically so far beyond the current state of the art. Richard Murray, an emerging-technologies expert at Innovate UK, Britain’s technology-strategy agency, says that the more transformative the technological change, the easier it is to miss opportunities.

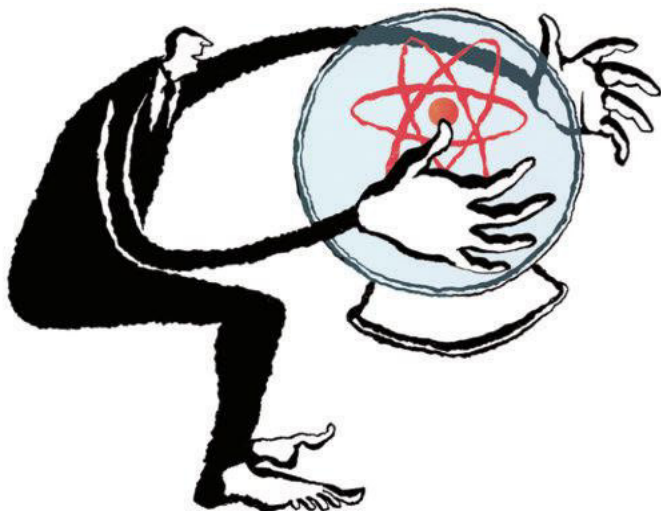
Material evidence

The opportunities are many, because at the level of components these technologies are intimately connected. Many of them depend, for example, on light sources that can spit out photons one at a time, every time, and detectors that can just as unfailingly catch just one—no small feat, considering that a 60-watt bulb is putting out 100,000,000,000,000,000,000 or so of them every second. This kind of kit was unimaginable a decade ago.

New materials, and precisely engineered versions of existing ones, will be needed too. Element Six, a subsidiary of De Beers, a diamond giant, has carved out a niche selling diamonds with bespoke “nitrogen vacancies”—flaws that turn them into sensors. Silicon carbide is tipped to be just as quantum-amenable as those diamonds, but so far expertise with it is thin on the ground.

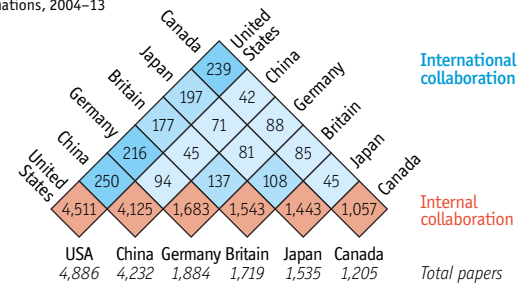
New alliances will be forged as the work on materials intensifies. Intel aims to build qubits into silicon, in order to piggyback on existing fabrication infrastructure. But that will require the material to be produced to a much higher purity. To that end, Intel has joined forces with Urenco and Air Liquide, two materials firms.

Michael Bolle at Bosch, the multinational engineering firm, envisages a seamless coming together of these diverse approaches in applications such as autonomous vehicles or the internet of



Foreign entanglements

Authorship of papers on quantum computing by nationality of authors*
Top 6 nations, 2004–13



Sources: Digital Science; Clarivate
*Collaborations between more than two countries may be counted multiple times

things: quantum sensors to gather sensitive readings, quantum cryptography to transmit them securely and quantum computing to gather insights from the resulting copious streams of data.

Many practitioners believe that the applications and technologies outlined in this report are just the beginning. As they become more familiar, they will give rise to new applications and wholly new hardware. Subjects that used to be mere footnotes to physics will rule, and engineers (and perhaps even consumers) will have to learn to speak quantum.

Yet some innovators may find themselves stymied. “The question is to what extent will export controls on these technologies become an issue, particularly if any of it has some defence potential,” says Stephen Ezell, of the Information Technology and Innovation Foundation, an American think-tank. Tech firms such as Intel and IBM have had trouble exporting parts and computers to countries like China, he says.

Such challenges aside, what is exciting about these efforts is how much is simply not known about their future. Bob Wisniewski, a manager at IBM’s microelectronics-research labs, says that “we’re not that far from being capable...of building quantum computers that will do things we cannot predict exactly.” John Preskill, a quantum expert at the California Institute of Technology, who coined the phrase “quantum supremacy”, has said that “a quantum computer can simulate efficiently any physical process that occurs in nature. Maybe. We don’t actually know for sure.”

That brings the potential of quantum technologies full circle, to the fundamental-science considerations from which they were born. Quantum computers and simulators should eventually be capable of solving some of science’s most basic and yet most daunting questions. Sensors of unparalleled precision may at last make it possible to test the predictions of physicists’ most abstract ideas, perhaps linking the theories of quantum mechanics and gravity.

“We certainly expect there are many additional things that we’ll be able to do with quantum beyond the things we know of,” says Tim Polk of the White House Office of Science and Technology Policy. “We had no idea of all the things we’d be able to build with the transistor, and we see the same thing with quantum.” ■

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The Dutch election

The populists' dilemma

HEERHUGOWAARD

Dutch voters are furious with their ruling class, but look set to return it to power

GEENPEIL ("no poll") is a new Dutch political party that has the unusual distinction of having no programme. Instead it promises to ask its members how to vote on every bill, via an online interface. Its founder, Bart Nijman, thinks this will help solve the biggest problem in Dutch politics: the sense many citizens have that they are ruled by an arrogant, unaccountable elite. On March 6th GeenPeil's campaign rolled into Heerhugowaard, a town of red-brick modern developments 30km (19 miles) north of Amsterdam. Some of the entourage went to canvass voters while Mr Nijman stayed on the bus, typing ceaselessly on a laptop.

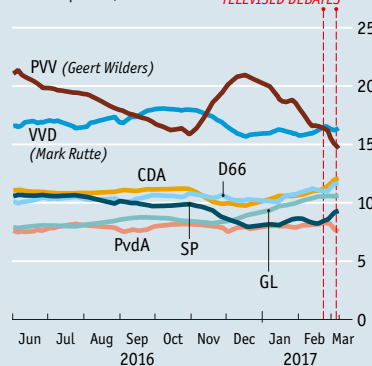
"We want to make democracy more flexible," says Mr Nijman. An editor at GeenStijl.nl, a popular and deliberately offensive right-leaning news website, he entered politics in 2015 by launching a campaign for a referendum on the European Union's association agreement with Ukraine. (Dutch voters rejected the agreement, only to see their prime minister negotiate a few provisos and sign it anyway.) Mr Nijman's take is much more nuanced than that of Geert Wilders, the populist leader of the Freedom Party, who blames the Netherlands' problems on Muslims, immigrants and the EU. But one point on which he agrees with Mr Wilders, and other populists across Europe, is that "citizens don't feel like they're being heard."

GeenPeil is one of a raft of new parties

competing in the Netherlands' parliamentary election on March 15th. Many Dutch call it the strangest race they have ever seen. Other newcomers include the Forum for Democracy (FVD), headed by Thierry Baudet, a swaggering Eurosceptic intellectual; For the Netherlands (VNL), a tax-cutting, anti-immigration party headed by a sassy news-comedian; Denk ("Think"), a party that appeals mostly to immigrants from Turkey and Morocco and their offspring; and the Dutch Pirate Party. Because the Netherlands has no minimum threshold for entering parliament, any of these parties could win seats.

Absence makes the Geert go under

Netherlands, voting intentions
Selected parties, %



Source: Peilingwijzer, Tom Louwse

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International interest has focused on the possibility that Mr Wilders might come first, adding another populist win to last year's Brexit vote and the election of Donald Trump. That may yet happen, but Mr Wilders, who led the polls for much of last year, has been sliding. The Liberals, the centre-right party of the prime minister, Mark Rutte, now lead with about 17% support, ahead of the Freedom Party's 16% (see chart). And Mr Wilders is unlikely to enter government: every other big party has ruled out a coalition with him.

The broader story in the Netherlands is one of popular frustration with the normal process of governance. That will make it hard to run the country no matter how the vote turns out. GeenPeil will probably not win a seat, but Denk, the FVD and VNL have a good chance of doing so. The number of parties in parliament could rise from the current 12 to 14 or more. Small, single-issue groups like the Party for the Animals and 50Plus, a pensioners' party, are likely to gain seats as well. The result could be a fragmented parliament roiling with anti-establishment sentiment, but unable to voice it coherently.

Too bold for the polder

"As a country made up of minorities, we hate the idea that anyone's voice is not heard in The Hague. But we also want our own voice to win," says Tom-Jan Meeus, a columnist at NRC *Handelsblad*, a daily. The contradiction is "very Dutch".

Dutch political culture is renowned for its "polder" model, in which disparate interest groups hammer out compromises through interminable negotiations. It is also notably detail-oriented. At the start of each parliamentary election, the government's Bureau for Economic Policy Analysis reviews the budget plans submitted by political parties and calculates their effects. ▶▶

▶ This analysis underpins the parties' jockeying for weeks afterwards.

A debate between the party leaders on March 5th was dominated by clashes over the bureau's scoring. The candidates argued about the merits of turning the car-ownership tax into a tax on mileage, and similar proposals. Their command of policy was impressive, but the debate failed to generate thematic conflicts that would allow any leader to pull away from the pack. In previous elections, the right and left have usually produced one large party each. Not this time. "I've never experienced an election like this, where there is no competition developing between the top two parties," says Sjoerd Sjoerdsma, an MP for the left-liberal D66 party.

One reason may be the Netherlands' strong economy (see page 66). GDP grew by 2.1% in 2016, and the government's preliminary estimates show that it ran a small budget surplus of €200m (\$210m). The prospect of winning budget goodies (spending or tax cuts) might reduce tactical voting, thinks Tom van der Lee, a candidate MP for the GreenLeft party. "Voters think, why should I pick my second-favourite?"

Yet the chief reason for the lack of a competitive race is the strange absence of Mr Wilders. He has declined to join any of the debates so far, instead campaigning chiefly through Twitter. That has sabotaged Mr Rutte's plan to confront him and pose as the populist's main opponent. Mr Wilders will take part in a final one-on-one debate with Mr Rutte, on March 13th. "That is the only hope to create that battle," says Henri Kruithof, a former spokesperson for the Liberals.

Without much excitement in the campaign, the mainstream parties' support bases have solidified. The Christian Democrats, the left-liberal D66 party, the environmentalist GreenLeft and the Labour Party are all polling somewhere between 8% and 12%. At that rate, the Liberals would need at least three other parties to form a coalition; they might need to perform the ideological acrobatic trick of teaming up with GreenLeft. That would require long negotiations and produce just the sort of compromise government that many Dutch have grown sick of.

If Heerhugowaard is any indication, mainstream voters are already voicing arguments once heard only on the extremes. Ruud Bakker, who sells cleaning supplies in the town's weekly market, is a lifelong Liberal voter who says he once hosted a family of Chechen refugees. This year he may vote for Mr Wilders or for Mr Baudet's FVD. "We used to be very liberal in this country," he says; now he worries that Islamists will try to "take over" and "tell our women how to dress".

For now, the polls show Mr Wilders's support continuing to sink. But some Dutch wonder whether the country is in

for a Trump-style surprise. Because the Freedom Party has been shut out of coalitions, a vote for it carries little cost. Sywert van Lienden, a former political activist now working for the mayor of Amsterdam, says he has heard even dissatisfied D66 supporters considering a protest vote for Mr Wilders. "When the curtain closes, you never know how strong that 'fuck 'em' factor will be." ■

A new charter for Turkey

Me, the people

ISTANBUL

The democratic constitution that never was

FOR the past 92 years, says Osman Can (pictured), a former heavyweight in Turkey's ruling Justice and Development (AK) party, his country has lived under three constitutions, each a product of upheaval and none of them democratic. The first set the stage for a secular one-party regime. The next two followed military coups. The newest, adopted by parliament in January and set for a referendum on April 16th, is no exception. Billed by the AK government as a safeguard against political chaos, the new charter would transfer all executive power into the hands of the country's authoritarian president, Recep Tayyip Erdogan. If approved, it would be the most comprehensive overhaul of the state apparatus since the birth of the Turkish republic.

It is not what Mr Can and most Turks had in mind. As a respected jurist, and subsequently as a member of AK's top executive body, Mr Can campaigned to replace the current junta-drafted constitution with a civilian one. A constitutional committee

was set up in 2011; more than 60,000 people, as well as hundreds of universities, think-tanks and NGOs, wrote in with proposals. Turks made it clear that they wanted a charter that enshrined new rights, notably by lifting restrictions on free speech, strengthening checks and balances and ensuring the independence of the judiciary, says Fuat Keyman of the Istanbul Policy Centre, a think-tank.

The committee collapsed after two years amid squabbles between AK and the Republican People's Party, the main opposition. Faced with a wave of anti-government protests, a corruption scandal and a falling-out between AK and the Gulen movement, a powerful sect, Mr Erdogan marshalled his nationalist base and stepped up repression. The constitution Mr Can had wanted to write went up in smoke. "The priority became to save the day and consolidate power," he says.

The new charter was drafted late last year, after a failed coup and amid a mass crackdown on any form of opposition. Some 40,000 people, including the leaders of the pro-Kurdish Peoples' Democratic Party and over 100 journalists, have been thrown in prison. Mr Erdogan rules by decree under a state of emergency that will remain throughout the referendum campaign. The press has been defanged.

The revised charter enshrines Mr Erdogan's power. It abolishes the office of prime minister, leaving the president fully in charge of the government. Instead of ensuring the separation of powers, it gathers them together under the roof of Mr Erdogan's gaudy 1,350-room palace. The Turkish leader would handpick his own cabinet, other senior officials and his party's MPs. He would be free to rule uncontested for up to two five-year terms, and under some circumstances into the early 2030s.

"Under normal circumstances this would not pass," says Mr Can, referring to ▶▶



The man who nearly reconstituted Turkey

▶ the constitutional changes. But normality in Turkey is gone. The Venice Commission, an advisory body to the Council of Europe, has warned in a leaked report that the country is on the road to autocracy. Mr Erdogan and his prime minister, Binali Yildirim, have threatened opponents of the new constitution by comparing them to terrorists and coup plotters. Neither Mr Erdogan's predecessor as president nor Mr Yildirim's as prime minister, both believed to be critical of the new constitution, have dared to make their views public. With thousands purged from universities across the country, many academics who took part in the constitutional debate in the early 2010s are also reluctant to speak up.

Members of Mr Erdogan's team insist the country needs strong leadership to stave off the turmoil at home and abroad, including terrorist attacks and the war in Syria. But the kind of democratic reforms under debate in the early 2010s are not off the table, suggests Mehmet Ucum, a presidential adviser. "Think of this [constitution] as the beginning," he says.

Mr Erdogan's critics think of it as the end. Those who can afford to do so have already started to vote with their feet. According to a recent survey, 6,000 millionaires left Turkey in 2016, a fivefold increase on the previous year. As Turkey's democracy unravels, more are likely to follow. ■

Humanitarian visas

Another way in?

BRUSSELS

The European Court of Justice declines to upend EU asylum rules

AN UNEASY paradox underlies asylum policy in Europe. As signatories to the Refugee Convention of 1951, all European Union countries must allow foreigners on their territory to apply for protection. But none is obliged to help them arrive in the first place. As most war-torn places are some distance from Europe, asylum-seekers must endure dangerous journeys, and rapacious people-smugglers thrive.

Resettling refugees directly from countries that host lots of them, such as Turkey, Lebanon and Kenya, is another option. A third is to issue humanitarian visas, which entitle the bearer to travel safely to his or her destination before claiming asylum. But European governments hand them out sparingly, and there is little legal clarity surrounding their use. Advocates for refugees hoped that the European Court of Justice might change that in a ruling this week.

The case before the court involved a family of five Christians from Aleppo, in Syria, who applied for humanitarian visas



No jumping the queue

at the Belgian embassy in Beirut last October. Belgian officials refused to consider the bid because the family intended to stay in the country longer than the permitted 90 days. But in February the court's advocate-general said the visa application should fall under the EU's Charter of Fundamental Rights, which protects against the sort of violent treatment the family claim to have suffered in Syria. That would have obliged Belgium to grant the visas—and could have opened the door to thousands more such applications from would-be refugees. Yet although the court usually follows the advocate-general's reasoning, this time it demurred, ruling that it was up to national governments whether or not to issue humanitarian visas.

NGOs, as well as the UN's refugee body, see humanitarian visas as a useful alternative to the cumbersome process of resettlement. Brazil, among other countries, has begun to issue them to Syrians. Yet many EU governments, 13 of which backed Belgium's case, insist that the EU visa code was never intended to impose humanitarian obligations on national authorities—and after the 2015-16 refugee crisis, there is little appetite for more generosity. After the ruling Theo Francken, Belgium's outspoken immigration minister, celebrated his victory over the NGOs he said were trying to extend Europe's borders to its embassies abroad.

Advocates themselves lamented what they consider a missed chance to save lives and dent trafficking. Yet, says Elizabeth Collett of the Migration Policy Institute Europe, a think-tank, they may have dodged a bullet. Had the court ruled the other way, governments would quickly have tightened EU visa law further. Worse, governments that have been quietly admitting

Correction: In a photo accompanying an article last week ("A Tale of Two Mayors"), the identifications of Virginia Raggi and Chiara Appendino, the mayors of Rome and Turin, were reversed. Sorry.

certain groups on humanitarian grounds (such as staff employed by their armed forces abroad, who face retribution from enemies) might have pulled back under the glare of the spotlight. The fight to find new ways to safety for refugees will continue: the European Parliament wants to clarify the conditions under which humanitarian visas can be issued, though governments are wary. But for now, the smugglers' business model is safe. ■

Macedonia's political crisis

Scared in Skopje

SKOPJE

A Macedonian-Albanian breakdown gets Europe's attention

IN NORMAL times, the world tends to ignore Macedonia and its 2m people, a quarter of them ethnic Albanian. But the world is not ignoring Macedonia now. Western politicians are rushing to Skopje, Russia is issuing warnings and Serbian newspapers proclaim that war is coming. "Geopolitical relevance is returning to the Balkans," laments Veton Latifi, an analyst.

The Macedonian crisis started with a coalition dispute. To preserve ethnic peace, governments consist of the winning Macedonian party and an Albanian one. Elections last December gave the incumbent Macedonian party, the nationalist VMRO, a slight edge. But after talks with the VMRO failed, the leading Albanian party, headed by Ali Ahmeti, opted for the Social Democrats. On March 1st Macedonia's president refused to ask the Social Democrats to form a government, saying Albanian demands would "destroy" the country. The Social Democrats called it a "coup".

Every weekday since, thousands of ▶▶



▶ Macedonians have demonstrated in support of the president. The European Union's foreign-policy chief, Federica Mogherini, along with the head of NATO and America's State Department, have pleaded with him to reverse his decision. VMRO has staunchly supported joining NATO, but in this crisis it is backed by Russia.

At a deeper level, the conflict goes back to 2015, when the Social Democrats began releasing tapes of conversations (tapped by the intelligence services) which implicated Nikola Gruevski, the VMRO prime minister at the time, in corruption. Under EU auspices, a special prosecution office was set up, but VMRO now claims it is packed with Social Democrats. Lately VMRO supporters have accused George Soros, a philanthropist named in many potty conspiracy theories, of plotting against them. Ms Mogherini has been attacked in the press as a "fascistic Sorosoid bimbo". American congressmen sympathetic to VMRO have attacked the American ambassador to Macedonia as a tool of Mr Soros.

At the centre of the crisis is Mr Ahmeti, a former guerrilla leader. Sharing power with Mr Gruevski since 2008 cost him support. He says Mr Gruevski would not agree to extend the mandate of the special prosecutor investigating him. Meanwhile, Albanian parties asked the government to keep its agreement to widen the use of Albanian as an official language.

According to Radmila Sekerinska, deputy head of the Social Democrats, Mr Gruevski instigated the crisis when he realised that he might lose power, which would leave him exposed to the special prosecutor investigating him. Not so, says Nikola Poposki, Macedonia's foreign minister and a VMRO official. The Albanian language demand accepted by the Social Democrats "endangers the unity and sovereignty of Macedonia", he says.

Mr Ahmeti warns against turning the crisis from a political one into an ethnic one, saying he has a tough job keeping his side's own nationalist radicals in check. He disclaims any plans for a Greater Albania. Russia, he says, is stirring the Balkan pot; the best way out is to accelerate Macedonia's accession to the EU and NATO. Good luck with that. ■

Strays in Istanbul

When fat cats are a good thing

ISTANBUL

A Turkish affection for street cats and dogs has blossomed online

SPRAWLING on doorsteps, on café benches, inside hamams: stray cats and dogs are everywhere in Istanbul. Some 130,000 dogs roam the city; at least 125,000 wild cats prowl its streets. The prevalence of strays across the city is nothing new: "The dogs sleep in the streets, all over the city," Mark Twain wrote after a visit in 1867 to Istanbul. "They would not move, though the Sultan himself passed by." More recently their presence has taken on a new, more modern twist.

The popularity of animal photos on social media—combined with a desire for a glimmer of good news in Turkey—has boosted the renown of these creatures both at home and abroad. There are at least half a dozen Facebook pages dedicated to the strays around Istanbul. One, "Cats of Istanbul", has nearly 70,000 followers; its canine cousin, "Pups of Istanbul", a more modest 20,000, attesting to the pointlessness of competing with cats on the internet. One particular photo, of Tombili, an obese feline who was papped leaning casually against a step, so tickled its fans that a bronze statue (pictured, with original) was put up in his honour after he died. The craze has also moved from the little screen to the silver one: in February "Kedi", a feature-length documentary about cats in the city, opened in New York. It is now being released across America.

Many Istanbulites treat these strays as their grandparents have done before

them: butchers leave out scraps; in winter locals build small huts for the cats to sleep in. Since 2004, following European convention rules, towns have had to neuter and vaccinate the dogs; almost all are fitted with electronic chips that record their health history. This is expensive: between 2009 and 2016 the central government spent some 19m Turkish liras (\$5m) in 40-odd municipalities on animal welfare. Cats seem to cause less trouble, although in 2005 Recep Tayyip Erdogan, the president, who was then the prime minister, successfully sued *Cumhuriyet*, a secular newspaper, and its cartoonist, after it depicted him as a kitty caught up in a ball of wool. The cartoonist in question is currently under arrest, one of the more than 100 journalists who have been rounded up since a failed coup last summer.

Authorities have taken drastic, and unpopular, measures to get rid of the creatures. In 2012 the government tried to introduce a law that would have consigned street dogs and cats to remote, deserted areas referred to as "nature parks". It was shelved after an outcry from animal-rights activists and dog lovers. Thousands marched in the streets. Last week several women wearing animal masks in Alanya, a coastal town, tried to file a petition "as cats" against the killing of around 50 of their fellow felines—to be told that only humans could file petitions. For now, anyway. A cat can always dream.



We prefer "statuesque"

Charlemagne | Go, speed racer, go

François Fillon's presidential race will appeal to those who watch for the crashes



WHEN a British television show, *Top Gear*, was marketed to the French a few years ago, it seemed an improbable proposition. The hit programme, which appeals to petrol heads and the nation's inner laddishness, was not an obvious fit for Gallic sensibilities. More improbable still, when the French version was launched in 2015, was the choice of an early special guest, whose challenge is to set the fastest time possible when driving an ordinary car round a race track: it was the rather dour, besuited, centre-right former prime minister, François Fillon.

As it turned out, Mr Fillon, who is now the Republicans' beleaguered presidential candidate, did rather well. Strapped into a specially adapted Dacia Sandero, equipped with a crash helmet and an internally mounted camera recording his every move, Mr Fillon was unerringly calm and focused at the wheel. His lap time earned him a highly respectable fourth place. Fillon devotees were not surprised. He is an amateur racing driver; his brother, Pierre, runs the 24-hour race at Le Mans, which lies in his rural former constituency of La Sarthe, in western France. For anybody else struggling today to understand why Mr Fillon has defied insistent calls from his own team to quit the French presidential race, despite a judicial investigation into alleged misuse of the parliamentary payroll, his *Top Gear* appearance offers an insight. This is a man who—alone, impervious to distraction, unafraid of risk, and under pressure—has an unwavering faith in his capacity to hold steady and make it over the finishing line.

Mr Fillon's troubles have turned an election that was difficult for the centre-right to lose into one that will be difficult to win. Last November, the politician once mocked as Mr Nobody surged from poll outsider to grab his party's nomination, with a sweeping 67% of centre-right voters. Overnight, Mr Fillon became the favourite in the election on April 23rd and May 7th. The sitting Socialist president, François Hollande, was so unpopular that he bowed out before he was pushed. *L'alternance*, or the habitual rotation of power between the left and the right, meant that centre-right politicians just assumed it was their turn.

Such expectations have now collapsed. Investigative judges say they will put Mr Fillon under formal investigation on March 15th over alleged fake jobs for his Welsh-born wife, Penelope, and two of his children. The sums were bad enough. The payroll bill

over the years came to €900,000 (\$949,000); the average pre-tax annual salary is €20,670. But there was also an uncomfortable sense of feudal entitlement about the affair. The tweedy Mr Fillon lives in a historic manor house in La Sarthe, complete with chapel and horse. *Paris-Match* once published a photo of him, a practising Catholic, and his large family, taking tea on its sweeping lawn. Worse, Mr Fillon insisted on his own reputation for probity. As disillusion grew, and his poll numbers sank, Mr Fillon dug in. It was a conspiracy, he exclaimed, fingering the usual suspects: the media, the left, even the judiciary. The people, he cried to die-hard supporters at a hastily organised weekend rally in Paris, had chosen him; they would be his judge. Mr Fillon hit the most discordant note of all when he sought to mimic the grandiose oratory of Charles de Gaulle, whose photo he kept on his bedroom wall as a child. "France", he declared, "is greater than my errors."

Nothing, it now seems, will deflect Mr Fillon from his course. Not the loss of his campaign manager, Patrick Stefanini, nor his spokesman, Thierry Solère, nor the scores of deputies who have also quit his campaign team. Defeat in the first round, said Mr Stefanini, could no longer be ruled out. In their despair over the weekend, defectors appealed to the primary's runner-up, Alain Juppé, another ex-prime minister, to take over as candidate. Somehow, anyhow. But Mr Fillon was having none of it. It was all "too late", an embittered Mr Juppé replied: Mr Fillon had a boulevard in front of him, but has driven into a dead end.

Besides the harm done to the image of democratic politics, one casualty of this sorry saga is an ambitious economic programme, gone to waste. For all his flaws, Mr Fillon grasps the need to shake up France's rule-bound system to free up the creation of jobs, ideas and profits. He knows, having served as prime minister under President Nicolas Sarkozy, that reforms need to be spelled out before an election in order to secure a mandate to put them into place afterwards. But the damage now done to his credibility is such that, even were he to defy the odds and win, Mr Fillon would lack the authority to do what he has promised.

Tragédie française

Another is political unity on the French right. When Jacques Chirac stood for re-election in 2002, he brought rival cliques from the centre and the right together under a broad umbrella, originally named the Union for a Presidential Majority (UMP). It helped him in the run-off, where he roundly beat Jean-Marie Le Pen, of the nativist National Front. Today, Mr Le Pen's daughter, Marine, is likely to reach the second round, and Mr Fillon needs to keep those same constituent parts together in order to make it as well. Instead, the centrists are wavering. Many centre-right figures around Mr Juppé have quit the campaign. Mr Fillon is left with the socially conservative right wing, whose most organised element is a Catholic movement that mobilised vigorously against the legalisation of gay marriage.

This spectacle has blown the wheels off one of the few credible efforts to keep Ms Le Pen out of the Elysée. "If it's a choice between Fillon and Le Pen, I'll abstain," said a retired Socialist voter in Angers, a cathedral town near his rural fief. The stakes are higher than at any other election since de Gaulle established the Fifth Republic in 1958. Mr Fillon may think he can still make the final lap. But hopes of defeating Ms Le Pen are increasingly turning instead to a young centrist untested behind the wheel, Emmanuel Macron. And he, against all the unwritten rules of French politics, has never run for election to any office before. ■



The budget

Calm before the storm

The post-referendum economy continues to beat expectations, but the chancellor acknowledges big risks ahead

BY TRADITION the chancellor of the exchequer may drink alcohol during the budget speech, the only time of the year when any minister may imbibe in the House of Commons. On March 8th Philip Hammond stuck to water. But others were longing for a stiff drink as they watched his speech. He made a few good jokes but otherwise was monotone; he reeled off endless statistics (usually including the decimal point); and unlike his predecessor, George Osborne, he resisted the urge to pull rabbits out of his hat. Mr Hammond is in no mood to party, and for good reason. The economy is looking strong now but he knows that, with Brexit negotiations looming, things are likely to get worse.

Most economists had assumed that after the vote to leave the European Union the British economy would slow sharply. Heightened uncertainty would immediately deter investment and consumer spending, the thinking went. In its November forecast the Office for Budget Responsibility (OBR), the fiscal watchdog, reckoned that GDP growth in 2017 would be 1.4%—and that put it at the optimistic end of the spectrum.

The OBR has since revised its forecast to 2%, one of its biggest-ever upgrades. It reckons that in 2017 unemployment will remain around its current level of 5%, a slightly better reading than it gave in March 2016, when it assumed that Remain would pre-

vail at the referendum. (Wage growth, however, will be much weaker.)

Three factors help to explain the economy's resilience since the referendum. First, consumer spending has remained strong. With the benefit of hindsight this is unsurprising. Leave voters got what they wanted. And for Remainers, Brexit remains vague and some way off.

Second, businesses may be less worried about Brexit than economists had assumed. In two recent speeches Kristin Forbes of the Bank of England digs into the impact of uncertainty on economic growth. Following the referendum, there was a spike in a closely watched measure of uncertainty, built on analysis of newspaper articles. Yet this measure is weakly correlated with actual economic outcomes such as investment: what London-based journalists think is important may not matter much to a firm in Birmingham.

Other measures of uncertainty, such as those derived from surveys of firms, do correlate more strongly with economic activity. And these measures did not increase to nearly the same degree, Ms Forbes notes. Managers are perhaps too busy with their day-to-day jobs to worry about whether or not Britain remains in the EU's customs union in 2019. Many saw little point in adjusting their plans in light of the Brexit vote. Firms which export their wares may even have felt more confident about

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their future, thanks to the fall in the value of sterling.

The third factor concerns finance. Greater uncertainty can prompt banks to reduce lending. Dearer finance hampers consumer spending and investment. After Britain voted Leave, however, firms' funding costs if anything fell, partly because the Bank of England quickly relaxed credit. Indeed the worry now is that Britain, and especially its consumers, have over-borrowed.

Whatever the reasons, the stronger economic growth means juicier tax revenues. Thanks also to one-off factors, the OBR has handed Mr Hammond a fiscal windfall of £16bn (\$19.7bn) over the current and next financial year (equivalent to about 2% of annual government spending). Borrowing in 2016-17 will be £52bn, about £16bn less than was predicted in November.

Taking away the punch bowl

Some hoped that the chancellor would take advantage of his stronger fiscal hand to boost spending, in particular on the National Health Service, which is struggling in the face of its tightest-ever financial squeeze. Mr Hammond offered a smidgen of extra NHS funding and channelled an extra £1.2bn in 2017-18 towards social care, which will ease the burden on hospitals.

That was by far Mr Hammond's biggest new commitment. He made much of a tweak, costing £200m-odd in 2017-18, that will lessen the impact on firms due to pay higher business rates (a tax on property) in April. Mr Hammond also started to harmonise the way that self-employed and employed workers are taxed, generating a bit of extra revenue and a lot of outcry (see next story). All in, though, this was one of the least fiddly budgets in memory; the document itself was less than half as long as Mr Osborne's last. ▶▶

▶ By maintaining an austere stance, Mr Hammond has now amassed what is being called a £26bn “reserve”. Contrary to what is implied, that is not a piggy-bank of free cash. Instead it is the difference between two things: the OBR’s forecast of the budget deficit, adjusted for the economic cycle, in 2020-21 (£19bn); and the chancellor’s self-imposed limit for that measure in that year (£45bn or so).

Nonetheless Mr Hammond will be glad that he can increase spending if need be and still meet his fiscal goal. No one has the foggiest idea how the economy will perform from 2018 onwards, when the terms of the post-Brexit settlement become clearer. For now the government’s strategy remains vague. Even the OBR appears to have no answers to the simplest questions, such as the terms of the deal hammered out with Nissan, which has pledged to keep making cars in Sunderland. Its best guess is that GDP growth will average just

under 2% in 2018-21.

Yet the OBR’s outlook is rosier than that of most economists. Judging by its forecasts for trade and immigration, the OBR appears to be assuming a “soft” Brexit, where Britain retains some form of membership of the EU’s single market and access to its workers. But the government has signalled otherwise; Britain could even quit the EU with no trade deal at all.

In the event of a hard Brexit, Mr Hammond could deploy his fiscal reserve, but it would not be enough to offset fully a serious slowdown. Even a mild recession would force him to spend it quickly. Britain also faces a large “Brexit bill” on quitting the EU. Beyond that, he has diminishing room to boost the economy: the ratio of public debt to GDP is already around 85%. The chancellor’s sober approach to budget-making is the right one. Still, if the economy is really buffeted as Brexit gets under way, he will only be able to do so much. ■

Northern Ireland

An upset in Ulster

BELFAST

The unionist majority is destroyed by a surge in republican turnout

SINCE the partition of Ireland in 1921, parties supporting the union with Britain have been comfortably in control of the island’s north. On March 2nd that changed. In a surprise election result the two main unionist parties, the Democratic Unionists (DUP) and Ulster Unionists, won only 38 seats in the 90-member Assembly. Sinn Fein, the main republican party, came within fewer than 1,200 votes of overtaking the DUP to become the Assembly’s biggest force (see chart). “The notion of a permanent or perpetual unionist majority has been demolished,” said Gerry Adams, Sinn Fein’s president.

The historic tilt in the sectarian balance of power followed a disastrous campaign by the DUP and its leader, Arlene Foster, who has been Northern Ireland’s first minister since January last year. The election, which came only ten months after the previous contest, was triggered when Sinn Fein’s leader and deputy first minister, Martin McGuinness, resigned in protest at Mrs Foster’s “arrogance” and supposed refusal to work with republicans in the power-sharing administration. Sinn Fein further accuses Mrs Foster of wasting hundreds of millions of pounds in her handling of a green-energy initiative known as the “cash for ash” affair.

Her response was to run a hardline campaign, curtly rejecting any suggestion of concessions to Sinn Fein. “If you feed a crocodile it will keep coming back and looking for more,” she declared. Sinn Fein made hay with this, a dozen of its members wearing crocodile costumes cavorting on stage to Elton John’s “Crocodile Rock”. ▶▶

New taxes

Read my lips

A raid on the self-employed pleases economists but annoys Tory voters

WHEN Philip Hammond announced an increase in tax for self-employed workers in his budget on March 8th, many asked whether the Conservatives still stood for the “strivers”, as they have long claimed to do. Not only did Mr Hammond break a manifesto promise by raising the rate of class four national-insurance contributions (NICs), a tax on the profits of self-employed people. He also cut the value of dividends that investors could withdraw from their companies tax-free.

As the self-employed fumed, experts swooned. Mr Hammond’s move nudges the tax system closer to their rational ideal, bringing the taxes paid by the self-employed closer to those paid by employees. Once, the lower rate of NICs paid by the self-employed—which equates to a subsidy of £1,240 (\$1,510) per person, according to the Institute for Fiscal Studies, a research institute—was justified by their worse state-pension entitlement. But as of last April that is not the case. The self-employed still lack benefits like sick pay or maternity pay. Mr Hammond has commissioned a review to look into it.

Taken in conjunction with another forthcoming tweak to NICs, 1.6m people will pay more. Analysis by the Resolution Foundation, a think-tank, finds that 96% of the extra tax will be paid by the highest-earning half of households. Those struggling in low-paid jobs in the “gig economy” will be exempt. Self-employed

hairdressers, who earn £12,700 a year on average, will see their annual NICs bill drop by £70. Taxi-drivers, earning an average of £17,300 a year, will fork out an extra £20. Those making £51,100 a year, the average for a self-employed management consultant, will send an extra £620 to the exchequer.

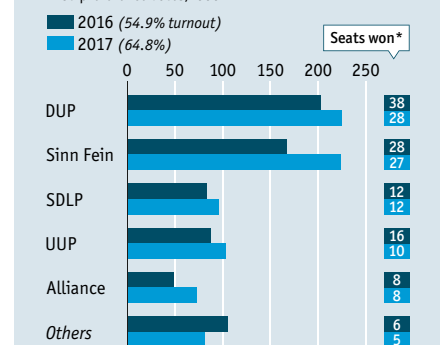
There is still a gaping hole between taxes paid by employees and the self-employed. Companies face an incentive to hire self-employed workers, to avoid paying their own NICs of 13.8%. Mr Hammond could go further and close this gap. But there is political risk involved in swiping at the self-employed, who make up around 15% of Britain’s workers.

Lowering the threshold of dividends that can be withdrawn tax-free, from £5,000 a year to £2,000, will hit some of the same people. Those affected will find their wallets lighter to the tune of £320 a year, on average. Most of the cash will be stumped up by higher-rate taxpayers. The government also hopes to hold back the surge of people registering themselves as company directors. Since 2008 the number of company owner-managers has almost doubled, which looks more like mass tax-dodging than a surge of enterprise.

These changes are sensible, but may not raise as much money as Mr Hammond hopes. In targeting the self-employed he is taking aim at a particularly slippery form of tax revenue—and giving those who would pay it a year’s notice.

DUP in the dumps

Northern Ireland Assembly elections
First-preference votes, '000



Source: Electoral Office for Northern Ireland

* Assembly reduced from 108 to 90 seats in 2017



Sinn Fein, doing fine

► Anxiety about Brexit, which the DUP supported but 56% of Northern Irish voters opposed, may have contributed to high turnout. But the main factors were local, Mrs Foster's language energising Sinn Féin supporters and boosting the party's previously faltering vote. Edwin Poots, a DUP Assemblyman, admitted to the *Ulster Star*: "Unfortunately nationalists and republicans turned out in a way they haven't done for a long time...We have managed to get [them] angry and that has led to them winning more seats."

Republican jubilation, and a sharp increase of unionist anxiety, will do little to increase the prospects for success in the negotiations which the British government launched this week with the aim of getting the Assembly back in operation again. Sinn Féin has a new leader in the north in the form of Michelle O'Neill. (Mr McGuinness is said to be gravely ill in hospital.) Sinn Féin insists it will accept Mrs Foster as first minister only if she is cleared by a public inquiry into the green-energy debacle, due to start soon. The party has further made it plain that it will not accept her unless she softens her attitude.

The law says that a fresh election must be called if an agreement is not reached within three weeks. Few believe that a breakthrough can be made within that timescale. But nor do many want a re-run of the poll, and so the likelihood is that an extension will be arranged so that the parties can be kept at the negotiating table, probably for months.

All of Northern Ireland's parties, as well as the governments in London and Dublin, want devolution to continue, rather than return to direct rule from Westminster. But the negotiations will be a long, hard slog. And it will be some time before all sides come to terms with this sudden and dramatic change in the political landscape and the balance of power. ■

European Union migrants

Administrative agonies

The real worry is not whether to let EU migrants stay but how to process them

LEGISLATIVE ping-pong continues between the two houses of Parliament over the bill allowing Theresa May to invoke Article 50 of the EU treaty, which will kick off the Brexit process. The prime minister hopes to persuade the Commons next week to reject two amendments made by the Lords, so that the bill can become law shortly afterwards. Yet many Tory MPs sympathise with at least one of those amendments, to instruct the government to guarantee the right to remain of over 3m EU nationals resident in Britain. The bipartisan Commons Brexit committee has just unanimously endorsed this suggestion.

Mrs May has long claimed that she too would like to do it. But last summer she declared that she could not without getting a reciprocal guarantee for the 1m or so Britons resident in other EU countries. Many of these feel neglected by their home government; most also support a unilateral guarantee for EU nationals. But some other EU countries say they cannot act until the Brexit negotiations begin. The impasse has created uncertainty and much anguish on both sides of the Channel.

In practice everyone agrees that almost all residents will be allowed to remain. Two-thirds of the 3m-plus EU nationals will have been in Britain for five years before Brexit, so they should qualify automatically. The bigger concern is the bureaucracy involved. A first problem is lack of information. Britain has no identity cards, no register of EU nationals and no checks on who comes and goes. The official numbers (see chart) are estimates that may well understate the true figures.

A second issue is the cut-off point for EU nationals who want to stay. Some have proposed June 23rd 2016, the date of the referendum, but this has no basis in law. Others are arguing for when Britain actually leaves, probably in March 2019, but that could encourage a last-minute surge. A report in December from British Future, a think-tank, floated a compromise of the day when Mrs May triggers Article 50 later this month.

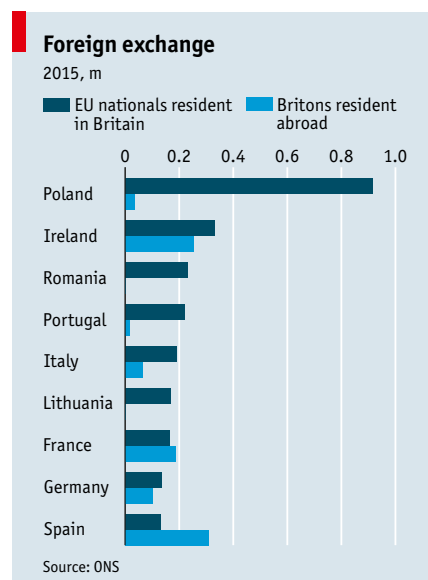
Third and most problematic is the administrative burden of securing permanent residence, a necessary step towards citizenship. Last autumn Oxford's Migration Observatory noted that, at current rates, it would take 140 years to process all those eligible. In the six months since the referendum the number applying rose to over 135,000. Many more are to come. The

Home Office does not have enough staff to cope. Yet despite this it has tightened rather than relaxed the rules recently, says Colin Yeo, a specialist migration barrister.

Applicants must pay £65 (\$80) and fill in an 85-page form (similar forms run to just two or three pages in Ireland and France). Many need legal help, as well as evidence of utility bills, payslips and all outward travel for five years. The process can take six months, during which time the Home Office keeps applicants' passports. More bizarrely, any applicant who has been economically inactive must have had comprehensive sickness insurance, even though EU citizens have a right to use the National Health Service.

Sunder Katwala, director of British Future, says the proportion of applications being rejected because of such complexities is 30%. He reckons this would fall and the process speed up if those in work could bypass the Home Office and ask local-authority nationality-checkers to use income-tax data to confirm their status. He also suggests dumping the rule about sickness insurance. Yet the Home Office is a suspicious place that frets about ever being seen to let in even one illegal immigrant. Hard-luck stories and litigation lie ahead.

And this is all before, fourth, a new migration regime is put in place. The Commons Brexit committee suggests that EU citizens should be given preferential treatment. With industries such as agriculture and hospitality dependent on them, that may be sensible. Yet drawing up a system, getting employers and landlords to police it and persuading other EU countries to work with it will be hard—and could affect how long it takes to agree to let residents stay where they are. As Mrs May prepares to invoke Article 50, she must sometimes wonder if it would have been wiser to offer a unilateral guarantee to EU residents months ago, earning goodwill all round. ■



Bagehot | Theresa May sallies forth

As it prepares for Brexit, the British state is under strain



“EVERYWHERE things are lean. And not in a strategic, managed way.” It is March 8th. In Westminster Philip Hammond is giving the budget speech. And in the West Midlands Caroline Leighton is pondering the British state. As chief executive of the Citizens Advice Bureau (CAB) in Coventry, she knows her stuff. The CAB network is where people who have been failed by the public sector come for support: those who have fallen through the social safety net, are tangled up in the legal, tax and health systems, or otherwise need help and do not know where to turn. So the waiting room outside her office is a sort of dashboard, constantly measuring Leviathan’s performance. Today it is flashing red: standing-room only. In the past year the CAB’s workload has grown by over 20%.

You do not have to spend long here to find evidence of a public sector under intense pressure. One visitor could not get a doctor’s appointment despite acute mental-health problems. Another, a 50-hour-a-week floor-layer swindled by his boss, was failed by the authorities and ended up at food banks. Staff talk of civil servants simply disappearing. “You call an office and the phone rings for ever because no one is there any more,” says Ed Hodson, the research boss. Pressured bureaucrats get client numbers wrong, lose documents and misspell names, leaving vulnerable citizens without income for weeks. Increasingly ubiquitous at the Coventry CAB are people who have fallen into the gaps between systems—think the man with mental-health problems, unpayable debts and thugs outside his front door. From 2014-15 to 2015-16 the average number of “issues” per visitor rose from 2.8 to 3.5.

Coventry is not an outlier. It is pure Middle England, close to the national average on most economic and demographic indicators. Its economy blends manufacturing (the largest private employer is Jaguar Land Rover) with services (Barclays bank and the local building society provide plenty of financial jobs). Like many English cities it was heavily bombed in the second world war and was insensitively rebuilt afterwards. The centre is a concrete tangle of highways and roundabouts encircling windswept, early-1960s pedestrian plazas. The average resident of Coventry is neither rich nor poor, neither cosmopolitan nor rural, and gets on with life in a cityscape forged by a past generation’s nightmares and Utopias.

And, like many other cities, Coventry has seen its public services pruned. On the budget’s eve, Bagehot spoke to Ed Ruane, the councillor in charge of children’s services. He had come fresh from a meeting at which it had been decided to end all remaining council provision of youth services, close 11 of 18 children’s centres and hand many libraries to voluntary associations. Such facilities, he says, were about more than keeping kids occupied; they were an early-warning system alerting authorities to things like child sexual abuse. The Wood End estate, in Mr Ruane’s north Coventry ward, saw violent riots in 1992. Now he fears for the institutions—the libraries, sports centres and social programmes—established to heal the wounds.

To be sure, Coventry’s council has adapted. It now shares functions with neighbouring authorities, puts services out to tender and limits its use of back-office staff. It is much more open to ad hoc partnerships with NGOs, says Ms Leighton. These changes would be welcome even in the absence of austerity. But such reforms have their limits. The city’s public sector has started to struggle. At the hospital 23% of emergency patients now breach the NHS’s four-hour target for treatment, up from 13% a year ago. The nearest prison saw a 12-hour riot in December. At night rough sleepers shiver in doorways. “The number rose 30% in 2016, on top of 50% in 2015,” explains Matthew Green, a local homelessness campaigner. Even in Coventry’s wealthy, sinuous suburbs, like Woodlands, concerns about anti-social behaviour and crime are rising.

The wages of Brexit

The city is a cross-section of the British state. The austerity cuts began in 2010. For several years the effects were limited. Nationally, confidence in the police service grew despite a real-terms cut of 17% in spending. Violence in prisons was flat despite an 18% cut. Hospital admissions outpaced funding increases while satisfaction levels remained stable. But since about 2014 the figures have turned. The administrators of the British state have run out of fat to cut. Assaults on prison staff are up by 75% in three years. Homelessness in England has grown by a third. The proportion of emergency hospital admissions hitting the four-hour target has fallen from 98% in 2010 to 82%.

Now some services are in full-blown crisis and remain alive only thanks to emergency infusions from Mr Hammond. It was prisons in November, social care in January, and both social care and the NHS in the budget on March 8th. To quote the Institute for Government, a neutral think-tank, “crisis, cash, repeat” has become the new philosophy of the British state. The next flash-points will probably be the police (who warn the coming cuts will start to reverse the recent fall in crime) and schools (which are already experiencing a recruitment crisis and face an 8% fall in spending per pupil over the course of the Parliament).

And things are set to get worse. In the budget Mr Hammond confirmed that the austerity programme launched in 2010 will continue at a similar pace, accelerating in sensitive fields like prisons and local government. Other pressures are growing. Inflation is rising and the population is ageing. And all this as Britain’s exit from the EU threatens the very tax base that keeps the show on the road. The Institute for Government now talks of “a disastrous combination of failing public services and breached spending controls just as we exit the European Union in 2019.” At best the coming years will be a rough ride. At worst they could buck the government out of its saddle. ■



Grain consumption

Of rice and men

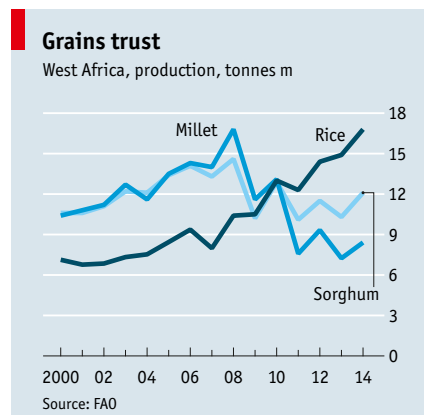
LOS ANGELES, SINGAPORE AND TIASSALÉ

West Africans are eating more like Asians. Asians are eating more like Americans. And the richest Americans...

IF YOU think of food simply as sustenance, or as a source of pleasure, a trip to the farmer's market in Pacific Palisades will open your eyes. To the Lycra-clad shoppers in this wealthy district of Los Angeles, eating is an intensely tricky activity. A woman in a felt hat, Julie, says she tries to avoid white flour because it makes her feel bloated—though she makes an exception for tortillas. A mother of a four-year-old eats rice five times a week, but is “not proud of it”. Having educated herself about food, a third woman, Suzanne Tatoy, favours brown rice, quinoa, amaranth and millet.

Food fads are strange, powerful things. Between the 1970s and the 1990s Americans ate more and more wheat, partly because they were trying to avoid cholesterol. Then came a string of popular low-carbohydrate diets, from Dr Atkins to paleo. A rise in coeliac disease and self-diagnosed gluten intolerance has made wheat seem decidedly dangerous. Between 1997 and 2015 flour consumption in America fell from 67kg per head to 60kg.

Yet the foodies of Pacific Palisades are not just swayed by science—or even pseudoscience. They are also driven by fashion, which has decreed that some grains are out and others are in. In that sense they are part of a huge global trend. People in many countries are dropping fa-



miliar grains for new ones, for reasons to do with agricultural technology, work, health and social aspirations. This shift is more-or-less circular. Everybody is trying to eat more of the grains that better-off people are eating, except the very wealthy, who prize poor people's food. The story begins in the fields of west Africa.

About Kobena has been growing rice near Tiassalé, in Ivory Coast, since 1991. He has many complaints. The pump that draws water from a nearby river to irrigate his 35-hectare farm is on the blink again. The machines he has bought to speed up harvesting have proved a poor advertise-

ment for Chinese engineering. Labour is expensive, he says, and “people have become lazy.” Worst of all, the price his crops fetch is far lower than a decade ago. The problem, says Mr Kobena, is that now everybody is growing rice.

Africa mostly missed out on the green revolution that boosted agricultural production in Asia from the 1960s onwards. That was partly because of war and lousy government. Another problem is that growing conditions in Africa are both distinct from those in Asia and highly varied across the continent. “We don't have the same soils, we don't have the same diseases, we don't have the same pests,” says Harold Roy-Macauley, the head of Africa Rice, which co-ordinates research in Africa. Yet the continent is beginning to catch up, with rice farmers in the vanguard.

Faster, cheaper, better

Between 2000 and 2014 rice production in west Africa jumped from 7.1m tonnes to 16.8m tonnes (see chart). In Ivory Coast, which is mostly known as a cocoa producer, the rice harvest tripled over that time. New hybrid seed lines developed specifically for Africa, such as NERICA and WITA, have boosted yields and enabled farmers to grow rice in dry areas where sorghum was once the dominant crop.

Rice has long been popular in some west African countries, such as Senegal. It is becoming a staple in much of the region. Thomas Reardon, who studies food at Michigan State University, says that urbanisation is driving demand. Urban workers developed a taste for rice in cafés and now cook it at home. Besides, rice is less fiddly to cook than millet or sorghum, adds Mr Roy-Macauley—a convenience food for Africa's ►►

▶ tired city workers.

The Food and Agriculture Organisation, a branch of the UN, estimates that rice consumption per head is growing faster in sub-Saharan Africa than in any other region. That is likely to persist, because Africa's cities are adding inhabitants so fast—by 3% a year, on average. So there is plenty of opportunity for African farmers. And African demand is also a boon to the rice-producing countries of Asia. They could do with some new customers, because demand at home is not what it was.

So central is rice to life in Asia that in many countries, rather than asking “how are you?” people ask, “have you eaten rice yet?” Around 90% of the world's rice is consumed in Asia—60% of it in China, India and Indonesia alone. In every large country except Pakistan, Asians eat more rice than the global average.

Between the early 1960s and the early 1990s, rice consumption per head rose steadily, from an average of 85 kilograms per year to 103. As Asia scraped its way out of poverty people began to consume more food, and rice was available and affordable. In the poorest Asian countries, such as Bangladesh and Cambodia, a full rice bowl remains a sign of plenty (70% of calories come from rice in Bangladesh) and people continue to eat more of it.

But rice consumption is now more-or-less flat in Asia as a whole. In better-off countries rice is going out of fashion. Figures from the United States Department of Agriculture (USDA) suggest that rice consumption per head has fallen since 2000 in China, Indonesia and South Korea, and has crashed in Singapore. Obeying a rule known as Bennett's law, wealthier Asians are getting more of their calories from vegetables, fruit, meat, fish and dairy products. And, as in Africa, many people are switching to another grain.

Whereas roadside stalls in South-East Asia still dish up rice to the masses, fancy shopping malls are increasingly dominated by wheat. A proliferation of bakeries offer traditional European pastries and breads as well as peculiar Asian inventions. BreadTalk, a fast-growing chain based in Singapore, does a roaring business in “floss buns”—sweet white buns larded with butter, coated with egg and rolled in dried shredded pork.

Joseph Lee, the owner of The Bread Table, another Singapore bakery, puts the growth in demand down to tourism and migration. “The more people started to travel, the more they wanted to find European bread when they came home,” he says. “Now we have people asking for sourdough.” He opened in 2013, the first of a rush of European-style bakeries.

Wheat consumption is rising quickly in countries like Thailand and Vietnam (see map). South-East Asian countries will consume 23.4m tonnes of wheat in 2016-17, esti-

mates the USDA—up from 16.5m tonnes in 2012-13. Almost all of it will be imported. In South Asia consumption is expected to grow from 121m to 139m tonnes in the same period. India, which was recently a large net exporter of wheat, has become a net importer. Some of the wheat is for animal feed, but most is simply for eating.

This trend has a long way to run, thinks Rabobank, a bank. South-East Asians still eat only 26kg of wheat a year, much less than the world average of 78kg. They seem unperturbed by price rises: wheat-eating kept growing even as the grain became more expensive between 2009 and 2013, although its use as an animal feed declined. Still, rice will remain central to many Asian cultures. People are unlikely to start greeting each other by asking if they have eaten bagels yet.

Newfangled ancient grains

As west Africans fill their plates with rice, and South-East Asians munch ciabatta, Americans are moving away from both. “You can only eat so many cakes,” suggests Graydon Chong, an analyst at Rabobank. And wheat has new competitors, especially in America's richest quarters. Or, to be precise, new ancient competitors.

Café Gratitude is a gourmet vegetarian restaurant in Venice Beach, a district of Los Angeles that is health-conscious even by the standards of that metropolis. Each item on the menu is an affirmation, so you are supposed to order a dish called Glorious by announcing, “I am glorious.” Pizza is available (“I am giving”), but it is made from einkorn and Kamut. Side dishes include brown rice and quinoa.

Einkorn and Kamut are both types of wheat. Their promoters say they have long pedigrees and have escaped meddling by modern plant-breeders. Quinoa is something else: the seed of a plant that grows mostly in Central and South America. Such grains, and various others besides,

tend to be marketed as “ancient grains”. Supposedly they are healthier and more authentic than plain old rice and wheat. Most assuredly, they are more expensive. A few miles north of Venice Beach, in the Santa Monica farmers' market, Larry Kandarian sells organic black barley for \$9 a pound and Ethiopian blue tinge farro (another kind of wheat) for \$7.

The fad for “virtuous” grains is spreading beyond Californian foodies. In 2015 General Mills, a large American food company, introduced a breakfast cereal called “Cheerios + ancient grains” containing Kamut, oats, quinoa and spelt. Ronzoni has created a pasta with amaranth, millet, quinoa, sorghum and teff. Datassential, a market-research firm that tracks restaurant menus, reports that 9% of casual restaurants and 16% of “fine dining” ones offered quinoa in 2016. Sorghum, which Americans have long fed to livestock, is also creeping onto menus for people. So is millet, which is normally treated as birdseed.

It is too early to tell whether ancient grains are more than a fad. Although global quinoa production rose from 58,000 tonnes in 2008 to 193,000 tonnes in 2014, it is still a trivial crop compared with rice, wheat or maize. The most important cereals benefit from dense networks of agricultural research institutes that work to raise yields and suppress pests and diseases. They are often subsidised.

Yet it is consumers, not governments, who ultimately drive changes in diets. And consumers almost everywhere seem to have acquired a taste for novelty. Packaged foods are becoming more popular even in poor African and Asian countries, says Mr Reardon. He is especially struck by the rise of wheat noodles in Africa. Indomie, an Indonesian firm, started making noodles in Nigeria in the mid-1990s. It now has several rivals in that country, and demand is rising elsewhere in west Africa. The reign of rice might prove brief. ■





The mining business

The richest seam

An industry only just emerging from crisis hopes that electric vehicles and batteries will unleash a new, green supercycle

FOR mining investors there is something sinfully alluring about Glencore, an Anglo-Swiss metals conglomerate. It is the world's biggest exporter of coal, a singularly unfashionable commodity. It goes where others fear to tread, such as the Democratic Republic of Congo (DRC), which has an unsavoury reputation for violence and corruption. It recently navigated sanctions against Russia to strike a deal with Rosneft, the country's oil champion.

Yet Glencore could still acquire a halo for itself. It is one of the world's biggest suppliers of copper and the biggest of cobalt, much of which comes from its investment in the DRC. These are vital ingredients for clean-tech products and industries, notably electric vehicles (EVs) and batteries.

The potential of "green" metals and minerals, which along with copper and cobalt include nickel, lithium and graphite, is adding to renewed excitement about investing in mining firms as they emerge from the wreckage of a \$1trn splurge of over-investment during the China-led commodities supercycle, which began in the early 2000s. The most bullish argue that clean energy could be an even bigger source of demand than China has been in the past 15 years or so.

Optimism about the mining industry is a remarkable turnaround in itself. In the past four years the business has endured a slump that Sanford C. Bernstein, a research

firm, judges to have been as deep as in the Depression. In 2014-15 the four biggest London-listed miners—BHP Billiton, Rio Tinto, Glencore and Anglo American—lost almost \$20bn of core earnings, or EBITDA, as commodities plunged. Glencore, which was hit hardest, scrapped its dividend and issued shares to rescue its balance-sheet.

Commodity valuations rebounded last year, and again led by Glencore, mining-company share prices rallied. Recent results show that the four biggest firms not only swung from huge losses to profits but also cut net debt by almost \$25bn in 2016. BHP and Rio made unexpectedly large payouts to shareholders. Ivan Glasenberg, Glencore's tough-talking boss, says the company is now in its strongest financial position in 30 years. "What a difference a year makes," he exclaims.

Underpinning the turnaround have been curbs on supply—both voluntary, to push up commodity prices, and involuntary, such as strikes and stoppages. Capital expenditure has fallen by over two-thirds since 2013 (see chart). All the firms are reluctant to embark on big new mining projects. Mr Glasenberg says the industry's pipeline of new copper projects, for example, is shorter than it was before the China boom. Rio's giant Oyu Tolgoi copper site in Mongolia's Gobi Desert is a rare exception. The main focus at all the mining firms is on rebuilding balance-sheets and rewarding

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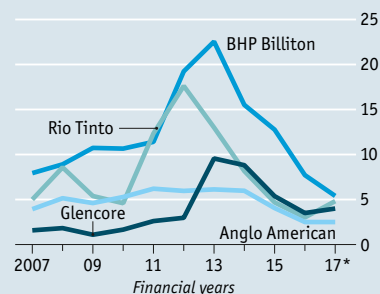
shareholders who kept the faith.

Even as they promise capital discipline, however, demand for green metals and minerals is tempting them to spend. Last year BHP declared that 2017 could be the year "when the electric-car revolution really gets started". A recent surge in the prices of battery ingredients, such as copper, cobalt and lithium, has added to the excitement. China, the world's biggest manufacturer of EVs, is gobbling up supplies. In November China Molybdenum, which is listed in Shanghai, became the majority owner of Tenke Fungurume, a vast copper and cobalt mine in the DRC. Tellingly, the price of platinum, which is used in catalytic converters in internal combustion engines, has lagged behind.

BHP, which has looked closely at EV-related demand, estimates that an average battery-powered EV will contain 80 kilograms of copper, four times as much as an internal-combustion engine. This is split between the engine (the largest share), the battery and the wiring harness. It forecasts that by 2035 there could be 140m EVs on the road (8% of the global fleet), versus 1m ▶▶

Out of a hole

Capital expenditure, \$bn



Sources: Bloomberg; company reports

*Forecast

▶ today. Manufacturing them could require at least 8.5m tonnes a year of additional copper, or about a third extra on top of today's total global copper demand.

According to Sanford C. Bernstein, which uses a bold estimate that almost all new cars will be electric by 2035, global copper supplies would need to double to meet demand by then. Finding and digging up all the metals that stand to benefit, plus new smelting and refining capacity, could require up to \$1trn in new investment by mining companies, it says. Hunter Hillcoat of Investec, a bank, says the transition

could require the addition of a copper mine the size of Chile's Escondida, the world's biggest, every year.

Therein lies the rub. By one estimate, it takes at least 30 years to go from finding copper deposits to producing the metal from them at scale. Some of the big ones in operation today were discovered in the 1920s. Because of declining ore grades, community resistance, lack of water and other factors, copper supply will be overtaken by demand in the next year or two. But prices would have to rise considerably to spur the necessary investment in mines.

Sharply higher prices for copper could, however, spur the search for alternative battery and EV materials such as aluminium. When prices of nickel, an additive in stainless steel, soared a decade ago, stainless-steel manufacturers found ways to make products less nickel-dependent.

Another difficulty in supplying a future electric-vehicle revolution is the often inhospitable location of some of the most promising minerals. Cobalt, for instance, is a by-product of copper and nickel. Total volumes are about 100,000 tonnes, and about 70% lies in the DRC. Unregulated artisanal miners produce a lot of it, which has led to worries about "conflict cobalt".

Indeed, the DRC is likely to be the main source of many of the minerals needed for EVs and batteries. Paul Gait of Sanford C. Bernstein calls it the Saudi Arabia of the EV boom, referring to the kingdom's role in oil markets. But firms such as BHP and Rio are thought to be reluctant to invest there because of concerns about the country's stability, transparency and governance.

In the short term the mining industry remains gun-shy about new investments. As Glencore's Mr Glasenberg notes, it has been fooled before by estimates that demand for copper will double—the latest such misjudgment came as recently as 2008. The very biggest firms, BHP and Rio, have an additional reason to hesitate before splurging on battery materials. Their cash cows are iron ore and coking coal, the raw materials of steel, which are used more heavily in petrol and diesel engines than in EVs. BHP also produces oil, demand for which could one day be affected by battery-powered vehicles. Anglo American has a large platinum and palladium business, feeding demand for diesel and petrol catalytic converters.

All the firms insist that such diverse mineral exposures in fact provide them with a "hedge" whichever way the vehicle fleet develops (though they play up the copper in their portfolio as possibly the best bet of all). Rio is unique among them in also having a lithium-borate project, in Serbia, which it is developing as an option on a batteries boom.

For an unhedged bet, it may be small miners such as Canada-based Ivanhoe that are best placed for a surge in EVs and batteries. Ivanhoe recently said it planned to develop the Kamoakakula deposit in the DRC (pictured on previous page), which it calls the biggest copper discovery ever, containing the highest-grade copper that the world's big mines produce. Zijin, a Chinese miner, sees the same opportunity and is paying Ivanhoe \$412m for half of its majority stake in Kamoakakula. Ivanhoe's founder, billionaire Robert Friedland, speaks of the metal as the king of them all. "Based on world ecological and environmental problems," he says, "every single solution drives you to copper." ■

Tech IPOs

Oh, Snap!

SAN FRANCISCO

A volatile start for the year's most high-profile tech offering

WHEN Snap, the parent company of Snapchat, an app popular among teenagers for its disappearing messages, staged a public offering on March 2nd, Evan Spiegel, its 26-year-old boss, became a self-made billionaire. (Only John Collison of Stripe, an online payments startup, rivals him for such youthful tycoonery). Whether public-market investors will strike it rich remains to be seen. In its first day of trading Snap's shares rose by 44%; they have since fallen by 16% from their peak, meaning around \$5bn of market value vanished in days.

The volatility will probably continue. Optimists reckon that Snap's market value could increase more than fourfold from around \$26bn today as it adds users and advertisers. Very few large internet companies have gone public recently, which gives it tremendous scarcity value, says Roger Ehrenberg of IA Ventures, an early-stage investment firm.

But sceptics are growing in number. Every analyst who has started covering Snap's stock has issued a negative rating. They question its high valuation and underline all the challenges. Snap's growth has slowed in recent months. Its total addressable market is estimated to be 80% smaller than that of Facebook, a social network, and it already has 50% penetration among its potential user base in America, reckons Laura Martin of Needham, an investment bank.

Snap also has an unconventional structure that gives shareholders virtually no power. This week it emerged that a group of large institutional investors had lobbied stock-index providers such as MSCI not to include Snap in their benchmarks for that reason. That will not directly affect share-price performance yet, but being viewed as an outlier on corporate governance does not help.

Analysts have also drawn attention to



Filter bubble?

Snap's losses. These could well rise from \$515m last year to a whopping \$3.7bn in 2017, according to Pivotal Research Group, a research firm. And that does not include huge stock grants to employees. In 2016 Snap had stock-based compensation expenses of around \$1.7bn, or roughly \$1.4m per employee, compared with Facebook's average of \$230,000 and Google's \$144,000 per employee. These grants dilute investors.

Before the offering, hopes had been high that Snap would spark a wave of public offerings by tech startups. Even if its shares sink further, many of them could still choose to go public, especially enterprise-software firms, which sell IT tools to other businesses. Their revenues are more reliable than those of Snap. One software company, MuleSoft, is likely to go public next week. Such companies do not attract the relentless public scrutiny that Snap and other tech stars do. Increasingly, that looks enviable.

PSA buys Opel

Used carmaker

GENEVA

PSA's turnaround will be hard to repeat at Opel

THE Peugeot 3008, a striking SUV, was voted European car of the year on March 6th, the eve of the opening of the Geneva motor show, an annual industry shindig. PSA Group, the maker of Peugeots and Citroëns, would doubtless view it as the second prize it scooped that day. News also came that the French carmaker was buying Opel (branded as Vauxhall in Britain), the European operation of America's General Motors (GM). Few of the car-industry experts at the show, however, would call Opel a trophy.

The consensus was that GM was right to rid itself of a business that had lost money for 16 years straight. Opel has around 6% of the European market; that makes it too small and inefficient in a business where scale is key. It has been confined mostly to Europe for three reasons: the particular tastes of the region's car buyers (for instance, for small diesel cars); tighter emissions regulations outside Europe; and GM's fear of taking sales from its other brands further afield. The result has been to leave it boxed in and isolated.

Shorn of Opel, the American firm can redirect investment to China and America, where its profit margins are healthy, and to technologies such as autonomous cars and ride-sharing schemes. That bucks the conventional car-industry wisdom of gaining market share whenever you can. One insider questions whether GM is as committed to carmaking as it is to the technologies that will underpin mobility in future.

PSA's adherence to carmaking is not in question. Buying Opel will propel it to second place in Europe with 16% of the market, overtaking Renault but behind Volkswagen (VW). But why Carlos Tavares, the firm's chief executive, wants to stake his reputation on a full revival of Opel is less clear. Executives from a rival European carmaker suggest that revenge might be part of his motivation. Leapfrogging Renault may be satisfying for Mr Tavares, since its chairman, Carlos Ghosn, sacked him as number two in 2013 after he expressed a desire to run a big carmaker.

After that, Mr Tavares turned PSA around from a state of near-bankruptcy to solid profitability in under four years. If he could do the same with Opel his credentials would soar higher. Yet the cost-cutting that helped PSA will be hard to repeat.

Mr Tavares did at least get a good price—just €1.3bn (\$1.4bn) for Opel and less than €1m for its finance arm. GM will still be re-

sponsible for massive pensions obligations. Mr Tavares reckons he can eventually save €1.7bn a year through economies of scale and other synergies. But most of the efficiency gains at PSA came from layoffs. Similar cuts at Opel will be much harder. Even if he can close factories, such as those in Britain, where labour laws are more flexible than in Germany and France, his plan to reinvent Opel as a brand suffused with German engineering prowess (and to fulfil PSA's dreams of exporting beyond Europe) will probably depend on keeping thousands of workers employed in Germany.

The biggest headache for the combined company will be its over-reliance on Europe, which will account for over 70% of sales. Recent rapid growth in car sales in Europe is now slowing. And Europe is the world's most competitive market: for mass-market carmakers, profits are much harder to eke out than elsewhere.

Whether or not Mr Tavares makes a success of the deal, it has given the car crowd a chance to speculate about further consolidation in the industry. One popular theory is that getting rid of Opel would eliminate GM's overlap with Fiat Chrysler Automobile in Europe (FCA's chairman, John Elkann, sits on the board of *The Economist's* parent company). That in turn could open the way for a mega-merger. Sergio Marchionne, FCA's boss, has long hoped to combine with GM to tackle what he sees as the industry's needless duplication of investment—even if nowadays Mr Marchionne is talking more about merging with VW, which is still struggling to move on from its emissions-cheating scandal. It remains to be seen whether other car bosses share Mr Tavares's appetite for an adventurous transaction. ■

Railways

The whistle's blowing

OTTAWA

Can Hunter Harrison, a railway legend, deliver at CSX?

HUNTER HARRISON, a veteran railway executive, tried retiring in 2010, after he made Canadian National (CN), a formerly state-owned company, the best-performing of the large railways in North America. But once he pocketed the gold watch and attended the retirement party he faced a void that raising and training horses for showjumping did not fill. By mid-2012 he was back at the helm of another railway, Canadian Pacific (CP), whose glory days were long past. Once he had turned around CP, he didn't make the same mistake again. On January 18th the 72-year-old Tennessean both announced



Just the ticket

his departure and entered negotiations with Florida-based CSX to become that railway's CEO.

Just the rumour that Mr Harrison might be moving to CSX caused the share price to rise by 23% in 24 hours. It continued to rise when the negotiations became public. At last, on March 6th, CSX appointed Mr Harrison as CEO and met the condition set by Mantle Ridge, an activist hedge fund with which he has partnered, to name five new board directors. Mr Harrison made long-term shareholders in CP and CN rich, tripling profits at both during his tenures. CSX shareholders expect the same.

Will he deliver? CSX is different from the railways Mr Harrison has run in the past. Its 21,000-mile network is concentrated, spaghetti-like, in heavily-populated eastern America, unlike the linear, continent-spanning networks of roughly similar total length that are operated by CN and CP. And he faces two new and potentially damaging headwinds: the decline of coal, a mainstay of railway-freight volumes; and Donald Trump's views on trade. Both could seriously disrupt business on North American railways.

Mr Harrison certainly knows the industry inside and out. He reportedly started out lubricating the undercarriage of railcars for \$1.50 an hour and worked his way up at Burlington Northern before leaving to work for Illinois Central. He joined CN when it bought Illinois Central in 1998. Along the way he became an evangelist for precision railroading, his concept that freight trains should run on a strict sched- ▶▶

rule regardless of whether they are near-empty or full. This went against the prevailing trend of adding more locomotives and cars and leaving their schedules flexible. Operating fewer trains, but on time, Mr Harrison showed, meant greater efficiency and better service for customers, who know when their shipments will arrive.

Another part of precision railroading is ditching old equipment and slashing staff. Mr Harrison retired 700 locomotives, or two-fifths of the fleet, at CP; about 6,000 of 20,000 jobs disappeared, largely through attrition. This earned him the ire of some unions, which also questioned the impact on safety of time-saving measures like allowing staff to jump on and off (slow-) moving trains or insisting that managers drive trains if no other staff were available. This reduced some managers to tears, says a former employee: "They weren't afraid of driving the train, they were afraid of crashing it." Mr Harrison thought the hands-on experience would help them do their desk jobs better.

CSX is in better shape than either of his previous two charges. CN was government-owned until 1995 and was hobbled by bureaucracy. CP, created to tie Canada together with a line extending to the west coast, was the laggard among the big North American railways when Mr Harrison arrived. Its operating ratio (operating expenses as a percentage of revenues) was 81.3 at the end of 2011. By 2016 it had been driven down to around 60, although some people quibble that one-off sales may have flattered the ratio. CSX had an operating ratio of 69.4 in 2016, and is already making many of the moves Mr Harrison has used elsewhere, like increasing the ratio of cars to locomotives and cutting staff.

As for coal, revenues from the commodity fell by nearly \$2bn to \$1.7bn between 2011 and 2016. Further falls are expected. The main replacement as a source of revenue is intermodal container freight carrying all manner of goods. Here Mr Trump is a problem. His proposed renegotiation of the North American Free-Trade Agreement (NAFTA) is creating alarm in the industry. Re-imposing borders in the North American market would have a "tremendously negative effect", says William Vantuono, editor-in-chief of *RailwayAge*.

Accepting the job, Mr Harrison confirmed that he will bring precision railroading to CSX. Might he have grander ambitions? Mr Vantuono believes that his ultimate goal is to arrange one of the mergers that eluded him in the past and to create a transcontinental railway. Others think he just wants to show—again—that his way is the right way. "There isn't a railroad that Hunter Harrison couldn't improve," says Anthony Hatch, a New York-based analyst. But it will be difficult to repeat his previous successes or to match sky-high shareholder expectations. ■

Rise of the micro-multinational

Chinese and overseas

GUANGZHOU

A new breed of startup is entering foreign markets early on

ON THE outskirts of Guangzhou, a city in southern China, lies an abandoned park filled with crumbling replicas of the wonders of the world. To the right are fading golden spires that are meant to represent Angkor Wat, a temple in Cambodia. On the left, a row of dusty Egyptian statues towers over a desolate Greek amphitheatre. Adding to the surrealism, the tops of the trees have been lopped off and a buzzing noise fills the night air.

This strange place is the testing ground for EHang, a Chinese startup that makes drones. (The treetops were chopped off, an employee explains, because drones kept crashing into them.) Hu Huazhi, EHang's founder, is beaming. His firm has just set a world record for a drone-swarm light show in Guangzhou, where it flew a thousand small drones in perfect unison. Next it plans to launch an autonomous flying-taxi service with a giant drone big enough to take a person (pictured). Dubai has just signed a deal with EHang to launch drone taxis this summer.

EHang is an example of a new kind of Chinese firm, labelled "micro-multinationals" by some. In the past, Chinese consumer-goods firms focused on the home market; startups were particularly inward-looking. The rare exceptions to this rule—firms like Lenovo, Haier and Huawei—were giant technology companies with deep pockets. That made sense: the main-



They're coming your way

land economy was growing at double-digit rates and China's rising middle classes were eager for new products. Marketing and distribution were easier to get right on the mainland than overseas.

But times are changing: more Chinese startups want to go global from the start. Often founders are mainlanders who have worked or studied abroad. In some cases, says Benjamin Joffe of Hax, a hardware "accelerator" in Shenzhen, the startups may have little choice but to widen their horizons. Their products may simply be too innovative and expensive for China's frugal consumers.

One such firm is Makeblock, a startup based in Shenzhen that sells do-it-yourself robot kits. Jasen Wang, its founder, says he went "global" from day one. His firm has quickly entered developed markets. Foreign sales (including to such big retailers as America's Radio Shack) make up nearly three-quarters of the firm's total revenues.

The fact that the mobile internet is particularly advanced in China means the mainland can throw up truly inventive new business models, says Shi Yi, a serial entrepreneur. DotC United, his company, looks for models on the mainland and then adapts them for foreign markets. "We are like Rocket Internet, but in reverse," he declares, referring to a German e-commerce conglomerate that takes business models from advanced markets and adapts them for developing ones. For example, Wifi Master Key is a Chinese sharing-economy app that lists details of private and public wifi networks around the world. Swift WiFi, Mr Shi's homage to it, now has over 150m users in 50 countries.

Musical.ly is another micro-multinational. Valued at about \$500m, it is one of the most fashionable apps among Western youngsters. More than 100m teenagers use it to share short videos of themselves lip-synching to popular songs. Teens and parents alike may be surprised to discover that this trendy app is run by Chinese engineers, working round the clock in an open-plan office in Shanghai in the company of the firm's mascot, a small white dog named Mu Mu.

Alex Zhu, Musical.ly's co-founder, reckons his firm can become "Instagram for music videos". Unlike other micro-multinationals, Musical.ly did give the local market a go but has flopped at home. Mr Zhu notes that Chinese schoolchildren typically have hours of homework and tutoring after school. They did not use his firm's app. In contrast, he observes, "American kids have lots of free time to play and experiment with social media after 3pm."

In the past, fear of getting sued over intellectual property (IP) kept many Chinese firms at home. The new micro-multinationals are tackling the issue head-on. Ninebot, a Beijing-based firm, makes better versions of the clunky, self-▶

▶ balancing scooters that were invented by America's Segway. Confronted with an IP lawsuit from the latter firm, Ninebot simply bought Segway. Now, argues Mr Joffe, it innovates "on top of Segway", which was stagnating, and the combined firm's strategy will be global.

Neil Shen of Sequoia, an American venture-capital firm, reckons this all adds up to a trend. Slowing growth in China

means the domestic market is less attractive than it used to be. A younger generation of founders unafraid of going global is in charge. David Cogman of McKinsey, a consultancy, who works with many Chinese entrepreneurs, recalls that a decade ago it was almost unheard of for small, consumer-oriented firms to look abroad. When he advises companies today, it is "a regular conversation". ■

tech steels especially for belt casting, including advanced low-density steels that are stronger, lighter and more flexible than conventional steel.

A twin-roll process, much as Bessemer conceived, is already employed by Nucor, a giant American steelmaker. Called Castrip, it is producing steel in two of its plants. A big advantage of twin-roll and belt-casting is compactness. Nucor reckons a Castrip plant needs only 20 hectares (50 acres) and provides a good investment return from the production of only 500,000 tonnes of steel a year. A conventional steel plant, by comparison, may sprawl over 2,000 hectares and need to produce some 4m tonnes a year to turn a profit.

Other firms are licensing Castrip as well. Shagang, a large Chinese steelmaker, is replacing a less energy-efficient plant with the new technology. The numbers look compelling enough to encourage a startup, too: Albion Steel is talking to investors about building a £300m (\$370m) Castrip plant in Britain. The plant would be "fed" by a low-cost mini-mill that melts scrap and produces steel for galvanising, mostly for the construction industry, says Tony Pedder, one of Albion's founders. Mr Pedder is the chairman of Sheffield Forgemasters, an engineering company, and a former boss of British Steel (which later became Corus). Britain has a surplus of scrap but imports galvanised steel. The plant would employ only about 250 people; traditional integrated operations need a thousand or so. "We believe in the technology," says Mr Pedder. "In our view it is past the point of being experimental."

Salzgitter, a German steelmaker, opened the first commercial single belt-caster at Peine, near Hanover, in 2012. It began by making construction steel but has progressed to more specialist steels. The trick is to keep the water-cooled belt perfectly flat, says Roderick Guthrie of McGill University in Canada, one of the pioneers of the technology. Salzgitter uses a vacuum under the belt to do that, whereas Mr Guthrie employs powerful magnets to the same effect on a pilot plant at the university. His research group is working with a number of companies, including a big carmaker. Whereas twin-roll casting is constrained by practical limitations, such as the size of the rollers, horizontal single belt-casting is less so, argues Mr Guthrie.

The techniques may end up being complementary. Their spatial efficiency and low cost would also allow production to be located closer to customers. Mr Guthrie thinks it is not inconceivable for such a plant to be integrated within a car factory. "If we can make the quality as good as the big slab-casting plants, it would change the face of the steel industry," he says. New technologies might just blast a dose of fresh air through an old industry, much as Bessemer's converter did 150 years ago. ■

New production technologies

Recasting steel

A 150-year-old idea could help to reinvent the steel industry

ALTHOUGH he is best known for developing a way to mass-produce steel, Henry Bessemer was a prolific British inventor. In the 1850s in Sheffield his converters blasted air through molten iron to burn away impurities, making steel the material of the industrial revolution. But Bessemer knew he could do better, and in 1865 he filed a patent to cast strips of steel directly, rather than as large ingots which then had to be expensively reheated and shaped by giant rolling machines.

Bessemer's idea was to pour molten steel in between two counter-rotating water-cooled rollers which, like a mangle, would squeeze the metal into a sheet. It was an elegant idea that, by dint of having fewer steps, would save time and money. Yet it was tricky to pull off. Efforts to commercialise the process were abandoned.

Until now. Advances in production technology and materials science, particularly for new types of high-tech steel, mean that Bessemer's "twin-roll" idea is being taken up successfully. An alternative system that casts liquid steel directly onto a single horizontally moving belt is also being tried. Both techniques could cut energy consumption—one of the biggest costs in steelmaking—by around 80%. Other savings in operating and capital costs are also possible. If these new processes prove themselves, steelmaking could once again be transformed.

On a roll

Steelmakers are cautious about new technologies. It was not until the 1960s that the industry ventured from casting ingots to building giant integrated plants for the continuous casting of steel. This involves pouring molten steel through a bottomless mould which, being cooled by water, partially solidifies it. The steel is then drawn down through a series of rolls to form sheet steel or other shapes required by factories and construction companies. Most



of the 1.6bn tonnes of steel produced annually worldwide is now made this way.

Continuous casting, however, still takes a lot of rolling to reduce slabs cast 80-120mm thick to the 1-2mm required by many producers, such as carmakers. Casting any thinner causes quality problems and flaws in the steel's microstructure. One reason for that is the bottomless mould has to be oscillated to ensure molten steel does not stick to its sides. The new techniques of twin-roll and single belt-casting are, in effect, "moving moulds"—the rollers and the belt move with the steel as it cools and solidifies. This allows direct casting to a thickness of just a few millimetres, requiring only minimal rolling thereafter.

The new techniques are particularly good for making higher-value, specialist steels, says Claire Davis, a steel expert with the Warwick Manufacturing Group at the University of Warwick in Britain. Ms Davis and her team are developing new high-

Schumpeter | Jiopolitics

India's richest man makes the business world's most aggressive bet



SOME businesspeople are guided by experts, spreadsheets and crunchy questions. What is your three-year target for market share? Will a project deliver a reasonable return on the capital invested? A few hurl all the forecasts and reports into the bin and surrender to their own hunger to make a mark.

One such figure is Mukesh Ambani, India's richest man. In September 2016 he placed one of the biggest business bets in the world by launching Jio, a mobile-telecoms network that allows India's masses to access data on an unprecedented scale. In the past six months it has won 100m customers. Only one other firm on the planet has such an acquisition rate—Facebook. From Kolkata's slums to the banks of the Ganges, millions of Indians are using social media and streaming videos for the very first time.

To achieve this, Mr Ambani has spent an incredible \$25bn on Jio, without making a rupee of profit, terrifying competitors and many investors. The motivation for his gamble probably lies with his turbulent family history. Reliance Industries Limited (RIL), Mr Ambani's company, was set up by his father, Dhirubhai, in 1957. Born in humble circumstances, Dhirubhai was famous for three things: running rings around officials; creating a fortune for himself and RIL's army of small shareholders; and his appetite for giant industrial projects. RIL jumped from textiles into oil refining and petrochemicals. Its refinery in Gujarat is one of the world's largest. It opened in 2000, two years before Dhirubhai died.

Mukesh Ambani and his brother, Anil, took the reins in 2002 and split from each other in 2005, leaving Mukesh in full control of RIL. Since then his record has been patchy. RIL's shares have lagged India's stockmarket over the past decade and its return on capital has sagged, halving from 12% to 6%.

Emulating his father, Mr Ambani has rolled the dice on several huge projects. He has invested huge sums to modernise the petrochemicals and refining business. This decision has been a success—it is an excellent operation that makes a return of about 12%. But Mr Ambani's other investment calls have flopped. In 2010-15 RIL spent \$8bn on shale fields in America. Now that oil prices are lower they lose money. The group invested about \$10bn in energy fields off India's east coast; they have produced less gas than hoped for and are worth little. And RIL has spent around \$2bn on a retail business that produces only small profits. All told, RIL's re-

fining and petrochemicals unit accounts for two-fifths of its capital employed but over 100% of operating profits. The other businesses, developed mainly after Mr Ambani took sole charge, swallow a majority of resources but don't make money.

A lesser man might have lost his nerve, but Mr Ambani has pursued another colossal bet in the form of Jio. He knows telecoms: in 2002 he oversaw the family's first attempt to build a big mobile-phone business (his brother now owns the struggling operation). The latest effort has been a decade in the making. Step by step, RIL acquired spectrum, worked with handset suppliers and built a "fourth-generation" network. Jio's offer of free services caused a sensation. A savage price war has ensued. One rival executive reckons Jio is carrying more data than either China Mobile or AT&T, the world's two most valuable operators.

That underlines the potential of India's telecoms market. Data usage is low, there are few fixed lines and most people don't have smartphones. The incumbent firms are heavily indebted, so have limited ability to respond to a price war.

Jio will start charging from April 1st. Yet even assuming it keeps cranking prices up and wins a third of the market, a discounted-cash-flow analysis suggests that it would be worth only two-thirds of the sum that Mr Ambani has spent. To justify that amount Jio would at some point need to earn the same amount of profit that India's entire telecoms industry made in 2016. In other words, there is no escaping the punishing economics of pouring cash into networks and spectrum. For every customer that Jio might eventually win, it will have invested perhaps \$100. Compare that with Facebook or Alibaba, both asset-light internet firms, which have invested about \$10 per user.

Jio's three main mobile competitors have scrambled to respond. Bharti Airtel is buying a smaller rival to try to lower its costs. Vodafone is in talks about merging with Idea Cellular, another operator. Half a dozen or so weaker companies (including the firm now run by Mr Ambani's brother) will probably disappear. The best hope for Jio is that in the distant future it will be one of three firms left and that a cut-throat industry will evolve into a comfy oligopoly, which is possible.

RIL's share price has gone nowhere for years but excitement about Jio's 100m new customers has helped it bounce over the past month. Still, the scale of the investment illustrates the risks that shareholders face at a firm that is controlled by one man. Even if Jio eventually gushes cash it is not clear if RIL will pay bigger dividends, or if Mr Ambani will instead pursue another grand project. As investors wait, however, many more of India's 1.3bn consumers will gain—not only from low prices, but a welcome splurge on the nation's telecom infrastructure.

Defiance from Reliance

And what of Mr Ambani? Perhaps he hopes to get his money back by turning Jio into an internet firm that offers payment services and content, not just connectivity. China's Tencent, which owns WeChat, a messaging service, has successfully diversified into games and banking. Still, no telecoms firm has managed this feat and it is hard to see how RIL's clannish culture can become a hotbed of innovation. More likely, Mr Ambani, aged 59, just doesn't care what all the spreadsheets point to. Sitting atop his skyscraper, overlooking teeming Mumbai, where some 5m new Jio customers are surfing the web at high speed for peanuts, he can at last say that he has changed India. When you are Dhirubhai's son, that is probably enough. ■



The future of insurance

Counsel of protection

Insurers move from simply paying claims to providing services

IN THE stormy and ever-changing world of global finance, insurance has remained a relatively placid backwater. With the notable exception of AIG, an American insurer bailed out by the taxpayer in 2008, the industry rode out the financial crisis largely unscathed. Now, however, insurers face unprecedented competitive pressure owing to technological change. This pressure is demanding not just adaptation, but transformation.

The essential product of insurance—protection, usually in the form of money, when things go wrong—has few obvious substitutes. Insurers have built huge customer bases as a result. Investment revenue has provided a reliable boost to profits. This easy life led to a complacent refusal to modernise. The industry is still astonishingly reliant on human labour. Underwriters look at data but plenty still rely on human judgment to evaluate risks and set premiums. Claims are often reviewed manually.

The march of automation and technology is an opportunity for new entrants. Although starting a new soup-to-nuts insurer from scratch is rare (see box on next page), many companies are taking aim at parts of the insurance process. Two Sigma, a large American “quant” hedge fund, for example, is betting its number-crunching algorithms can gauge risks and set prices for insurance better and faster than any human

could. Other upstarts have developed alternative sales channels. Simpleurance, a German firm, for example, has integrated product-warranty insurance into e-commerce sites.

Insurers are responding to technological disruption in a variety of ways. Two Sigma contributes its analytical prowess to a joint venture with Hamilton, a Bermudian insurer, and AIG, which actually issues the policies (currently only for small-business insurance in America). Allianz, a German insurer, simply bought into Simpleurance; many insurers have internal venture-capital arms for this purpose. A third approach is to try to foster internal innovation, as Aviva, a British insurer, has done by building a “digital garage” in Hoxton, a trendy part of London.

The biggest threat that incumbents face is to their bottom line. Life insurers, reliant on investment returns to meet guaranteed payouts, have been stung by a prolonged period of low interest rates. The tough environment has accelerated a shift in life insurance towards products that pass more of the risk to investors. Standard Life, a British firm, made the transition earlier than most, for example, and has long been primarily an asset manager (see next article).

Meanwhile, providers of property-and-casualty (P&C) insurance, such as policies to protect cars or homes, have seen their pricing power come under relentless pres-

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sure, notably from price-comparison websites. In combination with the stubbornly high costs of maintaining their old systems, this has meant that profitability has steadily deteriorated. The American P&C industry, for instance, has seen its “combined ratio”, which expresses claims and costs as a percentage of premium revenue, steadily creep up from 96.2% in 2013 to 97.8% in 2015, and to an estimated 100.3% for 2016 (ie, a net underwriting loss). Henrik Naujoks of Bain & Company, a consultancy, says this has left such insurers facing a stark choice: become low-cost providers, or differentiate themselves through the services they provide.

One fairly simple way to offer distinctive services is to use existing data in new ways. Insurers have long drawn up worst-case scenarios to estimate the losses they would incur from, say, a natural catastrophe. But some have started working with clients and local authorities on preparing for such events; they are becoming, in effect, risk-prevention consultants. AXA, a French insurer, has recently started using its models on the flooding of the Seine to prepare contingency plans. Gaëlle Olivier of AXA's P&C unit says the plans proved helpful in responding to floods in June 2016, reducing the damage.

Damage control

Tech-savvy insurers are going one step further, exploiting entirely new sources of data. Some are using sensors to track everything from boiler temperatures to health data to driving styles, and then offering policies with pricing and coverage calibrated accordingly. Data from sensors also open the door to offering new kinds of risk-prevention services. As part of Aviva's partnership with HomeServe, a British home-services company, the insurer pays ►

▶ to have a sensor (“LeakBot”) installed on its customers’ incoming water pipes that can detect even minuscule leaks. HomeServe can then repair these before a pipe floods a home, causing serious damage.

The shift towards providing more services fosters competition on factors beyond price. Porto Seguros, a Brazilian insurer, offers services ranging from roadside assistance to scheduling doctor’s appointments. In France AXA provides coverage for users of BlaBlaCar, a long-distance ride-sharing app. The main aim of the policy is to guarantee that customers can still reach their destination. If, say, the car breaks

down, it offers services ranging from roadside car-repair to alternative transport (eg, calling a taxi).

Insurers face many hurdles, however, to becoming service providers and risk consultants. Maurice Tulloch, head of the general-insurance arm of Aviva, admits that such services are yet to catch on with most customers. So far, his firm, like its peers, has focused on enticing them to adopt the new offerings by cutting insurance premiums, rather than on making money directly from them. It reckons it can recoup the cost of, say, the HomeServe sensors and repairs from the reduction in claims.

One example of what the future may hold comes from the car industry. Carmakers have traditionally bought product-liability insurance to cover manufacturing defects. But Volvo and Mercedes are so confident of their self-driving cars that last year they said they will not buy insurance at all. They will “self-insure”—ie, directly bear any losses from crashes.

Some think that such trends threaten the very existence of insurance. Even if they do not, Bain’s Mr Naujoks is not alone in expecting the next five years to bring more change to the insurance industry than he has seen in the past 20. ■

Peer-to-peer insurance

When life throws you lemons

Is the future of insurance named after a soft drink?

IT IS not typhoons or earthquakes that insurers should fear most, but geeks alert to their businesses’ inefficiencies. Daniel Schreiber and Shai Winger, tech entrepreneurs with no insurance background, spotted that the industry is huge (worth \$4.6trn in global premium income a year, reckons Swiss Re, a reinsurer), distrusted, antiquated and hopelessly unreformed.

In September they started Lemonade, a New York-based insurer for homeowners and renters. Some describe it as a peer-to-peer insurer (“Spiritually we’re a tech company,” says Mr Schreiber). Most agree that its app makes insurance a lot easier. This appeals to the digital generation: of 2,000 policies sold in its first 100 days, over 80% were to first-time buyers.

Insurance, the founders reasoned, suffers from misaligned incentives. Every dollar paid out comes from insurers’ pockets, encouraging poor behaviour. Normally upright people have few qualms about defrauding their insurer (as 25% of Americans do), pushing up premiums. Lemonade’s solution is to take 20% of premiums as a fee and to reward under-claiming customers by giving a share of unused income to a chosen charity.

This brings good publicity. But just as important is how different Lemonade looks behind the scenes. Instead of underwriters it uses algorithms; and instead of expensive brokers and salespeople it uses chatbots. It even uses AI and machine-learning to handle claims, a job typically seen as needing a human touch.

Late last year a customer called Brandon claimed for a stolen coat. He answered a few questions on the app and recorded a report on his iPhone. Three seconds later his claim was paid—a world record, says Lemonade. In those three seconds “A.I. Jim”, the firm’s claims bot,

When insurance quickened the pulse

reviewed the claim, cross-checked it with the policy, ran 18 anti-fraud algorithms, approved it, sent payment instructions to the bank and informed Brandon. The real-life Jim (Hageman), Lemonade’s chief claims officer, was driving home for Christmas at the time.

Lemonade’s bots are still learning and pass more complex claims to humans. It is hoped that one day they will handle 90% of claims. In an industry with expense ratios as high as 30% this could offer huge savings. But there are limits to the claims that bots can be let loose on. And insurance dinosaurs have one advantage: data. For bots to get really clever they need lots. If Lemonade’s customer numbers remain small, they will not learn fast enough to stay ahead of the big boys using the same technology.

But insurance moves slowly. Miguel Ortiz from BCG, a consultancy, says that the big bet for Lemonade is that “it can stay ahead of a sleepy industry by doing standard insurance processes better than everyone else.” Already, the shake-up it promises has added some fizz and zest.



Asset management

Choosing Life

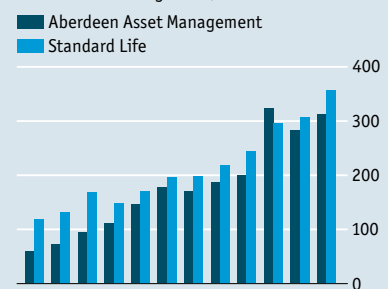
Two Scottish asset managers try to defend their share of a shrinking pie

From fishing buddies to co-CEOs: that is how the relationship between Martin Gilbert, chief executive of Aberdeen Asset Management, and Keith Skeoch, his counterpart at Standard Life, will change after the companies this week announced plans to join forces. The merged company, to be based in Scotland, will have £660bn (\$800bn) in assets under administration, making it Britain’s largest, and Europe’s second-largest, “active” asset manager.

Competition is forcing asset managers to consolidate. Henderson and Janus Capital teamed up last October; Amundi and Pioneer did the same in December. They hope to defend market share from fast-growing “passive” fund managers, whose funds track market indices rather than try to beat them, as active funds do. The research involved in trying to pick winners inevitably makes actively managed funds dearer than passive ones; once these costs are factored in, active managers tend to underperform passive ones. The fee gap is wide enough to have attracted scrutiny from British and European regulators: in ▶▶

Scottish widows

Assets under management, £bn



Source: Company reports

▶ Britain passive funds' fees are around 0.15% of assets under management, compared with 0.9% at actively managed funds.

Both Aberdeen and Standard Life have struggled to compete. Aberdeen has seen net outflows from its funds since 2013 (see chart on previous page), not helped by its focus on emerging-market and Asian funds, which have had a rough patch. At Standard Life, overall assets under management increased, but its flagship range of funds faced net outflows in 2016.

The hope is that coming together will change this picture. Standard Life—whose shareholders will own two-thirds of the

new company—will move even further away from its roots as an insurer, and will be able to make use of Aberdeen's more international client base. For its part, Aberdeen can sell its products through Standard Life's wider British distribution network. Another attraction is cutting costs: spending on IT and sales can be scaled back; underperforming managers fired. The companies estimate that the deal will generate annual savings of around £200m.

Shareholders seemed happy. Share prices for both companies rose by around 8% on the announcement. There are some uncertainties, though. Mr Gilbert and Mr

Skeoch may know each other well, but the history of such condominiums in other companies has not been happy.

The benefits to clients are also unclear, says Jonathan Miller of Morningstar, a research firm. Cost savings could end up boosting shareholder returns rather than lowering charges. Research by the Financial Conduct Authority, a British regulator, finds that increased scale does not lead to lower fees. The two firms say the merger will offer investors better value for money, through a wider choice of funds. It will need to, if it wants to keep regulators at bay and withstand the passives' aggression. ■

Buttonwood | A port in a storm

The mood in Singapore's financial sector is subdued

SINGAPORE owes its existence, and its prosperity, to its place at the heart of intra-Asian trade. In more than 50 years of independence, the city-state has striven mightily to attract investment from all over the world. Such has been its success, indeed, that others hope to imitate its open, low-tax model. In Britain, for example, there has been talk of the country turning into a "European Singapore" once withdrawal from the EU is complete. (It would be a nice start if London's Tube operated with anything like the same efficiency as Singapore's subway network.)

The current mood in Singapore, however, is far less buoyant than you might imagine. Singapore has survived and thrived by steering a middle course between America and China. It has been alarmed both by the isolationist rhetoric of President Donald Trump and by recent, highly unusual, public spats with China.

Global trade growth has slowed in recent years. Despite signs of a pickup, this has had a big effect in a city that has the world's second-busiest port and that (according to Barclays, a bank) is the country most exposed to the global value chains created by multinational companies. Annual GDP growth in 2016 was just 1.8%, the slowest rate since 2009. Even in this famously open economy, the government has been allowing in fewer foreign workers in the face of pressure from the voters.

The city still has enormous potential as a regional financial centre. Thanks to its political stability and strong legal and regulatory systems, Singapore looks like a natural haven—an Asian Switzerland. In particular, Indian offshore wealth is being attracted to the city, which hopes to be a hub for the budding market in *masala* bonds (rupee-denominated debt issued outside India).

Singapore has a rare AAA credit rating.



The IMF last year described its banks as "well capitalised", with adequate provisions for bad loans, despite worries about their exposure to oil-and-gas firms. Singapore is now the third-biggest trading centre for foreign exchange in the world (having overtaken Tokyo in 2013). It also has a growing derivatives market with daily over-the-counter volume of \$400bn, as of October 2015. Finance comprises 13% of the country's GDP, considerably more than the 8% share it contributes to Britain's.

But Singapore faces a strong challenge as a regional finance hub from Hong Kong, which benefits from far stronger links to the Chinese economy. Hong Kong has the upper hand over Singapore in terms of investment banking, particularly in corporate-finance businesses such as mergers and acquisitions. Hong Kong's capital markets are much deeper; the local economy in Singapore is simply not large enough to generate the same volume of business. Many of South-East Asia's businesses are family-owned and rely on banks (or reinvested profits) rather than the markets for finance. Singapore's daily stockmarket turnover in 2016 was around S\$1.1bn

(\$797m), down by 19% on 2013 and less than a tenth of the Hong Kong stock exchange's daily volume.

Indeed, the magnetic pull of China may only increase if America under Mr Trump retreats from its Asian role. Multinationals may feel that they simply have to locate more resources in Hong Kong than Singapore for the sake of proximity to the regional superpower.

Singapore's long-term prospects may depend on how two trends resolve themselves. Asians are becoming wealthier and are looking for other ways to invest their money aside from bank deposits and property. As Asian economies become more important to the world economy, so banks, insurance companies and fund managers will look to increase their operations in the region. As the thief Willie Sutton said when asked why he robbed banks: "That's where the money is."

At the same time, however, technology means that investors can manage their money with the click of a mouse or the swipe of an app. And they can do so at very low cost. Vanguard, an index-tracking fund manager, attracted more global mutual-fund inflows last year than its ten largest rivals combined. Index-tracking managers don't need to have a regional base in a gleaming office tower in Singapore or Hong Kong.

This city is trying to ride this trend by becoming known as a hub for "fintech", whereby new, technology-driven groups take aim at established, high-cost finance firms. But this is a tricky tightrope to walk. Fintech may cannibalise existing financial businesses without generating many additional jobs. The next 50 years may present Singapore with even greater challenges than its first half-century.

Deutsche Bank

Blues in a different key

FRANKFURT

Germany's biggest bank changes course

THREE times since the financial crisis, Deutsche Bank's bosses have turned to its shareholders for cash: €10.2bn (\$13.6bn) in 2010, €3bn in 2013 and €8.5bn in 2014. Since becoming chief executive in 2015, John Cryan has had no plans to ask for more. Deutsche still needed to thicken its equity cushion, but disposals, cost cuts and earnings (if any: it has made losses for the past two years) would provide the stuffing.

Well, plans change. On March 5th Mr Cryan announced an €8bn rights issue. Some comfort for investors: the price, €11.65 a share, is 39% below the previous close; and Mr Cryan, who had suspended the dividend, promises a return to "competitive" payouts next year. In another reversal, Deutsche will keep rather than sell Postbank, a mass-market retail business that was once part of the post office. Deutsche has owned it since 2010.

Postbank and the posher "blue" Deutsche Bank brand will be more closely integrated—notably, sharing computer systems. Mr Cryan is also selling a slice of Deutsche's asset-management division and some lesser assets. And he is reorganising its corporate and investment bank to concentrate on serving multinational companies, taking charge of the American business himself.

The shifts on Postbank and the share issue are two sides of a coin. Selling Postbank had been part of Deutsche's plan to raise its ratio of equity to risk-weighted assets—an important gauge of resilience—above 12.5% by 2018. With the capital increase, Deutsche says, the ratio would have been 14.1% at the end of last year, rather than 11.9%. It should stay "comfortably" above 13%.

Mr Cryan may be making virtue out of necessity: he was struggling to get the price he wanted for Postbank. However, Deutsche says altered circumstances have made Postbank a better prospect.

Supervisors demand a higher leverage ratio (of equity to total liabilities) of Deutsche than of the many smaller institutions, chiefly municipally owned savings banks or co-operatives, where most Germans stow their cash. But this has turned out to be lower than first expected—so that retaining Postbank requires less equity. Mr Cryan also reckons that the miserable, ultra-low-interest-rate economics of German retail banking are improving and that there is strength in scale in a land of more than 1,600 lenders. Postbank and the blue brand

each have around 5% of retail deposits.

A deal in January with America's Department of Justice has also made it easier to tap shareholders. In September the DOJ demanded \$14bn to settle claims that Deutsche mis-sold residential mortgage-backed securities in its swashbuckling pre-crisis days, and sent the shares plummeting. The eventual bill, \$7.2bn, less than half of it in cash, came as a relief.

Though Deutsche still claims "global corporate-and investment-banking ambitions", feeding the domestic roots looks wise: America's big banks show that domestic strength begets strength abroad. But there is another lesson. Like many European lenders, Deutsche has taken too long to choose a course. Meanwhile, the Americans have marched into the distance. ■

Trade with China

Shock horror

Research on the effects of Chinese imports has not been debunked

COMPETITION from Chinese imports may have cost some Americans jobs, but economists have done pretty well out of it. Since 2013 David Autor, David Dorn and Gordon Hanson have published nine separate studies digging into the costs of trade. They have found that, of the fall in manufacturing jobs between 1990 and 2007, one-quarter could be attributed to a surge in imports from China. Other sectors failed to soak up the extra workers. Their research also suggested that the China shock has cut the supply of marriageable men and opened the door of the White House to Donald Trump.

In recent weeks a dispute has erupted over their results. Jonathan Rothwell, an economist at Gallup, a pollster, alleged "serious flaws" in one paper, prompting a fierce eight-page response from the authors, and an acrimonious public tiff.

The row centres on how the effect of the China shock is measured. The trio wanted to isolate the effects of extra Chinese supply, rather than of something happening in America, so they checked that imports of particular Chinese products were surging in other rich countries, too. They then compared places in America more exposed to these Chinese imports—typically those with lots of labour-intensive manufacturing—with less exposed ones.

Mr Rothwell's critique does not attempt to debunk their research completely. But he asks whether combining changes in the 1990s and the 2000s makes sense. When he splits this period up, he confirms the finding that Chinese imports had large effects on American manufacturing employment. But several other effects of Chinese imports become smaller or no longer statistically significant. For example, the effect of Chinese imports on the size of the labour force falls to a quarter of its 1990s size in the 2000s. This is hardly conclusive—slashing sample sizes inevitably reduces the power of a test.

Mr Rothwell has not disproved anything. But he has provided an opportunity to think through the assumptions of the original research by Messrs Autor, Dorn and Hanson. Their attempt to isolate the effects of China would not have been entirely successful, for instance, if other countries were experiencing non-China-related shocks similar to those hitting America.

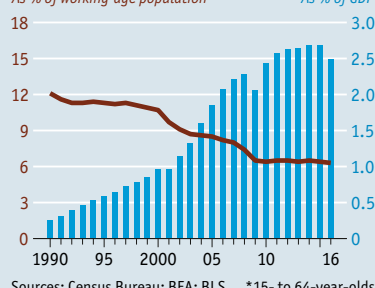
More broadly, it is impossible to know what would have happened had Chinese imports not surged. Monetary policy might have been different. And what a company such as Apple would have done without low-cost Chinese assembly workers is unknowable. Moreover, adding up individual effects over the whole economy could miss important interactions.

Mr Rothwell's strongest criticism is not of that China-shock literature at all, so much as of the way it was received. Some have taken evidence of disruption as proof that tariffs would be a good idea, or that trade with China has hurt America. But, as Mr Autor says himself, "our research does not tell you the net societal costs and benefits of trade." It does not estimate the benefits to exporters as China opened up (though this was smaller than the rise in imports) or to American shoppers able to buy cheaper stuff.

Other research is emerging that attempts to answer those questions. One paper, by Kyle Handley and Nuno Limão, found that the extra trading certainty associated with China's accession to the WTO lowered American manufacturing sales and employment by more than 1%, but also lowered American prices and raised consumers' incomes by the equivalent of a 13-percentage-point cut in tariffs. It also helped poor Chinese workers get richer, which isn't to be sniffed at either. ■

Cheap but not cheerful

United States

Manufacturing employment
As % of working-age population*Goods imports
from China
As % of GDP

Global property prices

Searching for sanctuary

Bolthole money pushes prices up for local and foreigner alike

MANY Americans were taken aback when news broke in January that Peter Thiel, an internet billionaire and adviser to Donald Trump, had New Zealand citizenship. For five years this backer of an “America first” president had kept his Kiwi passport quiet. Then the government released details of his \$10m-lakeside estate.

A growing horde of rich foreigners see New Zealand as a safe haven. In 2016 overseas investors bought just 3% of all properties. But their purchases were concentrated at the expensive end of the market, which is growing fast: sales involving homes worth more than NZ\$1m (\$690,000) increased by 21%. That helped push prices in the country up by 13% over the past year, to lead *The Economist's* latest tally of global house-price inflation (see table).

New Zealand is one of several countries where the impact of foreign money on housing is under scrutiny. Prices have also risen rapidly in Australia and Canada. Central bankers fret about the dangers fickle capital flows pose to financial stability. London's mayor has ordered a study on foreign ownership in the capital after property prices rose by 54% in four years.

Foreign capital also makes itself felt in America, where house prices have recovered to a new nominal high. Canadians once dominated; now they are outnumbered by Chinese citizens spending some of the \$1.3trn that has left the country since autumn 2014. The National Association of Realtors estimates that Chinese investors bought 29,000 American homes for a total of \$27bn in the year to March 2016. Foreign buyers focus on a handful of cities: San Francisco, Seattle, New York and Miami.

In some places, foreign investment has led to a construction boom. In Miami apartments are being built in numbers not seen since the financial crisis, financed in part by Venezuelan money. Australia lets foreigners invest only in new-build properties, and they do: 26,000 new flats are due on the market in Sydney and Melbourne over the next 18 months. In London 45,000 homes have been built since 2014—the highest rate in ten years—but locals grumble many are pads for footloose foreigners.

In many of these countries affordability looks stretched. *The Economist* gauges house prices against two measures: rents and income. If, over the long run, prices rise faster than the revenue a property might generate or the household earnings that service a mortgage, they may be un-

The Economist house-price indicators

December 2016 or latest available

	Real % change		Under(-)/over valued*, %, against:	
	on a year earlier	Since Q1 2007	Rents	Income [†]
New Zealand	12.7	35.9	114	59
China	12.0	29.9	36	na
Canada	11.1	47.4	112	46
Ireland	5.9	-35.7	30	1
Germany	5.6	31.4	-2	-4
Britain	5.3	-3.8	45	30
Spain	4.2	-36.0	25	16
United States	3.7	-15.0	11	-3
Hong Kong	2.9	129.8	86	49
Australia	2.4	34.8	71	50
Japan	2.3	5.2	-21	-31
Switzerland	1.7	35.5	3	nil
France	1.5	-5.9	28	22
Italy	-1.1	-25.7	-7	-2
Singapore	-3.1	10.1	17	-42

Sources: Haver Analytics; OECD; Thomson Reuters; national statistics offices; *The Economist*

*Relative to long-run average †Disposable income per person

sustainable. By these measures house prices in Australia, Canada and New Zealand look high. In America as a whole, housing is fairly valued, but in San Francisco and Seattle it is 20% overpriced.

Haven investors may disregard affordability measures. Property can either be a bolthole or earn an income; in many supply-constrained cities its value may rise rapidly; even if not, the risks may be lower than at home. Investment from China has gone up as its own property market has become stretched, fears of devaluation have risen and a crackdown on corruption continues. A study in 2016 found that increased political risk in places such as Greece and Syria explained 8% of the variation in London's house prices since 1998.

Policymakers may well scratch their heads. It is difficult both to make housing more affordable for a country's own citizens and to encourage foreigners to buy. Britain has in fact tried to curb foreign enthusiasm with higher taxes, and by publishing a registry of 100,000 British homes owned by foreign companies—a potential embarrassment for some.

But unintended consequences lurk. After a 15% levy on purchases from abroad was introduced in the Canadian city of Vancouver last August, the number of foreign buyers dropped by 80%. That helped dampen house-price inflation there but pushed up demand in nearby Victoria. It also deterred highly skilled immigrants. The levy will soon be amended to exclude foreigners on skilled-work visas.

Some foreigners will stump up even if costs rise. More Americans are house-hunting abroad, for example. By one measure, interest in boltholes in New Zealand has tripled since Mr Trump's election. ■

Green-shipping finance

Light at the end of the funnel

How to help a bankrupt industry pay for energy-efficiency upgrades

SHIPPING may seem like a clean form of transport. Carrying more than 90% of the world's trade, ocean-going vessels produce just 3% of its greenhouse-gas emissions. But the industry is dirtier than that makes it sound. By burning heavy fuel oil, just 15 of the biggest ships emit more oxides of nitrogen and sulphur—gases much worse for global warming than carbon dioxide—than all the world's cars put together. So it is no surprise that shipowners are being forced to clean up their act. But in an industry awash in overcapacity and debt, few have access to the finance they need to improve their vessels. Innovative thinking is trying to change that.

A new report from the Carbon War Room (CWR), an international NGO, and UMAS, a consultancy, highlights the threat that new environmental regulations pose to the industry. The International Maritime Organisation, the UN's regulatory agency for shipping, has agreed to cap emissions of sulphur from 2020. Last month the European Parliament voted to include shipping in the EU's emissions-trading scheme from 2021. Without any retrofitting of ships to meet the new rules, many firms may be forced out of business. That also imperils banks across the world, which have lent \$400bn secured on smoke-spewing ships.

Tens of billions of dollars are needed to ►►



Smokestack lightening

► pay for upgrades to meet the new rules, according to James Mitchell at CWR. But the industry can hardly pay even its existing debts. Freight rates have collapsed owing to a slowdown in world trade since the financial crisis and to enormous overcapacity. An earnings index compiled by Clarksons, a research firm, covering the main vessel types (bulk carriers, container ships, tankers and gas transporters), touched a 25-year low in 2016. Banks do not want to throw good money after bad.

Even those that are expanding their ship-lending have seen less demand than they expected for retrofit loans. ABN AMRO, a Dutch bank, and a market leader in this business, has made less than \$500m in green loans over the past five years, says Gust Biesbroeck, its head of transportation finance. The problem, he adds, is one of incentives. Ship owners, who would normally borrow for such upgrades, do not benefit from lower fuel bills. It is the firms chartering the vessels that enjoy the savings. But their contracts are not long enough to make it worthwhile to invest in

green upgrades. The average retrofit has a payback time of three years, whereas 80% of ship charters are for two years or less.

Hence the interest in new green-lending structures. One, called “Save as you Sail”, comes from the Sustainable Shipping Initiative, another NGO. The idea is to share the fuel savings between the ship-owner and the charterer over a longer contract, giving both an incentive to make the upgrades. Such schemes used to be thwarted by the difficulty of measuring exact fuel consumption on ships. New technologies allow more accurate readings.

Finance providers are keen to get involved. Last June the European Investment Bank announced €250m (\$282m) in funding for such retrofits; it hopes other banks will follow suit with billions more. In future, the idea might be extended to greening aircraft and trains. For now these businesses do not suffer a shortage of finance. But a downturn is a matter of “when not if”, says Michel Dembinski at MUFU, a bank. Green finance could rescue many other industries sailing into a storm. ■

that, in a country once enthusiastic about the EU, 46% favour a “Nexit” referendum on whether to leave.

Yet it is precisely places such as Rotterdam, the Netherlands’ “gateway to Europe”, that stand to lose the most from any retreat from globalisation. Over the past 20 years the Netherlands’ lucrative re-exports (computers shipped in from China, say, and then sent on to Germany) have quadrupled by value.

So Brexit and a protectionist America under the presidency of Donald Trump both threaten the Netherlands more than most. In an otherwise upbeat report on the country’s prospects, the European Commission picks out Brexit-related risks as an Achilles heel. Ratings agencies put the Netherlands (along with Belgium, Ireland and Malta) as being at high risk from Brexit. By value added, Britain is the Netherlands’ second-biggest export market after Germany (see chart).

Around 80% of the flowers and 70% of the plants that Britain imports come from the Netherlands. Growers could be particularly hard hit if Brexit led to new trade barriers. At a parliamentary hearing last month, representatives of other Dutch industries voiced similar concerns. The fishing lobby emphasised how much it needs access to British waters: 60% of the Netherlands’ fish, including 90% of its beloved herring, are caught there. Agricultural and food exports to Britain were worth €8.9bn (\$9.8bn) last year. The farming lobby says it is already suffering from sterling’s weakness, which makes its products 20% dearer, and worries that the EU’s farming policy will become more subsidy-driven when Britain no longer has a seat at the table.

The country’s economic-policy bureau, the CPB, estimates that a “hard” Brexit, in which British trade is governed just by WTO rules, could cost the Dutch economy 1.2-2% of GDP by 2030. And Britain is not the only headache. Exports to America—and hence the threat of American tariffs—also matter disproportionately to the Dutch: 3.4% of GDP (compared with 2.6% on average for the EU) and 300,000 jobs depend on them.

Needless to say, a Nexit would cause much greater upheaval. Leaving the EU would hit the Netherlands much harder than Brexit will hit Britain, says Wim Boonstra, an economist at Rabobank’s research arm: “We’re the world’s second-largest exporter of agriculture; without free trade we would drown in milk and cheese.” The country grew rich in its golden age by sailing the seas and trading globally; on many measures it is still the world’s most open economy. Today it is the fifth-largest exporter of goods. A third of its GDP comes from exporting goods and services. Few countries have as much to lose from a world where drawbridges are pulled up and ships are kept in port. ■

The Dutch economy

Who’s Nexit?

AMSTERDAM

If globalisation is in retreat, the Netherlands would be a big loser

AS ANY football fan knows, little delights the Dutch more than beating the Germans. So, as the country prepares for an election on March 15th, it should be cheering an economy that, after lagging behind Germany’s for years, is at last outpacing it. GDP grew by 2.1% last year, which was the fastest rate since 2007 and a stronger performance than its neighbours, including Germany. Unemployment has fallen to 5.3% and more people are in work than before the crisis in 2007-08.

After years of belt-tightening, households are spending again, thanks to a strong housing-market recovery and rising wages. Government finances are sound. This year the budget may be in balance—perhaps even in surplus—and public debt may drop below 60% of GDP. Yet this sunny outlook has not brightened the mood of a tetchy election campaign.

That is not so surprising. Marieke Blom, the chief economist at ING, a bank, attributes the positive forecast mostly to tough government reforms over the past few years—particularly raising the retirement age to 67 (from 2021) and reforming the financing of the health-care system. Years of reform, austerity and recession have taken their toll. Pollsters predict strong votes for protest parties such as the Socialists and



the PVV of Geert Wilders, an anti-immigration populist.

Niek Stam, a trade-union leader, says that dockworkers in the port of Rotterdam will vote for Mr Wilders—not because they are racist but because they fear for their jobs, which are being threatened by robots, and for their pensions, which they see receding as the retirement age creeps up. Referring to Brexit, Mr Stam says some think “maybe we should do what the English are doing, as globalisation also brings harm.”

Jeroen Dijsselbloem, the finance minister, acknowledges that, despite positive forecasts, “many of our voters have really had some harsh times.” So truculent is the mood that a poll by Ipsos last May found

Free exchange | Borrowed time

Economic recovery will put the theory of “secular stagnation” to the test

IN PERIODS of economic stress all sorts of theories are entertained about the nature of the problem. When better times return, some theories fade from memory. Others linger, however. During the economic mess of the past decade, economists frightened themselves with tales of “secular stagnation”: a nasty condition that dooms its victims to chronically weak growth. Now that the economic outlook is brightening a bit—deflation has been dispatched, and for most advanced economies 2017 is forecast to bring a third consecutive year of economic growth—it is tempting to laugh off the idea of secular stagnation as a bit of crisis-induced hysteria. Tempting, but also premature.

In a time of secular stagnation, the normal relationship between saving and investment goes haywire. People save some portion of their income each year. Because one person's spending is another's income, such saving can drain away demand and lead to recession, unless the funds set aside by savers are reinjected into the economy through lending to those looking to invest: as when banks lend savers' deposits to businesses, for example. Central banks help manage this process. When planned saving threatens to outstrip desired investment, they will reduce interest rates to keep the two in line and the economy on track. But when secular stagnation strikes, the gap between what people want to save and what they want to invest grows too large to reconcile. The interest rate needed to balance the two drops, ultimately to below zero. Central banks are stymied. The result is chronic economic weakness: low growth, low inflation, low interest rates and the constant threat of recession.

Several years ago those symptoms could be found across much of the global economy. No longer. Headline inflation is trending upward, even in Europe and Japan. Commodity prices have stabilised, helping struggling emerging markets. And America's Federal Reserve has begun raising its benchmark interest rate, suggesting that the American economy is no longer trapped in a world in which rates cannot be pushed low enough to keep growth on track. In a speech on March 3rd Janet Yellen, the chairwoman of the Fed, reckoned that America was ready for more rate hikes than in 2015 and 2016, including at least three this year.

But the most devilish aspect of the secular-stagnation story is that good times do not necessarily indicate underlying health. The persistent gap between desired saving and investment that it describes can result from a scarcity of attractive investment options—owing to an ageing population or a slowdown in techno-

logical progress, for example. But it can also be driven by the concentration of income among those with little inclination to spend. Income inequality could contribute to stagnation, for instance, by leaving a shrinking share of income in the hands of the poorer households that would most like to spend.

In such cases, the bonds of secular stagnation may temporarily be broken by a period of financial excess in which bubble conditions drive speculative investment, or in which groups short of purchasing power borrow from those with savings to spare. The reason to doubt the solidity of this recovery is that we have been in such circumstances before, only to watch it end in tears. In the late 1990s, for example, soaring tech stocks drove a wave of investment in internet infrastructure which yanked the American economy out of a jobless recovery. When that fever broke, the economy slumped again, until the global financial system found a way to funnel credit to American households looking to buy or borrow against a home. In the euro area, thrifty core economies lent heavily to the periphery, often against soaring property prices, fuelling an economic boom that ended disastrously.

Post-traumatic stress

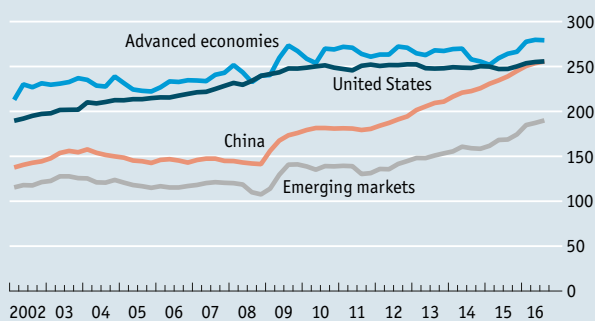
Is this time different? It is, a bit. Across advanced economies, borrowing capacity is still impaired after the trauma of the crisis; and banking reforms mean that credit taps cannot be turned back on so easily. Those obstacles might simply delay rather than prevent a return to form, however. A mood of optimism is fuelled by a stockmarket that is scaling new heights. In America, household debt is rising again, driven by loans to students and for cars. Across advanced economies, private debt as a share of GDP is above the pre-crisis level and rising fast (see chart). Most dramatic of all has been the increase in borrowing in China, where private debt as a share of GDP has nearly doubled since 2008. It seems very unlikely that the world economy would have escaped its deflationary doldrums without this vast credit expansion, which has kept its building boom rumbling along.

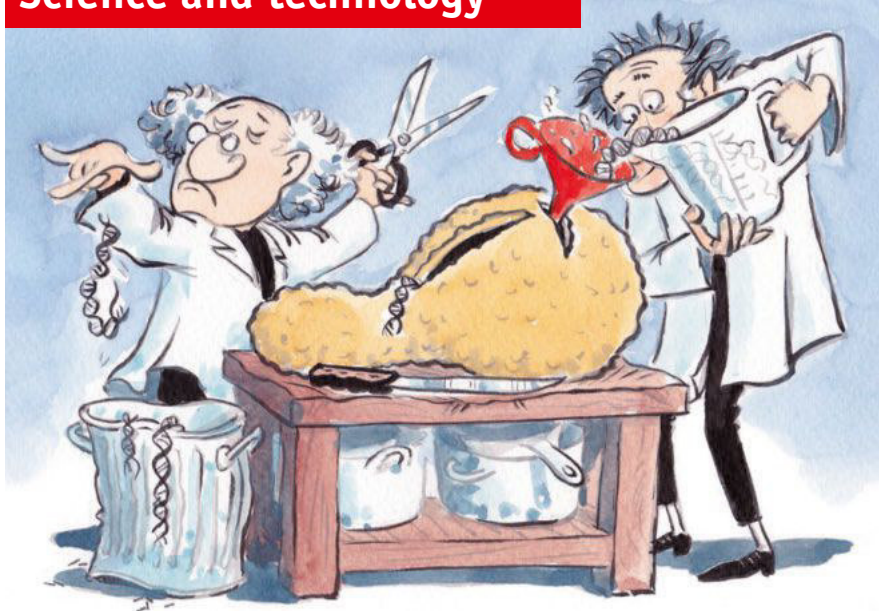
Economists sympathetic to the secular-stagnation story argue that there are ways to escape the trap. Firms might suddenly find new capital projects in which to invest: thanks, perhaps, to technological advance. An effort to reduce inequality could be a way out: the rich could be taxed and their wealth redistributed rather than lent. A massive public-investment campaign would be another. Emerging markets contributed to the world's savings glut by buying government bonds in order to build up their foreign-exchange reserves, funnelling money to governments of advanced economies with little appetite for fiscal stimulus. Rather than see the private sector overextend itself, those rich-country governments could instead seize the opportunity to borrow more, soak up excess savings and invest the proceeds in new roads and railways, electric grids and broadband.

If the secular-stagnation idea holds, central banks face a stark choice until politicians do some of these things. The Fed, poised to raise rates later this month, seems confident it can tap its brakes and keep the American economy on a safe growth trajectory. But it might face a nastier dilemma: to tolerate the rising asset prices and indebtedness which enable recovery, or to choke off recovery and wait for the government to solve the problem. Just what sort of story best describes the state of the economy—and how scary it is—will become clear this year, one way or another. ■

Debt be not proud

Private-sector credit, as % of GDP





Synthetic biology

Something's brewing

An international consortium is trying to make an artificial yeast genome. Success would usher in true genetic engineering

BIOLOGY'S biggest division is not between plants and animals, nor even between multicellular and single-celled creatures. It is between prokaryotes and eukaryotes. Prokaryotes—bacteria are the most familiar sort—are simple. Their DNA is an unadorned circular molecule between 500,000 and 10m genetic “letters” long. As such, it is fairly easy to replicate from off-the-shelf chemicals.

The DNA of eukaryotes—animals, plants, fungi and so on—is both more abundant and more complex than that. It may have hundreds of millions, even billions, of letters and it is organised into several elongated chromosomes inside a cell's nucleus. Synthesising a eukaryote's genome is thus a far harder task than creating its prokaryote equivalent. But if biology is ever to be brought within the realm of technology in the ways that physics and chemistry have been, it is an essential task.

This week has seen a big step towards that achievement, with the publication in *Science* of recipes for five artificial chromosomes for yeast cells. Yeast, a fungus, is one of the workhorses of eukaryotic genetics. The chefs who have devised these recipes are members of a consortium called the Synthetic Yeast Genome Project (Sc2.0). In 2014, as an aperitif, Sc2.0 created a single artificial yeast chromosome. The latest set of papers are the meat of the matter, meaning that over a third of the yeast genome has now been synthesised. The remaining ten chromosomes are still cooking, but

they will be served up soon.

Rather than building entire chromosomes in one go, Sc2.0's researchers proceed in stages. They start with pieces of DNA 750 letters long. These, known as oligonucleotides, can be synthesised, by special apparatus, with the genetic letters in any desired order. The consortium's teams then stitch appropriate oligonucleotides together to build chunks about 10,000 letters long. Finally, they splice these chunks into “megachunks”, with 30,000-60,000 letters each. Those get inserted one at a time into natural yeast chromosomes by being swapped for corresponding sections of existing DNA. The result is tested each time by checking that the modified chromosome still allows the cell it is in to grow and reproduce. Once it has passed that test, another megachunk can be swapped in, and the process repeated until the whole chromosome is made of synthetic DNA.

Shock and awe

There would be little point to all this, though, if the DNA going in was the same as that coming out. The value of being able to synthesise a genome lies in being able to manipulate it. And this, tentatively, is what the members of Sc2.0 are trying to do.

First, they are clearing out the rubbish. The final synthetic genome, as currently planned, will be 8% smaller than a natural one. The difference is bits of DNA that seem to serve no useful purpose. Such DNA is not always easy to identify, for many parts

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of chromosomes that were once believed useless are now known to have functions. But some useless DNA does exist and the Sc2.0 researchers are getting rid of it.

They are also cleaning up the genetic code's punctuation in their new chromosomes—reducing the number of types of three-letter “stop” signals that mark the ends of genes from three to two. Their hope is that the redundant signal's triplet code (one of only 64 available) can then be used to extend from 20 to 21 the range of amino acids, the building blocks of proteins, which the new chromosomes can encode. That would permit the production of completely new sorts of protein. And they are moving certain genes that sometimes get in the way of DNA replication to a special extra artificial chromosome that will exist in addition to the conventional 16, in effect quarantining them.

The aim of all this is twofold. One goal is to make a genomic “platform” that can be adapted to do useful things. Genetically modified yeasts already make vaccines, drugs and speciality chemicals. Sc2.0's technique means that it will be possible to design completely new yeasts, and the range of products will widen.

That will be to the good. But the other goal may disturb some people, for it is to test techniques that could then be used on other eukaryotes. It is here that a pause should be taken for thought. The trivial modifications that have already been made by genetic engineers to crops and animals are as nothing compared with what might be possible if whole genomes could be manipulated at will. Even CRISPR/Cas9, a technique much in the news at the moment, modifies only small bits of DNA at a time. The Sc2.0 approach writes entire genetic sequences from scratch. The results could be awesome. To make sure they are not also shocking, people should start thinking about them now. ■

Unmanned underwater vehicles

A clever solution

Aluminium batteries could let submarine drones range farther

MUCH is made of the potential of flying drones. But drones are useful at sea, too. Unmanned underwater vehicles (UUVs), as they are known technically, are employed for things ranging from prospecting for oil and gas to naval warfare. Like their aerial cousins, though, ocean-going drones have limited ranges—limits that are often imposed by their batteries.

At the moment those batteries are usually either alkaline or lead-acid. Lithium-ion batteries, fashionable elsewhere, have not conquered the UUV world. Their tendency to catch fire counts against them. And they are sensitive to pressure, which is undesirable in devices that operate underwater. But a firm in Massachusetts, called Open Water Power (OWP), is offering an alternative: batteries based on aluminium. With these, its engineers hope to extend the ranges of underwater drones tenfold.

Each of OWP's battery cells has a block of aluminium as its anode. The cell's cathode is made of nickel. In a working battery, these anodes and cathodes alternate, and are bathed in an electrolyte made of seawater with some potassium hydroxide dissolved in it. This chemical keeps the battery free from marine organisms that might otherwise grow within it. It also plays two other roles. These are in the battery's chemical operation.

One of these roles lies in the reaction that drives the battery, between the aluminium of the anode and the hydroxide ions in the electrolyte. A hydroxide ion is a negatively charged combination of a single hydrogen atom and a single oxygen atom (OH⁻ in chemical shorthand). Unadulterated water contains some hydroxide ions (its molecules, H₂O, sometimes disintegrate spontaneously into OH⁻ and positively charged hydrogen ions, H⁺) but adding potassium hydroxide boosts their number.

The result of the reaction is aluminium hydroxide, which is electrically neutral, and electrons, which carry away the hydroxide ion's negative charge. These electrons then travel towards the cathode via a circuit that can, for example, power a motor. To complete the circuit, electrons at the cathode combine with hydrogen ions from the electrolyte's water to produce hydrogen gas, which is vented from the battery, leaving those ions' hydroxide partners behind to replenish the store of OH⁻.

Previous attempts to make a commercial aluminium battery have failed because their anodes have got clogged up

Women in research

Fairer than it was

Science is male-dominated. But a new report says females are catching up

MARCH 8th was International Women's Day. That seemed to Elsevier, an academic publisher, a good occasion to publish a report looking at the numbers and performance of female scientists around the world. The report, "Gender in the Global Research Landscape", analysed the authorship of more than 62m peer-reviewed papers published in 27 subject areas over the past 20 years, in 11 mostly rich countries and in the European Union as a whole. The papers and their citations are indexed in Scopus, a database that is run by Elsevier.

In the EU, and in eight of the 11 countries considered, the share of women authors grew from about 30% in the late 1990s to about 40% two decades later. Brazil and Portugal are closest to equality, each just a percentage point shy of it. In

Japan, by contrast, barely a fifth of researchers are female—a fact that may reflect the particularly uncool image science has among Japanese schoolgirls.

Women are best represented in subjects related to health care. In nursing and psychology, for example, they outnumber men in several countries, including America and Britain. Less than a quarter of researchers who publish papers in the physical sciences are women. Perhaps as a consequence of this, inventors who register patents are still almost all men. In the places covered by the report the share of patent applications by women ranges from 8% of those filed in Japan to 26% in Portugal. Women are, however, making progress, even in the still-male-heavy world of engineering. Though they constitute only between 10% and 32% of authors of papers in that field in the places the report looks at, the share of those papers in which a woman is the lead author is between 35% and 52%.

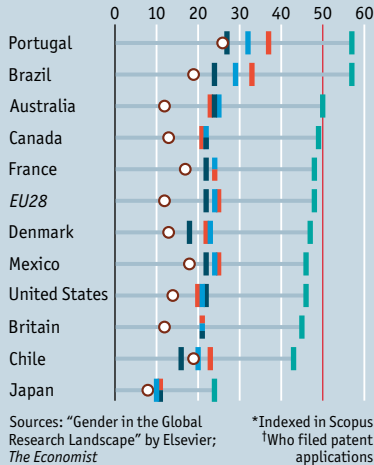
All of this is qualified good news. Women do, nevertheless, still suffer from a "leaky pipeline" phenomenon that sees them drop out of scientific careers at a higher rate than men do. At Imperial College, London, regarded by many as Britain's leading technological university, about 35% of undergraduates are women. But that percentage falls with each step up the career ladder. At the moment, only 15% of Imperial's professors are women.

Partly, this stems from the fact that when those professors were undergraduates the sex ratio was even worse. But it also reflects the problem of career-building which women face in all areas, not just science. Even in the most progressive countries, they still shoulder the lion's share of child care and housework. Boosting their numbers in the laboratory will take more than merely convincing girls that science is cool.

Still a man's world

Women among researchers with papers published* 2011-15, % of total, in:

health sciences engineering
physical sciences computer science, maths
Inventors†



with aluminium hydroxide, which is insoluble in water. This is where the added potassium hydroxide does its third job, for an aqueous solution of potassium hydroxide will dissolve aluminium hydroxide in a way that pure water cannot.

A pump circulates the potassium-hydroxide-bearing electrolyte through the battery, where it picks up aluminium hydroxide from the anodes. The resulting solution then passes through a chamber filled with a plug made of foam rubber. This is a material that packs an enormous amount of surface area into a tiny volume and

whose chemistry encourages the aluminium hydroxide to precipitate on that surface. A small piece of foam rubber can thus hold a lot of aluminium hydroxide. When a plug is saturated with the stuff the battery ejects it and replaces it with a fresh one that has been kept, compressed, in an adjacent plug store. Each battery carries enough plugs to keep it going until its supply of aluminium has run out.

One test of OWP's technology will come this summer, when the firm will fit its batteries into UUVs built by Riptide Autonomous Systems, which is also in Mas-

▶ sachusetts. Riptide's products are used by oil and gas companies to undertake underwater surveys. At the moment, they have a range of about ten nautical miles (19km). Riptide reckons that OWP's batteries could increase that to 110 nautical miles.

The armed forces are interested, too. Though OWP is coy about the details, records in the public domain show that OWP is working with America's navy and also with the country's Special Operations Command, which carries out clandestine missions. The navy contract asks for something to replace the existing batteries on its Shallow Water Surveillance System, a series of acoustic sensors designed to detect enemy submarines. The Special Operations contract is light on detail, but is for "man-portable UUVs".

One other use for aluminium batteries might be to power crewed deep-diving submersibles such as *Alvin*, which found fame in 1986 when it was used to explore the wreck of *Titanic*, a British liner sunk by an iceberg in 1912. At the moment *Alvin* still relies on lead-acid batteries. This limits its dives to eight hours and means it cannot go as far down into the ocean as its titanium shell would otherwise permit. Aluminium batteries would let it and its kind dive longer and deeper, letting researchers visit the abyss more easily in person. ■

Road accidents

Safe on taxis

What colour a cab is painted helps determine its chance of crashing

IN 1907 John D. Hertz, the owner of a taxi firm in Chicago, asked some academics at the University of Chicago to do a piece of research for him. He wanted to know what colour he should paint his cabs in order to make them stand out among the sea of black vehicles that then inhabited American city streets. The researchers' conclusion was: yellow. Now, more than a century later, a group of researchers at a different university have concluded that yellow was a wise choice for other reasons, too. In a study just published in the *Proceedings of the National Academy of Sciences*, Ho Teck Hua of the National University of Singapore and his colleagues show that yellow taxis are less likely to be involved in accidents.

Dr Ho's research made use of a merger that took place, in 2002, between two Singaporean taxi companies. One of the precursor firms had a yellow fleet. The other's was blue. The merged concern has continued that bichromatic tradition to this day. At the moment it owns 4,175 yellow taxis



Mellow yellow

and 12,525 blue ones. All are the same model (a Hyundai Sonata) and all undergo the same maintenance schedules. Any differences in safety between the two, Dr Ho reasoned, must therefore be caused by their respective colours.

To work out if such differences actually exist, he and his colleagues analysed three years' worth of data supplied by the firm. They found that its blue taxis were involved in an average of 71.7 accidents per thousand vehicles per month while its yellow ones were involved in an average of 65.6. The yellow ones, in other words, were 9% less likely to have an accident.

To confirm that what they had observed was nothing to do with the drivers of the respective cabs, Dr Ho and his team picked a fifth of those drivers at random and studied their behaviour behind the wheel. They did this by looking at data collected by satellite-tracking devices carried by each of the firm's taxis. These devices record, every 15 seconds, a cab's location and its status (free to pick up a fare, carrying a passenger or on a break). These data showed that yellow cabs' drivers were driving in an identical manner to those of blue cabs.

The researchers then delved into detailed accident reports, looking at the nature of each accident and the lighting conditions in which it had occurred. They had two hypotheses.

The first was that if yellow really was having a protective effect, a yellow cab would be less likely than a blue one to be involved in a collision when it was clearly in the view of the other driver involved, but not when it was not. This proved true.

The second hypothesis was that yellow would grant a greater advantage at night than during daylight hours, since it contrasts more strongly than blue does with a dark background. This, too, was true. When the researchers compared accidents occurring in the three sorts of lighting condition (daylight, streetlight and no light) listed in the accident reports, they found that the rate-difference was indeed greatest in scenes illuminated by streetlight. In this case, yellow cabs suffered 4.5 fewer acci-

dents per 1,000 taxis per month than did blue cabs, while in daylight, the difference was two. (There were not enough nocturnal collisions with no streetlights around for a meaningful comparison to be made in this third case.) Based on these findings, Dr Ho calculates that if the firm changed the colour of its entire fleet to yellow, it would, over the course of a year, have to deal with 917 fewer accidents and would save around S\$2m (\$1.4m).

Yellow, then, seems to be a lucky colour for owners of cabs and their customers. It certainly proved lucky for John D. Hertz. The Chicago Yellow Cab company, as he renamed his firm, was the foundation of a business empire that led, eventually, to the world's largest car-hire company. Its logo? The word "Hertz", in black, italic letters. On a yellow background. ■

Smartphone diagnostics

Pictures of health

The rise of the medical selfie

OF THE millions of photos shared online every day, which most faithfully represent their subjects? The popular #nofilter hashtag would suggest it is those that have not been digitally altered. But photographs of the same thing can differ greatly, depending on ambient light and the distance and angle they were taken from. So the right manipulation can actually make a picture more honest—and therefore more useful for medical purposes.

That is the idea behind an app from Healthy.io, an Israeli firm. Dip.io, as this app is known, uses mobile-phone cameras for clinical-grade urine analysis. The patient follows the instructions, waits for the colours on the dipstick to develop and then takes a picture of it against the background of a proprietary colour card. The app uses the card to correct the colours so that the

▶ dipstick appears as if in a neutral, standard ambient light. The result is then analysed automatically, in light of the patient's medical history. If this analysis suggests a consultation or prescription is needed, that can also be arranged automatically.

The first urine-dipstick test was developed in 1956, to look for glucose, which indicates diabetes. Since then, sticks have been used to test for the presence of blood, of protein, of hormones indicating pregnancy and also of various bacteria that cause urinary-tract infections. Some sticks, notably those employed for pregnancy tests, can be bought over the counter and used at home. But for tests that require colour-matching, rather than merely checking whether a single line is present or absent, home analysis is regarded as unreliable.

Point, click, treat

It is this unreliability that Healthy.io is attempting to deal with. The firm is, for instance, working with doctors in Israel on a system that lets pregnant women at risk of pre-eclampsia (dangerously high blood pressure, which is signalled by protein in the urine) use dip.io to monitor themselves at home. In Britain, meanwhile, the National Health Service (NHS) is starting to employ a version of the app to monitor those suffering from multiple sclerosis whose bladders are affected by the disease. Members of this group, which is around 60,000-strong, are at particular risk of urinary-tract infections. About 5,000 of them develop severe infections every year. At the moment, when someone in this position spots early symptoms he must go to a clinic to be tested. Home-testing, followed by a prescription posted to those who need it, should obviate that need, speed up treatment and also save the NHS around £10m (\$12m) a year.

A third dipstick test the app may soon be applied to is chronic kidney disease. In America alone some 26m people have this condition, which is often associated with diabetes and high blood pressure in a phenomenon known as metabolic syndrome. Patients in the late stages of kidney disease need costly dialysis. But if the illness is detected early, by screening the urine of those at risk to check for protein, sufferers can be given drugs that lower their blood pressure and thus slow the disease's progress.

Nor is urine analysis the only part of medical practice that may benefit from healthy.io's standardised selfies. Dermatology should profit, too. To diagnose a skin condition from a picture, or to monitor its development over the course of time, dermatologists need not only to control the colour of an image, but also its size and the angle from which it is taken. In this case Healthy.io's answer involves a sticking plaster printed with coloured hexagons that is placed near the relevant patch of skin. Like the dipstick card, the plaster acts

Sexual attractiveness

My chemical romance

Two putative human sex pheromones turn out not to be

FOR several decades biologists have pondered the question of whether men and women produce pheromones. A pheromone is a chemical signal from one animal to another. Often, though not always, such chemicals indicate sexual availability—and when it comes to human mating signals in particular, those looking into the matter have a couple of specific molecules in mind.

Androstadienone (AND) and estratetraenol (EST) are derived, respectively, from male and female hormones and are exuded in sweat. The idea that they are pheromonal is thus worth investigating. The results of such investigations as have been made so far, though, are contradictory. Some experiments have found that these molecules make opposite-sex faces, or photographs thereof, appear more attractive to heterosexual volunteers. Others discern no such effect.

Unfortunately, most of these studies were done with groups of volunteers too small for clear conclusions to be drawn, or using less-than-rigorous experimental methods. (That has not stopped businesses taking up the idea: several brands of “pheromone perfume” based on EST and, especially, AND are available for

hopeful Romeos and Juliets.) To try to clear up the confusion, a group of researchers led by Robin Hare of the University of Western Australia have performed one of the most stringent studies to date. They report their results this week in *Royal Society Open Science*.

Dr Hare and his colleagues took 43 men and 51 women, all of them straight, and gave them two tasks. One was to decide whether an androgynous computer-generated face was, on balance, more likely to be female or male. The other was to rate members of the opposite sex shown in photographs for both their sexual attractiveness and their likelihood of being unfaithful.

The participants completed both tasks twice, on consecutive days. On one day they were exposed to the appropriate molecule (AND for the women; EST for the men) and on the other to a placebo that ought to have had no effect. Crucially, the study was double-blinded, which meant that neither the researchers nor the participants knew which day was which. This should have made it impossible for unconscious biases on the part of the experimenters or the subjects to have had any effect on the result.

If AND and EST really are aphrodisiac pheromones, the researchers reasoned, then they ought to make participants more likely to assume that androgynous faces belonged to the opposite sex. They should also boost the sex appeal of the people in the photographs—and, because of that boost, increase the perception that those people might be unfaithful, since the attractive have more opportunities for infidelity than the plain.

In fact, they did none of these things. The study thus found no evidence that either AND or EST is a pheromone. Those who buy pheromone perfumes based on them would therefore appear to be wasting their money. Whether the triumph of hope over experience will cause them to carry on doing so anyway is a different question altogether.



No pheromones here

as a reference which the app uses to correct and standardise the resulting image.

Yonatan Adiri, Healthy.io's founder, has ambitions beyond even this. As he observes, phones are everywhere and are improving all the time without his firm having to lift a finger. By using their built-in cameras, the company can piggyback on phone-makers' research and development. Soon, his app may be able to employ

spectroscopy—a detailed analysis of the frequencies of light making up an image—or extend its range beyond visible light into the infrared and ultraviolet parts of the spectrum. This may help analyse wounds and surface infections, by studying characteristics that are invisible to the naked eye. That will save both doctors and patients time, and should result in better outcomes all round. ■



The future of America

Bland comfort

Two books examine American society. One analyses its growing complacency and another (see following page) the importance of serendipity in social discourse

AMERICA is the land of opportunity, they say. Inspired by the ambition of its Founding Fathers, its people revel in their dynamism. Diversity is their strength, as captured in the national motto—*E pluribus unum* (“Out of many, one”). Americans embrace change and reinvention, and this, they like to think, sets their country apart from Europe or Asia.

Tyler Cowen, an economist, believes that this ideal is self-indulgent nonsense. America is losing its vim, he says, and Americans are settling into stagnation. In his new book, “The Complacent Class”, Mr Cowen shows not only that Americans move less now, crossing state lines at around half the average rate that they did between 1948 and 1971, and stay longer in their jobs, but American entrepreneurialism is floundering too. Markets are becoming more concentrated. Fewer new companies are being started, and many struggle to grow. Even in the vaunted technology sector the creation and expansion of new firms peaked in 2000. Sluggish growth in productivity and living standards is making America more like Europe and Japan.

On the surface, Americans enjoy more choice than ever before. From over 1,400 types of music on Spotify, a music-streaming service, to a swipeable menu of dating options, and rare books available at the click of a button, consumers have never had it so good. But there is a dark side to be-

The Complacent Class: The Self-Defeating Quest for the American Dream. By Tyler Cowen. *St Martin’s Press*; 241 pages; \$28.99

ing able to select the perfect product, neighbourhood or partner. Freedom to choose means that it is ever easier for people to marry, live near or school their children with other people of the same kind. In the South, the proportion of black students in majority-white schools was 44% in 1988; in 2011 that figure was 23%—lower than in 1968. Segregation by income has risen dramatically in the past few decades. The American elite might celebrate diversity in dinner-table conversation, but in practice Americans are cocooning themselves in enclaves of like-minded folk.

Segregation shuts off growth and stymies innovation. Poorer states used to be able to attract talented people by offering them a combination of promising job opportunities and cheaper housing. But now no one expects Louisiana to catch up with Silicon Valley. For the past few decades poorer states have been caught in a vicious circle, says Mr Cowen, where the expectation that they will not catch up makes it harder for them to do so.

When it comes to economic segregation, market forces are not helping, or at least not when they are combined with

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restrictions preventing the construction of more low-cost housing. A housing market that allocates the nicest housing to the highest bidder will inevitably push poor folk out of sight—and thus out of mind. Richer, well-educated people want to live near each other, and high house prices conveniently discourage poorer people from spoiling the view.

There will be consequences, says Mr Cowen. Hyman Minsky, an economist who grew up during the Great Depression, had a theory that financial stability would breed overconfidence, sowing the seeds of future instability. Largely ignored in his lifetime as he pushed against the prevailing wisdom that efficient markets would protect capitalist society against disaster, his idea became widely celebrated only after the financial crisis appeared to confirm it in 2007-08. Complacent financiers, regulators and central bankers allowed risk to build and put the whole system in danger.

Extending the idea to all society, as Mr Cowen does, is tricky because of the difficulty in telling the difference between complacency, contentment and submission. He is unclear who the complacent class really are, and who exactly is responsible for the mess. Are Americans betraying their history of reaching for the American dream, or are they suffering because of a rotten system? (Were the bankers greedy, or responding to incentives?)

Still, there is some truth to Mr Cowen’s diagnosis that America’s strength is undermined by its divisions and by a willingness to protect the powerful. Pockets of rich Americans and the lack of opportunity implied for those who are shut out of those pockets represent a festering problem, says Mr Cowen. In a crisis, the system’s creakiness will leave it ill-equipped to cope. In the final chapter he reveals his fear that the

▶ biggest story of the last 15 years is the growing likelihood that “a cyclical model of history will be a better predictor than a model of ongoing progress.”

The main question Mr Cowen raises is whether a dose of disorderliness will jolt America back to strength. He offers an optimistic scenario, in which driverless cars allow Americans to overcome the pain of having to commute over longer distances, or where global crises convince them that they should live for the moment. Artificial intelligence, clean cheap energy and alternatives to tranquillising opioids could all return America’s lost dynamism.

But the pessimism of his analysis sits uncomfortably with these rosy scenarios. Other, likelier forms of chaos include populist politicians bent on sowing division, or even international violence. The path from those to a restored, vibrant America seems longer and rockier. In cycles, things often go down before they go up. ■

Social media

In praise of serendipity

#Republic: Divided Democracy in the Age of Social Media. By Cass Sunstein. Princeton University Press; 310 pages; \$29.95 and £24.95

LAST June Facebook announced a change to its newsfeed. Henceforth it would rejig the way stories were ranked to ensure that people saw “the stories they find most meaningful”. But what does “most meaningful” actually mean? Posts from family and friends, apparently, as well as those users you frequently “like”. Your newsfeed should be “subjective, personal and unique”, Facebook went on, promising to work on building tools to give users “the most personalised experience”.

Cass Sunstein, a law professor at Harvard University and Barack Obama’s former regulation tsar, is one of Facebook’s dissatisfied customers. “Facebook can do better,” he writes in “#Republic”, his new book about democracy in the age of social media. Mr Sunstein is disturbed by some aspects of ultra-customised information, yet he shows himself a master of restraint in his criticism. He clearly wants to influence Mark Zuckerberg and other tech titans without alienating them. Although Mr Zuckerberg dropped out of Harvard, perhaps he can still pick up the occasional book by a Harvard professor—along with his new honorary degree.

In some ways, “#Republic” is a kind of Democracy 101, a review of the basic requirements for those who may have skipped the course. These requirements in-

clude, among other things, that citizens be exposed to a wide range of ideas and perspectives—even, and especially, those they would not choose to see or hear. Unplanned, chance encounters—with a protest as one wanders down the street, or a competing argument aired on the evening news—help guard against “fragmentation, polarisation and extremism”. They ensure that people are not hearing only an echo of their own voice. They reduce the likelihood that people will be stirred to extremes, such as terrorism. And they promote shared information and experiences, making it easier to solve problems and govern in a heterogeneous society.

This is the positive side of the free-speech principle, Mr Sunstein writes. It means not only forbidding censorship, but also creating a culture where people engage with the views of fellow citizens.

In the digital age social media function as the public forums where ideas are exchanged. But when people filter what they see—and providers race towards ever greater “personalisation” in the name of consumer choice—democracy is endangered. People live in separate worlds. Even hashtags, meant to help users find information on a certain topic, lead them to different bubbles. Democrats use #ACA and #blacklivesmatter; Republicans use #Obamacare and #alllivesmatter. Partyism might be said to exceed racism in America, Mr Sunstein argues. Whereas in 1960 only 5% of Republicans and 4% of Democrats said they would be “displeased” if their child married outside their political party, by 2010, those numbers had reached 49% and 33%, a far higher percentage than those who would be “displeased” if their child married outside their race.

Mr Sunstein wants an “architecture of serendipity” to combat these forces: that is, media that promote chance encounters and democratic deliberation like the public forums of old. Facebook might design “serendipity buttons”, he suggests, allowing users to click for opposing viewpoints or unfiltered perspectives. Conservative news sites could feature links to liberal sites and vice versa, alerting people to material beyond their usual sources. A site like deliberativedemocracy.com—the domain is not yet taken—could offer a space for people of divergent views to discuss issues. Democracies should take their cue from Learned Hand, an American judge who said the spirit of liberty is that “spirit which is not too sure that it is right”.

It is not just up to Mr Zuckerberg, then, to foster a culture of curiosity and openness. Citizens must demand it, Mr Sunstein argues, and they must seek out those serendipitous encounters. “#Republic” is full of constructive suggestions. It should be required reading for anyone who is concerned with the future of democracy—in Silicon Valley and beyond. ■

Dutch fiction

Madness in words

The Evenings: A Winter’s Tale. By Gerard Reve. Translated by Sam Garrett. Pushkin Press; 317 pages; \$22 and £12.99.

A Foolish Virgin. By Ida Simons. Translated by Liz Waters. MacLehose Press; 216 pages; £14.99.

The Penguin Book of Dutch Short Stories. Edited by Joost Zwagerman. Penguin Modern Classics; 555 pages; £12.99

GERARD REVE’S diabolically funny novel, “The Evenings”, came out in 1947, but has only recently been translated into English. The book has been praised on both sides of the Atlantic and has led readers to other freshly translated modern classics of Dutch literature. Among these are Ida Simons’s comic “A Foolish Virgin” (1959), about pre-war Jewish life, and Joost Zwagerman’s collection of 36 landmarks of modernist short fiction for “The Penguin Book of Dutch Short Stories”. Together they map a landscape of the imagination that is far from flat and never dull.

Zwagerman, a prolific writer who committed suicide in 2015, says in the preface to the writers he selects share one aim: “To give a voice to madness”. As voters in the Netherlands prepare for an election on March 15th that may reward the unruly populism of Geert Wilders and his Freedom Party, readers abroad should hearken to that literary voice in all its cliché-busting oddity. Rational calculation and amiable consensus do not invariably govern Dutch heads and hearts. Dig beneath the topsoil of “this supposedly hard-headed country”, ▶▶



► advises Zwagerman, and you hit a contradictory layer of “contemplative arch-romantics” and “reserved iconoclasts”.

These quiet rebels are all over his anthology, from “An Eccentric” by Marcellus Emants, convinced that “we are doomed to live in absurdity”, to J.M.A. Biesheuvel’s tragicomic loser, plagued by “unspecified fears that devour the soul”. The colonial legacy of the Dutch East Indies sprinkles its fiery spice of adventure, danger, desire—and guilt—throughout the book. In a fable by Harry Mulisch, Sergeant Massuro literally turns to stone “from remorse” at his jungle atrocities in New Guinea. Several stories track the revenge that society takes on its heretics and mavericks. “We were on top of the world,” recalls the narrator of the 1915 tale “Young Titans” by Nescio (pen-name of J.H.F. Gronloh), “and the world was on top of us.” In Frans Kellendonk’s poignant “Foreign Service”, the Egyptian cleaner Gamal assesses his new neighbours. With the Dutch, he decides, “there is [a] war of the soul and the greediness and then the greediness wins.”

Driven by mischief and devilry, these books show the Dutch awkward squad on parade. Reve himself would rank as a colonel in any regiment of renegades; a gay Catholic, he offended every orthodoxy. “The Evenings” chronicles the ten final days of 1946 through the aimless encounters of a vain but troubled filing clerk, Frits van Egters, with his friends, his parents and strangers in a dank December Amsterdam. Reve combines a pitch-black comedy of manners with swingeing satire and metaphysical despair. He joins hilarity to heartbreak. “A day squandered in its entirety,” ponders Frits after another drab outing. “Hallelujah!”

Bleak, droll and exquisitely expressed, in the manner of Samuel Beckett’s near-contemporary works of fiction, “The Evenings” hints at the anguish that underlies this anomie. Frits and his jesting chums hardly mention the second world war, which inflicted such misery on the Netherlands. A mood of stunned trauma hangs over this novel like the clammy mist on Amsterdam’s canals. In this frozen aftermath, the memory of horror surfaces indirectly in Frits’s gruesome nightmares and, very occasionally, in overt allusions. A news report tells of a child blown up by a grenade. “Deferred suffering from the war,” remarks Frits. “That is always a joy.”

These kids’ air of brutal nonchalance—their morbid chats about diseases and accidents; Frits’s comic obsession with baldness as a harbinger of death; his claim that “Everything over 60 should be done away with”—masks the shock of damaged survivors. From the deep midnight of shattered Europe, Reve crafted not only an existential masterwork worthy to stand with Beckett or Albert Camus but an oblique historical testament. Sam Garrett’s splendid transla-

tion does justice both to the deadpan humour and the half-buried pain.

“The Evenings” mentions a schoolboy called Sal Jachthandelaar who “made it to Switzerland and from there to England. His family is dead.” No explanation given; none required. Under the Nazi occupation, more than 100,000 Dutch Jews (out of 140,000) were killed. Many English-language readers who pick up Simons’s “A Foolish Virgin” will have read only one other account of a Dutch Jewish girlhood: the diary of Anne Frank. Yet Simons, who narrowly avoided transportation to a death camp, refuses to let the grief of hindsight darken her effervescent story.

Astute but naive, little Gittel shuttles between her home in The Hague and relatives in Antwerp. In the 1920s, the Jews of both cities live safely, even merrily. Still, the grave banker Mr Mardell reprimands her skittish folly and insists that “there’s no joy without suffering.” This translation by Liz Waters conveys Gittel’s madcap exuberance amid fun-loving families who scent no storms over the horizon. Grandpa Harry is even “a Jewish anti-Semite”: a “relatively innocent pleasure” then, “of a kind no longer available to the gas-chamber generation”. Planted in this dancing novel, that phrase goes off like a bomb in a ballroom. Within living memory, this phlegmatic and pragmatic land has endured a state-enforced collective madness. For Zwagerman, Dutch writers habitually “explore the vague borderland between delusion and reality”. In public, as in private, that line may not always prove as firm as the sturdy dams and dykes of Zuiderzee. ■

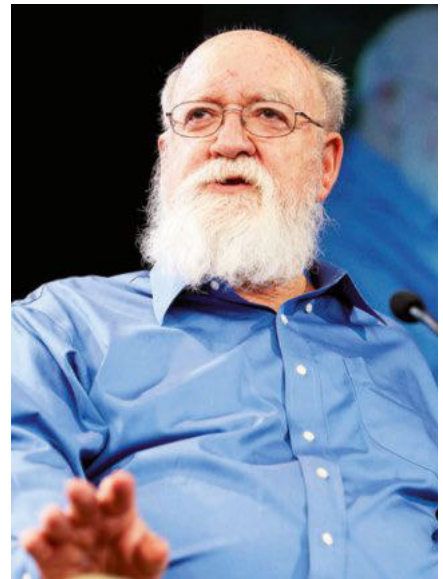
Consciousness explained

The blind Bach-maker

From Bacteria to Bach and Back: The Evolution of Minds. By Daniel Dennett. *W.W. Norton*; 496 pages; \$28.95. *Allen Lane*; £25

HUMAN neurons are distant relatives of tiny yeast cells, themselves descendants of even simpler microbes. Yet they are organised in structures that are capable of astonishing feats of creativity. How did the world get from bacteria to Bach, from fungus to fugues? Daniel Dennett, an American philosopher and cognitive scientist, tells the tale in his new book, revisiting and extending half a century of work on the topic.

The story is one of Darwinian natural selection: of complexity emerging gradually as beneficial mutations are preserved and harmful ones weeded out. It requires the reader to make some “strange inversions of reasoning”—bold changes of per-



Dan dares

spective on the nature of design, purpose and consciousness—to loosen the pull of “Cartesian gravity”, or the human propensity to think of the mind as mysterious and non-physical.

One of Mr Dennett’s key slogans is “competence without comprehension”. Just as computers can perform complex calculations without understanding arithmetic, so creatures can display finely tuned behaviour without understanding why they do so. The rationale for their behaviour (diverting a predator, say, or tempting a mate) is “free-floating”—implicit in the creatures’ design but not represented in their minds. Competence without comprehension is the default in nature, Mr Dennett argues, even among higher animals.

How then did human intelligence arise? People do not have a special faculty of comprehension. Rather, the human mind has been enhanced by a process of cultural evolution operating on memes. Memes are copyable behaviour—words are a good example.

Initially, memes spread in human populations like viruses, selected simply for their infectiousness. Some were useful, however, and the human brain adapted to foster them: genetic and memetic evolution working together. Words and other memes gave humans powerful new competences—for communication, explicit representation, reflection, self-interrogation and self-monitoring. To use a computer analogy, memetic evolution provided “thinking tools”—a bit like smartphone apps—which transformed humans into comprehending, intelligent designers, triggering an explosion of civilisation and technology.

Mr Dennett sees human consciousness, too, as a product of both genetics and memetics. The need to communicate or withhold thoughts gives rise to an “edited di- ►►

gest" of cognitive processes, which serves as the brain's own "user interface". The mental items that populate consciousness are more like fictions than accurate representations of internal reality.

"From Bacteria to Bach and Back" concludes with a look ahead. Mr Dennett expects that computers will continue to increase in competence but doubts that they will soon develop genuine comprehension, since they lack the autonomy and social practices that have nurtured comprehension in humans. He worries that people may overestimate the intelligence of their artefacts and become over-reliant

on them, and that the institutions and practices on which human comprehension depends may erode as a result.

This only hints at the richness of this book. Mr Dennett provides illuminating explanations of the ideas he employs and cites fascinating experimental work. Many of his claims are controversial, and some readers will be more persuaded than others. However, Mr Dennett has an excellent record of predicting developments in cognitive science, and it would be rash to bet that he is far off track. Persuaded or not, readers will find their minds enriched with many powerful thinking tools. ■

Traditional Japanese theatre

Enduring power

TOKYO

The thrill of an ancient tradition

JAPAN'S Westernisation is only skin-deep. For musical proof of this, consider the eagerness with which the Japanese periodically forsake their high-tech existence and immerse themselves in their age-old music-theatre. The most popular form of this is *kabuki*, which offers lashings of violence, gore and palpating, cross-dressed sex (all the actors are male). But the Japanese also love the exquisite restraint of *noh* theatre, and the sacramental grace of *gagaku* music, which has scarcely changed over the past 1,000 years. Each of these forms has been designated by UNESCO as representative of the "intangible cultural heritage of humanity", so the rest of the world might profitably pay attention.

Gagaku, which literally means "elegant music", was originally banquet music imported from China during the Tang dynasty. Only later was it adopted in Buddhist temples, Shinto shrines and the Japanese imperial court. Although the imperial household ensemble now only makes a handful of public forays each year, other ensembles are carrying this music far and wide.

Playing to a packed house in the National Theatre in Tokyo is one of those groups: the Reigakusha ensemble, led by Sukeyasu Shiba, a sprightly octogenarian (pictured). Dressed in medieval silk robes, the musicians are ranged motionless across the stage like chessmen. Their music unfolds at a glacial pace. A high wail on the flute is followed by a few notes ruminatively plucked on the *koto* zither; a slow skirl on the *sho* mouth-organ—17 bamboo pipes bound together vertically like a bunch of petrified icicles—is punctuated by three thunderous strokes on the big *taiko* drum. *Ma* is the word for the Japanese con-

The sounds of silence

cept of "the space between"—in sound it is something Westerners dismiss as mere silence. In Reigakusha's sonic realm, that silence is made to speak volumes.

Reigakusha also plays a new composition by Mr Shiba in which the traditional sounds are given a Western, jazzy twist, but one so subtle that the *gagaku* sound-world remains intact. Interviewed afterwards, he explains that he's not only reviving forgotten scores, he is also broadening the audience. "Hitherto, *gagaku* has been played only for God, the Buddha and the emperor. Now I want children to enjoy it, so we are going into schools, and speeding up the tempo." The zany *gagaku* spoof of a popular nonsense-song that his musicians

recently posted on the internet may help spread the word, but Mr Shiba admits that *gagaku* is still a minority interest.

His conservatoire-trained players make ends meet by teaching piano and violin, and by working as monks in shrines and temples. But he believes the music's future will be as bright as its past. A virtuoso on the *ryuteki* flute, he surveys his own past with a smile: "My father played the *ryuteki* in the imperial ensemble, as did my grandfather, as did his father, and so on back through eight centuries."

Meanwhile, on little wooden stages all over Japan, *noh* theatre is still being performed as it was 600 years ago on the penal island of Sado. At the National Noh Theatre in Tokyo, a performance of a ghost drama takes the audience into a world even more rarefied than that of *gagaku*. The gorgeously costumed actors pose like statues—with climactic moments of ferocious activity—and their sepulchral voices, accompanied by flute and drum, create the momentum of a dream.

Admirers of this art form in the West have included W.B. Yeats, an Irish poet, and Peter Brook, a theatre director. Among its Japanese devotees is Toshio Hosokawa, a composer who combines a successful avant-garde career in Europe with loyal adherence to his roots. *Noh* draws him, he says, through its notion of purification by contact with the spirit world, and through its reliance on the power of silence, as shown by the ritual gestures made by the musicians and actors before a drum-stroke or a sword-thrust. "My music is calligraphy painted on a canvas of space and time," says Mr Hosokawa. "Silent movement in the air—as the drummer makes his gesture—has as much life as sound. And this movement I imply in my music."

Does all this sound uncomfortably over-refined? Japanese audiences in the 17th century certainly thought so, with the result that *noh* was ousted as the main theatrical fare by the crazy flamboyance of *kabuki*, which was everything that *noh* is not. In place of the austere expressiveness of *noh*, *kabuki* made a brash appeal to the merchant class—and to the samurai, despite those warriors' being forbidden to attend its corrupting spectacle.

The 18th-century comedies and tragedies which audiences now flock to see at the Kabuki-za theatre in Tokyo represent a brilliantly choreographed and intensely physical art, whose lurid tales of love and death resonate powerfully for a 21st-century audience. If all this has something in common with theatre on Broadway and in the West End in London, there's an excitement in the air, particularly when one of the fabled Kabuki-za stars makes his entrance, which is quintessentially Japanese. Here, too, you catch the spirit of an ancient culture that is bursting with health—behind the façade of modernity. ■



Economic data

% change on year ago

	Gross domestic product			Industrial production	Consumer prices		Unemployment rate, %	Current-account balance		Budget balance	Interest rates, %	Currency units, per \$	
	latest	qtr* 2017 [†]	2017 [†]		latest	latest		2017 [†]	latest 12 months, \$bn			% of GDP 2017 [†]	% of GDP 2017 [†]
United States	+1.9 Q4	+1.8	+2.3	nil Jan	+2.5 Jan	+2.3	4.8 Jan	-476.5 Q3	-2.8	-3.5	2.51	-	-
China	+6.8 Q4	+7.0	+6.5	+6.0 Dec	+0.8 Feb	+2.3	4.0 Q4 [§]	+210.3 Q4	+2.0	-4.1	3.01 ^{§§}	6.91	6.51
Japan	+1.6 Q4	+1.2	+1.1	+3.2 Jan	+0.5 Jan	+0.8	3.0 Jan	+186.5 Jan	+3.6	-5.4	0.06	115	112
Britain	+2.0 Q4	+2.9	+1.6	+4.3 Dec	+1.8 Jan	+2.6	4.8 Nov ^{††}	-138.1 Q3	-4.4	-4.0	1.20	0.82	0.70
Canada	+1.9 Q4	+2.6	+1.9	+2.6 Dec	+2.1 Jan	+1.8	6.8 Jan	-51.2 Q4	-2.8	-3.3	1.78	1.35	1.34
Euro area	+1.7 Q4	+1.6	+1.6	+2.0 Dec	+2.0 Feb	+1.6	9.6 Jan	+399.5 Dec	+2.9	-1.7	0.37	0.95	0.90
Austria	+1.7 Q4	+2.0	+1.5	+2.1 Dec	+2.0 Jan	+1.7	5.7 Jan	+8.0 Q3	+2.6	-0.9	0.52	0.95	0.90
Belgium	+1.2 Q4	+2.0	+1.3	+9.5 Dec	+3.0 Feb	+2.0	7.7 Jan	+3.4 Sep	+0.9	-2.7	0.82	0.95	0.90
France	+1.2 Q4	+1.7	+1.3	+1.3 Dec	+1.2 Feb	+1.3	10.0 Jan	-34.5 Jan [†]	-0.9	-3.1	0.96	0.95	0.90
Germany	+1.8 Q4	+1.7	+1.6	nil Jan	+2.2 Feb	+1.8	5.9 Feb	+294.5 Dec	+8.3	+0.5	0.37	0.95	0.90
Greece	-1.4 Q4	-4.8	+1.2	+2.1 Dec	+1.2 Jan	+0.8	23.0 Nov	-1.1 Dec	-1.2	-6.4	7.23	0.95	0.90
Italy	+1.0 Q4	+0.7	+0.8	+6.6 Dec	+1.5 Feb	+1.2	11.9 Jan	+50.7 Dec	+2.4	-2.4	2.27	0.95	0.90
Netherlands	+2.3 Q4	+2.0	+1.9	+4.8 Dec	+1.8 Feb	+1.1	6.4 Jan	+57.1 Q3	+8.4	-0.9	0.44	0.95	0.90
Spain	+3.0 Q4	+2.8	+2.5	+7.2 Jan	+3.0 Feb	+2.2	18.2 Jan	+24.6 Dec	+1.5	-3.3	1.73	0.95	0.90
Czech Republic	+1.9 Q4	+1.6	+2.5	+2.7 Dec	+2.2 Jan	+2.3	5.1 Feb [§]	+3.7 Q3	+0.7	-0.5	0.69	25.6	24.5
Denmark	+1.9 Q4	+0.9	+1.3	+2.5 Jan	+0.9 Jan	+1.2	4.2 Jan	+24.5 Dec	+6.8	-1.8	0.37	7.04	6.75
Norway	+1.8 Q4	+4.5	+1.5	+0.6 Jan	+2.8 Jan	+2.2	4.4 Dec ^{††}	+18.1 Q4	+4.9	+4.1	1.78	8.49	8.54
Poland	+3.2 Q4	+7.0	+3.2	+9.0 Jan	+1.8 Jan	+1.8	8.5 Feb [§]	-2.5 Dec	-1.2	-3.3	3.73	4.08	3.92
Russia	-0.4 Q3	na	+1.4	+2.3 Jan	+4.6 Feb	+4.7	5.6 Jan [§]	+22.2 Q4	+2.8	-3.0	8.25	58.4	72.9
Sweden	+2.3 Q4	+4.2	+2.4	+1.3 Jan	+1.4 Jan	+1.6	7.3 Jan [§]	+23.7 Q4	+4.9	-0.4	0.65	9.03	8.47
Switzerland	+0.6 Q4	+0.3	+1.4	-1.2 Q4	+0.6 Feb	+0.2	3.3 Feb	+68.2 Q3	+9.6	+0.2	-0.09	1.01	0.99
Turkey	-1.8 Q3	na	+2.4	+4.2 Jan	+10.1 Feb	+8.8	12.1 Nov [§]	-32.6 Dec	-3.4	-2.2	11.31	3.73	2.91
Australia	+2.4 Q4	+4.4	+2.6	+1.0 Q4	+1.5 Q4	+2.1	5.7 Jan	-33.1 Q4	-1.4	-1.8	2.87	1.33	1.34
Hong Kong	+3.1 Q4	+4.8	+1.7	-0.1 Q3	+1.3 Jan	+1.8	3.3 Jan ^{††}	+13.6 Q3	+4.2	+0.9	1.87	7.77	7.77
India	+7.0 Q4	+5.1	+7.2	-0.4 Dec	+3.2 Jan	+4.8	5.0 2015	-11.1 Q3	-1.1	-3.2	6.86	66.7	67.4
Indonesia	+4.9 Q4	na	+5.2	+4.3 Dec	+3.8 Feb	+4.2	5.6 Q3 [§]	-16.3 Q4	-2.0	-2.1	7.35	13,350	13,143
Malaysia	+4.5 Q4	na	+4.6	+4.8 Dec	+3.2 Jan	+2.8	3.5 Dec [§]	+6.0 Q4	+1.9	-3.1	4.15	4.45	4.12
Pakistan	+5.7 2016**	na	+5.3	+7.0 Dec	+4.2 Feb	+4.9	5.9 2015	-4.9 Q4	-1.8	-4.8	7.59 ^{†††}	105	105
Philippines	+6.6 Q4	+7.0	+6.4	+23.0 Dec	+3.3 Feb	+3.3	4.7 Q4 [§]	+3.1 Sep	+0.5	-2.3	4.97	50.4	46.9
Singapore	+2.9 Q4	+12.3	+2.1	+2.2 Jan	+0.6 Jan	+1.1	2.2 Q4	+56.7 Q4	+19.3	-1.0	2.37	1.42	1.38
South Korea	+2.3 Q4	+1.6	+2.5	+1.7 Jan	+1.9 Feb	+1.7	3.8 Jan [§]	+96.8 Jan	+6.2	-1.0	2.30	1,146	1,207
Taiwan	+2.9 Q4	+1.8	+1.8	+2.8 Jan	nil Feb	+2.1	3.8 Jan	+70.9 Q4	+11.5	-0.7	1.14	30.9	32.8
Thailand	+3.0 Q4	+1.7	+3.3	+1.3 Jan	+1.4 Feb	+1.2	1.2 Jan [§]	+46.4 Q4	+10.9	-2.3	2.73	35.3	35.4
Argentina	-3.8 Q3	-0.9	+2.7	-2.5 Oct	— ***	—	8.5 Q3 [§]	-15.7 Q3	-2.9	-4.5	na	15.6	15.4
Brazil	-2.5 Q4	-3.4	+0.7	+1.4 Jan	+5.4 Jan	+4.5	12.6 Jan [§]	-23.8 Jan	-1.6	-7.7	10.12	3.15	3.79
Chile	+1.6 Q3	+2.5	+1.8	-0.9 Jan	+2.7 Feb	+3.0	6.2 Jan ^{§††}	-4.8 Q3	-1.2	-2.1	4.21	662	684
Colombia	+1.6 Q4	+4.0	+2.4	+2.2 Dec	+5.2 Feb	+4.2	11.7 Jan [§]	-13.7 Q3	-4.0	-2.8	7.23	2,987	3,174
Mexico	+2.4 Q4	+2.9	+1.6	-0.6 Dec	+4.7 Jan	+4.9	3.6 Jan	-27.9 Q4	-2.6	-2.5	7.36	19.6	17.9
Venezuela	-8.8 Q4~	-6.2	-5.8	na	na	+652	7.3 Apr [§]	-17.8 Q3~	-1.3	-19.5	10.43	9.99	6.31
Egypt	+4.5 Q2	na	+3.8	+17.2 Dec	+28.2 Jan	+19.2	12.4 Q4 [§]	-20.1 Q4	-4.7	-10.9	na	17.7	7.83
Israel	+4.2 Q4	+6.2	+4.2	-1.2 Dec	+0.1 Jan	+0.7	4.3 Jan	+12.4 Q4	+3.7	-2.4	2.39	3.69	3.90
Saudi Arabia	+1.4 2016	na	+0.8	na	-0.4 Jan	+2.0	5.6 2015	-46.8 Q3	-2.1	-7.3	na	3.75	3.75
South Africa	+0.7 Q4	-0.3	+1.2	-0.8 Dec	+6.6 Jan	+5.7	26.5 Q4 [§]	-12.3 Q3	-3.4	-3.1	8.67	13.1	15.4

Source: Haver Analytics. **% change on previous quarter, annual rate. [†]The Economist poll or Economist Intelligence Unit estimate/forecast. [§]Not seasonally adjusted. ^{††}New series. ~2014 **Year ending June. ^{†††}Latest 3 months. ^{††††}3-month moving average. ^{§§§}5-year yield. ***Official number not yet proved to be reliable; The State Street PriceStats Inflation Index, Jan 29.53%; year ago 30.79% ^{†††††}Dollar-denominated bonds.

Markets

	Index Mar 8th	% change on		
		one week	Dec 30th 2016	
			in local currency	in \$ terms
United States (DJIA)	20,855.7	-1.2	+5.5	+5.5
China (SSEA)	3,393.4	-0.2	+4.4	+5.1
Japan (Nikkei 225)	19,254.0	-0.7	+0.7	+2.5
Britain (FTSE 100)	7,334.6	-0.7	+2.7	+1.1
Canada (S&P/TSX)	15,497.0	-0.7	+1.4	+1.0
Euro area (FTSE Euro 100)	1,144.8	-0.1	+2.9	+3.0
Euro area (EURO STOXX 50)	3,389.6	nil	+3.0	+3.1
Austria (ATX)	2,813.7	+0.6	+7.5	+7.5
Belgium (Bel 20)	3,699.5	+1.1	+2.6	+2.7
France (CAC 40)	4,960.5	nil	+2.0	+2.1
Germany (DAX)*	11,967.3	-0.8	+4.2	+4.3
Greece (Athex Comp)	649.3	-1.0	+0.9	+1.0
Italy (FTSE/MIB)	19,482.4	+0.6	+1.3	+1.4
Netherlands (AEX)	502.8	-0.4	+4.1	+4.1
Spain (Madrid SE)	994.0	+1.0	+5.4	+5.4
Czech Republic (PX)	972.2	nil	+5.5	+5.6
Denmark (OMXCXB)	812.8	-2.0	+1.8	+1.9
Hungary (BUX)	32,547.4	-2.4	+1.7	+1.0
Norway (OSEAX)	764.8	-1.1	nil	+1.3
Poland (WIG)	58,559.1	-1.8	+13.1	+15.7
Russia (RTS, \$ terms)	1,097.4	-1.1	-4.8	-4.8
Sweden (OMXS30)	1,578.2	-0.8	+4.0	+4.6
Switzerland (SMI)	8,626.7	-0.1	+4.9	+5.1
Turkey (BIST)	89,484.9	+0.2	+14.5	+8.1
Australia (All Ord.)	5,799.5	+0.8	+1.4	+5.8
Hong Kong (Hang Seng)	23,782.3	nil	+8.1	+7.9
India (BSE)	28,901.9	-0.3	+8.5	+10.4
Indonesia (JSX)	5,393.8	+0.6	+1.8	+2.8
Malaysia (KLSE)	1,725.5	+1.6	+5.1	+5.8
Pakistan (KSE)	49,754.7	+1.6	+4.1	+3.6
Singapore (STI)	3,145.3	+0.7	+9.2	+11.3
South Korea (KOSPI)	2,095.4	+0.2	+3.4	+9.0
Taiwan (TWI)	9,753.5	+0.8	+5.4	+10.1
Thailand (SET)	1,551.7	-1.0	+0.6	+2.2
Argentina (MERV)	19,232.6	-0.7	+13.7	+15.4
Brazil (BVSP)	64,718.0	-3.4	+7.5	+11.2
Chile (IGPA)	22,441.6	+2.0	+8.2	+9.5
Colombia (IGBC)	9,836.2	-0.5	-2.7	-2.2
Mexico (IPC)	47,539.2	+0.2	+4.2	+9.6
Venezuela (IBC)	37,603.0	+3.8	+18.6	na
Egypt (EGX 30)	12,735.4	+6.1	+3.2	+5.7
Israel (TA-100)	1,280.7	-0.3	+0.3	+4.6
Saudi Arabia (Tadawul)	6,970.8	+0.1	-3.7	-3.7
South Africa (JSE AS)	51,300.0	-0.7	+1.3	+5.9

The Economist poll of forecasters, March averages (previous month's, if changed)

	Real GDP, % change				Consumer prices		Current account	
	Low/high range		average		% change		% of GDP	
	2017	2018	2017	2018	2017	2018	2017	2018
Australia	2.0/2.8	2.4/3.2	2.6	2.9	2.1	2.3	-1.4 (-2.2)	-1.9
Brazil	0.1/1.5	0.3/4.0	0.7	2.2	4.5 (4.9)	4.6	-1.6 (-1.5)	-2.0
Britain	1.2/2.0	0.7/1.7	1.6 (1.4)	1.2	2.6	2.7	-4.4 (-4.6)	-3.8
Canada	1.2/2.3	1.5/2.7	1.9	2.0	1.8 (1.9)	1.9	-2.8 (-2.9)	-2.5
China	6.2/6.8	5.8/6.9	6.5	6.3	2.3 (2.2)	2.4	2.0 (2.1)	1.8
France	1.0/1.6	1.1/1.8	1.3	1.5	1.3 (1.4)	1.3	-0.9 (-1.0)	-1.0
Germany	1.1/1.8	1.3/2.1	1.6 (1.5)	1.6	1.8	1.6	8.3 (8.4)	8.0
India	6.2/8.4	6.5/8.4	7.2 (7.4)	7.6	4.8	5.0	-1.1 (-1.0)	-1.4
Italy	0.6/1.1	0.6/1.2	0.8	0.9	1.2	1.2	2.4	2.2
Japan	0.6/1.5	0.6/1.6	1.1 (1.2)	1.0	0.8	1.0	3.6 (3.5)	3.6
Russia	0.6/2.6	0.9/3.0	1.4 (1.3)	1.8	4.7 (4.9)	4.3	2.8 (2.9)	2.6
Spain	2.3/2.9	1.7/2.8	2.5 (2.4)	2.1	2.2 (2.0)	1.4	1.5	1.5
United States	1.7/2.8	1.0/3.6	2.3 (2.2)	2.4	2.3	2.3	-2.8 (-2.7)	-2.9
Euro area	1.2/2.3	1.2/2.1	1.6 (1.5)	1.6	1.6 (1.5)	1.4	2.9 (3.0)	2.8

Sources: Bank of America, Barclays, BNP Paribas, Citigroup, Commerzbank, Credit Suisse, Decision Economics, Deutsche Bank, EIU, Goldman Sachs, HSBC Securities, ING, Itau BBA, JPMorgan, Morgan Stanley, Nomura, RBS, Royal Bank of Canada, Schroders, Scotiabank, Société Générale, Standard Chartered, UBS. For more countries, go to: Economist.com/markets

Other markets

	Index Mar 8th	% change on		
		one week	Dec 30th 2016	
			in local currency	in \$ terms
United States (S&P 500)	2,363.0	-1.4	+5.5	+5.5
United States (NAScomp)	5,837.6	-1.1	+8.4	+8.4
China (SSEB, \$ terms)	347.1	-0.9	+1.5	+1.5
Japan (Topix)	1,550.3	-0.2	+2.1	+3.8
Europe (FTSEurofirst 300)	1,469.2	-0.8	+2.9	+2.9
World, dev'd (MSCI)	1,834.7	-1.2	+4.8	+4.8
Emerging markets (MSCI)	934.9	-0.4	+8.4	+8.4
World, all (MSCI)	443.6	-1.1	+5.2	+5.2
World bonds (Citigroup)	880.3	-0.7	-0.4	-0.4
EMBI+ (JPMorgan)	792.3	-0.6	+2.6	+2.6
Hedge funds (HFRX)	1,222.9 [§]	-0.4	+1.6	+1.6
Volatility, US (VIX)	11.9	+12.5	+14.0 (levels)	
CDSs, Eur (iTRAXX) [†]	71.8	+1.3	-0.4	-0.4
CDSs, N Am (CDX) [†]	63.8	+6.1	-5.9	-5.9
Carbon trading (EU ETS) €	5.2	-4.4	-20.4	-20.3

Sources: Markit; Thomson Reuters. [§]Total return index.

[†]Credit-default-swap spreads, basis points. [¶]Mar 7th.

Indicators for more countries and additional series, go to: Economist.com/indicators

The Economist commodity-price index

2005=100

	Feb 28th	Mar 7th*	% change on	
			one month	one year
Dollar Index				
All Items	146.7	145.7	-1.7	+12.3
Food	156.4	155.5	-2.8	+5.1
Industrials				
All	136.7	135.5	-0.4	+22.3
Nfa [†]	144.2	146.1	-2.9	+28.8
Metals	133.5	130.9	+0.9	+19.4
Sterling Index				
All items	214.5	216.2	-0.3	+30.2
Euro Index				
All items	171.7	170.9	+1.0	+17.2
Gold				
\$ per oz	1,256.6	1,218.9	-1.2	-4.0
West Texas Intermediate				
\$ per barrel	54.0	53.1	+1.9	+46.5

Sources: Bloomberg; CME Group; Cotlook; Darmann & Curl; FT; ICCO; ICO; ISO; Live Rice Index; LME; NZ Wool Services; Thompson Lloyd & Ewart; Thomson Reuters; Urner Barry; WSJ. ^{*}Provisional

[†]Non-food agriculturals.



All the books in the world

Mostafa el-Abbadi, the man behind the recreation of the Great Library of Alexandria, died on February 13th, aged 88

“THE universe”, wrote Borges, “was called by some the library.” Mostafa El-Abbadi, foremost among Egyptian scholars of the Graeco-Roman world, was of the same opinion. His universe was the ancient Great Library of Alexandria, long since vanished, which had occupied his mind and heart since his student days.

As he told it, an elfin figure wreathed in smiles with the joy of it all, the original Bibliotheca Alexandrina had been inspired by the conquering expeditions of Alexander the Great, which had shown for the first time the diversity of mankind and the Earth; and had been funded by Ptolemy I, who wished it to contain “all the texts in the world that are worthy of study”. There had been half a million, maybe many more. Visitors to Alexandria were searched in case they had a book which was not in stock. Ptolemy III managed to acquire, by trickery, the originals of the plays of Sophocles, Aeschylus and Euripides. Mr Abbadi was sure the collection included books from Phoenecia, Buddhist texts from India, the Septuagint of the Hebrews and Mazdean writings from Persia.

Alexandria’s library was not the first. As a proud citizen—Alexandrian by both parents, holder (as was his wife, Azza Kararah) of distinguished posts at the university, admirer of the sea view from the balco-

ny of his elegant, book-crammed flat—he might have wished it so. But Syria and Babylon both had libraries earlier, as did the temple at Karnak. The difference was that these were regional institutions, with local interests. Alexandria’s library was the first to be set up as a repository of all human knowledge: the universe under one roof.

And it was never, he stressed, just a collection of texts. The real heart of the enterprise was the Museion or Shrine of the Muses, which was a centre of research. There, among walkways and arcades especially designed for thinking, Euclid came to formulate his theorems; Eratosthenes to measure the circumference of the Earth; and Herophilos to prove that the brain, not the heart, was the seat of the intellect. There, too (to Mr Abbadi’s chuckling delight), the philosopher Plotinus four times achieved complete union with the divine.

It struck him then as sad, when he returned to Alexandria in 1960 from his doctoral studies at Cambridge, that the modern city had no great library. Of course, Egypt had no sacks of silver now to spill out on culture, unlike the Ptolemaic kings. Yet the wonder of the library, despite Caesar’s incineration of it (for he held Caesar strictly to blame), had been seared on the memory of the world and on its image of Alexandria, as a cosmopolitan city of

learning. Imitations had been built in Baghdad, Córdoba, London and Washington, DC; visiting world leaders asked after what remained of it. So in the 1970s he began to float, gently, the idea or dream of a new library, following the “spiritual example” of the ancients. The seed did not take for years. In 1986, however, UNESCO agreed to help and money began to flow.

The sun half-rising

He was well aware of the project’s limitations. Because books were so costly, it seemed best to build up the library as a series of circles. He began by amassing all possible bibliographical references for the city of Alexandria, and then moved onwards: to Egypt, the Middle East, Africa. He did not say “the world”, but he intended it. The new library, like the old, should be universal, taking in donations from all countries, digitising texts (though his love was for physical books, not screens) and drawing scholars to a new Shrine of the Muses, where they could work in an almost sacred atmosphere of tolerance and bright ideas.

The regime of Hosni Mubarak could not see what he was getting at. Officials envisaged a big library and an Egyptian cultural centre; Egypt was, after all, paying half the \$225m cost. In 2002 the new Bibliotheca Alexandrina opened, with space for 8m books on 11 storeys—and four museums, 19 galleries, a Culturama Hall with a vast interactive screen, and gift shops. One museum was filled with the personal effects of Anwar Sadat, a former president. Mr Abbadi gave the library his precious 16th-century copy of the Codex of Justinian. It seemed slightly out of place.

He was not invited to the opening. He was known to have misgivings, and to have made a fuss when he spotted the bulldozers dumping chunks of mosaic in the sea; for the project involved huge excavations on the site of the Ptolemies’ palace, and he was a man whose idea of a holiday was to tour the ancient ruins of the Middle East. He did not carp about his exclusion, but kept quiet company in his study with his cat, Cleopatra. At least his booklet on the Great Library (only a booklet, he insisted, not a book) had been handed out at the opening. He did his job; they did theirs.

The design of the library, which he liked in principle, was a half-buried sphere that symbolised the sun rising, spreading the light of knowledge over the world. He only wished that it were true. The library made an efficient cultural centre, he sighed. But it did not function as a universal centre of research. Archimedes and Galen would not have done their thinking under that interactive screen. The Muses would not have touched brains, and hearts. And Plotinus would not have written, having encountered the One-and-its-power, “He is, Himself...the encompassment of all things.” ■