

Australia

Amid sweeping funding cuts and an often hostile political environment, the country's science leaders look outward for multi-disciplinary collaboration and prepare to take the long-term strategic view.

ARTICLE COUNT (AC): 2,496

FRACTIONAL COUNT (FC): 1,144.32

WEIGHTED FRACTIONAL COUNT (WFC): 950.22

In 2014, Australia's science leaders focused on promoting research in realms outside academia, encouraging commercial development of breakthrough discoveries from interdisciplinary research and increasing international collaboration in big science.

The bigger-picture approach is a necessary reaction to significant funding cuts, and a political apathy to the importance of scientific research, according to Andrew Holmes, president of the Australian Academy of Sciences and a University of Melbourne chemist. "We have to react by being smarter in the way that we work and also more convincing in persuading the political masters how effective science can be in creating wealth and raising our standard of living," he says. Holmes calls it the "foresight aspect" of how science is practiced and says the strategy has not been used much in the past in Australia.

CONTINUING BEYOND THE CUTS

In the short term, any Australian science and technology strategy must deal with dwindling federal funds. In 2014, Australian government spending on research and development dropped to its lowest level since 1984 — just 2.2% of the federal budget, down from a high of 2.8% in the mid-1990s, according to analysis by The Sydney Morning Herald. In effect, R&D investment has grown at less than half the

rate of total government expenditure — having punitive ramifications given that government funding still supports more than two-thirds of all Australian researchers.

Among the cuts announced, nearly US\$82 million of promised grant money will be taken from the major funding body, the Australian Research Council (ARC), over the coming four years. It means that by 2016–17 the ARC funds available for researchers will have dropped nearly 5%. Research dollars were also taken from

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the Commonwealth Scientific and Industrial Organisation (CSIRO), the Australian Nuclear Science and Technology Organisation (ANSTO) and the Defence Science and Technology Organisation (DSTO). At the end of 2014, there was continuing uncertainty about a US\$123 million provision for some of the country's major science infrastructure, including the Australian Synchrotron, because this funding lies in controversial budget provisions that were still being blocked by Australia's upper house.

In the case of the CSIRO, an approximate US\$91 million reduction in funding over four years — a 4% cut in the budget over 2014–2015 alone — is forecast to spell the end of 489 jobs by mid-2015. The cuts have already cost the CSIRO a funded position for chemist, San Thang, who is considered a strong future candidate for a Nobel Prize for his work as the co-inventor of the RAFT polymer process (reversible addition-fragmentation chain transfer). The CSIRO has historically been a strong performer in the Australian research community. Among other achievements, it was responsible for the development of Wi-Fi, and it was one of the global top-50 institutions for earth and environmental science publication in the 2014 Nature Index. Nonetheless, recent reports suggest funding cuts at the organization have forced researchers to take on cleaning labs and writing media releases.

ONGOING ADVANCES

Despite the funding crisis, Australia ranked fourth in overall publishing output in 2014 for the Asia-Pacific region. With an emphasis on chemistry, life sciences and physical sciences, Australia was once again ranked twelfth in the 2014 Nature Global Index, albeit with an increase in its weighted fractional count of 9.2% over its achievement in 2013.

Six of the country's research-intensive universities earned spots on the 2014 Nature Index's

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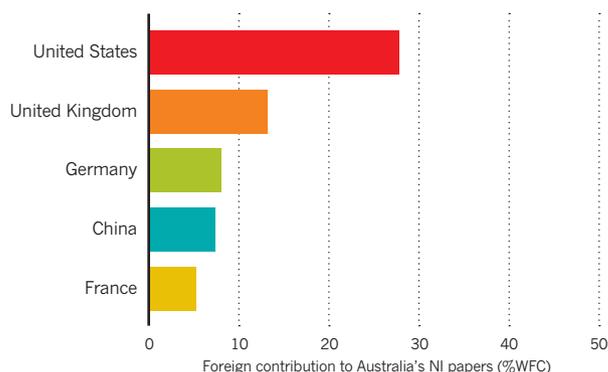
Top ten institutions

Among Australia's top ten institutions on the Nature Index (NI), those in the middle — third through sixth — finish very close, based on WFC.

RANK	INSTITUTION	WFC 2014	AC 2014
1	The University of Queensland (UQ)	108.83	392.00
2	Monash University	102.98	381.00
3	The University of New South Wales (UNSW)	88.12	277.00
4	Australian National University (ANU)	87.16	498.00
5	The University of Melbourne	82.47	474.00
6	The University of Sydney (USYD)	79.89	491.00
7	The University of Adelaide	38.73	180.00
8	The University of Western Australia (UWA)	37.45	294.00
9	Commonwealth Scientific & Industrial Research Organisation	33.01	237.00
10	Macquarie University	19.71	154.00

Top five collaborators

Australian scientists collaborate internationally on more than 60% of their articles in the NI WFC, and spread that more evenly than others in the region.



Top 200. Leading them was the University of Queensland, where Timothy Barnett from the School of Chemistry and Molecular Biosciences was one of the stars. Work by Barnett and his team reshaped understanding of how group A *Streptococcus* bacteria infects the body, effectively hiding from the immune system and growing within cells. The new comprehension of the bacteria's behaviour is an important step towards better treatment for an infection linked to more than 500,000 deaths globally each year.

Australia continues to perform well in life sciences — placing third in this category in the 2014 Asia-Pacific Index — despite funding austerity. Medical researchers in particular were buoyed by the government's proposed establishment of a Medical Research Future Fund worth approximately US\$16 billion. The fund would distribute around US\$820 million per year for medical research beginning in 2022 which would double the country's medical research funding. Researchers welcomed the proposal, but its funding source — a charge for patients for each visit to a physician — meant that the legislation was still under debate at the end of 2014.

In the physical sciences, Australians provide strong ongoing performances, exemplified by the quantum computation being led by the team at the University of New South Wales (UNSW) Centre of Excellence for Quantum Computation and Communication. Two separate papers from the centre were published simultaneously in *Nature Nanotechnology* in October 2014. They demonstrated two versions of silicon qubits, the building block for quantum computers, each able to process quantum data at above 99% accuracy, vastly exceeding levels for earlier silicon prototypes and within the realm of effective error correction. Quantum computing — using the spin of individual electrons to encode information — has potential to enable calculations of a scope and speed dwarfing anything today. The UNSW team leads the world in solid-state quantum computing using silicon, which has cost advantages and is already widely used in commercial electronics.



Funding cuts at CSIRO fuel protests.

Government cuts to renewable energy and climate-change research are beginning to bite, but Australia continues to publish strongly in earth and environmental sciences — also placing third in this category in the 2014 Asia-Pacific Index. Highlights include publication by the Australian National University (ANU) of extensive modelling of environmental conditions from the past and into the future. In one crucial study, ANU researchers, in collaboration with French and Chinese investigators, showed that recent rises in ocean levels are not within the scope of past natural fluctuations. In 2015 and beyond, marine investigations facilitated by the CSIRO's new US\$98.4 million research ship, the *RV Investigator*, will add to the country's earth and environmental sciences capabilities.

TOMORROW'S TEAMWORK

Looking ahead, the nation's leaders of science are hoping to fortify against future cuts. Among those leading the push for a more coherent national strategy, has been Australia's chief scientist, Ian Chubb. "You've got to invest in the long term," says Chubb, a neuroscientist. He consulted widely with the science community, government and business and is looking to develop a strategy that will help persuade the broader community of the high value of research and help it to attract younger Australians as a career choice.

Part of that strategy is greater collaboration, says Chubb, across disciplines and borders. There is growing enthusiasm about the potential of interdisciplinary research among Australian scientists and two major interdisciplinary centres were launched in 2014. At the University of Sydney, the Charles Perkins Centre opened with much fanfare in July and began bringing together mixed-discipline teams — from architects to cardiologists to economists — to work together on solutions for the country's rapidly growing chronic health problems, including obesity, cardiovascular disease and diabetes. Later in the year, the University of Adelaide, Macquarie University and RMIT University jointly established the Centre for Nanoscale Biophotonics, with the remit of convening researchers from medicine, engineering, biology and other areas to work together on better methods to observe and affect life on the nanoscale.

On a larger scale, Chubb is advocating the formation of an Asian Research Zone to foster greater collaboration in the region. He wants a genuine partnership between Asia-Pacific countries, a Southern Hemisphere version of the European Research Area. The starting point, he says, is to consider a multilateral approach to the science needed to overcome the region's challenges. He points to the risk of pandemics: "They are probably a subset of what the planet needs to confront," Chubb says.

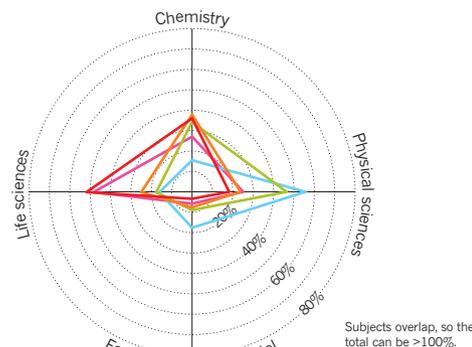
Chubb has already taken the ambition to the new Commonwealth Science Council, intended to be the government's chief strategy advisor on science and technology. Chaired by the Prime Minister and with members including the Ministers for Industry and Science, Health, and Education as well as business representatives and researchers, the council's endorsement could turn the Asian Research Zone to national policy. Such a policy will forge closer links between Australia and its regional neighbours such as China and Japan, enabling the sharing of science infrastructure and research talent. Given domestic deficiencies, the appetite for international science partnerships is only likely to grow in 2015. ■

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Institutional subject spread

The University of Queensland — Australia's leading institution on the NI WFC — publishes more than half of its articles in life sciences.

- The University of Queensland
- Monash University
- The University of New South Wales
- Australian National University
- The University of Melbourne



Nature and Science ratio

The University of Queensland hits nearly twice the global average on this NI metric.

