

**2011 RALPH SLATYER LECTURE
SCIENCE AND SOCIETY**

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It is a great honour to have been invited to present the inaugural Ralph Slatyer Lecture. I am a great admirer of the enormous contribution made by Ralph Slatyer to both science and science policy.

In my view, the establishment of Co-operative Research Centres was a masterstroke way ahead of its time. These Centres have enabled the development of great science with great application to industry, for the wider benefit of all.

It is worthwhile, therefore, to spend a little time considering Ralph Slatyer's background and reflect on some of the thinking that led to his significant contribution.

Ralph Slatyer grew up in Western Australia, attended Perth Modern School (at the same time as former Australian Prime Minister Bob Hawke) and Wesley College before enrolling in Agriculture Science at The University of Western Australia.

He regarded his degree as "very good, much hands on" and he singled out to senior academics at The University of Western Australia - Eric Underwood and Andrew Stewart – as being significant influences in his formative years.

He spent his vacations working with CSIRO in the far north of Western Australia in Kununurra and in Katherine in the Northern Territory being motivated by a desire as he described it: to "feed the world".

He joined CSIRO in 1951 and worked in Northern Australia rising to be Associate Chief, Division of Land Research before leaving CSIRO to be appointed the Foundation Professor of Environmental Biology in 1967 at the Australian National University. While working at CSIRO he completed a Masters and a Doctorate in Agricultural Science from The University of Western Australia.

At ANU, he developed the first agro-climatological and eco-climatological models in the world, establishing a world leading multi-disciplinary centre which made very many significant contributions.

From 1977 to 1982 he was Australia's Ambassador to UNESCO before returning to Australia to be Chair of ASTEC (1982-87).

In November 1989, he was appointed as Australia's first Chief Scientist and established the Prime Minister's Science, Engineering and Innovation Council.

His close relationship with his friend from Perth Modern School and The University of Western Australia – the (then) Prime Minister Bob Hawke – enabled considerable policy development while Chief Scientist.

One of the most significant of those developments was the establishment of Co-operative Research Centres.

In interview, Ralph was asked about the Cooperative Centres program. He said (and I quote): "I suppose I can't afford to be too immodest as I was largely responsible for it. I think people would agree it is the most significant development we have had in Australia since 1965 when the Australian Research Grants Committee was first established. The seed was sown at the first meeting of the Science Council when – not altogether planned – we had a parade of well-known scientists telling the Prime Minister and senior ministers that even in research areas where Australians had been leaders we were having trouble keeping up with the pace internationally, particularly in areas where you needed multi-faceted teams to make progress. Individual research support was not too bad, and things were happening for the support of smallish teams, but there was no mechanism to build large multi-disciplinary teams on the required scale." (end quote).

Ralph also pointed out that during the 1960's – as both CSIRO and the universities grew rapidly – CSIRO labs that had been on university campuses moved off campus and a very important nexus, which put together researchers and students, was broken. While he noted that in many cases the CSIRO labs didn't move very far – CSIRO and university staff were no longer working in each other's labs, something that had an effect on both research and research training.

He said of this (and I quote again): “... there is the reality that our Australian research enterprise is inevitably fragmented geographically because of the distribution of Australian centres of population, and also fragmented institutionally because of the separation of CSIRO and other government facilities from campuses. We have both arms tied behind our backs, in a sense, but because the institutional measures are not inevitable there was clearly a chance to do something about that aspect.”

He went on to say that: “... all of these ingredients added up to a case to the Prime Minister to create new centres that would be truly cooperative ventures – every one of them, should have a university component because of the importance of the teaching element.

And, wherever possible, researchers in centres should be together at the one location on a university campus, to recognise the universities' role as intellectual powerhouses in the country.” I have to say, Ralph wouldn't get any argument from the nation's research universities on that front!

But he also recognised the need for critical mass: Quoting again: “... we would try and link groups with common interests, even though they were geographically separated. So we were running a gigantic experiment in distance cooperation research as well. If ever a country needed to be very good at distance cooperation research – not just internally but internationally – it is Australia.”

In the second part of 1989, Ralph made sure he was up to speed with cooperative research ventures in the UK and other countries in Europe, the US and Canada and then towards the end of that year he put a proposal to the Prime Minister. In his words: “... to my absolute delight he smiled on it.”

Although signed, sealed and approved before the 1990 election, the proposal was caught up in that process and it wasn't until after the election that the program was given bilateral support.

Ralph has received many honours – among these, the award of Officer of Order of Australia and Companion of Order of Australia; Fellow of the Royal Society; Fellow of the Australian Academy of Science; Fellow of the Australian Academy of Technological Sciences and Engineering; Foreign Member National Academy of Sciences; and winner of the Australian Medal of Agricultural Science.

Ralph's genius has always been his ability to bring people together for the greater good. He has said that interaction with his colleagues throughout his research career was the reason for his and others' success. The coming together of minds with different abilities is what creates great science.

I too, am a graduate in Agricultural Science from The University of Western Australia. I also greatly admired Professor Eric Underwood who was still Director of The University of Western Australia's Institute of Agriculture when I arrived to undertake my PhD in 1966.

More importantly in the context of this address, in 1992, I was the Foundation Director of the Co-operative Research Centre for Legumes in Mediterranean Agriculture (CLIMA), a second round CRC which still operates as a joint research centre.

The CRC program has played a pioneering role in bringing together public and private sector researchers and research end-users to focus on solving real challenges of importance to Australia.

According to a review conducted by Insight Economics examining the economic impact of CRCs, the knowledge generated in these centres enabled improved productivity in existing industries, helps the development of new industries and leads to improved environmental and health outcomes – not only in Australia but globally.

Insight Economics' 2006 report stated that for every dollar invested in the CRC program rather than left with taxpayers:

- the Australian Gross Domestic Product was cumulatively \$1.16 higher than it otherwise would have been;
- total Australian consumption was \$1.24 higher than it would otherwise have been;
- and total investment was 19 cents higher than it would otherwise have been.

So, money put in the program bears great returns in more ways than one and it is obvious that the program delivers strong net positive economics for Australia.

Our CRCs are also hubs of “innovation”.

Innovation is the driver of any modern economy – it is the key to competitiveness, employment growth and social well being.

Those here today would recognise – as has the Australian Government Productivity Commission – that innovation is crucial to future wealth and prosperity, and the capacity to tackle social and environmental challenges locally, nationally and globally.

Australia's future success will depend substantially on our capacity to be players in the main game of the advancement of knowledge and innovation. And the cycle of innovation must be fed by new ideas and basic knowledge.

As economies become increasingly knowledge-based, scientific and technological efforts will be the essential determinants of industrial performance and international competitiveness.

Innovation is widely seen as increasing the adaptability of an economy to future international uncertainties. However, the recent Review of the National Innovation System led by Terry Cutler threw up some disturbing observations.

His report acknowledged that Australia is a prosperous country with a reputation for being inventive ... and that we have successfully overcome the issues of being a large isolated continent separated from many of our trading partners.

The Cutler Review noted that while it was clear that innovation had been pivotal in delivering economic success in the past, it was being reshaped by four powerful circumstances.

- The first is that the architecture of our innovation system is out of date.
- Secondly, the nature of innovation and our understanding of it are changing fast. We need to transform ideas into clever goods and services at a faster rate and we need to have a population who are as skilled and knowledgeable as our competitors.
- The third is that the rate of improvement has stalled and perhaps even declined. As a share of GDP, public support for research and development (whether

private or public) has fallen by nearly a quarter and public expenditure on education has slipped below the OECD average.

- Finally, the two most populous countries in our region – India and China – are becoming economic giants. And innovation is central to their self-transformation. Many developed nations, like Finland, Singapore and Korea, have responded by increasing their innovation effort. Australia must do so too or see our relative prosperity decline.

If Australia is to become the clever country where we use research and development and a well-educated workforce to drive innovation and economic prosperity, we need to address these concerns.

And I am pleased to say that some reforms have already been put in place since the publication of the report.

Science has a crucial role in identifying and analysing these challenges and must be considered in parallel with social, economic and political perspectives to find solutions.

In his report on Australia's 'innovation system', Cutler attests that the most fundamental drivers of innovation are the skills, knowledge and attitudes of the workforce – or the human capital of the nation.

In Australia, secondary students are becoming less interested in learning science and mathematics and the relative proficiency in science and mathematics is in decline. Not having scientifically literate leaders may stall our capacity to solve the major problems affecting Australia and the rest of the world.

Australia is located in the fastest growing region of the world and is consistently rated as one of the most desirable places in which to live. However, we are a relatively small country and only through explicitly targeted international collaboration can we gain access to foreign innovation networks.

Australia – representing only two per cent of the world's knowledge-generating capacity – needs to recognise the importance of international collaboration in terms of growing innovation capacity, enhancing participation in global knowledge networks, and increasing the impact of Australian research in the international arena.

Australia's ability to generate strong productivity growth requires that we perform nationally important research and that we successfully adopt and adapt the 98 per cent of innovative ideas that are generated in the rest of the world.

A strong research capacity enables us to participate on the international stage in fields of global and national importance. And our ability to attract the highest calibre international minds will allow us to engage with and contribute to international research at a highly competitive level.

Confirming these concerns, a recent report from the Royal Society, pointed to a new group of countries is emerging as major scientific powers to rival the traditional scientific superpowers of the United States, Western Europe and Japan. Led by China, and followed by India and others including Brazil, this new group has not been traditionally associated with strong science base.

The report also confirmed the importance of international collaboration in the conduct and impact of good science and its ability to solve global challenges such as energy security, climate change and biodiversity loss.

The report reemphasised that science is becoming increasingly global, with research undertaken in more and more places and to a greater extent than ever before. Today, more than 35 per cent of articles published in international journals are internationally collaborative, up from 25 per cent just 15 years ago.

International collaboration is growing for several reasons, including, most importantly, a desire to work with the best people, who may be based in increasingly divergent locations.

Another reason is that science is faced with issues of global concern. These include, along with those I have already mentioned, health issues including potential pandemics, and food and water security.

To our advantage developments in communication technologies and travel make it much easier to undertake international collaboration.

If we are to ensure a competitive economy, the Federal Government should set a goal of making Australia the pre-eminent location to attract the best researchers and be a preferred partner for international research institutions, businesses and national government.

Most Australian universities and research agencies are already involved globally through their research and publication activities, but there is room for Australia to enhance its capacity to engage internationally by both opening up current granting programs to international partners and participants and by increasing funding to specific programs in order to leverage investment.

In addition, many of our Asian neighbours currently have significant investment capital available. Mechanisms for appropriate provision of research funding should take into account the opportunities for engagement that exist in Asia, linking wherever possible our programs to take advantage of growth.

Our proximity and unique interactions with the Asia-Pacific region present extraordinary opportunities with which we need to engage fully.

At a more national level, we also need action. First, most of the problems of the world are multi-disciplinary yet our research organisations are frequently organised along discipline lines.

CSIRO and many universities have recognised this and attempted to address this issue by creating the Flagship Program (in the CSIRO) and Institutes which reach across disciplines (in our Universities).

Scale is also more important than ever and the development of collaborative partnerships between research institutions is essential. Co-location and formation of inter-institutional partnerships can assist.

For example, at my own institution – The University of Western Australia – CSIRO, the Australian Institute of Marine Science, and the State Government are to locate staff with The University of Western Australia in a new Indian Oceans Marine Research Institute on our campus. As well, our University is locating staff at CSIRO at in the Perth suburb of Floreat and at the Australian Resources Research Centre in Bentley with CSIRO and Curtin University.

A further example is in the area of medical research where we are fortunate to have particular strength as indicated by strong citation rates. This strong performance is despite

significant fragmentation that has developed between many medical institutions and many universities.

Our position could be strengthened internationally by providing strong incentives and implementing mechanisms that would remove this fragmentation by encouraging the streamlining of smaller medical research institutes through strategic collaboration, or through amalgamation of some institutes with universities.

We also face a serious run-down in the condition of university infrastructure. In Australia's Group of Eight research universities, we estimate that we have a backlog of building and maintenance in excess of 1.5 billion dollars. But in this regard, I would add that I believe the Federal Government deserves praise for increasing indexation and increasing funding to meet the indirect costs of research.

Another difficulty is locating individuals who can lead multi-disciplinary teams. Leaders of such teams require a significant "generosity of spirit" and an ability and willingness to work outside narrow disciplinary backgrounds. More effort needs to be placed on developing and rewarding such leaders.

This would improve the efficiency of the sector by bringing together teams of researchers into multi-disciplinary centres of excellence producing high-quality research outcomes.

Any discussion of the innovation system must acknowledge the vital importance of postgraduate students to the sustainability of our nation's research future.

Of great concern is the flat-lining of number of students starting research degrees. We need to take urgent action including:

- developing better research career structures;
- delivering larger stipends for PhD students;
- ensuring higher levels of funding per scholarship;
- delivering full support for the cost of providing research training, for both domestic and international students;
- considering mechanisms to develop strong intellectual communities that support research students in the same way that staff are supported; and,
- improving in how we take into account ethics, social inclusion, and global responsibility which are emerging as key issues worldwide in research training.

More broadly, Australia needs to comprehend what it means to be a player in the global knowledge economy and set about building relationships with the next generation of research scientists over a 25 year horizon.

The Cutler Review concluded that there are five broad principles for determining priorities to shape innovation policy and funding programs:

1. leveraging Australia's natural endowments to built strengths;
2. taking advantage of areas where there is a distinctly Australian challenge or an advantage in developing solutions to globally relevant challenges or markets;
3. identifying areas where there is scope to transform or reinvent existing industries and service delivery competitively;
4. internationalising our innovation system through global integration; and
5. investing in national capabilities, facilities and innovation infrastructure supporting these priorities.

To sustain economic competitiveness Australia cannot rely on a strategy of passive absorption of foreign technology. Free-riding on the rest of the world's research is not a

realistic option – because the links between researchers are personal and they are based on informal trading in ideas, techniques and devices.

To benefit from the public good of world knowledge we have to be actively engaged in cutting-edge research.

Cutler suggests that public support for the research sector should reflect the following aims:

1. Achieve internationally recognised excellence in research
2. Leverage the best collaborations, domestically and internationally, with both public and private sector researchers;
3. Develop and attract the best and brightest researchers, including a world-class cohort of post-graduate students;
4. Ensure that research institutions can respond to emerging challenges and changing circumstances; and
5. Assure sustainable infrastructure.

To achieve these aims, the resources and mechanisms for funding need to be reformed. Australia is falling behind developed and emerging economies in its commitment to research at universities, public research agencies and the many government and private bodies conducting public-funded research.

Australia is nowhere near to matching the scale of investment in research capability in the northern hemisphere, whether in North America, Europe, China, Korea or elsewhere. This is particularly true when considering major research platforms and facilities, distributed laboratory networks, and teams of young talent working with state-of-the-art equipment in modern facilities.

We are vulnerable to being passed-by, cut off and left behind in the advancement of knowledge. And if we allow that to happen we can say “goodbye” to an innovative Australia.

The way forward is to collaborate rather than compete. We need to explore co-investment in research platforms, shared facilities and networks. Two positive current examples of this are Australia’s involvement in the Square Kilometre Array Telescope project and the European Molecular Biology Laboratory.

In summary, the priority is to enhance our capacity for research of high quality by international standards. That means greater investment in the development of intellectual talent, deeper immersion into international research networks, and full funding of research and infrastructure.

And finally to conclude, let me return briefly to the legacy of Ralph Slatyer. There is no question that the standing of Australian science would not be what it is without his vision and direction.

We have a vibrant science and innovation environment. But it needs continuing support. As Ralph Slatyer saw so clearly, investment in, and encouragement of, innovation will help ensure that we advance both economically and socially; remain linked to the wider world of global knowledge; and provide a range of exciting opportunities for our young people.

The innovation road sets us a long and challenging journey, but we should not be daunted by this challenge. Innovation is the business of our future.

Thank you.