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Spreading life to the galaxy

Long shots

SANTA BARBARA

The idea of "seeding" alien worlds with Earthly organisms is now being discussed

SCIENCE fiction is filled with visions of galactic empires. How people would spread from star system to star system, and communicate with each other in ways that could hold such empires together once they had done so, is, though, very much where the "fiction" bit comes in. The universal maximum speed of travel represented by the velocity of light is usually circumvented by technological magic in such works. The truth is that, unless there has been some huge misunderstanding of the laws of physics, human colonisation of the galaxy will be hard.

A number of scientists reckon a more modest approach towards spreading life to other star systems might be possible. In the chill of deep space, bacteria somehow shielded from cosmic radiation might survive dormant for millions of years. Perhaps alien worlds could be seeded deliberately with terrestrial micro-organisms that might take hold there, jump-starting evolution on those planets.

There are many obstacles to directed panspermia, as this approach is known—and they are not just technical. Religiously minded critics claim "we're playing God", says Claudius Gros, a physicist at Goethe University in Frankfurt, who has floated the idea of scattering photosynthesising bacteria and algae on extrasolar planets. Critics argue in particular that "contaminating" other planets with terrestrial life in this way risks altering, or even destroying, any life that has arisen there independently. For support, they point to present-day concerns that bacteria carried by spacecraft might, if some form of life does exist there, do exactly that to Mars. This debate is hypothetical for now. But it will become more urgent if any of the projects currently being discussed to build probes to travel to nearby star systems gets off the drawing board and into space.

The seedling stars

One such proposal, sponsored by NASA, is called the Starlight project. Another, the brainchild of Yuri Milner, a Russian venture capitalist, is the Breakthrough Starshot. Both draw on the ideas of Philip Lubin of the University of California, Santa Barbara (UCSB). Dr Lubin suggests using powerful lasers to push craft attached to light sails in the direction of nearby star systems—probably starting with Alpha Centauri, the nearest of the lot. Light sails are thin, reflective sheets large enough for the pressure exerted by beams of light shone at them to provide a meaningful accelerating force in the vacuum of space. Though no such sail has yet been propelled by lasers, the principle of light-sailing has been established by spacecraft deploying sunlight-driven sails, which have successfully accelerated them.

If the sail is big enough, the craft small enough (say, a gram or two) and the laser powerful enough, then acceleration to a significant fraction (20% or so) of the speed of light should be possible. That makes journeys to Alpha Centauri (just over four light-years away) and other nearby stars a meaningful proposition. The idea is that, by the time such lasers could be built—perhaps within a couple of decades—electronics will have shrunk to a point where a spacecraft weighing a gram could carry meaningful instruments. It could also, though, carry quite a lot of bacteria.

At the Starlight project, for which UCSB is the operational headquarters, entertaining the idea of seeding other planets with life involves a certain amount of doublethink. Even looking into taking small, simple animals such as tardigrades along to see how they react to the journey is deemed too controversial for NASA, and thus has to be done on the other side of a metaphorical Chinese wall in the university—despite the fact that an animal could not possibly survive and breed without its supporting ecosystem.

As a private venture, Breakthrough Starshot suffers no such constraint. Although Gregory Matloff, a physicist at New York City College of Technology who is one of Dr Milner's advisers, says that this project, too, has yet to make up its mind on the question of sending germ packages, that position is not an actual "no".

One practical problem would be delivering such packages. They would be unlikely to survive collision with a planet at one-fifth light speed, so the craft carrying them would need to slow down beforehand. But this is not part of the plan for either Starlight or Breakthrough Starshot. They both envisage fly-by missions. The apparatus needed for deceleration would be too heavy.

For visionaries looking into the more distant future, however, weight is less of a problem. Those who really want to seed the universe with life are happy to do it slowly. Dr Gros, for one, imagines missions that might take thousands of years to arrive. For these, craft weighing kilograms rather than grams could be involved.

That would nevertheless require some serious rethinking of both the spacecraft and their living payloads. The threat to a craft of a long journey in deep space is that its electronics might be wrecked. Radiation, of which space is full, slowly displaces atoms in solids, to the detriment of any electronic components those atoms are part of. But if such electronics were heated periodically by a thermoelectric generator that employed radioisotopes—a widely used power source that has no moving parts—most of the dislocated atoms would recover their prior positions, Dr Gros says.

The threat to the bacterial payload is similar—too much radiation breaking up the complex molecules of life. To deal with that Hajime Yano of JAXA, Japan's space agency, suggests that the DNA in organisms on panspermia missions should be modified for extra robustness using the techniques of synthetic biology. This may sound ambitious, but at least one natural organism, a bacterium called *Deinococcus radiodurans*, has a DNA-repair mechanism that can rebuild genes correctly after heavy exposure to radiation.

To deliver the cargo of such a craft on arrival at a target planet, Dr Gros suggests it could first decelerate by opening a large loop of copper and superconducting ceramics with a burst of electricity. The current in this loop (which would circulate indefinitely, because a superconductor has no resistance) would create a magnetic field that gradually transferred the craft's kinetic energy to hydrogen atoms in the interstellar medium. Once in the target planet's gravitational field, the craft could use a tiny electromagnetic rail gun to fire payloads of microbes out of the back at a speed which cancelled out the craft's forward motion. These payloads would then fall gently to the planet's surface.

Why anyone would go to all this trouble is an intriguing question. Enthusiasts for the idea of directed panspermia, such as Michael Mautner, a biochemist at Virginia Commonwealth University who is the founder of the Interstellar Panspermia Society, say that if life has any purpose, surely it is to propagate. For him, that is enough. Some privately go further, seeing missions to oxygenate the atmospheres of sterile planets as preparing the ground for human colonisation in the far-distant future. That really is long-term thinking. Such a process would probably take hundreds of thousands, if not millions of years.

As for fears that terrestrial organisms could interfere with life that may exist elsewhere, most proponents of directed panspermia agree that missions should be limited to lifeless worlds. Indeed, if it turns out that life is common elsewhere then the whole idea would be rather pointless. A few, though, consider such precautions unnecessary, arguing that if terrestrial organisms prove more fit to survive on an alien world than life that may be there already, well, that is what evolution is all about. But this remains a fringe view, sometimes derided as "galactic imperialism".

Imperial Earth?

How to tell from far off whether a planet is indeed inhabited is a matter of debate. Some argue that it will be obvious from the atmosphere. No alien astronomer would doubt, looking at the amount of methane in Earth's oxygen-rich air, that something odd and probably biological was going on there—for methane is rapidly converted by oxygen into carbon dioxide and water. Mars, however, shows no sign of such chemical disequilibrium, yet many still hope it might prove to support a small amount of simple life.

The case of Mars is, indeed, pertinent. Despite stringent attempts to sterilise Mars-bound craft, Chris McKay, an astrobiologist at NASA, thinks a lot of terrestrial bacteria are already there. He calculates that *Curiosity*, one of NASA's Mars rovers, delivered almost 300,000 of them by itself. Those clinging to exposed parts of the rover have probably been killed by radiation in the 5½ years since it landed. But the rest—about half, he reckons, sheltered inside the vehicle—are probably dormant but alive. Were the planet's atmosphere ever to thicken it would screen radiation, warm Mars and allow rain. The creatures would then seep out and begin reproducing, "happy as pigs in mud", he says.

Mars's atmosphere may eventually thicken naturally, as an ageing sun puts out more heat and evaporates now-frozen carbon dioxide. But that will take hundreds of millions of years. Should people, Dr McKay asks, use their knowledge of greenhouse gases to accelerate the process, possibly thus making the place inhabitable by humans? Or should they remove their bug-harbouring gear from Mars, to avoid all risk of the bugs spreading? There is no consensus on these questions, nor on the wider ones of directed panspermia beyond the solar system. But those tempted to squash such efforts before they have even begun might ponder an intriguing fact. Life seems to have arisen surprisingly rapidly on Earth. One explanation for this is that terrestrial life is itself a gift which arrived from a distant living world. Perhaps it is time to pass the favour on. ■

Bone of contention

This specimen (viewed in the picture from four angles) is the middle phalanx of a human middle finger. It was collected from the Nefud desert of Saudi Arabia by Huw Groucutt of Oxford University and his colleagues. In a paper just published in *Nature Ecology & Evolution* they report that uranium-thorium isotopic dating suggests it is 88,000 years old—a time when the Nefud was a semi-arid grassland much less hostile than it is now. The date is significant because, except for a few excursions along the eastern shore of the Mediterranean, there was no previous evidence of *Homo sapiens* having left Africa before about 60,000 years ago. That exodus, DNA shows, led to the populating of Asia, Australia, Europe and the Americas. Dr Groucutt's discovery implies that the early non-African history of *Homo sapiens* was more complex than previously known. It also suggests that it might be worth re-examining other old bones which some think are evidence of similar early non-Africans.

Neuroscience

Brain teaser

Maybe adult brains can renew their neurons. Maybe they cannot

TWO papers with starkly contradictory conclusions, published three weeks apart, have reignited debate about whether adult human brains can grow new neurons. For over a century, neuroscientists believed brains have acquired all the neurons they will ever have shortly after birth. But research over the past two decades has questioned this, producing evidence that new neurons are indeed generated in the adults of several species, people included. The matter is of more than just theoretical concern. Understanding how neurons are generated might lead to new ways of dealing with cognitive decline in ageing, neurodegenerative disease and even depression.

The conflicting studies both involved inspecting post-mortem brain samples using a technique called immunostaining. The first to press, by Arturo Alverez-Buylla and Shawn Sorrells of the University of California, San Francisco, was published on March 15th in *Nature*. It claims that neurogenesis happens rarely, if at all, in adults. The other, by Maura Boldrini and René Hen at Columbia University, was published on April 5th in *Cell Stem Cell*. It claims neurogenesis persists through adulthood at a largely unchanged rate.

Immunostaining uses antibodies that bind to particular proteins and fluoresce in particular colours. Employing it, both teams focused their attention on DCX and PSA-NCAM, two proteins found more abundantly in newly generated nerve cells than in older ones. They looked, in particular, at the hippocampuses, two parts of the brain (see picture) involved in memory formation—a process that might easily be assisted by the generation of new neurons.

Using DCX and PSA-NCAM as indicators of youthful nerve cells, Dr Alverez-Buylla and Dr Sorrells describe a picture of abundant neurogenesis in prenatal and infant brains, which then declines sharply in the first year of life. The oldest hippocampus in which they saw new neurons had come from a 13-year-old. This supports the historical belief that adult brains do not generate new neurons. Dr Boldrini and Dr Hen, in contrast, saw signs of youthful neurons in people up to the age of 79.

How such contradictory conclusions emerged from similar approaches is now being debated. One difference was that Dr Alverez-Buylla and Dr Sorrells used samples collected up to 48 hours after death, whereas the upper limit used by Dr Boldrini and Dr Hen was 26 hours. That might

The seats of memory

be important. Studies on rats suggest DCX can break down within hours of death.

Moreover, though both teams used immunostaining, their procedures differed in other respects. In particular, Dr Boldrini and Dr Hen looked only at teenagers and adults, so could not have picked up the change that Dr Alverez-Buylla and Dr Sorrells saw in the earliest years, which provided an important reference point for the effectiveness of immunostaining. Conversely, Dr Boldrini and Dr Hen used other lines of evidence, such as the volume of the hippocampus (which did not seem smaller in old brains than in young ones), to support their conclusions.

The upshot is that old scientific cliché: "more research is needed". But the coincident publication of these two papers, each plausible in itself, is a useful reminder of the requirement, in science, to check the work. Then check it. Then check it again. ■

Innovation prizes

Turning carbon into gold

$15m is available to solve a burning problem. Ten teams are left in the race

THE X Prize foundation, based near Los Angeles, exists to encourage particular innovations that might be useful but from which conventional financial backers are likely to shy away. Previous X Prizes have been awarded for feats such as flying a reusable spacecraft to the edge of space, and designing cheap sensors to measure oceanic acidity. Those still on offer would, among other things, reward the mapping of Earth's sea floor, and a way of extracting water from air using renewable energy for less than two cents a litre.

Another prize that is still up for grabs is for carbon capture and storage, a putative approach to stopping the rise of climate-changing greenhouse gases in the atmosphere. To claim a share of the $15m on offer, winners will have to turn carbon dioxide extracted from power-plant flues into something useful—and do so profitably. On April 9th the ten-strong shortlist of those attempting this feat was announced.

At the moment, demand for carbon dioxide as a raw material is a trifling 80m tonnes a year. That compares with annual emissions of 52bn tonnes from power stations, vehicle exhausts, cement factories and so on. Moreover, the biggest use of the gas is to inject it into the ground to displace, and thus force to the surface, otherwise-inaccessible crude oil, so the net benefit in terms of global warming is close to zero. If new uses could be found—ideally ones that locked its carbon up in solid or liquid form for a long time—the market might be expanded into something big enough to make a dent in emissions.

The ten finalists hope to do this. They were selected from 27 teams (out of 47 original submissions) which managed to demonstrate, in a laboratory, that their ideas were feasible. Each was judged on how much carbon dioxide it extracted, net of any emitted in the production process or during subsequent use; by the value of the resulting product; and by the potential size of its market. Only those processes that needed less than 2,300 square metres of land and consumed less than four cubic metres of fresh water per tonne of carbon dioxide converted were deemed to qualify. As Marcius Extavour, who is in charge of the prize, explains, this stricture was intended to bar ideas like growing new forests—which are not exactly a novelty.

Four of the finalists plan to produce sturdy building materials such as cinder blocks made from the slag left over from steel production, cured with carbon dioxide. Another four will fashion the gas into plastics or carbon-fibre composites. The remaining two have invented ways to turn the stuff into carbon monoxide or methanol, which are industrial raw materials.

Each team in the final now gets $500,000 to spend on proving that its labworthy ideas will work at a scale which might make them useful. Half of the shortlist will compete for a pot of $7.5m at a coal-fired power station in Wyoming. The rest, seeking a similar prize, will set up shop at a gas-fired station in Alberta, Canada.

Some cynics have noted that a successful means of carbon capture and storage would be of great value to the prize's sponsors—NRG, an American energy company, and Canada's Oil Sands Innovation Alliance—since it would make it easier for them to keep their existing methods of business going. No doubt that is true. But in the fight against global warming many weapons will have to be deployed. If another can be added in this way, that is surely all to the good. ■

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Fascism in the 21st century

March of the times

A former secretary of state on the warnings of history and the present's real threats

Fascism: A Warning. By Madeleine Albright. *Harper Collins; 254 pages; $27.99 and £16.99*

WITHIN each human heart lies an inexhaustible yearning for liberty, "or so we democrats like to believe", writes Madeleine Albright near the end of "Fascism: A Warning", a book on how nations descend into tyranny. In reality, that desire often competes with another: the urge to be told what to do. When people are fearful, angry or confused, observes Mrs Albright, a former secretary of state, they are tempted to give away freedoms, or the freedom of others, to leaders promising order. In uncertain times many no longer want to be asked what they think: "We want to be told where to march."

Her book is dedicated to victims of fascism, but also to "all who fight fascism in others and in themselves". Mrs Albright has earned the right to that ambitious mission-statement. At a moment when the question "Is this how it begins?" haunts Western democracies, she writes with rare authority. She is not just a distinguished elder stateswoman, a former ambassador to the United Nations before leading the State Department from 1997-2001. She was also a child refugee, twice, once from a fascism of the right, then from one of the left.

Mrs Albright was a toddler in 1939 when goose-stepping Nazis drove her family from Czechoslovakia to exile in London. At war's end she returned home; her father resumed work with the Czechoslovak foreign service. In 1948 the crack of communist boots on cobblestones signalled a second, permanent exile, to America.

She sat through more sinister marching as Bill Clinton's chief diplomat. In October 2000 Mrs Albright found herself in a stadium in Pyongyang next to Kim Jong-Il, watching 100,000 North Korean children and adults dance and thrust bayonets in perfect unison. The dictator turned out to be short (Mrs Albright and her host wore heels of the same height, she found), well-informed and cordial, if disingenuous. He confided that he had designed the show himself. She left her reaction unsaid: that it takes fascist levels of discipline to make so many strut as one.

Nowadays Washington fills every few months with marchers vowing resistance to President Donald Trump (who recently ordered his generals to stage a military parade for him to review). A longtime professor of international relations at Georgetown University, Mrs Albright hears, and deplores, cries of "fascist" by hotheads on all sides. She has met too many real-life despots to indulge such sloppy thinking, and seen too much of their handiwork, starting with the murder of many of her relatives in the Holocaust.

She describes a graduate seminar with Georgetown students in her sitting room, "lasagne-leaking paper plates on their laps" as she challenges them to define fascism. She reminds the class that fascism wears different ideological guises, sometimes calling for a dictatorship of the proletariat or higher pensions for the old, at others seizing power in the name of a race, a religion or national rebirth. In a useful passage, she defines a fascist as someone who claims to speak for a nation or group, is unconcerned with the rights of others, and is willing to use all means, including violence: "A fascist will likely be a tyrant, but a tyrant need not be a fascist." One litmus test involves who is trusted with guns. Many kings or dictators fear the masses, and create corps of bodyguards to shield them, she notes. Fascists seek to have the mob on their side.

Mrs Albright sees only one true fascist regime today, in North Korea, with its ultra-nationalism and murderous contempt for human rights. Russia's president, Vladimir Putin, is not a full-blown fascist, she finds, because he has not yet felt the need.

Shame and submission

If Mrs Albright's learning is to be expected, her way with words is a happy surprise, as is her wisdom about human nature. Free of geopolitical jargon, her deceptively simple prose is sprinkled with shrewd observations about the emotions that underpin bad or wicked political decisions. In her first meeting with Mr Putin, for example, he conceded that the Berlin Wall could never have lasted for ever, but deplored the chaotic haste of the Soviet exit from East Germany. He "is embarrassed by what happened to his country and determined to restore its greatness", she jotted in a note. A proud man is, indeed, capable of almost anything to escape embarrassment.

Bookshops are full of expert guides to spotting a country's slide into autocracy. ▸▸

Bearing names like "How Democracies Die" or "Trumpocracy", they generally focus on the man in the White House. This book is broader; Mrs Albright says she first planned it as a primer for defending democracies worldwide, when she thought Hillary Clinton would win. Still, in historical chapters that a college might call Fascism 101, she has professorial fun describing despotic tactics with modern-day echoes, noting for instance that Benito Mussolini promised to "drain the swamp" by sacking Italian civil servants. Journalists were pointed out at his rallies so that his fans could yell at them. Only in periods of relative tranquillity are citizens "patient" enough for debate and deliberation, she writes, or to listen to experts.

As for Mr Trump, a tribune of the impatient, Mrs Albright's wariness of hyperbole does not mean that she is sanguine. She calls him America's first modern "anti-democratic president". Transplanted to a country with fewer safeguards, he "would audition for dictator, because that is where his instincts lead". In another era she would have been confident that such impulses would be contained by America's institutions: "I never thought that, at age 80, I would begin to have doubts."

If that sounds alarmist, it is supposed to. But her strictures are meant as much for diffident voters as for the president. She recalls her father's anxiety on arriving in post-war America and finding locals so accustomed to liberty—so "very, very free", he wrote—that they might take democracy for granted. Today she sees urgent work for citizens and responsible politicians, who may be tempted to close their eyes and wait for the worst to pass. She quotes Mussolini's scornful idea of a crowd's role: to "submit to being shaped". Submission is the first step on an avoidable march. ■

Art and addiction

Through a glass, humbly

The Recovering: Intoxication and Its Aftermath. By Leslie Jamison. *Little, Brown; 452 pages; $30. Granta Books; £20*

WHEN Leslie Jamison told people she was writing a book about addiction, their eyes glazed over. "Oh, *that book*, they seemed to say, *I've already read that book.*" They had a point, she concedes. With their tired tropes about spiralling downwards and the "tawdry self-congratulation" of recovery, such stories defy originality. More troublingly, tales of falling apart are usually more interesting than those of pulling it together. This insight threatened Ms Jamison's aspirations to get and stay sober. If accounts of drying out are dull, does sobriety come at the expense of art?

"The Recovering" offers ample evidence to the contrary. A blend of memoir, literary criticism and social history, it is as engaging as it is thoughtful. Ms Jamison proves both an insightful guide to decades of literature by and about addicts, and a self-aware chronicler of her own struggle with alcoholism.

This is a coming-of-age story, in a way, as she ultimately learns to trade the mythology of the drunken genius ("Whisky and Ink, Whisky and Ink" ran the headline of a profile of John Berryman in 1967) for the monotony of the anecdotes delivered in Alcoholics Anonymous meetings. It is an exchange she makes reluctantly. The University of Iowa's writing programme was, she found, haunted by boozy legends such as Berryman, Raymond Carver and John Cheever. Their drunkenness was part of their mystique, as if there was "a shimmering link between drinking and darkness, between drinking and *knowing*."

It was hard not to get swept up in this romance, even if "female drunks rarely got to strike the same rogue silhouettes as male ones". As Ms Jamison notes, the old intoxicated icons are all men. For literary women, such as Marguerite Duras and Jean Rhys, drinking was seen as weak, melodramatic or self-indulgent. She also acknowledges that, as a "nice upper-middle-class white girl", her relationship to the bottle could be seen as merely a cause for concern. In America, which "has never been able to decide whether addicts are victims or criminals", addicts of colour are far more likely to be punished.

By her early 20s Ms Jamison's drinking had gained a troubling momentum. She began every day pining for her first sip. She preferred drinking alone, with no witnesses to how much liquor she was putting back. "Passing out was no longer the price but the point," she writes. Why she became an alcoholic she can't quite say ("My childhood was easier than most"). But eventually she recognised that something was wrong.

At her first 12-step meetings, sipping bad coffee in church basements, she bridles at the clichés—the "insistence on soft-focus greeting-card wisdom" when she longed for nuance and novelty. But after years of hearing countless addicts share tales of cravings, shame and despair, she realises that the power of these testimonies lies in their banality. The very fact that "others have lived it and will live it again" means no one is suffering alone. Where once she distrusted the false cohesion stories lent to messy lives, now she sees that these narratives "could save us from our lives by letting us construct ourselves". She discovers work by Raymond Carver, Denis Johnson and David Foster Wallace that proves talent and recovery can be combined. She is even grateful for "the common currency of a phrase like *Take it one day at a time*, which seemed stupid until it didn't".

Recovery, she learns, involves blending humility with hope. People who are sober for decades still ask for the luck and strength to stay dry for another day. In "The Recovering", Ms Jamison has written a movingly humble book, filled to the brim with lessons learned the hard way. ■

Luxury and the leisure industry

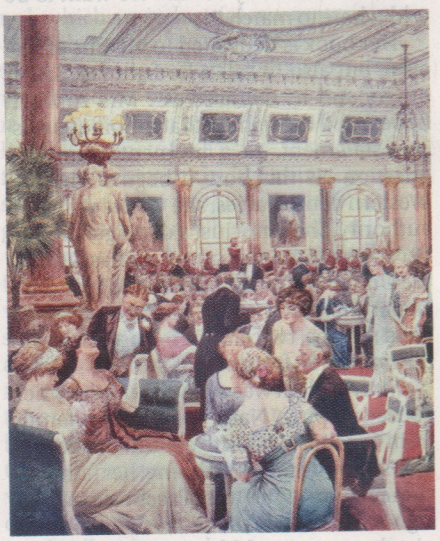
Sober cooks, tight shoes

Ritz and Escoffier: The Hotelier, the Chef and the Rise of the Leisure Class. By Luke Barr. *Clarkson Potter; 320 pages; $26 and £16.99*

ON MAY 25th 1895 the scandal of the century drew to its courtroom close. Oscar Wilde was convicted of "gross indecency" and sentenced to two years' hard labour. In London gossip swirled around the case's three most glamorous characters: Wilde himself; his lover, Lord Alfred Douglas—and the Savoy hotel. For it was in the Savoy that Wilde and Douglas had stayed for a whole month.

The details were enticing. They had, it was murmured, dined like kings, eating turtle soup and ortolans, washed down with bottle upon bottle of champagne. They had left stains on those expensive sheets. César Ritz, the Savoy's manager, was mortified—not at the flouting of morals, but at the breach of trust by the hotel. A hotelier should, he said, "keep his own counsel". Not advise the prosecution's.

Ritz felt he had failed his guest. He didn't fail many. As Luke Barr explains in "Ritz and Escoffier", at the end of the 19th century this hotelier, along with Auguste



Hail, César!

Escoffier, his chef, transformed not just hotels but the lexicon of luxury itself. When you eat a Peach Melba, or drink a Grand Marnier, you have these men to thank; they coined the names, then popularised the concoctions. Ritz himself became not merely a byword for luxury but the actual word for it: the Oxford Dictionary defines "ritzy" as "expensively stylish".

When Ritz and Escoffier arrived in London from Europe—they had been hired to transform the Savoy—they were shocked. This was the greatest city on Earth, yet its hotels were dismal. Their restaurants were unsophisticated, their kitchens filthy and their chefs rude—and often drunk. Together they revolutionised London society. Ritz purged the Savoy of its old-fashioned fussy trinkets and replaced them with elegant palm trees and banks of flowers. Escoffier introduced to the kitchens the concepts of electric light, hygiene and sobriety ("We are not drunks…We're cooks"). Food was fresh and gently marinated in delicate sauces; the guests were marinated in the finest bubbly.

The meals were astonishing. They were flavoured not merely with the garlic that Escoffier championed (popular opinion considered it "unrefined and repulsive") but with a whiff of *fin de siècle* extravagance. Johann Strauss and his orchestra were engaged to provide background music. Guests were presented with tiny peach and cherry trees from which they cut the fruit with golden scissors.

Historians usually prefer more serious fodder. Monarchs and crises are their meat and drink, not real meat and drink. But you can learn a lot from what people eat, including about money. Once, money had been held in the hands and lands of a few wealthy aristocrats. Now, it started to flow: into the new industrial classes, the leisure industry and the glasses of vintage champagne served by Ritz (after a falling-out at the Savoy, in hotels that bore his name).

As money shifted, so did social boundaries. Once, the grandest people had hosted their get-togethers "At Home". Now, all high society—the Duc d'Orléans, Princess Alexandra, even the Prince of Wales himself—entertained in Ritz's hotels. For Ritz, it was a triumph. He had been born the son of a Swiss peasant farmer and never forgot the pains of his origins. Quite literally: fearing his peasant feet were too large, he always wore his shoes a half-size too small.

The subtitle of this very readable book is "The Hotelier, the Chef and the Rise of the Leisure Class". But though it is the glittering *beau monde* which draws the reader's eye, this story is more about those who served them, and the rise of the less-glittering services industry. Ritz, in his too-small shoes, may have felt ennobled by the presence of Princess Alexandra and the Duc d'Orléans. But, today, it is not their names that are world-famous. It is his. ■

Miscarriages of justice

I knew I didn't do it

Levon and Kennedy. By Isabelle Armand and Tucker Carrington. *Powerhouse Books; 110 pages; $39.95 and £33.99*

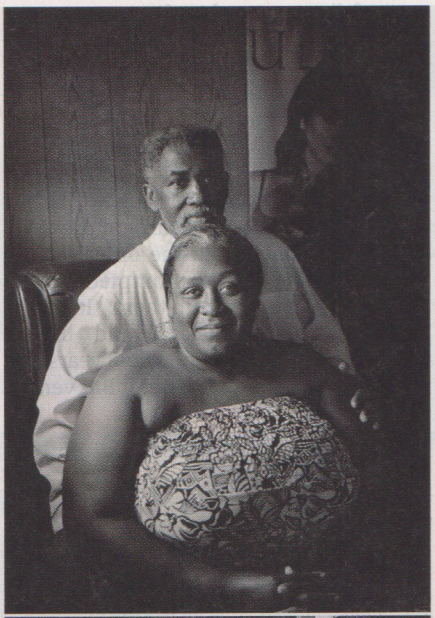
The Cadaver King and the Country Dentist. By Radley Balko and Tucker Carrington. *Public Affairs; 319 pages; $28.00*

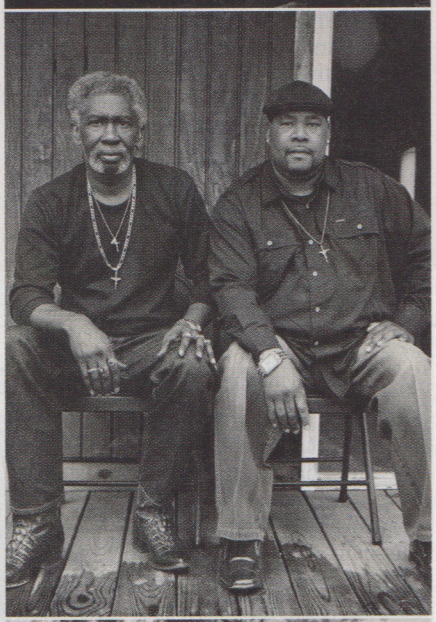
MAYBE the best argument against capital punishment is that it can kill an innocent man. This almost happened to Kennedy Brewer, who in March 1995 was convicted of the abduction, rape and murder of Christine Jackson, his girlfriend's three-year-old daughter. After a brief trial, the jury condemned him to death. Mr Brewer was driven to Mississippi's notorious Parchman Penitentiary, fitted with a red jumpsuit and locked in a maximum-security cell. His execution was originally set for May of the same year.

Levon Brooks was also at Parchman, convicted of the similarly gruesome rape and murder of Courtney Smith, another three-year-old girl, only a few miles from Mr Brewer's house. Mr Brooks was sentenced to life imprisonment. Both convictions largely relied on two witnesses. One was Steven Hayne, a medical examiner formerly responsible for up to 80% of Mississippi's annual autopsies; for a spell Mr Hayne performed over 1,500 a year, six times the professional standard. The other was Michael West, a dentist with a record of controversial testimony.

After spending a combined 29 years in prison both men were exonerated in 2008, thanks to the painstaking work of lawyers at the Innocence Project in New York, which investigates wrongful convictions. A DNA test in Mr Brewer's case pointed to Justin Johnson, a convicted sex-offender who lived nearby. On his arrest, Mr Johnson admitted to both crimes. He had briefly been a suspect in the murder of Courtney Smith, but Mr West had claimed his teeth failed to match what he identified as bite marks on the victim. It now seems possible that the little girl's body bore no bite marks at all (Mr Johnson made no mention of biting either child in his confession). Mr Brewer and Mr Brooks each received $500,000 in compensation.

These tragic events have yielded a pair of complementary books. In "The Cadaver King and the Country Dentist", Tucker Carrington of the Mississippi Innocence Project and Radley Balko, a journalist at the *Washington Post*, meticulously document the twin miscarriages of justice, laying bare the systemic problems and structural racism that lead poor black men to be ▸▸





wrongfully convicted in disproportionate numbers. "The core problem with the medico-legal system in Mississippi is that it's easily manipulated—it serves those in power," they write.

The other book is a volume of haunting pictures by Isabelle Armand, a French photographer, with accompanying text by Mr Carrington (see photo details on previous page). An article about the ordeal of Mr Brewer and Mr Brooks prompted Ms Armand to get in touch with them. "It was so shocking that forensics could be so flawed," she says. She spent five years taking thousands of pictures of Mr Brewer, Mr Brooks and their extended families (Mr Brewer has 14 siblings). The black-and-white images stand out for the beauty of rural Mississippi, the poverty of the two clans, who live mainly in trailers, and the indomitable spirit of the men—who had, almost literally, come back from the dead. "I never lost hope," Mr Brooks told Ms Armand. "I knew God was on my side."

Mr Brooks died of colon cancer in January. He lived only ten years after his release, but he made the most of them. He raised chickens, quails and rabbits and married Dinah Johnson in 2016 (see top image). Mr Brewer is younger and in relatively good health. He has a fiancée too, Omelia Givens (see bottom image). "I did good, some guys go crazy in prison," he told Ms Armand. "I knew I didn't do it."

Mr Carrington now hopes to exonerate Eddie Howard, who has been on Mississippi's death row since 2000 for the rape and murder of an 84-year-old woman. He was convicted largely because of a match of his teeth to bite wounds identified by Mr West. Genetic testing found no traces of Mr Howard on the murder weapon or the body or elsewhere at the crime scene. "In a fair world, he would be free," says Mr Carrington. "But this is Mississippi." ■

Johnson | 12 confused men

The language of jury instructions is dangerously ponderous and baffling

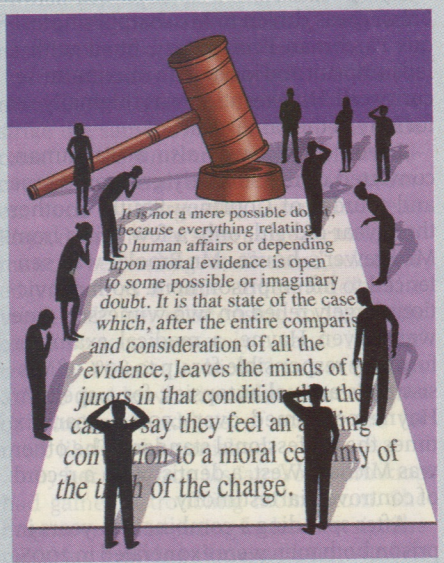
IN 1954 an Ohio jury was told it must acquit Sam Sheppard of murdering his wife if the jurors had a "reasonable doubt" that he had done so. The judge then defined "reasonable doubt":

> It is not a mere possible doubt, because everything relating to human affairs or depending upon moral evidence is open to some possible or imaginary doubt. It is that state of the case which, after the entire comparison and consideration of all the evidence, leaves the minds of the jurors in that condition that they cannot say they feel an abiding conviction to a moral certainty of the truth of the charge.

Sheppard was convicted. Larry Solan of Brooklyn Law School reckons that this and other baffling instructions misled the jury into thinking that the burden of proof was on Sheppard to prove himself innocent, not on the state to prove him guilty beyond a reasonable doubt. In a second trial, in 1966, he was found not guilty and freed.

A jury is a buffer between defendants and the might of the state, and a jury trial is guaranteed in America's bill of rights. But there is reason to worry that juries often do not understand what they are told to do to fulfil this role. Jurors are not (usually) lawyers, which is the point. They are the defendant's peers. But their instructions are written by lawyers, who are often so immersed in their professional argot that they do not realise how impenetrable it can be to outsiders.

Take this sentence from Massachusetts's civil-jury instructions: "A preponderance of the evidence is such evidence which, when considered and compared with any opposed to it, has more convincing force and produces in your minds a belief that what is sought to be proved is more probably true than not true." The sentence is not only long; the bigger problem is that it has four clauses, embedded within one another. This kind of prose is hard to process, especially for non-native speakers, even more so when it is spoken rather than written down.



Another problem is the passive voice. Though the passive has some applications, it is overused in formal contexts. Like convoluted clauses, passive jury instructions can be hard to follow. Research has shown that when people hear sentences such as "the woman was visited by the man", and are quickly prompted to identify who was the "do-er" and who "acted upon", their reaction time and accuracy are considerably worse than when hearing the active-voice equivalent.

A final problem is legalese. Lawyers love words such as "notwithstanding" and "inference", but studies suggest as many as half of jurors think "preponderance" has something to do with pondering. Even plain words like "burden" have specialised meanings in court.

Janet Randall, a psycholinguist at Northeastern University, has found that rendering these instructions in plain English, stripping out passives and legalese especially, makes them much easier to interpret. Providing a written version brought an even bigger benefit. She first recorded modest results when testing psychologists' favourite lab rats—their students. But these are people who did well on English tests to get into university. When she recruited respondents online, who looked more like the actual jury pool overall, the good effects of the plain-English instructions shot up.

The Supreme Court has weighed in on ambiguous jury instructions, but has not yet struck down those that are merely hard to comprehend. Some American states have adopted simplified language, and some provide each juror with written instructions. But some still have not. A justifiable reason is that it can be difficult to render legalese accurately into terms that sound like conversational English. Less defensible reasons are mere inertia or, even worse, the belief on the part of a few judges that cumbersome formal language is needed to give jurors a sense of the majesty of the law.

Jurors will not often want to admit they don't understand. They are eager to end the trials and get back to their lives, and lawyers and judges in crowded court systems want them to get on with it, too. But bafflement should worry anyone who may face a jury, particularly in a country where the state can execute a defendant (see previous story). As long as that is the law in America, every easy reform that makes the system work better should be seized with urgency. Cleaning up the language of courtrooms is an obvious place to start.