

The  
Economist

things we learned in

2017

*Our selection of the year's highs and lows*

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**The  
Economist**

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## 1. Lexington

# Donald Trump, man of God

MAY

To know why Christians can love a much-married braggart, study the prosperity gospel

**M**ANY titles bestowed on Donald Trump—from president to commander-in-chief—are hard for non-supporters to digest. But the honorific that most puzzles the world, perhaps, is that bestowed by American conservatives who praise the swaggering, thrice-married tycoon as a man of God.

Expect that gulf of perception to grow still wider as Mr Trump embarks on his first presidential trip overseas on May 19th. Sceptics remember Candidate Trump stoking sectarian rage on the campaign trail. They remember a man who proposed a complete ban on Muslim arrivals and scorned Pope Francis as a Mexican “pawn” for questioning his immigration plans. Yet now White House aides call President Trump a leader bent on uniting the great faiths, who will bring a “message of tolerance and of hope to billions” during stops in Saudi Arabia, Israel and Rome. Sceptics have long suspected that conservative Christians—and above all white evangelical Protestants, who are among his most loyal backers—are embracing the president for a mix of reasons, including worldly politics and tribal loyal-

ties. Opponents assume that is why pious followers overlook such Trumpian sins as pride, wrath and bearing false witness (or fibbing, to use a layman’s term). They note that when Jerry Falwell junior, head of Liberty University, a Christian college, called Mr Trump a “dream president”, he listed achievements that straddle the realms of God and man, from his appointment of a conservative Supreme Court justice, Neil Gorsuch, to his vocal support for Israel.

Some political scientists sound more like anthropologists than theologians when they dissect Mr Trump’s success with whites who call themselves evangelical Protestants and attend church regularly—fully 80% of whom told a recent survey by the Pew Research Centre that they approve of his job performance. Those scholars note that for many whites, notably in small towns and rural areas, adhering to traditional Bible values and embracing a personal relationship with Jesus Christ—to use one common definition of evangelical faith—is another way of saying “I am an upstanding citizen”. Seen that way, piety is hard to untangle from other markers of conservative identity, from gun

ownership to feeling the country is going to the dogs.

Still, it is a mistake to seek purely secular explanations for Mr Trump’s bond with religious conservatives. For one thing, the president’s rhetoric is steeped in time-worn stories about a Christian nation under siege. He is the latest in a long line of politicians to cast believers as a faithful remnant, under attack from the sneering forces of modernity. More specifically, Mr Trump’s language is filled with echoes of a much-mocked but potent American religious movement with millions of followers, known by such labels as “positive thinking” or the “prosperity gospel”.

To historians of religion, like Kate Bowler of Duke University, when Mr Trump speaks of spiritual matters his words fairly ring with the cadences of prosperity preachers. In an address to graduating students at Liberty University on May 13th, Mr Trump promised his audience a “totally brilliant future”, and said that his presidency is “going along very, very well”. He ascribed both happy observations to “major help from God”. Lots of believers credit God for success, but Mr Trump went further. He described an America in which winners make their own dreams come true. He hailed a 98-year-old in the audience whose death by the age of 40 had been predicted by experts. He praised strivers who speak hopes aloud, ignoring doubters, and growled: “Nothing is easier or more pathetic than being a critic.”

That boosterism would sit happily in a sermon by preachers like Joel Osteen, rou- ➤



▶ tinely watched by television audiences of 7m, or Creflo Dollar, the Rolls-Royce-owning pastor of an Atlanta megachurch with 30,000 members. This is no accident. As Ms Bowler explained this month at the Faith Angle Forum, a twice-yearly conference about the interplay of politics and religion, as a young man Mr Trump attended a New York church led by Norman Vincent Peale, a “positive thinker” who also officiated at his first marriage. A prosperity preacher, Paula White, spoke at Mr Trump’s inauguration, despite grumbles about her hard-sell techniques, with worshippers prodded to make such “demon-slaying, abundance-bringing” donations as \$229, chosen to honour I Chronicles 22:9, with its talk of Solomon earning respite from “enemies on every side”.

### Favoured by the Almighty

Prosperity preachers are often dismissed by mainstream theologians as pompadoured hucksters (think Oral Roberts, a pioneering televangelist) or as near-heretics, for suggesting that believers can achieve God-like powers over their own health and wealth. But they reflect a Trumpian worldview. “Blessed”, a book about the prosperity gospel by Ms Bowler, describes the fine line between telling boastful untruths and “positive confession”, by which a bankrupt might thank God for an imaginary gusher of money, or a deathly ill congregant might insist that she is already cured, in the belief that naming a desire will bring it about. Like the Trump family, megachurch pastors and their immaculately groomed wives and children are held up as models of divine favour: winners who have found the rungs of an invisible ladder to success. Prosperity ministries revere celebrity—a Los Angeles church gave Jesus his own star, evoking the ones on Hollywood’s Walk of Fame. The movement has deep roots, stretching back to 19th-century touring mesmerists and Pentecostal healers, and to the Depression-era pastor whose version of Psalm 23 began: “The Lord is my Banker, My Credit is Good.”

Not every prosperity worshipper is a Trump voter, not least because many are black. But the movement’s influence on the religious right is hefty, and growing. It is a theology for self-made men who scorn the idea of luck. God gives him “confidence”, the president bragged last year. That is a very American creed. ■



## 2. Waste disposal

### Moth-eaten

APRIL

#### Could caterpillars save the planet from plastic waste?

Most scientific research follows a logical progression, with one experiment following up on the findings of another. Every now and then, however, serendipity plays a part. Such is the case with a paper just published in *Current Biology*, which reveals to the world a moth capable of chewing up plastic.

The experiment behind the paper was inspired when Federica Bertocchini, an amateur beekeeper who is also a biologist at Cantabria University, in Spain, noticed caterpillars chewing holes through the wax in some of her hives and lapping up the honey. To identify them, she took some home in a plastic shopping bag. But when, a few hours later, she got around to looking at her captives she found the bag was full of holes and the caterpillars were roaming around her house.

After rounding them up, she identified them as larvae of the greater wax moth, a well-known pest of bee hives. On considering their escape from their shopping-bag prison, though, she wondered whether they might somehow be put to work as garbage-disposal agents.

Past attempts to use living organisms to get rid of plastics have not gone well. Even the most promising species, a bacterium called *Nocardia asteroides*, takes more than six months to obliterate a film of plastic a mere half millimetre thick. Judging by the job they had done on her bag, Dr Bertocchini suspected wax-moth caterpillars would perform much better than that.

To test this idea, she teamed up with Paolo Bombelli and Christopher Howe, two biochemists at Cambridge University. Dr Bombelli and Dr Howe pointed out that, like beeswax, many plastics are held together by methylene bridges (structures that consist of one carbon and two hydrogen

atoms, with the carbon also linked to two other atoms). Few organisms have enzymes that can break such bridges, which is why these plastics are not normally biodegradable. The team suspected wax moths had cracked the problem.

One of the most persistent constituents of rubbish dumps is polyethylene, which is composed entirely of methylene bridges linked to one another. So it was on polyethylene that the trio concentrated. When they put wax-moth caterpillars onto the sort of film it had taken *Nocardia asteroides* half a year to deal with, they found that holes appeared in it within 40 minutes.

On closer examination, Dr Bertocchini and her colleagues discovered that their caterpillars each ate an average of 2.2 holes, three millimetres across, every hour, in the plastic film. A follow-up test found that a caterpillar took about 12 hours to consume a milligram of shopping bag. Such bags weigh about three grams, so 100 larvae might, if they spent half their lives eating, consume one in a month.

Whether releasing wax moths on the world’s surplus plastic really is sensible is not yet clear. For one thing, it has not been established whether the caterpillars gain nutritional value from the plastics they eat, as well as being able to digest them. If they do not, their lives as garbage-disposal operatives are likely to be short—and, even if they do, they will need other nutrients to thrive and grow. Another question is the composition of their faeces. If these turn out to be toxic, then there will be little point in pursuing the matter. Regardless of this, though, the discovery that wax-moth larvae can eat plastic is intriguing. Even if the moths themselves are not the answer to the problem of plastic waste, some other animal out there might be. ■

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### 3. Bagehot

## Decline and fall

JUNE

**Britain has not cut such a pathetic figure on the global stage since Suez**

WRITING to his wife in May 1942, Evelyn Waugh recounted a true story of military derring-do. A British commando unit offered to blow up an old tree-stump on Lord Glasgow's estate, promising him that they could dynamite the tree so that it "falls on a sixpence". After a boozy lunch they all went down to witness the explosion. But instead of falling on a sixpence the tree-stump rose 50 feet in the air, taking with it half an acre of soil and a beloved plantation of young trees. A tearful Lord Glasgow fled to his castle only to discover that every pane of glass had been shattered. He then ran to his lavatory to hide his emotions, but when he pulled the plug out of his washbasin "the entire ceiling, loosened by the explosion, fell on his head."

A year on from the Brexit referendum Britain feels like Lord Glasgow's castle. The most visible damage has been done to its domestic politics. With the Conservative Party in turmoil Jeremy Corbyn, Labour's hard-left leader, talks about being prime minister in six months. But just as serious is the blow to Britain's global standing, which is lower than it has been at any time since the Suez crisis in 1956, when America crushed Anthony Eden's attempt to reassert British power in Egypt.

For decades Britain's foreign policy has rested on three pillars: the United States, the European Union and the emerging world. Winston Churchill, the son of a British aristocrat and an American heiress, coined the phrase "special relationship" to describe the ties of blood and language that bind Britain to America. As a former imperial power, Brit-

ain had close ties with dozens of African and Asian countries. With one of Europe's largest economies, it had a big say in Europe's future, often acting as a counter-balance to the Franco-German axis.

British diplomats can be starry-eyed about this. The Suez crisis demonstrated that America was happy to dump the "special relationship" whenever it clashed with its national interest. The British have always been second-division players in Europe. Yet the three pillars have not only stood the test of time. They have also reinforced each other. Britain's membership of the EU bolstered its influence in America just as its close relations with America increased its clout in the EU. The EU magnified Britain's global power, bringing with it trade deals with 53 other countries.

Britain's decision to leave will obviously diminish its influence in Europe. Even if it can negotiate favourable access to the single market it will no longer be part of the EU's decision-making apparatus. Its weakness has already been exposed: David Davis, Britain's chief Brexit negotiator, has so far done little but make concessions. So has its isolation. Theresa May is now routinely asked to leave meetings when EU business is discussed.

Britain is leaving the EU at a time when its relations with the United States are perilous. Donald Trump is a volatile figure whose lodestar is "America first". He is extraordinarily divisive, meaning that the closer Britain gets to Mr Trump the more it alienates anti-Trumpists. A survey of 37 countries by the Pew Research Centre found that just 22%

of people thought that Mr Trump would "do the right thing" in international affairs. Barack Obama scored 64% in the final year of his presidency.

What of the third pillar? The Brexiteers' strongest card is that they are globalists. Untethered from Europe's rotting corpse, they argue, Britain will be free to engage with the emerging world. Yet there is no evidence that British companies were held back from this by EU membership. The EU hasn't prevented Germany's Mittelstand companies from becoming global powerhouses. The reverse might be the case: emerging countries are interested above all in access to the EU's market of 500m people.

The self-reinforcing logic of the old system will go into reverse over the next few years, whoever sits in Downing Street. Henry Kissinger told a conference in London this week that Brexit provides a chance to renew the transatlantic relationship. But he was forgetting the question he supposedly asked when he ran American foreign policy: "Who do I call if I want to speak to Europe?" America will spend more time on the phone with a convivial power inside the EU than outside (Mr Trump is to visit France on Bastille Day, whereas his proposed trip to Britain is up in the air). Emerging markets will be more interested in dealing with great power blocks than with a small country with idiosyncratic rules and volatile politics. This could happen even faster if Britain elects Jeremy Corbyn, who has made a speciality of criticising the world's leading powers while cuddling up to its basket cases.

### From virtuous to vicious circle

Since the 1980s Britain and America have been the world's leading apostles of the ideology of the moment, neoliberalism. British consultants travelled around Europe and the former Soviet Union offering lessons on privatisation. The Swedes introduced internal markets into their welfare state. The Germans tried to adopt "shareholder capitalism". But neoliberalism took a beating with the 2008 financial crisis. Britain and America have since been humbled by a populist tide that produced Brexit on one side of the Atlantic and Mr Trump on the other. Brexiteers argued that a Leave vote would produce a "Brexit spring" as the ancien régime tottered and the euro plunged. Instead, the EU is in its best shape in years, with a young reformer installed in the Élysée Palace and the Franco-German axis solid. Across the continent the press talks of Britain as the "sick man of Europe".

In the aftermath of the Suez crisis, Dean Acheson lamented that Britain had lost an empire and failed to find a role. In the subsequent decades, post-imperial Britain in fact found several roles: as a fulcrum between Europe and America; as an old hand at globalisation in a re-globalising world; and as a leading exponent of neoliberalism. Thanks to the combination of the financial crisis and Brexit, it has lost all of these functions in one great rush. The windows have shattered and the ceiling has fallen in. ■





#### 4. Regulating the internet giants

## The world's most valuable resource

MAY

**Vast flows of data give some firms unprecedented power. To keep them in check, antitrust rules must catch up**

A NEW commodity spawns a lucrative, fast-growing industry, prompting antitrust regulators to step in to restrain those who control its flow. A century ago, the resource in question was oil. Now similar concerns are being raised by the giants that deal in data, the oil of the digital era. These titans—Alphabet (Google's parent company), Amazon, Apple, Facebook and Microsoft—look unstoppable. They are the five most valuable listed firms in the world. Their profits are surging: they collectively racked up over \$25bn in net profit in the first quarter of 2017. Amazon captures half of all dollars spent online in America. Google and Facebook accounted for almost all the revenue growth in digital advertising in America last year.

Such dominance has prompted calls for the tech giants to be broken up, as Standard Oil was in the early 20th century. This newspaper has argued against such drastic action in the past. Size alone is not a crime. The giants' success has benefited consumers.

Few want to live without Google's search engine, Amazon's one-day delivery or Facebook's newsfeed. Nor do these firms raise the alarm when standard antitrust tests are applied. Far from gouging consumers, many of their services are free (users pay, in effect, by handing over yet more data). Take account of offline rivals, and their market shares look less worrying. And the emergence of upstarts like Snapchat suggests that new entrants can still make waves.

But there is cause for concern. Internet companies' control of data gives them enormous power. Old ways of thinking about competition, devised in the era of oil, look outdated in what has come to be called the "data economy" (see Briefing). A new approach is needed.

#### Quantity has a quality all its own

What has changed? Smartphones and the internet have made data abundant, ubiquitous and far more valuable. Whether you are going for a run, watching TV or even just

sitting in traffic, virtually every activity creates a digital trace—more raw material for the data distilleries. As devices from watches to cars connect to the internet, the volume is increasing: some estimate that a self-driving car will generate 100 gigabytes per second. Meanwhile, artificial-intelligence (AI) techniques such as machine learning extract more value from data. Algorithms can predict when a customer is ready to buy, a jet-engine needs servicing or a person is at risk of a disease. Industrial giants such as GE and Siemens now sell themselves as data firms.

This abundance of data changes the nature of competition. Technology giants have always benefited from network effects: the more users Facebook signs up, the more attractive signing up becomes for others. With data there are extra network effects. By collecting more data, a firm has more scope to improve its products, which attracts more users, generating even more data, and so on. The more data Tesla gathers from its self-driving cars, the better it can make them at driving themselves—part of the reason the firm, which sold only 25,000 cars in the first quarter, is now worth more than GM, which sold 2.3m. Vast pools of data can thus act as protective moats.

Access to data also protects companies from rivals in another way. The case for being sanguine about competition in the tech industry rests on the potential for incumbents to be blindsided by a startup in a garage or an unexpected technological shift. But both are less likely in the data age. The giants' surveillance systems span the entire economy: Google can see what people search for, Facebook what they share, Amazon what they buy. They own app stores and operating systems, and rent out computing power to startups. They have a "God's eye view" of activities in their own markets and beyond. They can see when a new product or service gains traction, allowing them to copy it or simply buy the upstart before it becomes too great a threat. Many think Facebook's \$22bn purchase in 2014 of WhatsApp, a messaging app with fewer than 60 employees, falls into this category of "shoot-out acquisitions" that eliminate potential rivals. By providing barriers to entry and early-warning systems, data can stifle competition.

#### Who ya gonna call, trustbusters?

The nature of data makes the antitrust remedies of the past less useful. Breaking up a ▶▶

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► firm like Google into five Googlets would not stop network effects from reasserting themselves: in time, one of them would become dominant again. A radical rethink is required—and as the outlines of a new approach start to become apparent, two ideas stand out.

The first is that antitrust authorities need to move from the industrial era into the 21st century. When considering a merger, for example, they have traditionally used size to determine when to intervene. They now need to take into account the extent of firms' data assets when assessing the impact of deals. The purchase price could also be a signal that an incumbent is buying a nas-

cent threat. On these measures, Facebook's willingness to pay so much for WhatsApp, which had no revenue to speak of, would have raised red flags. Trustbusters must also become more data-savvy in their analysis of market dynamics, for example by using simulations to hunt for algorithms colluding over prices or to determine how best to promote competition (see [Free exchange](#)).

The second principle is to loosen the grip that providers of online services have over data and give more control to those who supply them. More transparency would help: companies could be forced to reveal to consumers what information they hold and how much money they make from it. Gov-

ernments could encourage the emergence of new services by opening up more of their own data vaults or managing crucial parts of the data economy as public infrastructure, as India does with its digital-identity system, Aadhaar. They could also mandate the sharing of certain kinds of data, with users' consent—an approach Europe is taking in financial services by requiring banks to make customers' data accessible to third parties.

Rebooting antitrust for the information age will not be easy. It will entail new risks: more data sharing, for instance, could threaten privacy. But if governments don't want a data economy dominated by a few giants, they will need to act soon. ■

## 5. Russia under Vladimir Putin

### A tsar is born

OCTOBER

**As the world marks the centenary of the October revolution, Russia is once again under the rule of a tsar**

**S**EVENTEEN years after Vladimir Putin first became president, his grip on Russia is stronger than ever. The West, which still sees Russia in post-Soviet terms, sometimes ranks him as his country's most powerful leader since Stalin. Russians are increasingly looking to an earlier period of history. Both liberal reformers and conservative traditionalists in Moscow are talking about Mr Putin as a 21st-century tsar.

Mr Putin has earned that title by lifting his country out of what many Russians see as the chaos in the 1990s and by making it count again in the world. Yet as the centenary of the October revolution draws near, the uncomfortable thought has surfaced that

Mr Putin shares the tsars' weaknesses, too.

Although Mr Putin worries about the "colour" revolutions that swept through the former Soviet Union, the greater threat is not of a mass uprising, still less of a Bolshevik revival. It is that, from spring 2018 when Mr Putin starts what is constitutionally his last six-year term in office after an election that he will surely win, speculation will begin about what comes next. And the fear will grow that, as with other Russian rulers, Tsar Vladimir will leave turbulence and upheaval in his wake.

#### Firm rule

Mr Putin is hardly the world's only autocrat.

Personalised authoritarian rule has spread across the world over the past 15 years—often, as with Mr Putin, built on the fragile base of a manipulated, winner-takes-all democracy. It is a rebuke to the liberal triumphalism which followed the collapse of the Soviet Union. Leaders such as Recep Tayyip Erdogan of Turkey (see [article](#)), the late Hugo Chávez of Venezuela and even Narendra Modi, India's prime minister, have behaved as if they enjoy a special authority derived directly from the popular will. In China Xi Jinping this week formalised his absolute command of the Communist Party (see [article](#)).

Mr Putin's brand of authoritarianism blazed the trail. It evokes Russia's imperial history (see [Briefing](#)), offering a vivid picture of how power works and how it might go wrong.

Like a tsar, Mr Putin surmounts a pyramid of patronage. Since he moved against the oligarchs in 2001, taking control first of the media and then of the oil and gas giants, all access to power and money has been through him. These days the boyars serve at his pleasure, just as those beneath them serve at their pleasure and so on all the way down. He wraps his power in legal procedure, but everyone knows that the prosecutors and courts answer to him. He enjoys an approval rating of over 80% partly because he has persuaded Russians that, as an aide says, "If there is no Putin, there is no Russia."

Like a tsar, too, he has faced the question that has plagued Russia's rulers since Peter the Great—and which acutely confronted Alexander III and Nicholas II in the run-up to the revolution. Should Russia modernise by following the Western path towards civil rights and representative government, or should it try to lock in stability by holding fast against them? Mr Putin's answer has been to entrust the economy to liberal-minded technocrats and politics to former KGB officers. Inevitably, politics has dominated economics and Russia is paying the price. However well administered during sanctions and a rouble devaluation, the economy still depends too heavily on natural resources. It can manage annual GDP growth of only around 2%, a far cry from 2000-08, ►►





▶ which achieved an oil-fired 5-10%. In the long run, this will cramp Russia's ambitions.

And like a tsar, Mr Putin has buttressed his power through repression and military conflict. At home, in the name of stability, tradition and the Orthodox religion, he has suppressed political opposition and social liberals, including feminists, NGOs and gays. Abroad, his annexation of Crimea and the campaigns in Syria and Ukraine have been burnished for the evening news by a captive, triumphalist media. However justified, the West's outrage at his actions underlined to Russians how Mr Putin was once again asserting their country's strength after the humiliations of the 1990s.

What does this post-modern tsar mean for the world? One lesson is about the Russian threat. Since the interference in Ukraine, the West has worried about Russian revanchism elsewhere, especially in the Baltic states. But Mr Putin cannot afford large numbers of casualties without also losing legitimacy, as happened to Nicholas II in the Russo-Japanese war of 1904-05 and in the first world war. Because today's tsar knows history, he is likely to be opportunistic abroad, shadowboxing rather than risking a genuine confrontation. The situation at home is different. In his time in power Mr Putin has shown little appetite for harsh repression. But Russia's record of terrible suffering suggests that, whereas dithering undermines the ruler's legitimacy, mass repression can strengthen it—at least for a time. The Russian people still have something to fear.

### Mother Russia's offspring

The other lesson is about succession. The October revolution is just the most extreme recent case of power in Russia passing from ruler to ruler through a time of troubles. Mr Putin cannot arrange his succession using his bloodline or the Communist Party apparatus. Perhaps he will anoint a successor. But he would need someone weak enough for him to control and strong enough to see off rivals—an unlikely combination. Perhaps he will try to cling to power, as Deng Xiaoping did behind the scenes as head of the China Bridge Association, and Mr Xi may intend to overtly, having conspicuously avoided naming a successor after this week's party congress. Yet, even if Mr Putin became the *éminence grise* of the Russian Judo Federation, it would only delay the fatal moment. Without the mechanism of a real democracy to legitimise someone new, the next ruler is likely to emerge from a power struggle that could start to tear Russia apart. In a state with nuclear weapons, that is alarming.

The stronger Mr Putin is today, the harder he will find it to manage his succession. As the world tries to live with that paradox, it should remember that nothing is set in stone. A century ago the Bolshevik revolution was seen as an endorsement of Marx's determinism. In the event, it proved that nothing is certain and that history has its own tragic irony. ■

## 6. Materials science

### A film worth watching

FEBRUARY

#### Keeping cool without costing the Earth

ABOUT 6% of the electricity generated in America is used to power air-conditioning systems that cool homes and offices. As countries such as Brazil, China and India grow richer, they will surely do likewise. Not only is that expensive for customers, it also raises emissions of greenhouse gases in the form both of carbon dioxide from burning power-station fuel and of the hydrofluorocarbons air conditioners use as refrigerants.

As they describe in a paper in this week's *Science*, Ronggui Yang and Xiaobo Yin of the University of Colorado, in Boulder, have a possible alternative to all this. They have invented a film that can cool buildings without the use of refrigerants and, remarkably, without drawing any power to do so. Better yet, this film can be made using standard roll-to-roll manufacturing methods at a cost of around 50 cents a square metre.

The new film works by a process called radiative cooling. This takes advantage of that fact that Earth's atmosphere allows certain wavelengths of heat-carrying infrared radiation to escape into space unimpeded. Convert unwanted heat into infrared of the correct wavelength, then, and you can dump it into the cosmos with no come back.

Dr Yang and Dr Yin are not the first to try to cool buildings in this way. Shanhui Fan and his colleagues at Stanford University, in California, demonstrated a device that used the principle in 2014. Their material, though, consisted of seven alternating layers of hafnium dioxide and silicon dioxide of varying thicknesses, laid onto a wafer made of silicon. This would be difficult and expensive to manufacture in bulk.

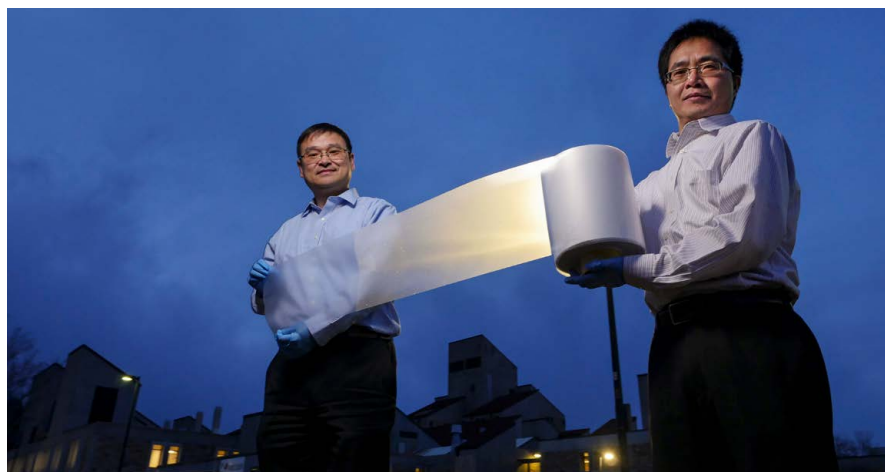
Dr Yang's and Dr Yin's film, by contrast, was made of polymethylpentene, a commercially available, transparent plastic sold under the brand name TPX. Into this they mixed

tiny glass beads. They then drew the result out into sheets about 50 millionths of a metre (microns) thick, and silvered those sheets on one side. When laid out on a roof, the silver side is underneath. Incident sunlight is thus reflected back through the plastic, which stops it heating the building below.

Preventing something warming up is not, though, the same as cooling it. The key to doing this is the glass beads. Temperature maintenance is not a static process. All objects both absorb and emit heat all the time, and the emissions are generally in the form of infrared radiation. In the case of the beads, the wavelength of this radiation is determined by their diameter. Handily, those with a diameter of about eight microns emit predominantly at wavelengths which pass straight through the infrared "window" in the atmosphere. Since the source of the heat that turns into this infrared is, in part, the building below, the effect is to cool the building.

That cooling effect, 93 watts per square metre in direct sunlight, and more at night, is potent. The team estimates that 20 square metres of their film, placed atop an average American house, would be enough to keep the internal temperature at 20°C on a day when it was 37°C outside.

To regulate the amount of cooling, any practical system involving the film would probably need water pipes to carry heat to it from the building's interior. Manipulating the flow rate through these pipes as the outside temperature varied would keep the building's temperature steady. Unlike the cooling system itself, these pumps would need power to operate. But not much of it. Other than that, all the work is done by the huge temperature difference, about 290°C, between the surface of the Earth and that of outer space. ■







## 7. Testing basic incomes in Finland

### Northern pilot

JUNE

#### An experiment offers some early lessons

**J**UHA JARVINEN, an unemployed young father in a village near Jurva, in western Finland, brims with ideas for earning a living. He has just agreed to paint the roofs of two neighbours' houses. His old business, making decorative window frames, went bust a few years ago. Having paid off debts, he recently registered another, to produce videos for clients.

Mr Jarvinen says that for six years he hoped to start a new business but it was impossible. The family got by on his wife's wages as a nurse, plus unemployment and child benefits. He had a few job offers from local businesses, which are mainly in forestry, furniture and metalwork. But anything less than a permanent, well-paid post made no sense, since it would jeopardise his welfare payments. To re-enroll for benefits later would be painfully slow.

Mr Jarvinen's luck turned in January, when he was picked at random from Finland's unemployed (10% of the workforce)

to take part in a two-year pilot study to see how getting a basic income, rather than jobless benefits, might affect incentives in the labour market. He gets €560 (\$624) a month unconditionally, so he can add to his earnings without losing any of it.

If Mr Jarvinen is making progress, it is too soon to draw overall conclusions. Kela, Finland's national welfare body, which runs the pilot, will not contact participants directly before 2019, lest that influences outcomes. Instead it monitors remotely, using national registers of family incomes, taxes paid and more. (Anonymised data will be made available to researchers.)

Some lessons are emerging. Olli Kangas, who helped to design the study and now runs it for Kela, says the process is far harder to implement than expected: "a nightmare". He decries politicians who blow hot and cold, yet insist the study must be wrapped up before an election in 2019. He calls them "small boys with toy cars, who become bored

and move on". Finnish politics is intricate: the Centre party, Greens and a far-left party back the study. So does a libertarian wing of the conservatives, hoping to pare the welfare state. Sceptics include traditional conservatives, many Social Democrats and big unions.

Such unions, with (mostly male) members in permanent jobs in heavy industry, manage unemployment funds and do not want to lose control, so they dislike the idea of a basic income, says Mr Kangas. In contrast the idea appeals to those who represent part-time service staff, such as (mostly female) cleaners or retail workers. He says surveys show the wider public wavering: 70% like the idea of the grant in theory, but that drops to 35% when respondents are told that income taxes—already high—would have to rise to pay for it.

The study's design faced constraints. The constitution ordains equality for all, so getting permission to afford some welfare recipients special treatment was difficult. That limitation, and a budget of only €20m (plus diverted welfare funds that would have otherwise gone to the recipients), restricted the sample size to just 2,000 people. Mr Kangas frets that might prove too small to be statistically robust. And it limits the questions the study can investigate.

He would like to try similar grants on those with low-income jobs, to see if such recipients choose to work less, for example. It would also have been instructive—if expensive and politically difficult—to give grants to residents of entire towns to see how local economies are affected. The timescale is another limitation. Kate McFarland, of the Basic Income Earth Network, which has promoted the idea of basic incomes since the 1980s, says a two-year study is too short to learn how the psychology of beneficiaries changes.

Whatever its flaws, the pilot is a good example of the Finnish penchant for social experiments. Participants will be followed for ten years to identify long-term effects. International interest in the pilot programme has been intense. This month television crews from South Korea and Sweden have been queuing up to see Mr Kangas; he regularly lectures abroad and advises others on similar studies. Just getting started counts as a success, he says. "This is trial and error, and the door is now open for better experiments." ■

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## 8. Demography

# The rise of childlessness

JULY

**More adults in the rich world are not having children. That is no reason to panic**

**P**OCKET LIVING has been building and selling small flats in London since 2005. The flats have many of the things that young, single people want, such as bicycle storage, and lack the things they do not, such as large kitchens and lots of bookshelves. At first, Pocket expected that most buyers would be in their late 20s, says Marc Vlessing, the firm's boss. Instead the average age is 32, and rising. It is not that many buyers are yet to have children, speculates Mr Vlessing; rather, they probably will never have them.

A growing number of city-dwelling Europeans are in the same situation. Just 9% of English and Welsh women born in 1946 had no children. For the cohort born in 1970—who, barring a few late surprises, can be assumed to be done with babies—the proportion is 17%. In Germany 22% of women reach their early 40s without children; in Hamburg 32% do.

All of which might seem to suggest that Europe is bent on self-erasure. Childlessness is “a symptom of a feeble and terminally ill culture” that has lost touch with its heritage, according to Iben Thranholm, a conservative Danish journalist. The suggestion is misleading, however. Mass childlessness is not a sign of demographic collapse, nor is it remotely novel. It would be more accurate to say that rich countries are updating a long tradition.

In some European countries, such as Germany and Italy, the overall birth rate is low and childlessness is common. But oth-

er countries, such as Britain and Ireland, combine a high birth rate (by European standards) with a high rate of childlessness. And in still other countries, especially formerly communist ones in eastern Europe, childlessness is rare but birth rates are low, because many women have one child. Overall, there is surprisingly little correlation between childlessness and fertility (see chart 1).

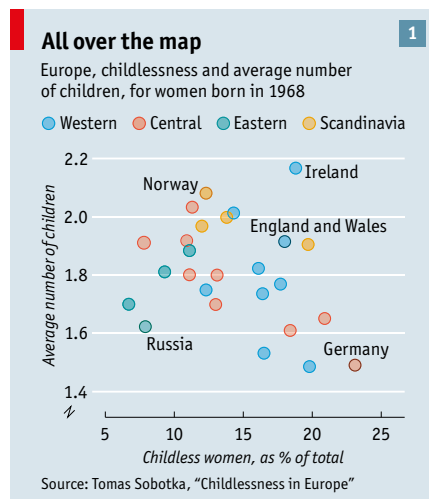
Many countries that have lots of childless women today had even higher rates in the early 20th century. Indeed, the baby-filled late 20th century looks like a blip (see chart 2). That reflects deep-rooted social norms. In pre-industrial western Europe, men and

women did not marry while they were maids or apprentices, but only when they could set up households of their own. To stay unmarried and childless was a sign of economic failure. But it was not shameful in itself. “It is poverty only which makes celibacy contemptible,” explained the heroine of Jane Austen’s novel, “Emma”.

The attitude lingers. In western Germany, people without children tend to feel only mild social stigma. “It’s something that requires an explanation, but not a lengthy one,” says Tanja Kinkel, a successful novelist who did not have children because she did not find a suitable partner. And western Germany combines a forgiving attitude to childlessness with a harsh view of working mothers. Until recently, nurseries were rare; a woman who put her child in one might be abused as a “Rabenmutter” (raven mother). Many happily working women simply opt out.

Childlessness is becoming more common in countries like Italy and Spain, which also squeeze working mothers. But perhaps the best example is Japan. Even if Japanese mothers were not pressed to stop working (which they are) they would be pushed into it by a brutal office culture. In a Japanese firm everybody is responsible for everything, complains one woman, an architect who lives in Tokyo. As a result, nobody dares to leave work early, which makes parenthood almost impossible. She delayed having children and is undergoing fertility treatment at the age of 41. Japan’s childless rate has shot up from 11% for women born in 1953 to 27% for women born in 1970.

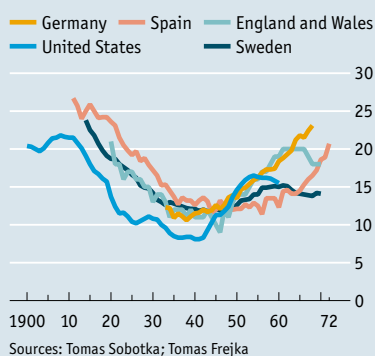
The reasons why people do not have children are varied, complex and often overlapping. A few (but, pollsters find, not many) never wanted them. Others do not meet the right person. Some fall in love with people who already have children, and feel satisfied. Others suffer from medical problems. A great many fall into a group that Ann ▶▶





## Not so hot on tots

Childless women, as % of total, by year of birth



Sources: Tomas Sobotka; Tomas Frejka

► Berrington, a demographer at the University of Southampton, calls “perpetual postponers”. Waiting to start a family until they are finished with education, until they have a stable job and a house, they find it is too late.

Almost everywhere, the most educated women are least likely to have children. And the highest rates of childlessness are found among women who pursue degrees in non-vocational subjects. Researchers at Stockholm University have found that 33% of Swedish women born in the late 1950s who studied the social sciences did not have children, compared with 10% of primary-school teachers and just 6% of midwives. It may be that teaching and midwifery attract women who strongly desire children, or that these jobs offer more parent-friendly hours and conditions. But the difference is probably also down to job security. A trained teacher

can expect to find a stable job at a younger age than a trained anthropologist can.

## The charitable childless

Although childlessness makes some people utterly miserable, that is not the case for most. One multi-country study by two demographers, Rachel Margolis and Mikko Myrskylä, suggests that childless people aged 40 and over in formerly communist eastern Europe are a little unhappier than people with children, once you control for things like wealth and marital status. That might reflect the stigma against childlessness in those countries. In liberal Anglo-Saxon countries, though, middle-aged childless people appear to be slightly happier than parents. The same demographers find that young parents are gloomier than childless youngsters.

Amazing as it may seem to parents who spend their evenings and weekends traipsing to football training and piano lessons, childless people find plenty of things to do with their time. Among these are good works. One German study found that 42% of charitable foundations were created by childless people. Ms Kinkel started a charity called Bread and Books, which operates mostly in Africa. She describes it as her way of nurturing the next generation.

People without children are far more likely to bequeath money to charity, points out Russell James, an expert on philanthropy at Texas Tech University. In 2014 fully 48% of married childless people aged at least 55 who had written wills or will-like documents committed to giving something to charity. That was true of only 12% of parents and a mere 8% of grandparents. Knowing this, American universities have become acutely interested in whether their alumni have offspring, says Mr James.

That question is easier to answer for women than for men. Men’s fertility declines with age, but less predictably than women’s fertility. So, whereas demographers and fundraisers can reasonably assume that a 45-year-old woman will have no more children, they cannot assume the same for a man. Worse, men sometimes forget their children when filling in census forms—and may have fathered children they do not know about. Still, two things are clear. Childless men are numerous, and quite different from childless women.

Men are erratic. Some are reproductive prodigies, having many children with more than one partner. Others—more than is the case for women—have none at all. Ms Berrington finds that 22% of British men born in 1958 were childless at the age of 46, compared with 16% of women. And in many countries childless men are disproportionately working class. French men who have never worked are about twice as likely to have no children as men who hold good white-collar jobs. Michaela Kreyenfeld, a demographer at the Hertie School of Governance in Berlin, finds that 36% of west German men without university degrees born in the early 1970s were childless in their early 40s. Among men

with degrees, the rate was 28%.

That suggests men and women end up childless for quite different reasons. Women often have no children because they have prioritised education or work in their 20s and 30s. Men are more likely to remain childless because women do not view them as good boyfriend material—let alone good husband or father material. “They have a problem finding partners,” suggests Ms Kreyenfeld.

The distinction might be disappearing, however. In western Germany, childlessness is rising among less educated women, who are converging with their highly educated peers. In Finland, a switch has already occurred: women with only a basic education are the most likely to remain childless. It may be that, as two-earner households become more common, men have taken to judging women as women have long judged men. Those who fail to land dependable jobs might not be given a good opportunity to have children.

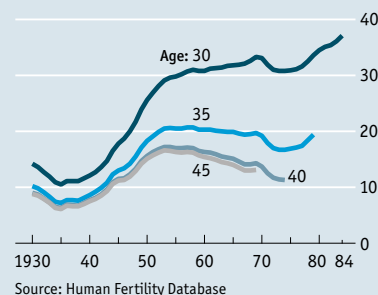
Nobody knows whether childlessness will rise further. It has been going up in most European countries, but not all: the rate has fallen in Switzerland, for example. One possibility is that childlessness will veer up and down, mirroring the economic cycle. As the average age of marriage rises and couples push childbearing into their mid- or even late 30s, they become increasingly vulnerable to shocks. A bad recession or a mortgage-lending squeeze will encourage couples to pause—and, because many now give themselves only a narrow window before their fertility drops, some will be knocked out of childbearing altogether.

That seems to be happening in America, points out Tomas Sobotka, of the Vienna Institute of Demography. The proportion of 45-year-old American women without children has fallen steadily since the turn of the century. Following the financial crisis of 2007, though, childlessness among 30- and 35-year-old women shot up (see chart 3). No matter what their intentions, many of these women are likely to remain childless.

That will not be such a terrible fate. Childlessness is often undesired, but in rich Western countries it is hardly calamitous. As the peculiarly procreative generation born around the middle of the 20th century passes away, it will come to seem ever more normal. ■

## Get ready for another baby bust

United States, childless women at selected ages, by year of birth, %



Source: Human Fertility Database

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## 9. Greater fool theory

# The bitcoin bubble

NOVEMBER

**There may be good reasons for buying bitcoin. But the dominant reason at the moment is that it is rising in price**

Put the word bitcoin into Google and you get (in Britain, at least) four adverts at the top of the list: "Trade bitcoin with no fees", "Fastest Way to Buy Bitcoin", "Where to Buy Bitcoins" and "Looking to Invest in Bitcoins". Travelling to work on the tube this week, your blogger saw an ad offering readers the chance to "Trade Cryptos with Confidence". A lunchtime BBC news report visited a conference where the excitement about bitcoins (and blockchain) was palpable.

All this indicates that bitcoin has reached a new phase. The stockmarket has been trading at high valuations, based on the long-term average of profits, for some time. But there is nothing like the same excitement about shares as there was in the dotcom bubble of 1999-2000. That excitement has shifted to the world of cryptocurrencies like bitcoin and ethereum. A recent column focused on the rise of initial coin offerings, a way for companies to raise cash without the need for a formal stockmarket listing—investors get tokens (electronic coins) in businesses that have not issued a full prospectus. These tokens do not normally give equity rights. Remarkably, as many as 600 ICOs are planned or have been launched.

This enthusiasm is both the result, and

the cause, of the sharp rise in the bitcoin chart in recent months. The latest spike was driven by the news that the Chicago Mercantile Exchange will trade futures in bitcoin; a derivatives contract based on a notional currency. More people will trade in bitcoin and that means more demand, and thus the price should go up. But what is the appeal of bitcoin? There are really three strands; the limited nature of supply (new coins can only be created through complex calculations, and the total is limited

to 21m); fears about the long-term value of fiat currencies in an era of quantitative easing; and the appeal of anonymity. The last factor makes bitcoin appealing to criminals (although this is even more true of cash) creating this ingenious valuation method for the currency of around \$570.

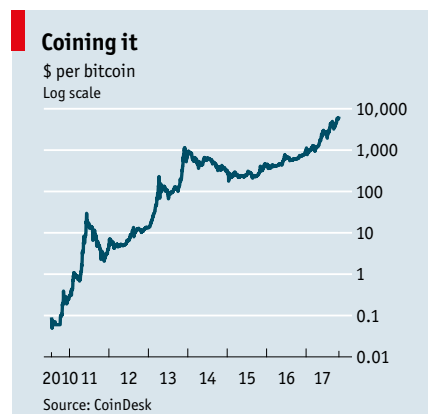
These three factors explain why there is some demand for bitcoin but not the recent surge. The supply details have if anything deteriorated (rival cryptocurrencies are emerging); the criminal community hasn't suddenly risen in size; and there is no sign of general inflation. A possible explanation is the belief that blockchain, the technology that underlines bitcoin, will be used across the finance industry. But you can create blockchains without having anything to do with bitcoin; the success of the two aren't inextricably linked.

A much more plausible reason for the demand for bitcoin is that the price is going up rapidly (see chart). As Charles Kindleberger, a historian of bubbles, wrote

*There is nothing so disturbing to one's well-being and judgment as to see a friend get rich*

People are not buying bitcoin because they intend to use it in their daily lives. Currencies need to have a steady price if they are to be a medium of exchange. Buyers do not want to exchange a token that might jump sharply in price the next day; sellers do not want to receive a token that might plunge in price. As Bluford Putnam and Erik Norland of CME wrote

*Wouldn't you have regretted paying 20 bit- ▶▶*





► *coins for a \$40,000 car in June 2017 only to see the same 20 bitcoins valued at nearly \$100,000 by October of the same year?*

Indeed, the chart is on a log scale to show some of the huge falls, as well as increases, that have occurred in bitcoin's history. As the old saying goes "Up like a rocket, down like a stick."

People are buying bitcoin because they

expect other people to buy it from them at a higher price; the definition of the greater fool theory. Someone responded to me on Twitter by implying the fools were those who were not buying; everyone who did so had become a millionaire. But it is one thing to become a millionaire (the word was coined during the Mississippi bubble of the early 18th century) on paper, or in "bits"; it is another to be able to get into a bubble and

out again with your wealth intact.

If everyone tried to realise their bitcoin wealth for millions, the market would dry up and the price would crash; that is what happened with the Mississippi and the contemporaneous South Sea bubbles. And because investors know that could happen, there is every incentive to sell first. When the crash comes, and it cannot be too far away, it will be dramatic. ■



attending an elite college is a good way of securing an upper-middle class lifestyle—graduates of Ivy League-calibre universities have roughly the same chance of breaking into the top 20% of the income distribution, regardless of family background. Paths to the upper-middle class exist for those who graduate from lesser-known universities too, since earnings can depend even more on what one studies than where. On average, graduates of lesser-known engineering colleges such as Kettering University and the Stevens Institute of Technology do just as well as those from the Ivy League.

But a good education alone cannot propel the merely upper-middle class into the ranks of the rich. Few engineers, nurses or pharmacists make it to the top 1%, which is dominated by bankers and other financiers. Recruiters in the financial industry place high premiums on pedigree. Here the Ivies play an outsize role; products of elite private universities such as Harvard and Yale are much more likely to end up on Wall Street. Moreover, data from Mr Chetty and colleagues show that it helps to start off rich in the first place.

This trend is even more pronounced at the very top of the income distribution. Between 1999 and 2004, just 2% of Princetonians came from the families in the lowest 20% of earnings, while 3.2% came from families in the top 0.1%. The admissions process at top colleges is sometimes further skewed by the preferential treatment given to family members of alumni. Of Harvard's most recently admitted class, 27% had a relative who also went to that "college near Boston" (pictured). That suggests that the simplest way to become extremely rich is by being born to the right parents. The second-easiest way is to find a rich spouse. If neither approach works, you could try to get into a top college—but remember that not all Princetonians become plutocrats. ■

## 10. The Economist explains

# How to get rich in America

FEBRUARY

**Entering the upper-middle class is not impossible. Breaking into the 1% may as well be**

**A**MERICANS are admirably optimistic about shaping their own future. One survey found that nearly three-quarters of Americans thought hard work was a "very important" component of success, while just 62% put it down to a good education and less than a fifth to coming from wealth. But the United States ranks poorly compared to other advanced economies when it comes to income inequality and social mobility. So what must an ambitious

young American do to get rich?

A new study by Raj Chetty of Stanford University and a collective of other economists helps answer this question. By matching data from the Department of Education with 30m tax returns, Mr Chetty and his colleagues have constructed a data set that reveals to researchers both the income distributions of graduates of particular colleges, and how incomes vary depending on how rich the graduates' parents were. The data show that

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