Australian Government

AUSTRALIA'S CHIEF SCIENTIST

PROFESSOR IAN CHUBB

THE ROLE OF ENVIRONMENTAL SCIENCE IN MEETING AUSTRALIA'S FUTURE

CANBERRA

AUGUST 20, 2013

********** CHECK AGAINST DELIVERY **********

Good evening,

As Chief Scientist, my job is to provide independent advice to the Australian government on issues regarding science.

My focus for much of this year has been to improve the science system as a whole. There are many things we do well in this country, but there are also many things we could do better.

For too long we have worked on fixing one thing, often simultaneously neglecting another. We haven't taken the time to step back and look at our system with a wider lens.

I've had a few wins – and I'm pushing for another, all of which I will talk about later this evening.

But it is always a pleasure to attend events like this, to step in and examine the parts, as well as the whole.

Because Australia's prosperity - our innovation, our economy, our international influence - would be nothing without the individual disciplines that support our scientific enterprise.

And perhaps nowhere is this statement truer than in the area of environmental science.

So tonight I will talk about the future – the 'where we want to be'.

And I will talk about the now – how environmental science fits and the current state of environmental science – our university

enrolments, the way our subjects are taught in schools, and the perception of this discipline by students and the public.

There will be some disjunction between the two – the where we are, and the where we want to be. But I will talk about how we might bridge that gap.

And throughout, I hope that I consistently make it clear how valuable Australian environmental science is to both our prosperity, and that of the rest of the world.

Our current performance

In environmental science, our contribution to the global stock of knowledge is great. Australia contributes 2.4% of the world's total publications overall, but we contribute 4% of environmental science publications[1].

And overall, the quality of our research is on par with other disciplines. For environmental science citations, our performance has steadily improved during the last decade, and the latest analysis puts us at around 12th in the world[2]. We are above world average, but sit just below the Western European average – the benchmark I believe we should strive to exceed.

When you drill deeper, there are sub disciplines in which we perform strongly, well above the European average – water

[1] SCOPUS data
[2] Ibid

science and technology, ecological modelling, and nature and landscape conservation[3].

There are also some where our contributions lag in quantity, and sometimes quality.

But we should not automatically assume this is a crisis.

Of course ideally we would produce only the best papers 100% of the time, across 100% of our disciplines. Not even a powerhouse like the United States can achieve that.

But we ought to be realistic.

There has never been a time in history, nor will there ever be in future, when we can fund every research project. We always have, and always will, ration our support for research.

And rationing means prioritising.

So we must also acknowledge that there are some areas that are critical to our nation's interest. And when we do, we can't just assume that they will all be ok and there when we need them.

I mentioned earlier that I had had a few wins this year. One of them was the announcement of 15 Strategic Research Priorities to guide public investment in research.

[3] SCOPUS data

These will ensure that a proportion of public funding is directed to areas of critical importance to Australia's future.

Of course, I do not claim the win on my own.

The priorities were not developed in isolation. Consultations were substantial and the evidence supporting the approach is comprehensive.

In preparing these priorities, my office conducted a study into the funding approaches taken by countries that have similar science systems to us, and that, largely, perform better than us.

The study found that all but two countries had strategic research priorities to guide their government investment in research.

The following common attributes emerged:

- Many countries identify priorities to guide public research funding.
- Several countries that we collaborate with most frequently, such as the US, and countries within the EU, begin with identifying high level societal challenges, and then select research priorities within those challenges
- All have mechanisms to ensure that curiosity-driven research is also supported.

- All acknowledge that research leading to innovation is of critical importance.

The process to develop our fifteen new priorities was aligned with what is happening in these countries.

So we began by identifying the five most important societal challenges facing Australia.

These are:

- Living in a Changing Environment
- Promoting Population Health and Wellbeing
- Managing our Food and Water Assets
- Securing Australia's place in a Changing World
- Lifting Productivity and Economic Growth.

Then, after consultation with 100 or so leaders from research sectors, we developed three research priorities for each challenge, to be reviewed every two years.

They may not be perfect –indeed some have argued that they are too broad and some have argued they are too specific.

Whatever people might think they are, I know what they are. They are the areas where we must be sure that we support research. We did not go looking for what we did not do – we went looking for what we had to ensure that we did do.

And to meet these challenges, specifically the first three, tasked with the changing environment, population health and food and water, we will need a strong capacity in environmental science.

Many of the challenges we face in Australia, we share with the rest of the world. Climate change, biodiversity, extreme weather management and resilient infrastructure are all dependent on the work of environmental scientists.

But we also face our own challenges specific to the vast, fragile environments of the 'sunburnt country'.

For example, we have one of the seven natural wonders of the world, the Great Barrier Reef, which is under threat from increased coral bleaching due to ocean warming, ocean acidification, and other environmental impacts.

The great majority of Australia's plants and animals are found nowhere else on earth. As a result, many species are repositories of unique genes and evolutionary strategies, living in unique ecosystems. [4]

And despite having the world's third largest Fishing Zone, Australian wild fish catches have declined and are not sustainable. Australia is now a net importer of fish for food[5].

And yet, with the challenges increasing, it is not certain we will be able to maintain our current capacity, let alone increase it.

[4] Tim Flannery, After the Future.
[5] PMSEIC, 2010. Australia and Food Security in a changing world, Preparing for the Future with Foresight

As at November 2012, Australia had just less than 20,000 environmental scientists. The Department of Employment expects this to increase to by 2500 workers over the five years to November 2017 – around 11%[6].

But enrolment in undergraduates environmental and agricultural sciences declined between 2002 and 2012 by a percentage that almost makes it look like I made it up… 11% again[7].

And in high school, only 54 of the 2241 Victorian schools offer Environmental Science as a senior subject and in other schools exposure to environmental science during the final years of schooling is minimal[8].

Worse than that is that in the same period, even though enrolments stayed fairly flat, undergraduate course level completions declined by 20.4% so we are seeing considerable attrition[9].

The Academy of Science quoted that *'the future will not take care of itself as we worry about the present*.'[10] It is as true of the environment, as it is of our science enterprise.

Which brings me to the win Australia needs most.

[6] Australian Government (2013). Aussie Jobs Looking Forward Looking Back 2007-2017
[7] Health of Australian Science, 2012
[8] B.A. Christie , K.K. Miller & J. Kirkhope (2013) Student perceptions of environmental management: profiling the future environmental manager, Australasian Journal of Environmental Management, 20:2, 147-160
[9] Health of Australian Science, 2012
[10] Australian Academy of Science (2012). Negotiating our future: living scenarios for Australia to 2050

Last month I released a position paper for a national strategy for science, technology, engineering and mathematics.

It looks not just at university enrolments, or research funding levels, or innovation systems - it looks at the enterprise as a whole.

The key message, if there can only be one from a 30,000 word document, is that for too long Australia has had a piecemeal approach.

Other nations are preparing their countries for a future dependent on STEM. Australia needs to do the same. And we need to do it with a long-term vision of where we want to be.

The paper looks at the four components of the science system – education, innovation, new knowledge and influence. It does so from a broad holistic position.

But the ideas, and the vision, are just as applicable to environmental science as a discipline.

Education

If we look at the first element, the paper calls for a need for all Australians to have a quality education in science and mathematics.

I always enjoy Carl Sagan's quote "*We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science*."

It is the responsibility of government to prepare and equip society to adapt and make sound choices.

Manageable threats can become serious crises if a community is made nervous by how evidence is used or misused.

This is especially true of environmental science, and the classic example of climate change, where many Australians listen not to experts, but to those with the loudest voices.

STEM education, at all levels, requires our attention.

We spend less than 5% of primary school teaching time on science. The Western European average is 9%.[11]

Time and time again, research has shown that the quality of science and mathematics teaching has the greatest impact on how students perceive those subjects.

And yet reports in Australia, the US and the UK have shown that a significant portion of primary school teachers do not feel confident teaching science.[12]

[11] Organisation for Economic Cooperation and Development (2012) Education at a Glance 2012, http://www.oecd.org/edu/eag2012.htm

[12] Morgan, A. 2012. Me as a science teacher. Australian Journal of Teacher Education, 37, 6.

And somewhere between primary and secondary school, we are losing our students. Twenty years ago, 94 per cent of year 12 students were enrolled in at least one science subject, but in 2010, it was only 51 per cent.[13]

If we want a community where people appreciate the value of science, we need an education system that excites students about science. An education system where teachers are enthusiastic not scared of science. We need to support our teachers, as much as we support our students.

Better STEM education will lead not only to a more informed and better skilled population, it will also lead to a greater generation of ideas that can be presented to that community.

Knowledge

Those ideas are essential. We don't know what this new knowledge looks like yet, but we do know that we will need it.

We still have so much to learn about our world - the natural and the constructed world. By discovering something tomorrow, that we did not know today, we break new ground, develop creative solutions and excel in fields that truly matter. New knowledge is the second element of the strategy.

[13] Goodrum, D, Druhan, A & Abbs, J (2011) The Status and Quality of Year 11 and 12 Science in Australian Schools, Report prepared for the Office of the Chief Scientist by the Australian Academy of Science, Canberra, p.10

Transformational change is driven by turning curiosity into knowledge, forming a reservoir from which we draw for application and innovation.

So we must support those Australians pushing the boundaries of discovery. We must offer them certainty in straitened times.

The strategic research priorities I mentioned earlier should help offer that certainty, and will place great emphasis on the importance of environmental science.

And as we generate new knowledge in this area, we also need to know how to develop new products and services to maintain and improve our quality of life.

Innovation

Unfortunately innovation, the second element of the strategy, is not something we do particularly well.

Almost all other OECD countries are much more likely than Australia to develop innovations that are new to international markets.

Between 80-95% of Australian innovative businesses develop innovations new only to their own companies.

Only around 4% of Australian businesses work towards innovations new to international markets.

The majority (64%) work on modifying products that already exist in domestic markets.

If we want to improve our innovation capacity, we need to change our culture.

We need to minimise risk aversion and maximise risk management.

And we need to create better links between business and publicly funded research agencies and universities.

In environmental science, there is great opportunity for new products, services and ways of operating.

A report launched earlier this year by the Australian Academy of Technological Science and Engineering highlighted major green growth opportunities in the production and supply of sustainable liquid aviation fuels and in low-emissions electricity generation technologies. Environmental science will play a key role here.

We need not only single innovations, but the ability to create entire new industries. The possibilities of environmental science to contribute to new solutions to the societal challenges we mentioned earlier are enormous.

But for this people, and their ideas, are key.

I have already spoken about university enrolments and workforce predictions for environmental science. The same is true of STEM skills more broadly. In the US, it is suggested that 60 per cent of the workforce of 2020 will require skills held by only 20 per cent of the current workforce.

I have heard arguments that we do not need more trained scientists, since there are more and more researchers competing for less and less funding.

Those who take that view rely exclusively on the idea that what is good enough today will be good enough for tomorrow.

We would be one of very few if not the only country to think in those antediluvian terms.

We have only 9 doctorates per thousand in the workforce, when Switzerland has 28.

Only 30% of Australian researchers work in the business sector, compared to 80% in the US, 64% in Switzerland and 70% in Japan .

There are places for researchers to go, which would no doubt benefit our ability to innovate, but we need a cultural shift to get us there.

When we get all of these elements right - strrong education, innovation and research systems, and we are contributing even

more so on a global scale, we will gain influence, the final component.

Influence

Enduring links with the rest of the world are important. Any country with aspirations for the future has STEM activities that are international at their core - global presence is essential, not an optional add-on.

Indeed, the nature of the problems that require substantial research efforts are so substantial that collaboration is now of critical importance. No one nation has the people, or the resources, to do on its own all that could be done.

A strategy is important in determining what to do and with whom to share it.

Country-to-country frameworks – encouraging strategic development and co-investment when appropriate – should sit side-by-side with research driven by individuals, with a shared hope to understand better our world.

And it would be hard to argue that any other STEM discipline is more international than environmental science.

The environment is a global issue – the entire planet takes responsibility for the protection of our atmosphere, our oceans and our biodiversity.

In fact, capacity in environmental science is key to our membership of the World Trade Organisation, international trade and international relations.

As a member, Australia must abide by the 1994 Marrakesh Agreement – which refers to the importance of optimally using the world's resources in accordance with the objective of sustainable development and seeking to protect and preserve the environment.

It is important to buy us a seat at the table.

Of course all four of these elements must be supported by the community for whom they operate for.

In the position paper, I refer to this as the social compact.

Social compact

Tony Blair understood this when he told the Royal Society: *The benefits of science will only be exploited through a renewed compact between science and society, based on a proper understanding of what science is trying to achieve.*

In Australia, the beneficiaries of STEM (the community at large) and the practitioners of STEM (scientists, technologists, engineers and mathematicians) have in many ways muddled along, vaguely aware of the obligations they have to each other.

The position paper states what the mutual obligations should be.

The practitioners must conduct their work in an ethical, transparent manner. And in turn, the community must commit to supporting them, and taking an interest in being able to understand the work being conducted.

If we establish this trust, through a renewed social compact, it becomes the game-changer needed to improve Australia's entire science enterprise.

On one hand, environmental science has one of the best compacts with society.

In 2007-08, 82% of Australian adults reported that they were concerned about at least one environmental problem. For us in this room, it might be comforting to know that the ACT had the highest rate of concern about the environment in Australia, with 90%.[14]

Environmental science also has the advantage of being visible and tangible – whereas physics and chemistry can be thought of as relatively abstract, the community can see the environment for themselves, and experience the effects of the environment in their daily lives. They experience pollution, drought, floods and can notice changes in wildlife and fauna.

[14] ABS, 2010. Environmental awareness and action. http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4102.0Main+Features20Jun+2010

We do need them to understand that Environmental Science uses physics, chemistry, biology and mathematics at its heart.

Environmental science also has probably the largest amount of citizen science compared to any other discipline as well.

For example, the University of South Australia has run a citizen science project each year to learn about animal behaviour in urban areas. Operation Bluetongue was the first in 2007, followed by Operation Possum, Operation Magpie, Operation Spider and the Great Koala Count.

As well as promoting environmental science and community management of wildlife, it is also a genuine research asset. As the Professor managing the projects stated: *"Enlisting thousands of people from all over the region could never be replicated by even the richest researchers."*

Unfortunately, the compact is also weak at points.

In a survey conducted this year by the Department of Science, 1186 participants were asked to nominate important issues for science to address.

Only 33% of people said climate, 19% said environment, 9% said renewable energy, and 6% said water[15].

[15] OCS survey, 2013

We have all also seen the quality of the climate change debate, and the way public opinion dips and falls in the face of high decibels.

The community may not always like the message the science delivers: but it does need the confidence to see why they'd be wise to listen to the experts – to the robust exchanges between experts.

Better education about the way science is conducted, about what uncertainties mean in science, and why the public contest of ideas is valuable, are key to the social compact.

A national STEM strategy is a win this country needs. But it is far from locked in.

Three weeks ago, I launched the position paper at the National Press Club.

It has been supported broadly by the science areas, as well as by industry – just this week the Business Council of Australia and I plan to release a joint op-ed on the need for a strategy.

But this is a national plan that needs support by federal governments beyond electoral cycles, as well as state governments.

If I have managed to whet your appetite, you can go to the Office of the Chief Scientist website where you will find the full

paper. In that you will find the objectives, actions and rationale in fuller form than time allows for any one speech.

Let me finish by saying that we in Australia have a choice. We can act strategically to prepare a future we want, or we can settle back and persuade ourselves that what we do now will be good enough – just because we do it now.

Australia can build capacity if we commit to a strategy. Get the big picture right and that will filter down to individual disciplines like environmental science.

If you choose as I would choose – that we need to take a concerted and strategic approach to Australian STEM – I ask that you keep the message alive out there and running for the next weeks and months.

Thank you.