A Place for Hype

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THE SHOCK OF THE OLD: TECHNOLOGY AND GLOBAL HISTORY SINCE 1900
by David Edgerton.
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A NEW GOLDEN AGE of technological hype seems to be dawning. This January, at the Consumer Electronics Show in Las Vegas, a small unfurnished booth cost $24,500. Some 2700 companies proved willing to pay the fee, and 140,000 people visited the show. To coincide with it, Steve Jobs, the Apple CEO, launched the iPhone in San Francisco: a mobile phone with a touch-screen and other familiar functions: web browser, camera, MP3 player. Apple shares went up more than 8 per cent that day, though the phones won't be released until June, will sell for between $499 and $599, and hadn't been independently tested. In January's issue of *Scientific American*, Bill Gates predicted 'a future in which robotic devices will become a nearly ubiquitous part of our day to day lives'. According to Gates, the South Korean government plans to get a domestic robot into all its households by 2013, while the Japanese Robot Association expects there to be a $50 billion a year worldwide personal robot market by 2025.

Ambitious predictions are all very well, but there have also been chastening reminders of previous rounds of misplaced hype. In *New Scientist* last November, the AI researcher Rodney Brooks forecast that at some point in the next fifty years a solution would be found to the 'recognition problem': a computer's inability to tell, as a two-year-old child could, whether an object is a hat, a chair or a shoe on the basis of its general properties. Confident as Brooks was, he acknowledged that his own attempt to solve it in his 1981 PhD dissertation had been unsuccessful.

Academic scientists, medical researchers and technological entrepreneurs are taught to avoid extravagant claims and to rely instead on sober peer review. Yet they are also aware that hype can help win research grants and capital funding and can affect share prices. An adequately supported project may fail, but an overlooked one will not succeed. According to the Thomas Theorem popularised by Robert Merton: 'If men define situations as real, they are real in their consequences.'

David Edgerton's *The Shock of the Old*, with its ironic echoes of bestsellers by Robert Hughes and Alvin Toffler, is not an attack on innovation as such. Rather, it is a call for a new way of thinking about technological change, not as a sequence of revolutionary discoveries, but as a complex and often

paradoxical interaction between old and new: 'technology in use' as opposed to an 'innovation-centred' history.

We are said to be living in an age of unprecedented change; indeed, we have been told this in the popular media for the past century at least. Yet much of the technology that now surrounds us would have been clearly recognisable to previous generations. Edgerton doesn't fully explain this paradox, but he does provide many examples, four of which will serve to illustrate the complexities of technology in use: the horse, the Kalashnikov rifle, the B-52 bomber and the flat-pack bookcase.

The horse may be the most surprising case. Edgerton emphasises its continuing role in urban transportation and in warfare in the early to mid-20th century. Hitler's army marched on Moscow with many more horses than Napoleon's, and in 1945 the German army had 1.2 million of them, possibly an even higher ratio of horses to men than in previous centuries of warfare. Horses and other draught animals are still widely used in poor countries: in India, as recently as 1981, animals produced more megawatts of power than all mechanised sources combined, and there were twice as many bullock carts as there had been at independence in 1947. Even in the United States, Amish farmers continue to work with horses, and there seem to be tens of thousands of non-Amish farmers with draught animals, including 3500 oxen teams in New England. Amish artisans continue to develop more efficient agricultural equipment, and have a worldwide market.

It's surprising how many supposedly pre-industrial tools survive in the allegedly post-industrial world. Advocates of development and technology may be embarrassed that horses are still used as draught animals, but they also ignore the proliferation of simple tools and labour-intensive maintenance. In the vast workshop districts of Ghana, known as 'magazines', motor vehicles from the industrialised world have for decades been adapted and refitted for rugged African conditions. They can be maintained indefinitely in this new state, using only simple parts, a sophisticated improvisation that Edgerton calls 'creolisation'. 'At dusk,' he writes, 'bright intermittent light from welding illuminates streets all over the world, issuing from maintenance workshops which might also make simple equipment.'

Edgerton cites the Kalashnikov assault rifle, the AK47, and its descendants to illustrate how effective simplicity can be. Ever since the rifle's introduction in the Soviet Union in 1947 it has been a favourite of both guerrillas and their enemies. Of between 90 and 122 million assault rifles estimated to have been produced since the Second World War, between 70 and 100 million were Kalashnikovs. Together, these small arms have been responsible for more civilian deaths than attacks from the air or the gas chambers. Nuclear weapons, it was once thought, would transform warfare, but they were economically dubious from the start. If the $2 billion spent building the Hiroshima and Nagasaki bombs had been used for conventional weaponry, Edgerton argues, the war might have ended sooner. Likewise, Germany could have built 24,000

fighters for the cost of the V-2 project; each V-2 cost two lives to make and killed on average only one civilian.

The B-52 bomber illustrates a third argument: that the thinking of the military and industrial establishments of the richest countries has changed far less than we imagine. The B-52 was introduced in 1952 and no more were built after 1962, yet in the first Gulf War it dropped 31 per cent of all US bombs. In 2004, the same B-52 used to launch X-15 planes to the edge of space in the 1960s was the platform for testing Nasa's latest space aircraft, the X-43A, which was heralded as a dramatic breakthrough even though the X-15 had flown nearly as fast. The B-52 is expected to remain in service until 2040.

Fourth, and perhaps most significant, the globalisation of the trade in wooden furniture is evidence of the conservatism, not the technological transformation, of the industrial order, and also of the continued dominance of rich countries. Ikea has sold 28 million Billy bookcases since 1978, manufactured from wood using conventional mass-production methods. Final transportation and assembly of Billy and other flat-pack Ikea products are left to unpaid consumers. (Ikea and its suppliers employ an estimated one million people worldwide; the founder of this family business is said by some to be worth more than Bill Gates.) The example is even better than Edgerton suggests: the global manufacture and shipping of inexpensive unassembled wooden furniture dates from the middle of the 19th century, when the Thonet brothers of Vienna established factories in the beech forests of Moravia to make virtually indestructible bentwood café chairs.

Edgerton uses stories like these to challenge many of the clichés of technology and business journalism and 'innovation-centric' political rhetoric. He is a formidable polemicist with an encyclopedic grasp of business and economic history and policy, as well as the history of technology, qualities which were manifest in his recent study of British military and industrial history, *Warfare State*.* There are many revelations in *The Shock of the Old*, some of them grim: for example, whaling was revived in the 20th century mainly in order to produce margarine. By the 1990s, half of all antibiotics produced in the US were fed to animals, mostly to accelerate growth.

The book's most puzzling theme, though, is one that Edgerton explores only obliquely. Why are older technologies still so prevalent? Or to put it another way: why have so many promising ideas produced less than we expected, at least so far? One 'miracle' after another has turned into a mirage. The future is running behind schedule. Just as the use of horses persisted well into the 20th century, so piston-driven internal combustion engines, developed in the 1870s and 1880s by Otto and Benz, continue to dominate passenger transport. The limited range of all-electric cars has (so far) doomed them commercially. Indeed, poor battery life continues to bedevil devices from cars to digital music players. The miles per gallon achievable by hybrid cars have been even more exaggerated than is the case with conventional cars. The trains that carry commuters in Europe and the US

run on rails similar to those of the 1890s, while diesel trains use an air brake system patented in 1872. Magnetic levitation trains were in service as early as 1984 in Birmingham, yet are still largely at the demonstration stage; a disaster in which 23 people were killed disabled a German experimental project in September 2006.

What of medicine? Cancer survival rates continue to improve, but back in 1971 some of the senators who supported the US National Cancer Act talked of achieving a cure by the Bicentennial of 1976. In rich countries, Aids is now considered a chronic disease rather than a plague; hopes for a vaccine have not been realised. In the mid-1980s one was predicted by the mid-1990s; in 1995, the date was shifted back to 2000. Treatments improve, but no cure is in sight. Bacteria remain just as alarming. In 1969, William Stewart, the US surgeon general, believed we could soon 'close the book on infectious diseases'. But overuse of antibacterial agents helped to promote resistance to antibiotics, leading to today's multi-resistant bacteria, the superbugs of newspaper headlines. Today's antibiotic innovation is a heroic attempt to hold ground thought secured fifty years ago.

Improved medication for progressive diseases such as Parkinson's has made for impressive gains in the control of symptoms. But, as the writer Phyllis Richman recently recalled in a piece for the *Washington Post*, in the 1960s she heard a cure was expected within a decade (the claim seemed credible because of progress made against tuberculosis, polio and malaria), and similar predictions are made today. She repeats a familiar criticism of medical research: 'There's a surer profit in developing another variation of a successful drug than in creating a new kind of drug, for which the clinical trials are not only apt to be more expensive, but the chance of failure runs higher and the approval process is likely to take longer.'

The most significant recent breakthrough in the technology of power transmission, the discovery of high-temperature superconductivity in 1986, seemed to herald virtually resistance-free electric cables, but is still far from being a large-scale application. Consider, too, the crisis over climate change. Optimism about the introduction of nuclear power during the decades before Three Mile Island and Chernobyl may have diverted attention from the dangers of fossil fuel emissions. John von Neumann, the US's most brilliant scientific-political adviser of the postwar decades, wrote in *Fortune* magazine in 1955 that once nuclear power generation had overcome the design limits of older hydrocarbon plants, 'energy may be free – just like the unmetered air – with coal and oil used mainly as raw materials for organic chemical synthesis.' Von Neumann was already aware of the likelihood of global warming from burning hydrocarbons, but saw it not as a cause for worry so much as a possible means for humans to control the climate: we would soon be able to warm or cool the world, or parts of it, mitigate storms and control rainfall. He didn't seem to doubt this would happen; his concerns were over conflicts between winners and losers after the global thermostat had been adjusted.

Von Neumann, who may have known more about computing than any of his contemporaries, believed that increased computer processing power would help make these and other advances – including transmutation of the elements – possible. What he apparently did not foresee was that computational power might have a conservative effect, by prolonging the lives of older technologies. Consider the Rolamite, a type of bearing patented in 1967 and celebrated in the media as a rare example of a basic new mechanical device. It is basically a band wrapped in an S-shape around two rollers moving in a kind of track. The band can be modified to delay movement until a predetermined force is applied; Rolamites have been used as accelerometers in airbags. But the most ingenious and complex applications predicted were never achieved. The major reason may have been that the Rolamite appeared on the eve of microprocessor control, and it became easier and cheaper to produce programmed chips than to etch patterns into mechanical Rolamite bands.

That so many of the claims made for revolutionary technology between the 1950s and the 1980s have been frustrated leaves us looking for explanations for the surprising technological stability of the present age. There are two possibilities, one structural and one cyclical. The first starts from the premise that the three decades from 1885 to 1915 were unique in the history of technology. (The idea that there was a second industrial revolution, usually dated from 1871 to 1914, originated in 1915 with the Scottish biologist and planner Patrick Geddes, was popularised by David Landes in *The Unbound Prometheus* in 1965, and was affirmed most recently, though with a different starting date, by Vaclav Smil.[†]) Highly developed craft skills, rapid growth in scientific and medical knowledge, and mass promotional techniques came together in the expanding cities of Europe and North America. The basic form of many of today's machines was laid down during these decades and they were mass-marketed surprisingly rapidly, from the Daimler-Maybach engine of 1885 to the Model T Ford of 1908, from the Wright Brothers' flyer of 1905 to the monoplane with joystick control – the basis of most subsequent aircraft design – developed by Louis Blériot and Robert Esnault-Pelterie a few years later. The Rover Safety Bicycle of 1885, designed by an Essex market gardener's son called John Kemp Starley, was the first widely successful design of the type that has dominated ever since. The Scottish vet John Boyd Dunlop introduced the first successful pneumatic tyre in 1888, and most car and bicycle tyres use essentially the same valve patented by George Schrader in 1893.

The same period also saw the extension of continuous processing for mass consumption, with systems that continue to be used today. The crimped bottle cap as we know it was invented in Baltimore in 1891 by William Painter and developed by his company, Crown Cork and Seal, while one of Painter's salesmen, the unsuccessful novelist King C. Gillette, collaborated with the engineer William Nickerson to create the first commercially successful disposable safety razor blade in 1903. Henry Ford's was not the only assembly line: the automatic lasting machine developed in the

mid-1880s by Jan Matzeliger increased the number of finished shoes a worker could produce from 50 to 700 a day, laying the foundation of the United Shoe Machinery Co, the international cartel of the 1890s that marketed – with a ruthlessness resulting in decades of antitrust litigation – factory equipment that remains the basis of today's leather shoe industry.

The period from 1945 to 1975 saw radical developments – commercial jet aircraft, antibiotics and vaccines – but in retrospect the great leap forward during these years was in the miniaturisation of electronics. In just three decades we went from publication of von Neumann's proposal for the stored-program computer in universal use today to the unveiling of the Altair 8800 as a 'hobbyist' kit. Bill Gates dropped out of Harvard to develop software for the Altair and its successors. But the paradox remains that the functions of the iPhone, and of today's operating systems and computers, have long been routine.

The structural interpretation of this recent history of innovation is that we have now picked the low-hanging fruit of technology and that the future will be one of continued refinement. This seems to be Edgerton's point of view: he is a partisan of adaptation and improvisation. But a cyclical interpretation is also possible. We may be on the brink of a new era of change, following a thirty-year cycle of incremental improvements, such as the doubling of the Boeing 747's fuel efficiency since its introduction in 1970.

Edgerton does not discuss this alternative. The great strength of his book is its global perspective, which sees poor countries coexisting with rich ones by adopting and adapting. He gives the example of shipbreakers in India, Pakistan and Bangladesh, who dismantle the obsolete vessels of the world's navies and shipping lines, and reroll and rework the steel in them. In this scheme of things, the plans of scientists and engineers in industrial countries are marginal indeed. But Edgerton's viewpoint has its limits. Many poor people in India and Africa can now make inexpensive calls using village cellphones. Edgerton's linear account sidesteps the intriguing question that can be answered only in real time: will hopes of radical technological progress remain unfulfilled, or will nanotechnology, gene-based medicine, quantum computing and other long-touted innovations eventually find widespread application?

The rhetoric of technological revolution can be hazardous; it can even help hold back innovation. In the 1950s, Lord Cherwell, one of Churchill's senior advisers, successfully recommended against modernising the railways on the grounds that rail was 'obsolete', and that 'helicopters or other formats of transport' would make it less important. Indeed, the railways provide stunning support for Edgerton's argument; computerised analysis has enabled significant improvements in the wheel-rail interface, resulting in greater fuel economy and lower operating costs.

Some commentators are impatient with incremental change; Edgerton sees it as a

sensible alternative to the cult of revolutionary transformation as expressed in the hype of the popular press. And so it is, up to a point. But cumulative improvement has left many diseases still incurable, though more humanely managed, and travel times for some air and road journeys have been increasing. (An airline flight from Philadelphia to Los Angeles now takes nearly an hour longer than it did forty years ago.) There may be a legitimate role for hype because of, not despite, the recent absence of anything as 'novel or . . . significant as penicillin or the Model T'. Hype may be an adaptive strategy for building morale and encouraging investment in the face of discouraging experience: the great majority of patents go unrenewed.

Edgerton is right to object to the setting of 'the agenda for discussing the past, present and future of technology . . . by the promoters of new technologies'. And he recognises that the well-meaning invention of 'appropriate technology' for poor countries has been much less successful than grassroots ingenuity. However, solar-powered light-emitting diodes are already reducing indoor pollution, aiding literacy and protecting children's vision in rural India. Sometimes, technological hype is a sensible response to the intransigence of reality. the