SERIOUSLY CURIOUS

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The Economist Explains

The FACTS and FIGURES THAT TURN YOUR WORLD UPSIDE DOWN

Edited by

TOM STANDAGE

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Introduction: the case for being seriously curious

WHAT LINKS DETECTIVES, scientists, economists, journalists – and cats? The answer, of course, is curiosity. They all want to discover more about the world. But their curiosity is driven by more than just a desire to understand the way things are. They also want to understand the underlying mechanisms that explain how things got to be that way, so that they can anticipate, predict or explain future events. Detectives want to uncover people's motivations and solve crimes. Scientists want to devise new theories that will deepen their grasp of reality. Economists want to improve their understanding of the transactions that underpin human societies. Journalists want to create narratives that help people make sense of current affairs. Cats want to maximise their chances of getting their paws on more roast chicken.

All of them are constantly gathering evidence, devising theories and testing new avenues in pursuit of their goals. In all these fields, curiosity is not merely useful – it is vital. It is a willingness, or in fact a hunger, to discover new, previously unknown things. No wonder Thomas Hobbes called it "the lust of the mind". Curiosity provides the spur to gather more raw material for analysis, by probing the limits of what is known.

Alas, the information-driven, evidence-based way of looking at the world has lately fallen out of favour. In a "post-truth" world, knowledge is scorned, facts are optional (or can be challenged by "alternative facts") and reality can be distorted or ignored. But the seriously curious know that in the long run, reality will

always prevail. Curiosity leads people towards a more accurate understanding of the world; only the terminally incurious can maintain a distorted or inaccurate worldview for long, and only then by walling themselves off from evidence that challenges their outlook. Curiosity is the royal road to truth.

So this book takes a stand, in its own small way, for the forces of curiosity, evidence and reason. It brings together unexpected explanations and fascinating facts from *The Economist*'s output of explainers and daily charts. Its mission is to show, through a series of entertaining examples, how logic and data can illuminate the hidden mechanisms that make the world work the way it does. Why do tennis players grunt? Why does polygamy make civil wars more likely? What is the link between avocados and crime? Why is there a shortage of sand? How does fracking boost birth rates?

Each of these questions is a miniature mystery story. Each one challenges you to imagine your own explanation, like a detective arriving at the scene of a crime. (You are probably wondering about those criminal avocados right now.) After a paragraph or two of context comes the explanation, and enlightenment dawns – or, just as satisfyingly, you discover that your theory was indeed the correct answer. Moreover, you now understand an aspect of how the world works better than you did before.

We hope this collection will stimulate and satisfy your curiosity. The very fact that you are reading this book at all, and have bothered to read to the end of this introduction, grants you admission, along with the detectives, scientists and cats, to the ranks of the seriously curious. Welcome to the club.

Tom Standage
Deputy Editor, *The Economist*
July 2018

Seriously curious: unexpected explanations to stretch your mind

Why polygamy makes civil wars more likely

Wherever polygamy is widely practised, turmoil tends to follow. The 20 most fragile states in the world are all somewhat or very polygamous. Polygamous nations are more likely to invade their neighbours. The polygamous regions of Haiti and Indonesia are the most turbulent; in South Sudan, racked by civil war, perhaps 40% of marriages involve multiple wives. One study, by the London School of Economics, found a strong link between plural marriage and civil war. How come?

Polygamy nearly always involves rich men taking multiple wives. And if the top 10% of men marry four women each, then the bottom 30% cannot marry at all. This often leaves them not only sexually frustrated but also socially marginalised. In many traditional societies, a man is not considered an adult until he has found a wife and sired children. To get a wife, he must typically pay a "bride price" to her father. When polygamy creates a shortage of brides, it massively inflates this bride price. In South Sudan, it can be anything from 30 to 300 cattle – far more wealth than an ill-educated young man can plausibly accumulate by legal means.

In desperation, many single men resort to extreme measures to secure a mate. In South Sudan, they pick up guns and steal cattle from the tribe next door. Many people are killed in such raids; many bloody feuds spring from them. Young bachelors who cannot afford to marry also make easy recruits for rebel armies. If they fight, they can loot, and with loot, they can wed. In a paper published in 2017, Valerie Hudson of Texas A&M University and Hilary Matfess of Yale found that a high bride price is a "critical" factor "predisposing young men to become involved in organised group violence for political purposes". Jihadist groups exploit this, too. One member of Pakistan's Lashkar-e-Taiba, which carried out the attack on Mumbai in 2008 that killed 166 people, said he joined the organisation because it promised to pay for his siblings to get married. Radical Islamist groups in Egypt have also organised (and helped to pay for) marriages for members. In northern Nigeria, where polygamy is rife, Boko Haram still arranges cheap marriages for its recruits.

Globally, polygamy is in retreat, but in some pockets support for it is rising. After America's Supreme Court legalised same-sex marriage in 2015, some people argued that plural unions should be next. According to Gallup, a pollster, the proportion of Americans who consider polygamy to be morally acceptable rose from 5% in 2006 to 17% last year, among the most dramatic jumps in the subjects it tracks. Campaigners in Kyrgyzstan, Turkmenistan and other central Asian states are seeking to re-establish men's right to take multiple wives. In Kazakhstan, a bill failed in 2008 after a female MP included an amendment stipulating that polyandry (women taking multiple husbands) also be allowed. Advocates claim that polygamy promotes social harmony by giving lusty husbands a legitimate alternative to infidelity. But the mayhem in places like South Sudan, Afghanistan and northern Nigeria suggests otherwise.

Why there is a shortage of sand

Sand is in high demand. In some parts of the world, people are going to increasing lengths to get their hands on the golden grains. A "sand mafia" in India intimidates locals in order to extract and transport the material. In Morocco and the Caribbean, thieves are stripping beaches bare. Even though fully accounting for illegally mined sand is not possible, sand is easily the most mined material in the world. According to the UN Environment Programme (UNEP), sand and gravel account for up to 85% of everything mined globally each year.

Modern cities are built with, and often on, sand. Most of it is used in the construction industry to make concrete and asphalt. No surprise, then, that Asia is the biggest consumer of sand. China alone accounts for half of the world's demand. That reflects the country's breakneck pace of construction: according to the United States Geological Survey, China used more concrete from 2011 to 2013 (6.6 gigatons) than America did in the entire 20th century (4.5 gigatons). Sand also has industrial uses: it is used to make glass, electronics, and to help extract oil in the fracking industry. Vast quantities of sand are dumped into the sea to reclaim land. Singapore, for example, has expanded its land area by more than 20% since the 1960s in this way. The Maldives and Kiribati have used sand to shore up their islands against rising sea levels. The UN forecasts that, by 2030, there will be over 40 "megacities" home to more than 10m inhabitants (up from 31 in 2016), which means more housing and infrastructure will need to be built. And sea levels will continue to rise. All of this means that sand will only become more sought after.

So why is there a shortage, when sand seems so abundant? The trouble is that desert sand is too smooth, and cannot be used for most commercial purposes. Australian sand was transported to a faraway desert to build Dubai's Burj Khalifa tower. Most countries also have rules in place about where, and how much, sand can be mined. But voracious demand has sparked a lucrative illegal trade

in many rapidly developing countries. The result is that existing deposits are being mined more quickly than they can be naturally replenished, which is damaging the environment. Dredging causes pollution and harms local biodiversity, while thinning coastlines affect beaches' capacity to absorb stormy weather.

Fortunately, there are substitutes for sand: asphalt and concrete can be recycled, houses can be built with straw and wood, and mud can be used for reclamation. In rich countries, government policy will encourage a shift towards such substitutes. According to Britain's Mineral Products Association, for example, nearly a third of all housing material used in Britain in 2014 was recycled. Singapore is planning to rely on Dutch expertise for its next reclamation project, which involves a system of dykes and is less dependent on sand. In poorer countries, too, builders are likely to shift away from sand as its price rises. But unless law enforcement improves, that will be a very slow process, and the shortage of sand will persist.

How shoelaces untie themselves

Engineering brings great benefit to humanity, from bridges to computer chips. It has, though, had difficulty creating a shoelace that does not accidentally come loose. This was, in part, because no one truly understood why shoelaces come undone in the first place. But that crucial gap in human knowledge has now been plugged. Christopher Daily-Diamond, Christine Gregg and Oliver O'Reilly, a trio of engineers at the University of California, Berkeley, have worked out the mechanics of shoelace-bow disintegration. They have finally solved the mystery of how shoelaces untie themselves.

Technically, a shoelace bow is a type of slip knot that has, at its core, a reef knot. Like conventional reef knots, bows can be mistied as "granny" knots, which come undone more easily than a true reef does. But even a shoelace bow with a true reef at its core will fail eventually, and have to be retied. That is because walking involves two mechanical processes, both of which might be expected to exert forces on a shoelace bow. One is the forward and back movement of the leg. The other is the impact of the shoe itself hitting the ground. Preliminary experiments carried out by Mr Daily-Diamond, Ms Gregg and Dr O'Reilly showed that neither of these alone is enough to persuade a bow to unravel; both are needed. So they had to devise experiments which could measure and record what was going on while someone was actually walking. The "someone" in question was Ms Gregg, who endured numerous sessions on a treadmill so that the behaviour of her shoelaces could be monitored. Using cameras, and tiny accelerometers attached to the laces, the researchers realised that two things are important. One is how the act of walking deforms the reef at the centre of a bow. The other is how the different inertial forces on the straight-ended and looped extremities of the bow conspire to pull the lace though the reef in the way a wearer would when taking a shoe off.

During walking, the reef itself is loosened by the inertial forces of the lace ends pulling on it. This occurs as a walker's foot moves first forward and then backward as it hits the ground during a stride.

Immediately after that, the shock of impact distorts the reef still further. This combination of pull and distortion loosens the reef's grip on the lace, permitting it to slip. In principle, the lace could slip either way, giving an equal chance of the bow eventually undoing completely or turning into a non-slip knot of the sort that long fingernails are needed to deal with. In practice, the former is far more common. The reason turns out to be that the free ends of the bow can swing farther than the looped ends do. The extra inertial force this causes favours slippage in the direction of the longer of the free ends. To start with, the effect is small. But as the free end in question continues to elongate, the disparity in inertial force gets bigger – and, eventually, only two or three strides are needed to take a shoe from being apparently securely tied to being untied.

Probably, nothing can be done about this differential elongation. But it might be possible to use the insights Mr Daily-Diamond, Ms Gregg and Dr O'Reilly have provided to create laces that restrict the distortion of the reef at a bow's centre, and thus slow the whole process down. Understanding how laces untie themselves is, you might say, an important step on the way to inventing a solution.

Why the sea is salty

Seen from space, the Earth is a pale blue dot. Two-thirds of its surface is covered by water. But most of that water by far – around 97% – is salty. Of the 3% that is fresh water – which is the kind humanity needs to drink, wash, make things and (most of all) produce food – about two-thirds is locked up in glaciers, ice caps and permafrost. That leaves less than 1% of the planet's water easily accessible in rivers, lakes or aquifers. In short, the salinity of the oceans means useful water is scarce, while the less useful kind is abundant. So why is the sea salty?

The salt in the ocean mostly got there as the result of a process called weathering, which transfers mineral salts from rocks on land into the sea. Rain is not pure water, but contains small amounts of carbon dioxide absorbed from the air, which makes rainwater very slightly acidic. When this weak acid falls on land, tiny traces of minerals are dissolved from rocks into the water, and these minerals separate into charged particles called ions. These ions travel along with the water into streams, rivers and eventually into the ocean. Many of these mineral ions are subsequently removed from the sea water by marine plants and animals, but others remain in the water, and their concentration builds up over millions of years. Over 90% of the ions in sea water, accounting for about 3% of the ocean by weight, are sodium and chlorine ions, which are the chemical constituents of common salt. Other processes also play a role. Underwater volcanoes and hydrothermal vents discharge mineral salts into sea water. And isolated bodies of water with insufficient drainage may become increasingly salty through evaporation, which carries water away while leaving dissolved minerals behind. The Dead Sea (which contains about 30% mineral salts by weight) is the best-known example.

The natural processes that make the seas salty can be reversed by desalination technologies that turn sea water into fresh water. This involves either boiling and then recondensing water, or pumping it at high pressure through reverse-osmosis membranes that allow

water molecules to pass, but are impermeable to larger mineral ions. Both processes are energy-intensive, however, though reverse osmosis has become far more energy-efficient in recent years. Accordingly, desalination plants are generally found in places where water is scarce but energy is cheap, such as the Middle East.

As climate change causes "global drying" – making some wet parts of the world wetter, and dry parts drier – demand for fresh water will intensify in the coming years; half the world's population is expected to live in water-stressed areas by 2050. Better water-management policies and more water-efficient agricultural practices (such as drip irrigation) are needed. Improvements to desalination technology would help too, by allowing mankind to tap the oceans' inconveniently salty water. "If we could ever competitively – at a cheap rate – get fresh water from salt water," observed President John F. Kennedy in 1961, "that would be in the long-range interests of humanity, which would really dwarf any other scientific accomplishment."