THE CENTRE FOR INDEPENDENT STUDIES

MATT RIDLEY

# Innovation in Australia

# Innovation in Australia

Matt Ridley


CIS Occasional Paper 176

THE CENTRE FOR
INDEPENDENT
STUDIES

**2020**

Published October 2020
by the Centre for Independent Studies Limited
Level 1, 131 Macquarie Street, Sydney NSW 2000
Email: cis@cis.org.au
Website: cis.org.au



---


A catalogue record for this book is available from the National Library of Australia

# Innovation in Australia

When I was born more than half the world lived in extreme poverty. Today, even corrected for inflation, just 9% of people live like that. Average lifespan is increasing globally by about five hours a day. Child mortality, the greatest measure of misery I can think of, is plummeting on all continents. Global inequality is falling as people in poor countries get rich faster than people in rich countries. The average person is wealthier, healthier, cleverer, cleaner, safer, kinder, freer and even happier than ever before: that's what the data say.

These unprecedented trends are mostly not caused by better government, the accumulation of more capital, the exploitation of more resources, or some kind of magic, but by one simple thing: innovation. The creation of new products, practices and services that do useful things for us, making us more productive as we work for each other in the global marketplace: that is the big theme of the last two centuries, and it continues today. So what is innovation and how do we get hold of it?

A happy feature of the modern world is that if somebody on the other side of the planet invents a better mousetrap, or a new phone app, we all still get to use it. That was mostly not true until the past two or three centuries, and it's still not true for some people today: most North Koreans, some Zimbabweans and a few little-contacted tribes in the New Guinea highlands. The rest of us have access to a global cloud to share ideas and devices.

Australia, with a relatively wealthy but small population that happens to be a long way from almost all of the rest of the world, benefits more than most from this global trade in new things and new ideas. The vast majority of the innovations Australians use today were invented a long way away. For instance, zero as a number in its

own right was invented in India around 1500 years ago and helped to transform arithmetic. It reached Australia via Arabia, Italy and Britain.

Nineteenth century Britain and twentieth century America, by contrast, really could claim to be net donors of innovations to the rest of the world for a time. Despite being a global phenomenon in terms of its use, innovation itself tends to happen in a concentrated way in one part of the world at any one time: China today, California in the 1950s, northern England in the 1850s, the Netherlands in the 1650s, Italy in the 1450s, China in the 1050s, Arabia in the 850s, India in 250BC, and so on.

This is not meant to imply that Australia does not pull its weight in innovation. Far from it. With 0.3% of the world population, Australia has probably contributed a lot more than 0.3% of the innovations we all need and use, from electronic pacemakers and aircraft black boxes to pink cricket balls. Besides, innovation is not the same as invention: the hard work of turning a novelty into a reliable, affordable and useful service is far more dispersed throughout the world. To use cricket as an example again, both test matches and one-day matches may have started in Britain, but it was Australia that showed how to win them.

## The black box

Some key innovations were made in Australia, by Australians, and copied or perfected elsewhere. One of these is the 'black-box' flight recorder. On 3 March 1953, a Comet jet operated by Canadian Pacific Airlines crashed while attempting to take off at Karachi airport en route to Australia. All five crew and six passengers died. This was the first fatal jetliner accident.

Piecing together the cause of the crash was made harder by the lack of survivors in the cockpit. So it was that two weeks later on 17 March, at the Melbourne Aeronautical Research Laboratory, David Warren had an idea. Why not install a device that continuously recorded the most recent conversations and instrument readings in an airliner's cockpit?

Warren and three colleagues tried to sell the idea to the aircraft industry but nobody bit, so they developed a prototype themselves

in 1957. The next year, visiting British air vice-marshal Sir Robert Hardingham was impressed and took the concept back to the Ministry of Aviation in London, which soon ordered airlines to install the technology. In 1960, following a crash in Queensland that killed 29 people, a judge ordered Australia to make the black box mandatory here too.

Black boxes are actually orange, the better to stand out in the wreckage. They nowadays come in two kinds: instrument and voice. Their value has been proven again and again, and they have helped drive down the accident rate in passenger jets to extraordinarily low levels. In 2017, for the first time, there was no fatal commercial passenger jet accident all year, despite a record 37 million commercial flights. Indeed, the rate of death from all air accidents has fallen steeply from 3,218 fatalities per trillion revenue-passenger-kilometres in 1970 to just 40 in 2019 — an 81-fold decline. The two highly publicised crashes of the Boeing 737-MAX8 aircraft in 2018 in Indonesia (189 fatalities) and 2019 in Ethiopia (157 fatalities) did not reverse this downward trend. If we are ever to understand what happened to the Malaysian airlines flight 370 that vanished over the Indian Ocean in 2014, it will be David Warren's invention that achieves it.

## Setting the pace

Dr Mark Lidwill is another Australian innovator who did the world a favour. Not by being the first person to catch a black marlin on rod and line — though in some circles he is better known for that — but by inventing the pacemaker. In 1926, while working at the Crown Street Women's Hospital in Sydney, he used electricity to resuscitate a newborn baby. The idea that you could stimulate muscles to contract using electricity was not new (Luigi and Lucia Galvani had discovered it in 1780 and the plot of Mary Shelley's Frankenstein was built on it), but Lidwill realised that electric pulses could reset the rhythm of a heart. He described the experiments thus:

"Voltage was used from 1.5 up to 120 and it was found that somewhere about 16 volts was the pressure required. The method was tried in two or three cases and was completely successful in the case

of a stillborn infant, when everything else had been done to revive the child, artificial respiration, injections of pituitrin and adrenalin injected into the heart itself. After this had failed, the needle machine was plunged into the auricle and various voltages were tried with no result. The needle was then plunged into the ventricle, and the heart responded to each impulse. At the end of ten minutes the current was stopped and it was found that the heart would beat of its own accord. The child recovered completely and is now living and quite healthy."

Lidwill here shows a characteristic habit of great innovators: trial and error. The difference between a Thomas Edison and an also-ran innovator is that the former was prepared to try, fail and try again. Edison tested 6,000 different samples of plant material before settling on Japanese bamboo to make a filament for a light bulb that could be relied on to last a long time. This is one reason Edison succeeded where 20 people who invented light bulbs independently around the same time did not. "I've not failed," he once said. "I've just found 10,000 ways that don't work." Invention, he added, is 2% inspiration and 98% perspiration.

## Taking flight

The same lesson was taught by Orville and Wilbur Wright, the inventors of the aeroplane. Unlike the rival project of Samuel Langley, which was heavily supported by the US government, the Wright brothers did endless experiments before trying to build a complete flying machine. They built gliders galore, and models of wings to test in wind tunnels, and different shaped propeller blades. In December 1903 they achieved the goal long sought by so many: powered lift-off.

Yet it was an Australian who supplied the Wright brothers with some of their key insights. Without Lawrence Hargrave, it is likely that the Wrights would never have flown when they did and it is certain that the independent French pioneers of flight would not have done. Hargrave is a frustrating near-miss for Australia. Had he pushed just a little harder and faster, he might have been the first to achieve powered flight, giving the then-tiny nation a remarkable first.

The link between Hargrave and the Wrights is a French-American engineer by the name of Octave Chanute. A designer of bridges and railways, based in Chicago, Chanute turned his attention to flight in 1883, when he was nearly 50 years old. He set out to discover who was working on flight and what they had discovered, collating his findings in a series of articles that became a book in 1894. In that book he wrote that Lawrence Hargrave was the man most likely to fly first.

Hargrave was already a famous explorer of northern Australia and New Guinea, who settled at Stanwell Park, south of Sydney, where consistent onshore winds make hang gliding popular to this day. An ingenious inventor of various boating devices, he then built gliders, tried making flapping flyers called ornithopters and experimented with engines to power planes. His three key innovations were the curved profile of an aerofoil wing, the box kite and the rotary engine.

The cellular or box kite is perhaps the most surprising of these. Hargrave realised that side panels on a biplane kite would stabilise it, and on 12 November 1894 he ascended 16 feet into the air, held aloft in a stiff breeze by a tandem arrangement of three tethered box kites. The idea caught on. Chanute soon reported that the skies of America's eastern states were "red with Hargrave kites", as people rose into the breeze to take aerial photographs or sent box kites aloft with instruments aboard to study the weather. The Wright brothers used Hargrave kites in some of their early experiments, but Chanute, with his experience of diagonal ties to strengthen railway bridges, used wires instead of side panels on his gliders, passing this design on the Wright brothers. Hargrave box-kite wings and tail planes later became standard on many early aeroplanes, especially in France.

It would be a mistake to fall into the trap of saying that Hargrave was robbed of his place in history by the piratical Wrights. They did after all lift off at Kitty Hawk and received a message of enthusiastic congratulations from Hargrave. Innovation is always a process of collaboration and standing on the shoulders of others. The lucky fellow in a chain of innovators who gains a patent, prize, fame or fortune rarely deserves to be singled out as much as he usually is, but nor is he fully undeserving either.

In one respect, though, Hargrave was both generous and unusual. He did not believe in patents. Whereas the Wright Brothers — like many inventors — ruined the best years of their lives fighting to protect their intellectual property in the courts, Hargrave did not. He wanted to root out the idea among inventors that "by keeping the results of their labours to themselves a fortune will be assured to them." He went on: "Patent fees are much wasted money. The flying machine of the future will not be born fully fledged and capable of a flight for 1000 miles or so. Like everything else it must be evolved gradually. The first difficulty is to get a thing that will fly at all. When this is made, a full description should be published as an aid to others."

Both Lidwill with his pacemaker and Warren with his black box were to take a similar line. Quite right too. The evidence from history that patents are necessary to encourage innovation is threadbare in the extreme, and the evidence that instead they hinder innovation by putting obstacles in the way of evolving and shared ideas continues to grow more convincing by the year. Studies show that strengthening of intellectual property does not result in more innovation, while weakening it — think music streaming — does not result in less. The expiry of a patent often results in a burst of innovation. It happened with corrugated iron in the 1840s and with 3D printing in the 2010s. Ask yourself this: if there were no patents would Hargrave, Chanute and the Wrights have decided not to try?

I find that Americans, being much more wedded to doing things through the law in general, and devoted to patents in particular, struggle to see this argument, compared with Brits. I sense that Australians get it, though.

## The origin of antibiotics

Howard Florey is a different kind of Australian innovator: one who did his work abroad. Unlike Hargrave, he was not the originator of his innovation, penicillin. That accolade goes to Alexander Fleming, a Scot working in St Mary's Hospital in London. But it was Florey, along with a Jewish refugee from Germany, Ernst Chain, who turned Fleming's curious discovery into a useful innovation that was available to treat diseases.

In the 1930s, attempts to use penicillin as an antiseptic applied to infected wounds failed, and anyway nobody could think how to make it in quantity. In 1936, the pharmaceutical company Squibb wrote the chemical off: "In view of the slow development, lack of stability and slowness of bacterial action shown by penicillin, its production and marketing as a bactericide does not appear practicable."

Then, on 6 September 1939, three days after Britain declared war on Nazi Germany, Florey and Chain applied to the Medical Research Council and the Rockefeller Foundation for a grant to study penicillin again. They were convinced it could be made into a useful thing and were beginning to think about it as a medication to be injected rather than a cream to be applied. Because of the outbreak of war, they received less money than they wanted, but it was enough to get started. In the following May, having grown enough mould and extracted the penicillin from it, they tried injecting four of eight mice before infecting all eight mice with streptococcus bacteria. The four untreated mice promptly died; the treated mice survived.

In February 1941 they tried to cure Albert Alexander, a 43-year-old policeman dying of septicaemia. The penicillin brought an instant improvement in his condition, but the supply ran out and he died. Florey had seen enough to convince him that this drug could cure bacterial infections. He flew to America in July 1941 to seek out firms that could invest in growing the mould and extracting the antibiotic on an industrial scale. American industry took over the project, finding high-yielding varieties of mould and new ways of extracting it and scaling up production. Being American, they then promptly patented many of these, to the ire of Florey and Chain. By D Day, penicillin was saving lives from infection on the battlefield as no medication had ever done before.

## Crinkly tin

If penicillin is an innovation pioneered by an Australian abroad, corrugated iron is an innovation from abroad that flourished in Australia as nowhere else. Low technology it may be, but as I recount in my new book *How Innovation Works*, corrugated iron is one of the most useful things ever invented, especially for the global poor;

providing shelter for millions from the rain and sun in slums and shanty towns to this day.

Invented in London, it came of age in Australia, finding new uses, new forms and new applications. The original inventor was Henry Robinson Palmer, who was born in 1795 in east London, the son of a parson, and apprenticed as a civil engineer. In 1826, Palmer oversaw the extension to a dock in east London and its associated buildings. Wanting a strong, cheap roof for a warehouse with a wide span he had the idea of passing a wrought-iron sheet through rollers to give it a wavy pattern that lent extra strength to it. "It is, we should think, the lightest and strongest roof (for its weight), that has been constructed by man, since the days of Adam," wrote one admiring observer. On 28 April 1829 he patented "the use or application of fluted, indented or corrugated metallic sheets or plates to the roofs and other parts of buildings."

Palmer sold the patent to his assistant, Richard Walker, who started a dynasty of manufacturers of the material, becoming wealthy before the patent expired in 1843. By 1837, Walker was advertising corrugated iron for use in Australia, a land that was to become the metal's "spiritual home" in the words of Adam Mornement and Simon Holloway in a 2007 book. A specially composed "Tin Symphony" was included in the opening of the Sydney Olympics in 2000.

This connection with Australia was partly a matter of timing — with emigration to Australia peaking in the mid 1800s — and partly a matter of the scarcity of labour in the emerging colony. Victoria's goldrush of the 1850s, in particular, stimulated demand for prefabricated material for buildings. In 1853, Samuel Hemming shipped a complete corrugated church from London to Melbourne from where it was transported to Gisborne by bullock cart.

By the end of the nineteenth century, corrugated iron's largest market was Australia, so it was here that further innovation in the material took place, continuing into the twentieth century. BHP patented corrosion-resistant Zincalume steel in the 1970s, a corrugated material made of steel, but coated in 55 per cent aluminium, 43.5 per cent zinc and 1.5 per cent silicon.

## A map from a spare bedroom

Australia has also contributed a far more recent and high-tech innovation to the world. It's a shock to realise that Google Maps was not invented by a Californian but by four Sydney-based programmers: Australians Noel Gordon and Stephen Ma, and Danes Lars and Jens Rasmussen.

In the grim aftermath of the dot-com bust at the turn of the century, all four men had lost their jobs. They set up a software company called Where 2 in Noel Gordon's spare bedroom in the Sydney suburb of Hunters Hill, and quickly developed a mapping application called Expedition. But when they tried to interest Google in it, they received the answer that apps were not of interest: a web-based program was what Google wanted. By 2004, the four Australians had achieved this goal, and Google promptly acquired them, and their company, as only its second purchase; renaming the program Google Maps. Weeks later, Google floated on the stock market.

As this example demonstrates, the most lucrative innovations of recent years have required relatively little money, machinery or real estate to turn into big businesses. Google's parent company Alphabet is worth over $900 billion. Twenty-two years ago, it was two students in a borrowed garage. There is a myth abroad that today innovation requires large teams and lots of money while in the past it was done by clever people with no facilities. If anything, the trend is going the other way: in the 1910s, BASF's pioneering project to fix nitrogen from the air to make fertiliser, using a process invented by Fritz Haber and Carl Bosch, was a vast undertaking with far more money, people and infrastructure than any start-up requires today. The Manhattan Project of the 1940s dwarfs anything in the innovation space today.

This return of lightweight innovation has implications for Australia. The relatively small size of its economy and population is less of a barrier to innovation than it would have been in the early twentieth century when the development of cars, fertiliser or nuclear weapons demanded gigantic investment.

## When innovation meets resistance

Innovators rarely have an easy ride to riches and fame. They usually face derision or suspicion. "When a new invention is first propounded," said pioneering medic and economist William Petty in 1679, "in the beginning every man objects and the poor inventor runs the gauntloop of all petulant wits." Vested interests in existing technologies mobilise against them.

No better example of this resistance to innovation exists than the case of Barry Marshall, a medical innovator from western Australia. "Everyone was against me," he once said, "but I knew I was right." What Marshall was right about was the cause of gastric and duodenal ulcers. In the 1980s, drugs to treat ulcers were among the most profitable medications produced by the pharmaceutical industry. These drugs treated the supposed cause of ulcers, excess secretion of acid in the stomach, in turn thought to be the result of stress. SmithKline Beecham's Tagamet and Glaxo's Zantac earned their makers billions of dollars a year in the 1980s. There was a huge vested interest in the acid theory.

Marshall began working at the Royal Perth Hospital with Robin Warren, who had found from stomach biopsies that a bacterium with a distinctive curved shape was surprisingly able to live in the acidic environment of the stomach of some people. Marshall moved to Fremantle hospital and continued the work, suspecting that the microbe was not harmless, but was causing illness. He tried to culture the bacterium, now named *Helicobacter pylori*, from the stomachs of 100 people with ulcers. The first 30 seemed to have failed but the 31st succeeded, because the lab technicians forgot to follow their usual practice of discarding the culture after two days. It became clear that the bacterium was present in the stomachs of most people with ulcers, but rare in others.

Marshall and Warren submitted their results to the Gastroenterological Society of Australia. It was rejected because it did not fit the conventional wisdom. Marshall presented the results at conferences but "I was met with constant criticism that my conclusions were premature and not well supported. When the work was presented, my results were disputed and disbelieved, not on the

basis of science but because they simply could not be true. It was often said that no one was able to replicate my results. This was untrue but became part of the folklore of the period. I was told that the bacteria were either contaminants or harmless commensals."

Marshall tried to induce ulcers in pigs by infecting them with *Helicobacter* but failed. So he decided there was nothing for it but to infect himself. In 1985, without informing either the ethics committee of his hospital or his wife, he drank a broth of *H pylori*, expecting to develop an ulcer months or years later. He was stunned to find himself suffering classic symptoms within days. Endoscopies revealed a major ulcer. After two weeks, Marshall took antibiotics and bismuth to kill the bacteria and quickly recovered. "If I was right," he wrote, "then treatment for ulcer disease would be revolutionized. It would be simple, cheap and it would be a cure."

He had discovered that a vast and lucrative industry of lifetime ulcer treatments — and sometimes surgery — could be replaced with short courses of cheap antibiotics. No wonder he was unpopular. Fortunately, Procter and Gamble took up his cause, having a vested interest in bismuth treatments. Still, it took ten years of being a zealot (his word) before the world changed its mind. In 1994, the National Institutes of Health in Washington formally accepted that Marshall was right. A decade after that, he was in Stockholm receiving the Nobel Prize.

## The boomerang effect

Innovation is not itself an innovation. It has been happening for tens of thousands of years — albeit very slowly until recent centuries. And there is one pattern that emerges clearly: it depends on exchange between people. It is not something done by lonely geniuses. Thus, Pacific islanders had more sophisticated and varied fishing tackle if they lived on islands with lots of trading contact with other islands. We innovate between our brains, not within them.

A striking case history of this comes from Australia. Tasmania became an island around 10,000 years ago when the last ice age ended and rising sea levels cut it off from what would later become Victoria. Thereafter, Tasmanian hunter-gatherers, around 4,000 in

number, remained wholly isolated till contacted by western sailors in the nineteenth century.

They missed out on innovations that happened elsewhere in Australia during that time, such as the boomerang. The inhabitants of an otherwise similar island, Tierra del Fuego, were luckier, because the Magellan Strait is much narrower than the Bass Strait and trading contact with South America continued.

The Tasmanians also largely ceased innovating themselves, but what is more astonishing is they gradually lost some of the technologies they had at the start: bone tools, fishing equipment and more. The reason for this rare phenomenon of 'disinnovation', anthropologists reckon, was not that there was anything wrong with their individual brains, but that their collective brain, their shared intelligence, was too small to allow the division of labour necessary to maintain technologies. Think how few of your own technologies today you could sustain if there were just a few thousand of you stuck on an isolated island for scores of centuries. Innovation is a social phenomenon.

The twentieth century saw incredible innovations that would have been indistinguishable from magic to most previous human beings, from cars and planes to computers and online maps. The twenty-first will inevitably see many more changes that will be even harder to imagine today. Australia can play a huge part in that innovation if it puts its collective mind to work while opening it up to those of other continents.


**The Centre for Independent Studies** is a non-profit, public policy research institute. Its major concern is with the principles and conditions underlying a free and open society. The Centre's activities cover a wide variety of areas dealing broadly with social, economic and foreign policy.

The Centre meets the need for informed debate on issues of importance to a free and democratic society in which individuals and business flourish, unhindered by government intervention. In encouraging competition in ideas, the Centre for Independent Studies carries out an activities programme which includes:

- research
- holding lectures, seminars and policy forums
- publishing books and papers

For more information about CIS or to become a member, please contact:

Level 1, 131 Macquarie Street,
Sydney NSW 2000 Australia
Ph: 02 9438 4377
Email: cis@cis.org.au

**cis.org.au**

# Innovation in Australia

In the mid twentieth-century, half the world still lived in extreme poverty. Today, even corrected for inflation, just 9% of people live like that. Average lifespan is increasing globally by about five hours a day. Child mortality, the greatest measure of misery I can think of, is plummeting on all continents. Global inequality is falling as people in poor countries get rich faster than people in rich countries. The average person is wealthier, healthier, cleverer, cleaner, safer, kinder, freer and even happier than ever before: that's what the data say.

These unprecedented trends are mostly not caused by better government, the accumulation of more capital, the exploitation of more resources, or some kind of magic, but by one simple thing: innovation. The creation of new products, practices and services that do useful things for us, making us more productive as we work for each other in the global marketplace: that is the big theme of the last two centuries, and it continues today. So what is innovation and how do we get hold of it?

**Matt Ridley** is a British journalist and businessman. He is best known for his writings on science, the environment, and economics. He has written several science books, including *The Red Queen: Sex and the Evolution of Human Nature*, *Genome*, *The Rational Optimist: How Prosperity Evolves*, *The Evolution of Everything: How Ideas Emerge*, and his most recent: *How Innovation Works, And Why It Flourishes in Freedom*.

CIS Occasional Paper 176
ISBN 978 1 925744 65 1
ISSN 0155 7386

**cis.org.au**

THE CENTRE FOR INDEPENDENT STUDIES

CIS Pandemic to Prosperity