DOI: 10.1002/anie.201204044

Australian Chemistry under the Spotlight

*Colin L. Raston**

The gross domestic product expenditure for research and development in Australia has increased, breaking through the 2.0% barrier in 2008, and sitting at 2.21% in 2010. This, coupled with a hard-working ethos, has helped the country advance in science. In the last decade, there has been major investment in the Australian Synchrotron and research facilities at the ANSTO nuclear reactor, with ongoing upgrades of other research facilities through the Australian Research Council (ARC) and other government funding schemes such as the National Collaborative Research Infrastructure Strategy (NCRIS). The ARC is the primary source of research funding, and supports excellence in research through international benchmarking. While the success rates for ARC grants in science for the main Discovery Program have been relatively steady at close to 20%, the percentage of funds awarded against requested funds is getting smaller, currently at 51%, which may become unsustainable for viable research programs.

International benchmarking rates Australia as performing well in science in general. In benchmarking chemistry, four chemistry departments, namely those of Monash University, The University of Western Australia, The University of New South Wales, and The University of Sydney, are in the top 100 worldwide according to the Academic Ranking of World Universities (ARWU).[1] Other chemistry departments are tracking well, particularly those in the so-called "Group of Eight" (GO8) universities, of which the above universities are members, the others being The University of Adelaide, The University of Queensland, The Australian National University, and The University of Melbourne. Nevertheless, looking at chemistry departments alone is not necessarily a reflection of activity in the chemical sciences, with many chemical-based publications in leading journals from other university sectors. There has been major investment in new laboratories in Australia in the last decade, and activity in the chemical sciences is set for further growth.

Priority research areas have been established by the ARC:[2] environmentally sustainable Australia, promoting and maintaining good health, safeguarding Australia, and frontier technologies for building and transforming Australian industries. The latter is particularly applicable to the chemical sciences, with the potential for supporting competitive grants focused on fundamental research. However, there is a growing tendency for greater success in securing funding for strategic fundamental research. At the same time, multidisciplinary research is developing, which is not surprising given cutting-edge research in general appears more at the interface of chemistry with other fields. I am involved in ARC- and industry-funded research connecting chemistry with medicine, engineering, and physics, with colleagues across several countries, some involving PhD exchange programs. While challenging, it's proving to be a winner for all personnel and organizations involved.

The ARC supports research for all academic fields, except clinical medicine, which is funded through the National Health and Medical Research Council (NHMRC). The ARC has undergone major changes over the last two decades. The creation of ARC Federation Fellowships in 2001 as part of the centenary celebrations for the Commonwealth of Australia was one such change. These five-year fellowships were established to retain and attract world leaders by providing significant funds with attractive salaries, and they have had a profound effect in ramping up the quality of research in the sciences, in creating areas of critical mass, and in supporting new initiatives. Some Federation Fellows are Paul Burn (organic photonics and electronics, The University of Queensland), Paul Mulvaney (colloidal and surface science) and Frank Caruso (nano-biomolecular engineering, both at The University of Melbourne), Cameron Kepert (materials chemistry, The University of Sydney), Gordon Wallace (conducting organic materials, University of Wollongong), Alan Bond (electrochemistry) and Doug McFarlane (ionic liquids, both Monash University), and Mark von Itzstein (chemistry of carbohydrates, Griffith University). Another defining change in research in Australia has been the evaluation of research quality through the Excellence for Research in Australia (ERA) initiative,[2] where the quality of publications (as defined by citations) rather than quantity now becomes a driver for funding disciplines.

A suite of fellowship schemes is currently operated by the ARC for attracting "global researchers" across all levels of career development. The 2001 Federation Fellowship scheme was recently replaced by the similar Laureate Fellowship scheme. DORA Fellowships are also available for leading researchers, with Future Fellowships for mid-career researchers, and DECRA Fellowships for early-career researchers. The fellow-

[*] Prof. C. L. Raston
Centre for Strategic Nano-fabrication
School of Chemistry and Biochemistry
The University of Western Australia
Crawley WA 6009 (Australia)
E-mail: colin.raston@uwa.edu.au

ship schemes provide a career path for researchers, and a mechanism in building up chemistry departments, as well as opportunities for devoting more time to research, with some undergraduate lecturing for attracting potential PhD candidates. In Australia, PhD candidates tend to stay in the same university, maybe because of the large distances needed to move, especially for far-flung Perth, which is 2138 km "as the crow flies" to the closest interstate university. Overall, ARC fellows have greatly enhanced chemistry in Australia, with higher success in securing other funding, and in establishing viable research groups and tackling the big issues—there are many success stories.

Research Centres of Excellence (COEs) funded by the ARC are an integral part of chemical research as a prestige program for multidisciplinary research. Current centres that involve more than one university, along with industry and hospital support, with a chemistry focus cover "Free Radical Chemistry and Biotechnology", through The University of Melbourne, and "Electromaterials Science", through the University of Wollongong.[2] The Centre for Green Chemistry at Monash University was initially supported under this program in 2000 for the maximum nine years. Federal government Cooperative Research Centres (CRCs) offer another form of securing funding for research, as distinctly different to the COE program, in now being directed to end-user collaborative research that deals with the major challenges facing Australia.

State governments support research to varying degrees, with Queensland, Victoria, and Western Australia (WA) leading the charge. WA even boasts a State Premiers Fellowships Scheme for attracting research leaders into the state, and was successful in attracting Julian Gale to Curtin University.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is the national government body for scientific research in Australia. Its Flagship Program supports large-scale multidisciplinary research partnerships for tackling national priorities in areas of human, environmental, and economic significance. The Flagship Program fosters collaboration between the CSIRO, universities, and industry in taking outcomes for practical benefits. In the chemical sciences, this covers programs in energy, for example in hydrogen storage, and in manufacturing.

Opportunities abound for international collaboration, being supported by government with country-specific programs available including the Australia–China Science and Research Fund and the Australia–India Strategic Research Fund, which has a "grand challenge" feature that supports chemistry at the interface with health and energy. The ARC also supports international collaboration. I currently hold a Discovery Grant with Federico Rosei (INRS, Montreal) that involves PhD exchange research. The Australian Academy of Science is the national body for IUPAC, and administers several international collaborative programs. Interestingly, researchers "down under" are increasingly involved in major research programs with funding agencies overseas, including the National Institutes of Health (NIH) and the National Science Foundation (NSF).

Industry is also involved in university research through the ARC Linkage Program. Here, funding from local and/or overseas industry provides leverage for securing ARC funding with an attractive success rate close to 40%. The tax concession is attractive to industry, as is the ability for industry to gain access to expertise and equipment, and to undertake research at a fraction of the cost relative to research undertaken exclusively in industry, while being seen as good corporate citizens. The program has been very successful in establishing large consortia of researchers and companies around the world in order to tackle major problems, for example biomass utilization. Some initiatives arise from industry partners contacting university research offices to identify potential researchers. The ARC Linkage Program also funds Australian Postdoctoral Fellowships (Industry) and Linkage Industry Fellowships to facilitate the transfer of research to industry.

Challenges for chemistry "down under" are not unique, with the squeeze on basic research. The distinction between ARC funding and NHMRC-type research has created some uncertainty, with a push for any nonclinical medical research to be directed to the NHMRC. The wider communities are more tuned to the sciences and technology, and it is now important to engage them in addressing concerns, for example the potential risks to human health and the environment that are associated with nanomaterials.

Australia's economy is traditionally heavily dependent on mining. The big challenge is to ensure that the country invests in science and technology for the future, to eventually deal with the challenges once the mining boom is over. This will require greater government investment at the state and federal levels, and be enhanced through greater international engagement of the researchers.

[1] http://www.arwu.org/SubjectChemistry2010.jsp.
[2] http://www.arc.gov.au/about_arc/arc_profile.htm.