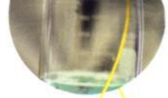
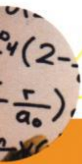



CIRCLES




FIFTY ROUND TRIPS THROUGH

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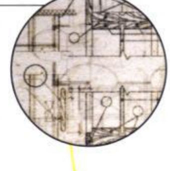
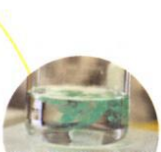
JAMES BURKE

BESTSELLING AUTHOR OF THE KNOWLEDGE WEB

CIRCLES

50

Round Trips
through
History,
Technology,
Science,
Culture

JAMES BURKE

ILLUSTRATED BY DUŠAN PETRIČIĆ

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CIRCLES

FOREWORD

I SUPPOSE THE real reason for taking an interest in history is, as some ship's navigator must have once said, you can only predict where you're going if you know where you've been. So it probably seems perverse that I have chosen to write a series of historical tales that go, as it were, round in circles, since, in some way, each of them ends where it begins. This is because of the view I take of how things happen and, specifically, of how you write about them.

First, the view. Like everything in life, the key to success, happiness, and all those other things people want lies in how good you are at prediction. The more accurately you foresee what's coming, the better you're going to be placed to (a) avoid it or (b) benefit from it. The problem is (as history shows all too painfully) that, as the great Danish physicist Niels Bohr once said, "Prediction is extremely difficult, especially about the future." This is because the future is almost never a linear extension of the present. Which all too soon becomes obvious. A few cases in point: Gutenberg thought he'd print a few Bibles, and that'd be that; in the 1940s the head of IBM said America would need about half a dozen computers, and the magazine *Popular Science* predicted they would not weigh more than 1½ tons; Alexander Graham Bell believed the telephone would be used only to tell people to expect delivery of a telegram.

Trapped inside the knowledge context of the time, people in the past were no better at second sight than we are. Which is why serendipity plays a key role in the historical sequence and the process of change. This is as true for the present as it was for the past. How many times in your own life did things come about thanks to accident of circumstance? I'll bet happenstance played a part in how you met your partner or chose your career or live where you do or a long list of other character-forming events that now make you different from anybody else. That journey from past to present, full of unexpected encounters and events along the way, has brought you to where you are and who you are at this moment, reading these words.

This is why the past is no foreign, unknown land. The people in the past were trapped in their context, just as we are in ours. Nobody back then knew what was going to come round the corner to change his or her best-laid plans.

What makes the investigation of this process so exciting (and often amusing) is that with the benefit of hindsight we can see why they thought and acted as they did. From our high ground we can also see why things almost never worked out the way they expected because, unlike us, they couldn't see round their corner.

This was why the mid-nineteenth-century coal-gas makers threw away their coal-tar by-product, unaware that within a decade it would be revealed as a valuable cornucopia of products including aspirin, antiseptic chemicals, dyes, timber preservative, and fuel.

In the eighteenth century, Italian scientist Alessandro Volta produced a gas-testing eudiometer. It consisted of a bottle into which led two wires whose ends almost touched. The experimenter filled the bottle with the gas to be investigated. A charge of electricity was then sent down one of the wires and jumped the wire gap, and the gas would explode (or not). After this kind of experiment was discontinued, the eudiometer lay around for more than a hundred years. Then it became the basic element of the spark plug.

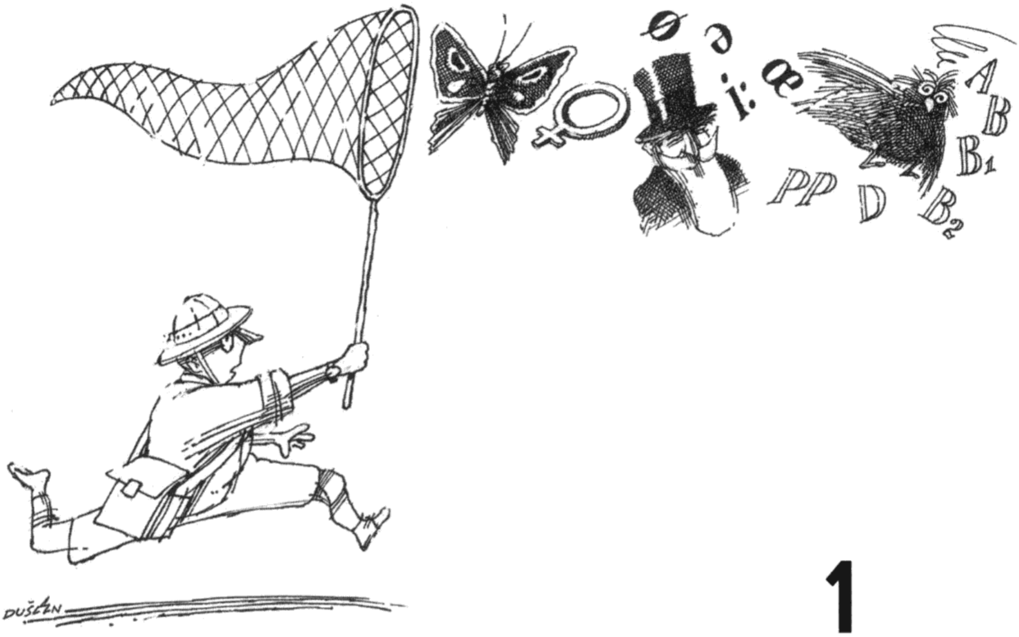
The eighteenth-century Jacquard automated silk-weaving system, which used perforated paper as a control mechanism, inspired Herman Hollerith to develop the punch card for data processing during the 1880 U.S. census. The tabulating company he founded to exploit his idea went on to become IBM.

As I hope these essays will show, the other fascinating thing about the way events unfold is the extraordinary variety of the elements involved. In spite of the tendency in schools to segment the past into subject areas (history of chemistry, art, music, transportation, and so on) in which advances and discoveries developed the discipline into its modern form, such an approach to teaching very rarely reflects what actually happened. For instance, a "history of communication" might lead back from the 1947 Bell Labs development by Shockley of the transistor (electronics). It used germanium, the deposits containing which were first located in the United States by nineteenth-century rock-hound William Maclure (geology), who also funded a commune in New Harmony, Indiana, set up by Robert Owen, a mill-manager from Britain (textiles), who learned his utopian views from William Godwin, founder of the socialist movement (politics), whose daughter Mary wrote *Frankenstein* (novelist), after she married Percy Bysshe Shelley (poet).

The essays in this book follow the same kind of unexpected path in an effort to recreate a feeling of what it was like to be constrained by the contemporary context. I hope that each time the story rounds a corner the reader will experience a little of what it was like to be the characters themselves, and to be as surprised as they were at the turn of events. Sometimes the turn is a trivial matter, sometimes not. That's how things happened.

Earlier I mentioned the circular structure of these essays. There are two reasons why I make such play of the unstructured nature of history, but then, in this book, give it a formal shape. One reason is that otherwise these essays would have mirrored the serendipity I described, just going from anywhere to anywhere, with no reason for beginning where they start from, or ending where they go to (and leaving as many dangling readers as participles). Choosing to go round in circles, and to end each story where it begins, lets me illustrate perhaps the most intriguing aspect of serendipity at work, which shows itself in the way in which history generates the most extraordinary coincidences. In this sense, history repeats itself all the time.

You may not agree with the way these essays present events. That's fine. There is no single correct way to track from the past to the present. And if your disagreement goes so far as to drive you to find alternate routes for what I write about that are even better, write your own history. The more of us doing so, the better.



1

A BIT OF A FLUTTER

I SUPPOSE MY view of history tends away from the orderly and toward the chaotic, in the sense of that much overused phrase from chaos theory about the movement of a butterfly's wing in China causing storms on the other side of the world. Which is why I decided to have a go at reproducing the butterfly effect on the great web of knowledge across which I travel in these essays.

This thought came to me at the sight of a giant cabbage white in a *Lepidoptera* exhibit at the Natural History Museum in London, which reminded me of the other great Natural History Museum, the Smithsonian. Which owes its life to the persistence of one Robert Dale Owen. The two-term Democrat from Indiana almost single-handedly pushed through Congress the 1845 Bill accepting the Englishman James Smithson's $2-billion-and-change bequest (in today's money) that helped to set up the esteemed institution. Owen's efforts also involved unraveling one of the shadier deals in American financial history: most of Smithson's money, which had arrived in the United States a few years before, was at the time in the dubious grip of a foundering real estate bank in Arkansas, into which the U.S. Treasury had thoughtlessly placed it for safekeeping.

Owen was a liberal thinker, the son of a famous British reformer who had earlier started an unsuccessful utopian community in New Harmony, Indiana. Well ahead of his time, Owen championed women's rights, the use of plank roads (for rural areas not served by the railroads), emancipation, and family planning. This last he espoused in a pamphlet in 1830. Subtitled "A Brief and Plain Treatise on the Population Question" (which gives you a feel for the cut of his jib), it advocated birth control by everybody and included three examples of how you did it. Two years later much of Owen's text was lifted (unacknowledged) for a bestselling tract by Dr. Charles Knowlton of Boston: "The Fruits of Philosophy," which went into greater physiological detail.

Forty years on, Knowlton's/Owen's work was republished by activist Annie Besant in England, where it was judged obscene and likely to pervert morals. Ms. Besant conducted her own defense at the trial and in doing so became the first woman to speak publicly about contraception. Which earned her a fine and a sentence. Undeterred, Besant took up larger causes: Indian independence (she was President of the first Indian National Congress), vegetarianism, and comparative religion. This was some years after she'd broken off a romantic interlude with another left-winger, a penniless nobody called George Bernard Shaw, with whom Annie played piano duets at the regular meetings of William Morris's Socialist League in London. Later, Shaw would become fairly well known as the author of *Pygmalion* and then world-famous as the author of its Hollywood remake, *My Fair Lady.* The play was all about talking proper (which Eliza Doolittle didn't, you may recall) and featured a prof. of elocution, Henry Higgins, whom Shaw modeled on a real-life linguistic academic named Henry Sweet.

In the 1880s Sweet was one of the inventors of the phonetic alphabet, interest in which was triggered by the contemporary craze for old languages kicked off by William Jones, a Welsh judge in Calcutta. In 1786 Jones had revealed the extraordinary similarities between the ancient Indian language of Sanskrit and Latin and Greek. The revelation revved up nationalism among early-nineteenth-century Romantic movement Germans (whose country had not long before lost a war with the French and was going through a period of cultural paranoia) because it gave them the idea that they might be able to trace their linguistic roots back into the Indo-European mists of time, thus proving they had a heritage at least as paleolithic as anybody in Paris.

This mania for reviving the nation's pride might have been why German graduate students were also getting grants for such big-science projects as sending out forty thousand questionnaires to teachers all over the country asking them how the local dialect speakers pronounced the sentence "In winter the dry leaves fly through the air." On the basis of such fundamental research, pronunciation atlases were produced, and dialectology became respectable. So much so that at the University of Jena, a guy called Edward Schwann even got the money to do a phonometric study of zee French accent. Nice work if you can get it. Schwann was aided in his task by the eminent German physicist Ernst Pringsheim.

In 1876 Pringsheim was one of the science biggies visited by Franz Boll, a researcher who was working on the process by which the human eye is able to see in low light, thanks to the presence of a particular chemical. Or not, in the case of its absence. The whole view of such visual deficiency was taken a stage further by a sharp-eyed Dutch medical type, Christiaan Eijkman. This person happened to be in Java with a Dutch hospital unit, sent out there in 1886 to grapple with the problem of beriberi, a disease that was laying low large numbers of colonial administrators and army people. Eijkman happened to notice some chickens staggering about the hospital compound with symptoms not unlike those of the disease he was studying. But because these were chickens and not humans, he did nothing about it. Until suddenly, one day the chickens got instantly better. What kind of fowl play was going on here?

Turned out, the new cook at the hospital had decided that what was good enough for the local Javanese workers was good enough for birds. So he had stopped feeding to the chickens gourmet leftovers from the table of the European medical staff. Difference being in the rice. Europeans were given polished rice ("military rice"); locals and the chickens got the stuff with the hulls left on ("paddy"). Months of chicken-and-rice tests by Eijkman ended up with a meaningful thought: There had to be something in the rice hulls that was curing the chickens. Or, to put it *more* meaningfully, without this "something" in their diet, the chickens got the staggers. So was that why people did the same?

A few years later, in England, Gowland Hopkins, an ex–insurance broker turned biochemist, observed that baby rats wouldn't grow, no matter what they were fed, if their diet didn't include milk. He became convinced there was something in normal food that was essential for health and that wasn't protein, carbohydrate, fat, or salt. Gowland labeled these mystery materials "accessory food factors" and went on to share the Nobel with Eijkman, because their work would lead to the discovery of what these accessories actually were: vitamins (in the case of the chickens, thiamine).

Now, why all this made me think that how the web works might remind you distantly of chaos theory was because of what Gowland had been doing before he got into nutrition. He was able to work with pure proteins and their role in nutrition once new techniques had been developed (at Guy's Hospital in London, where Gowland had trained) to analyze uric acid proteins in urine.

And he was interested in uric acid because his very first scientific work had been with insects, when he had conjectured (wrongly, as it turned out) that uric acid was involved in producing the white pigment of the wings of the cabbage white butterfly.

2

SATISFIED CUSTOMERS

THE MODERN DEPARTMENT store, with its money-back-guaranteed merchandise, is one of the great examples of industrial democracy in action. Thanks to mass production and distribution, I can go back to the shop and get a free replacement copy for a cup that I found a flaw in last week. It was one of those willow-pattern things. Genuine Wedgwood. An ironic term, really, because Wedgwood's original stuff was fake. Josiah Wedgwood was a potter who started his career repairing Delft chinaware (fake porcelain, first made for the Dutch middle classes, who couldn't afford the sky-high prices of the real thing coming in from the Far East). Then, in 1769, Wedgwood graduated to crafting his own stuff (fake Greek vases, first made for the English middle classes, who couldn't afford the sky-high prices of the real thing coming in from southern Italy).

The source of Wedgwood's inspiration was an amateur archeologist and site-robber by the name of Sir William Hamilton, who had been appointed English minister to the court of Naples in 1764, not long after the first systematic excavation of the nearby ancient city of Pompeii. So there was a ton of classical bits and pieces lying around for what might charitably be referred to as "collecting." Hamilton's collection grew so big that he published catalogues, one of which influenced Wedgwood.

From time to time, Hamilton would return to England to sell his latest haul of antiquities to institutions like the British Museum or the duchess of Portland. On most of these occasions, the sales agent was his nephew, a ne'er-do-well called The Honourable Charles Greville. Now, there must have been something ne'er-do-well in the Hamilton blood, because Sir William's own mother had seduced the Prince of Wales, and in 1785 he himself took over Greville's mistress (to "save the boy the expense"). The lady in question was a strapping lass thirty-five years Hamilton's junior, who called herself Emma Lyon and who was into "attitudes" (posing, in diaphanous outfits, as various classical Greek and Roman personages).

Emma might have learned the trick while working as an "attendant" for James Graham, one of the era's greater electricity quacks. Graham boasted an impeccable scientific background from Edinburgh University, where he had studied under such medical greats as Joseph Black, the discoverer of latent heat. Electricity at the time was something like cold fusion in the 1990s: Nobody quite understood it, but people supposed that it might do miracles. They knew that an electric current (produced by rubbing glass with a silk cloth, or by touching a Leyden jar) could cause dizziness, a quickening of the heart rate, and spots before the eyes. Maybe electricity was good for the health.

Graham claimed electricity cured only everything. At his posh London Temple of Health (in its elegant, Adam-designed premises), the elite took mudbaths and shocks while surrounded by scantily dressed nubile maidens (Emma was one for a while) and protected from the rude gaze of the riffraff by six-foot-tall bouncers on the front door. Graham had the London demimonde knocked out cold by the star of his shocking show: the amazing "magnetico-electrico-celestial" bed, guaranteed to fix infertility and almost anything else that ailed you. The line of the credulous infertile ran all the way around the block.

Back in Naples, Sir William Hamilton set Emma up in a plush villa, where she continued to assume attitudes. Not surprisingly, her posing turned out to be just the thing to catch the attention of a prominent Navy type who had been at sea for too long (that, and possibly the fact that, as he later noted, Emma never wore underwear). The sailor in question was the hero of the day, Horatio Nelson, whose charms were so renowned that when he sailed into Naples there was female fainting all round. He met Emma in 1798. Quicker than you could say "Admiral of the Fleet," she was his mistress, and they were canoodling on the island of

Malta, where the commissioner ruling the place was another old sea-dog, Captain Alexander Ball, who had once saved Nelson's ship and life.

In those days, Malta was a strategic hotspot in the conflict between Napoleon and the rest of Europe. Malta gave Nelson control of the Mediterranean sea lanes and hence secured the route through Egypt to British India. Which was why Napoleon was after Malta. And others. So the island was full of intrigue, and Russian, French, and Turkish spies. There were also a few Americans (resting up after their war with Tripolitania), who had their own transatlantic reasons for undermining the Brits.

All this international hugger-mugger meant that when Ball was not entertaining Nelson and Emma, he was busy writing secret dispatches, night and day. And, because Ball was better at navigation than prose, the dispatches were being edited, day and night, by his new rewrite man, a passing opium addict and Romantic poetry maven named Samuel Taylor Coleridge, who had arrived on the island in 1804, on the run from his wife and his habit.

Coleridge had journeyed to Malta to recover his health and financial well-being. After nearly two years, neither goal had been achieved, so the poet headed back to London via Rome, where he met and was painted by an American artist called Washington Allston. The two soon became close friends, and on a later visit to England, Allston introduced Coleridge to his protégé, a young American whose aim in life was to create one of the murals for the Capitol Rotunda in Washington, D.C. Alas, the job never came his way, although he did become the rage of New York's art world, founded the National Academy of Design, and made portraits of such movers and shakers as General Lafayette and DeWitt Clinton. In 1829, this young painter headed once again for Europe, where he gradually came to realize that his future might lie elsewhere than on canvas.

On the return trip, in 1832, he came up with the idea that made him so much more famous than did his art, that you are probably still wondering who it is we're talking about. The man was Samuel Morse, and the idea, of course, was sending messages along a wire. Six years of development later, Morse was only about the sixth guy to produce a telegraph, but his version hit the jackpot for at least two reasons. One was the Morse Code. Nobody is totally sure that he didn't snitch it from his partner (and supplier of free hardware) Alfred Vail. Be that as it may, compared with the complicated, telegraph-and-printer models developed by his competitors, Morse's technique was a breeze. It needed just a simple contact key (to send simple groups of five on-off signals), required only a single operator, worked over low-quality wire, and was cheap.

The other reason for Morse's success was also financial. Back then, railroads often ran both ways on single tracks (this saved money) and they frequently crashed (this lost money). Operators urgently had to find a way to instruct trains, coming in opposite directions, when to move and when to wait. The telegraph did just that, for the first time, in 1851 on the Erie Railroad. But it also complicated matters for its users.

By the mid-1850s the Erie employed over four thousand people and the rail network was growing like Topsy. In 1860, the company had around thirty thousand miles of track and things were threatening to go off the rails. The problem was that railroad companies served as many different enterprises all at once: shops, terminals, rail track, marshaling yards, warehouses, and engineering units. Moreover their materials, personnel, and money were spread across thousands of miles. And the nature of the business meant that, from time to time, they had to make instant, system-wide decisions. If the companies were to survive, they needed a radically new kind of command-and-control organization.

Three engineers came up with the solution, making use of the rapid communications facilitated by the new telegraph. Daniel McCallum (of the Erie), J. Edgar Thomson (of the Pennsylvania Railroad), and Alfred Fink (of the Louisville & Nashville Railroad) devised the first business administration organization chart, the idea of line-and-staff management and divisional company structure, and the first true cost-per-ton-mile financial analysis. As a result, the railroads were soon able routinely to handle thousands of articles (passengers and freight) at high rates of turnover (getting them on and off trains) at low margins (cheap prices) on a huge scale (all across the continent).

By the 1870s, railroad management techniques had helped establish another industry built on the frequent and regular delivery of goods. Like the railroads, these businesses operated on a large scale, at low margins, and with high-volume turnover. Like the railroads, their staffs outnumbered the population of many cities. And like the railroads, their organization was departmental. Which is why they became known as "department" stores. These places proved a great hit, and went on to generate the democracy of possessions that characterizes the modern industrial world.

So thanks in the first place to Wedgwood (whose factory is still operating), everybody today can buy his crockery. And anything else they desire. And if there is something wrong with it, get a free replacement, guaranteed.

A practice first introduced, in his London showrooms, by Wedgwood.

3

FOLIES DE GRANDEUR

SITTING HERE AT my trusty computer, I look out on the River Thames and Brunel's beautiful railway bridge, so I'm constantly reminded of the way nineteenth-century iron and steel technology gave them all machine-assisted *folies de grandeur.* So there I was, dredging my mental silt for a line on folly with which to start this essay, when one floated past, under the bridge. A dredger, that is.

Which suggested the Suez Canal, the *folie de grandeur* project of them all. Everybody, from the Romans on, had a go at it. Even Napoleon tried and gave up, when he invaded Egypt in 1798. His committee of scientists (who accompanied the troops) had told him the thirty-inch difference in water level between the Mediterranean and the Red Sea made it inadvisable. But in 1859, twenty-five thousand *felaheen* laborers, together with a financial consortium made up of Switzerland, Italy, Spain, Holland, and Denmark, finally succeeded. It was during the last stages of construction that suction dredgers were employed.

Both the canal and the pneumatic sand removal had been French ideas. The canal itself was masterminded by a think-big entrepreneur called Ferdinand de Lesseps (who then went on to bankruptcy over a similar job that didn't go so well in the Panama isthmus). Industrial-scale pneumatics had been introduced earlier, when the French were digging the first railway tunnel through the Alps under Mont Cenis. This was intended to unite Italian Savoy (north of the mountains) with the rest of Italy (south of them) and also make it possible for people sailing home from India and the East to pick up a train somewhere like Brindisi, instead of having to sail all the way round Spain. Unfortunately, before the tunnel was complete, war gave Savoy to the French. Still, the tunnel would be good for tourism.

In 1861, not far into the Alpine rock face (after three years of boring hand-boring, and advancing all of twenty centimeters a day), the chief engineer, Germain Sommelier, decided to try something that would finish the job in less than his lifetime—a specially built reservoir, high above the tunnel entrance, providing a head of water that would compress air to supply pneumatic drills that would get him through the rock faster. As it happened, the drills sped things up twenty times faster, but Sommelier never made it. He died of a heart attack a little later.

The Mont Cenis tunnel amazed everybody almost as much as the Suez Canal, and its new wonder-drills featured in a magazine picked up one day by a young American whiz kid, George Westinghouse. In 1869 he turned the pneumatic concept into an airbrake for use on trains. Compressed air, running through pipes underneath the train, held back pistons. In the event of the air pressure being released (either deliberately or by a rupture in the pipes), the pistons would slam forward, driving brake shoes against wheels. This would stop a 30-mph, 103-foot train in 500 feet, and made it possible to schedule more trains, more closely spaced than had previously been wise.

This in turn required better signaling. Which is why, in 1888, Westinghouse fell in with an inventive Croat who wore a new red-and-black tie every week and lived in a hotel room full of pigeons. Name of Nicola Tesla, this person came up with a way to send electrical power long-distance along railroad tracks, so as to operate railway signals. And then invented a little device so fundamental to the modern world that most of the time you don't even know it's there. He sent alternating current into two sets of coils wound on iron, setting up currents that were ninety degrees out of phase with each other. These generated a magnetic field that rotated with each successive burst of current. The rotating magnetic field caused a copper disc to spin. When you put a belt on the disc you had an electric motor.

By World War I this trick was just what the captains of the new monster-size battleships were looking for. First of all, because metal ships carrying on-board electric power had been making life difficult for a magnetic compass. So you could easily get lost. And second of all, in a rough sea the giant new fourteen-inch guns, which fired 850-pound shells nearly ten miles, couldn't hit an enemy barn door if the ship were rolling heavily at the time. Tesla's little motor helped solve both these problems, because it could spin gyroscopes of at least three different sizes. There were tiny gyros for true-north-pointing gyrocompasses (once you spin the gyro, if you leave it alone it stays pointing the way you set it spinning, come hell or, more appositely, high water). There were also humungous, four-thousand-ton gyros, spinning in the center of a ship and compensating for the roll of the sea. And finally there were midsize gyros, doing the same favor for all the gun platforms and permitting dreadnoughts to live up to their name. In her first wartime encounter, the newly gyro-stabilized USS *Delaware* shot every attacking plane out of the sky. During a storm.

This use of the gyroscope was the brainchild of a Brooklyn electrical component manufacturer called Elmer A. Sperry, and it made his fortune. Mind you, persuading the Navy to buy hadn't all been plain sailing. And the financial risks were real high-wire stuff. Which, as it happened, was where Sperry had originally (and for only once in his life) failed. Early on, he'd tried to talk showman P. T. Barnum into featuring a gyro-stablized wheelbarrow in one of his circus trapeze acts.

The likely reason for Barnum's refusal was that he didn't have much to do with technology except briefly, in the 1840s, when he first set out to be a showman and went looking for curiosities to exhibit. His wish list included "industrious fleas . . . fat boys . . . rope dancers . . . and knitting machines." Moreover, by the time Sperry was pitching the gyro idea, Barnum was well beyond wheelbarrows (or industrious fleas, for that matter), touring "The Greatest Show on Earth" (eight hundred people, ten thousand miles a year by special train), and had already invented the three-ring circus. Known as the "Prince of Humbug," Barnum could have sold refrigerators to Eskimos. In his Big Top, the crowned heads of Europe went crazy over his midget admirals, buffalo hunts, and elephants, as well as spectacular reruns of the such modest moments as the Destruction of Rome, the Fall of Babylon and the American War of Independence.

From time to time Barnum's personality would do a flip-flop and he'd give it all up for temperance work. Or, on one occasion, in 1850, to manage a U.S.–Cuba tour for the greatest soprano in the world, Jenny Lind. In 1844 Ms. Lind had given her first performance outside Sweden (in Berlin) and was so extravagantly successful that she became an instant diva at the age of twenty-four. People paid crazy prices for tickets to her appearances, even if they couldn't make it. One fan wanted only to touch her shoulder "to see where the wings began." Queen Victoria threw her own bouquet at Lind's feet. In the street she caused scenes that wouldn't be witnessed again until the Beatles. In 1845 Her Majesty's Theater in London decided to commission a new opera for Lind and offered the job to the other contemporary operatic superstar, Giuseppe Verdi. Two years later Verdi obliged with *I Masnadieri*, starring Lind in the role of Amalia. Boffo success.

Verdi was always delighted to accept foreign writing work because it paid up to seven times more than he got at La Scala, Milan, in spite of the fact that he was Italy's premier musical nationalist at the time. In the 1840s Italy was occupied by the Austrians, and Verdi was craftily getting round problems with the censor with inflammatory stuff about killing *Swedish* kings, and going on about *Israelites* in bondage, and *American* revolutionaries, and other "geddit?" subtleties like that.

This might be the reason Verdi got the chance to write what turned out to be the most popular opera ever: *Aida.* Ruling Egypt at the time was a khedive (ruler) named Ismail, whose local engineering improvements had cost so much he was severely short of funds, and had to sell his shares in an engineering project that he had hoped would be a major national money-earner (and to celebrate which *Aida* was originally commissioned). The opera, set in pharaonic Egypt, was also supposed to glorify the country's ancient past and cock a snook at Ismail's Turkish overlords.

It didn't do much in that particular vein, perhaps because it took so long to work out a deal Verdi would accept that delivery of the score was nearly two years too late for the occasion it was supposed to celebrate: the opening of the Suez Canal.

Which ends my machine-assisted *folie* for now.

4

A LOT OF BALONEY

I HAVE TO confess a fatal weakness for Bologna, Italy. Apart from the fact that it has the oldest university in Europe, and the most elegant women on the planet, it also happens to be the food capital of the known universe.

After visiting the Diana restaurant (unsolicited recommendation) and lunching on works of gastronomic genius (don't miss the tortellini alla panna), you can walk a few hundred meters and savor another work of mouth-watering precision: a giant brass meridian line, inlaid across the floor of the city's cathedral. Put there by Gian-Domenico Cassini, the hottest astronomer around in 1667. Which was when his reputation brought him an offer he couldn't refuse from Louis XIV's right-hand man, Jean-Baptiste Colbert: to run the new Paris Observatory. And then get involved in the great French effort to identify the shape of the Earth (which the French thought was not flattened at the poles).

Colbert needed to know such arcana so that the new navy he was building for France would more accurately be able to relate star-fix angle to position on the planetary surface (different on an Earth that *was*, or was *not*, flattened at the poles). This way, French ships would be able to navigate better. And rule the waves. And also, perhaps, give the English one in the eye, by snitching the Prime Meridian from Greenwich and moving it to Paris. Unfortunately for French *amour propre*, they were wrong about the shape, which is why I'm writing this in GMT.

The sidereal shenanigans were a key element in Colbert's grand plan to make France a mercantile superpower, as part of which he also offered tax breaks to anybody interested in sailing off (more accurately, it was now hoped) to exotic foreign parts and coming back with import deals for high-end consumables. Idea being, Colbert could then turn this trade into a French monopoly and make oodles of ecus for king and country. Well, king.

This perfectly legitimate scheme for avoiding tax was yet another offer too good to refuse, so in no time at all, freebooters were returning from Senegal in West Africa with shiploads of gold, ivory, slaves, and gum. Senegal gum

I said, he did help to give us Romanticism, which in turn gave us pathology and radio (of which more in another essay).

Meanwhile, why would a guy like McPherson be on an antiquarian ballad-hunt in the first place? Well, I suppose because back then, the future for Scottish culture was looking bleak. As a result of the fact that, ever since 1715, the Catholic Stuarts had been submitting claims to the English throne (now occupied by Protestant Germans) in the form of armed uprisings, so there were Redcoats all over the Highlands. Where matters such as clans, tartans, and speaking the local lingo were all things that could get you seriously hanged. The English even wrote a special extra verse to the National Anthem, all about "rebellious Scots to crush!" Things came to a head in 1745 when the last royal Stuart, Bonnie Prince Charlie, and his murderous band of cutthroats (aka "band of brave patriots") got as far south as Derby, in consequence of which there was a run on the pound. Now, you don't mess with the Bank of England and get away with it. But get away he did. In the words of the song, "over the sea to Skye," and then across the Channel to the Continent. All thanks to a supporter named Flora McDonald (who subsequently lit out for North Carolina). To this day, in memory of Charlie's flight to foreign parts, romantic Scots will raise their glasses to "the king over the water."

And finally: the reason why I began this particular example of tortuously crafted baloney the way I did. Because . . . guess where Charlie ended up spending the best of his declining years in exile? Well, where would *you* go, if (like him) you were looking for intellectual chat, enjoyed the company of elegant women, and overindulged in food and drink (of which the Prince ultimately expired)?

Whichever way you sliced it (OK: sorry!), there was only one choice: Bologna.

5

IMPRESSIONS

FORTUNATELY FOR ME, the other evening at a reception to mark the opening of an art exhibition I noticed a woman drinking a glass of champagne and got the impression she was closely scrutinizing one of those French paintings you can really only appreciate from a distance. I say "fortunately," because the event provided me with an idea for this piece (and several glasses of champagne).

Early in the nineteenth century, up to his ears in conflict with practically everybody else in Europe, Napoleon must have been thoroughly fed up with the fact that thanks to the massive levels of industrial output by the enemy Brits, he was fighting them armed with British-built cannon manned by troops wearing uniforms made in England! *Zut!* So he set up a Society to Encourage French Inventors (very rough translation), and in 1810 a total nobody named Nicholas Appert stepped forward to take the Society's prize of twelve thousand francs for a crazy idea he'd tried out on the French navy a year or so earlier. Appert had come up with an idea for preserving food. All you had to do was seal the food in a champagne bottle (Appert was a cook and champagne bottler), and then immerse the bottle in water, which you then brought to the boil for long enough to kill the germs that caused putrefaction. As is so often the case with these major advances in science and technology, Appert didn't know that bactericide was what he was actually doing. But never mind.

Poetic ravings about about how M. Appert's bottled veggies "brought spring and summer to winter" appeared in the French press, at which point the Brits got to hear about it. In wartime 1811 an Anglo-French go-between, John Gamble, one of the British prisoner-of-war exchange team in Paris (who was also married to a Frenchwoman), managed to get hold of Appert's patent. One year later, together with a couple of partners (Bryan Donkin and John Hall), Gamble set up a business in Bermondsey, South London, repeating the food-preservation trick, but this time in tin cans (one of his partners had experience in iron-making).

After the British royal family had tried some of the new products and pronounced them "delicious," how could canning fail? In 1818 the industry got another major boost when the exploratory Captain John Ross sailed off in a blaze of publicity to find the Northwest Passage, carrying a large supply of the canners' carrots and gravy, soup, roast veal, and peas.

In 1824, the intrepid captain's next, similarly provisioned expedition (funded, in keeping with this gastronomically oriented article, by Felix Booth, distiller of the eponymous gin) discovered the Magnetic North Pole. And named a very northern bit of North America the "Boothia" Peninsula. The actual magnetic discovery was made by Ross's nephew and traveling companion, James, who was so bitten by the polar bug that in 1839 he shot off in the opposite direction, on board HMS *Erebus*, to spend four years finding and mapping large bits of Antarctica and other spots en route.

On this occasion, one member of his crew was a young man called Joseph Hooker, who afterward became famous by writing up the botanical discoveries made on the trip, and then going on to do the same thing again on assorted sorties to Sikkim, Nepal, Assam, and India. As a result of these Himalayan ramblings, Hooker became known to gardeners everywhere when he introduced the West to most varieties of rhododendron, and then over a number of years patiently catalogued more than three hundred types of impatiens. For such persistence, in 1865 Hooker was made director of the British Royal Botanical Gardens at Kew (following his father in the job) and proceeded to turn the place into the international center for botanical research it is today. He also saved many a latter-day tourist (and me) from the rigors of bone-chilling London winter afternoons, when he commissioned the tropically warm splendors of Kew's beautiful Palm House. Speaking of which, Hooker did at least two other things that matter to the twentieth century. He helped to organize the smuggling of rubber seedlings out of Brazil (not British at the time) so that they could be nurtured and then transplanted to the Malaysian archipelago (mostly British at the time), thus laying the foundations of the entire rubber industry, and making possible the invention of the raincoat.

Hooker went on to do the same trick for the West African oil palm. About which you should only concern yourself if you happen to be watching your weight and laying off the animal-fat intake. Palm oil really came into its own thanks to Napoleon's nephew (Napoleon III) and *his* problem: feeding the troops and a rapidly rising population. In response to yet another imperial call to the flag (and the offer of another fat prize), a French chemist called Hyppolyte Meges-Mourriès changed the nature of the sandwich with what was, in its earliest form, a mixture of animal fat churned with milk and salt, chilled, kneaded, and packaged. Alas, poor old Hyppolyte never got his hands on the prize money. And to add insult to injury, certain others, recognizing on which side their financial bread was buttered (so to speak), promptly took advantage of patent-law loopholes to mass-produce their own versions of his new food substitute (known as margarine), and to become major modern industrial giants (in later years, using palm oil in preference to animal fats).

Meges-Mourriès had derived all he knew about fats (and probably also the name he gave his invention) from the great Michel-Eugène Chevreul. In 1889, when Chevreul died at the age of 102, France declared a day of national starting to see in all the cops-and-robbers movies. All thanks to a Swedish Nobel laureate, Arne Tiselius, who made all this fun possible back in the thirties when he worked out how to make protein molecules line up according to their weight, by putting them in a gel and then zapping it with various charges. The heavier the molecules were, the less far they moved. Electrophoresis.

The hardly visible differences in the gel caused by the presence of the proteins was more easily seen with *schlieren* photography, which shows up the slightest change in density because of the way light behaves when it comes through differing media. Like gel containing different amounts of protein. Or like turbulent air. Which is why, right from the start, *schlieren* was also a great success with airflow freaks like Theodore Von Karman (whose famous vortices you'll sometimes see at takeoff on a damp day, curling away from the wings).

Both Von K. and his curls were well-known to a pal, Anthony Fokker, of the planes of the same name. But Fokker did something else besides build great flying machines that would first cross the United States nonstop in 1926, and a year later take Byrd over the North Pole for the first time. During World War I the Germans captured a French invention, and Fokker turned it into a clever way to synchronize a propeller with a machine gun, so fighter aces wouldn't shoot their props off. And since all you had to do with this new system was point the plane and fire, the arrangement was so successful (in the hands of hotshots like Manfred von Richthofen, the Red Baron, in his red Fokker) it became known as "the Fokker scourge."

At the time, machine guns were doing well elsewhere, too. Specially when thousands of infantry were snagged on barbed wire during an advance. Sitting ducks, really.

Which is what the amazing new tank was supposed to prevent, by crawling over (and knocking down) the barbed wire, thus clearing a path for the troops. Irony was, that the tanks were driven by members of the old cavalry regiments, because it had been lack of horse in wartime America that had kicked off traveling armor in the first place. Most of America's farm horses had been requisitioned for use by transport regiments in Europe, to carry supplies to the men who were now *also* missing from the farms. Back home, this shortage of horse-and-man-power got a fellow named Ben Holt inspired to invent an entirely new kind of agricultural implement, because in the San Joaquin Valley (where he was at the time) a lot of the land was so wet it wouldn't support anything on wheels (or in some cases, hooves). Holt invented a crawler tractor, running on tracks that spread the load. A friend of his remarked it looked like a caterpillar, and the rest is farm-equipment history.

Most of the early Holts were sold to the Allies in World War I, were noticed by the military, and bingo: tanks. Holt's early tractors ran on gasoline, but later he switched to (and made a great success of) the diesel engine, which was itself so successful because it was cheaper to run than gasoline engines, it would start cold, and people thought it would burn almost any junk (there was even one version that ran on peanut oil). It may have been this last selling point that got Diesel his financial backing in the first place. Because right from the start, when talking to anybody about his engine he used the magic word "coal."

It was how the engine worked that made this possible. With a diesel, all you do is compress air in a cylinder so its temperature goes up to near eight hundred degrees Centigrade. At the top of the piston stroke, when the air is hottest, you inject a suitable liquid, gas, or particulate. The heat of the air causes it to combust. That pushes the piston down, to start the cycle all over again. So the diesel looked as if it'd burn anything that . . . well . . . burned. Like coal dust. In 1897, this sounded like sweet music to a man who ran the biggest steel-making plant in Europe, ran several railways, and owned all the coal mines to supply their fuel: Fritz Krupp.

Not surprisingly, Fritz's father, Alfred (who'd brought the firm to greatness earlier in the century), had been less than keen on the new wind of socialism sweeping through the industrial world at the time. For him it meant anarchy and the end of order. So he came up with a way to keep his workers sufficiently happy not to want such revolutionary stuff as trades unions. He gave his workers canteens, pensions, housing, company discount stores, and even uniforms to wear at home (what would you expect from a guy who once said: "As pants the deer for cooling streams, so do I for regulation").

It was this welfare scheme (as well as his love of trees, and dislike of company) that bonded him with the fellow running Prussia at the time. This person was, I suppose, regulation personified. Otto von Bismarck (who also loved trees and hated company) and Krupp were meant for each other. After all, Otto made war and Alfred made guns. Bismarck was also keen on welfare (he started the first universal old-age pension) and statistics and such, because the more numbers you had on all the average joes out there in the streets, the better you could regulate people so as to increase national output (or fight wars). Bismarck had developed this passion for the average joe because Ernst En-gel, the head of the Prussian Statistical Bureau, greatly admired the Belgian astronomer who had *invented* the average joe: Alphonse Quételet.

In 1835 Brussels, Quételet modified the kind of math that astronomers used (to calculate the probable path of heavenly bodies of which too few sightings had been made to be certain) to do the same thing to population statistics, because he believed if you applied this math to large numbers of people you could develop what he called "social physics." This way, you could work out what the average joe was up to, and do statistically meaningful sampling. Well, this was better than previous counting methods (like multiplying the number of chimneys by an assumed average family size to get the population), so it attracted the interest of such mathematical biggies as Charles Babbage.

His involvement with Quételet led to the formation of statistical societies in Britain and eventually inspired a young man called Francis Galton to go looking for ways in which any individual could be singled out from the mass. The result of his work was the discovery of a sure-fire way to spot one person from another, known as the fingerprint. Which was, until the advent of the DNA version I saw on TV the other night, the ultimate ID.

PS: Ironically (given how valuable electrophoresis was to prove in the original discovery of DNA), guess who Galton's cousin was. Darwin.

7

WHAT GOES AROUND COMES AROUND

BACK IN THE dawn of time I reported for the BBC whenever an Apollo lifted off, so nowadays every time a Shuttle comes back for recycling I am reminded of those long-gone, "use-once-and-throw-away" Saturn V days. On