Australian Government

AUSTRALIA'S CHIEF SCIENTIST

ADDRESS TO THE NATIONAL PRESS CLUB

25 – 30 MINUTE SPEECH PLUS 1 HOUR Q & A

NATIONAL PRESS CLUB - BARTON

23 MAY 2012

CHECK AGAINST DELIVERY

Thank you for your generous words of welcome and thank you for the invitation to speak here today. I did warn last year that I would be back for a fifth time, to secure my membership and my access to the car park.

And I probably said then that I hoped I would have something to say.

My report for the year would reveal some highs, and some lows. The mighty Swannies losing even one game is an obvious low, but an even bigger one, it has to be said, was the blurring of science with politics in emotional debates about climate change.

As for the highs, the budget announcement was the peak: $54 million for mathematics and science on the back of recommendations we made to the Prime Minister would be hard to beat – and I acknowledge Minister Evans who put in hard yards to achieve that outcome. Others include the start of our Occasional Paper series, appointment as Chair of the Australian Research Committee, and the revamp of the Prime Minister's Science, Engineering and Innovation Council. This revamp included an allocation of $10m to **all four** learned academies to enable them **jointly** to provide the research-based evidence that my Office needs to underpin recommendations to the Council.

And, before I am asked, I have indeed had several constructive conversations with the Prime Minister during the year, and many meetings with the relevant Ministers, as well as with others. I have had a number of engaging meetings with members of the Opposition.

While on high points, one might be that I am approaching my seventieth speech as chief scientist. I hope my various audiences found them relevant to their own smorgasbord of interests. Certainly, the invitations to appear and speak and comment still well exceed my capacity to accept them all.

It is not a chore, if a little tiring for a retired gentleman. I am proud to be out there talking about science, our science, and its importance, for the simple reason that science is so central to us and to how we live our lives.

You would think it would be one of the easiest sells in the world.

And yet sadly, it is not.

Around the world, and in Australia, there are numbers of scientists who are distrusted, accused of bending to political pressure, of having vested, even venal, interests, and their expertise often aggressively challenged publicly.

Even worse, probably, our younger generations appear to be disinterested - even disengaged from science – even though

they use its applications every day: from their food, to their pens, to shoes, to clothes, to smart phones, iPods, televisions and laptops.

Of the year 11/12 students **not** studying science in 2011, only 4 per cent thought science was ‘almost always’ useful in everyday life while 60% thought it ‘never’ or only ’sometimes’ useful; 1% thought it relevant to their future ‘almost always’ while 42% thought ‘never.’

Students studying science had a different but still alarming view: only19% thought that science was ‘almost always’ useful in their everyday lives, and just 33% thought it was relevant to their future ‘almost always’. Happily, only 9% thought it was never relevant to the future.[1]

But I have quoted these figures before, and as I mark my one year anniversary today, or my 68th speech (whichever seems the longer), you might be wondering what more I could possibly say.

Well, today, I am here to launch the result of 8 months of intensive work by members of my Office in the form of the Health of Australian Science (HAS) report.

[1] Goodrum et al 2012, The Status and Quality of Year 11 and 12 Science in Australian Schools

I have thought for a long time that we need to have a comprehensive overview of the Australian scientific system – primarily from the supply side – the universities and schools. If our aim is to build an Australia that is healthy and safe, socially, culturally and economically prosperous; an Australia facing the future with confidence, we need productivity and innovation. And science, technology, engineering and mathematics will be at the heart of our capacity to deliver what we want – or need. And for that to happen, we need solid educational foundations – a first rate and strategic supply side.

What we plan for our future may mean that we need to change the path we're on; and to do that we first need to know where we're standing on the map.

The HAS report provides a comprehensive profile of the state of science, technology, engineering and mathematics in Australia, including biomedical, agricultural and veterinary sciences. And a good deal of what follows is drawn from that Report.

It identifies disciplines that are strong, and some that are vulnerable due to training, workforce or funding issues; it examines how reliant each discipline is on government, higher education and industry and it makes international comparisons.

We bit off a lot when we decided to do this; and the available statistics did not always easily reveal what we needed to know. So there are still some gaps.

But my team persevered and spent months submerged in data. The members are listed in the Report and I acknowledge their superb commitment to this task. I should add here that there is a great deal of detail in this Report. I have asked members of the team to join me here at 2:00 pm so that if there are any questions of that detail, will be handled with them.

The upshot of their work is that we now have a broad overview of our capacity. We initiated this review in my Office. As a consequence, it is a Report with findings. We know where more work needs to be done, and what discussion to have. I expect that recommendations will follow that additional work.

Let me get to the good news first.

Australian science overall, is in good health – it does not rate a ‘low grade.’ We should be proud of what our scientists, our engineers and our mathematicians achieve.

We have many strengths.

Our education systems produce graduates across a broad profile. They contribute their skills in Australia and elsewhere

in the world – because they are well trained, well educated and knowledgeable.

We are well represented in the international arena; our researchers are some of the most productive in the world.

We have better and additional teaching and research facilities because of substantial investment from the Government's Education Infrastructure Fund.

However, despite substantial success, we must not be blind to vulnerabilities. And we have some of them, too. Not calamities, not catastrophes but vulnerabilities that we should now reflect on and take action when and where warranted.

Our vulnerabilities are illustrated in Table 7.2.1 on pages 164 & 165 of the Report. In summary, the light at the start of the pipeline in some areas is not as bright as the light at its end. Simply put, that means we risk losing capacity.

And in our system this is largely, **not wholly but largely**, down to student numbers.

The statistics about students' perceptions of science and, indeed their choices of subjects at school are quite alarming.

Since the 1990s these choices have translated into a decline in the popularity of a major in mathematics, physics and chemistry (the enabling sciences). By 2010, for students enrolled in a BSc or similar degree, only 13.0 % of teaching at the second

and third year levels was in mathematics, 10.0 % was in chemistry, and 5% was in physics.

I know that offers for entry into the natural and physical sciences increased in 2012.

But the pattern of enrolments, both starting and continuing, not offers, directs funding. We don't yet know whether the additional offers will turn into enrolments, and what the students continuing interests will be. But if they follow the present pattern, they will make little difference to the enabling sciences.

In a speech I delivered last week, I outlined how vulnerabilities could arise because of the way we allocate funding to universities.

I remarked then that important disciplines may be at risk simply because they are not popular right now.

Funding follows the undergraduate students and their study choices. If we look at the process broadly (because there are cross-subsidies and all sorts of intricate arrangements inside universities) but if we look broadly, then the path is as follows: if fewer students enroll in an area, less Commonwealth funding is allocated to it. Less funding means fewer staff (eventually). Fewer staff means less research and less innovation. Less research will mean fewer PhD candidates (the discipline of

Statistics as coded by universities is down to fewer than 40 EFTSL). Fewer PhD **graduates** will mean fewer staff, and that will mean fewer students and less research and less innovation. And all that adds up to a reduction in capacity - and the trigger was a decline in undergraduate numbers – as they exercise their undisputed right to choose what they want to study.

Reduced capacity in some areas may or may not be important. But what is unarguably important is that we need to know. And we need to consider the implications; we need to have a reasoned discussion. We need to decide whether the research profile of Australia should be so seriously, perhaps so tightly, influenced by the study choices of undergraduate students, or be so dependent on a web of subsidies and cross-subsidies within the universities.

But let me be clear - I **do not** argue that funds should not follow students! Nor am I arguing that universities should not allocate resources according to their patterns and their needs – I would even argue that sometimes distributions should be based on value and not cost or only on enrolments.

But I do question whether all of so much funding (Estimated $5.9 Billion in 2012) should be so tightly linked to study preferences.

I contend that we need to examine all the implications and possible responses. For example: one response could be

that we selectively untie some disciplines from student numbers – at least temporarily. If so, we need to resolve how and to what extent? We need to know how we can be nimble and responsive as influences and needs change – as they will. We need to understand and manage the range of consequences that may arise **when** we do something, or **if** we do nothing.

For example, Australia's aid program is to be focussed on health outcomes and agriculture (food security). Declining student enrolments in Agricultural Science (down 31% between 2002 and 2010) and Forestry (the total taught to students in all undergraduate degrees is down 45% since 2002 to a grand total of about 53 EFTSL) may thus impact not just on Australian producers but also on foreign policy. The profile of enrolments suddenly becomes a government issue not one exclusive to education.

Because of a perceived need for a strategic and considered and a whole-of-government approach to research, The Australian Research Committee (ARCom) was established by Government some five months ago. I Chair that Committee.

The first task of ARCom is to develop a National Research Investment Plan. This plan will provide a strategic framework to help government make decisions about funding priorities.

Whatever choices may be made, we will need the human resources to develop them; and we need the workforce to use them.

We need a way to ensure that we have the right skill sets in Australia. And we should not expect to be able just to go and buy them when we realise we need them. The 'market' is likely to be fierce in both price and competitiveness. We must develop our home-grown capacity and that means luring some of the best minds in Australia into the areas we need. We need to encourage all Australians to reach their potential – and we need to ensure that some of the gender imbalances in some sciences, mathematics and engineering, which have been so entrenched for so long are challenged, the reasons identified and corrective action taken. It is antithetical to our national interest to waste talent.

Attracting students to science, engineering and mathematics was the subject of the first of our reports – the one supported in the budget.

The thinking behind that report was simple: in our country, students have a right to choose what they want to study. So our task is to make the study of science, mathematics and engineering so compellingly interesting, with employers offering fantastic career options, that greater numbers than ever will want to study them.

We have some way to go. In 2002, something like 22% of the graduating class from Australian universities was in the sciences, technologies, engineering and mathematics (STEM) by 2010 it had dropped to about 18%. The proportion in China in 2002 was 52%, Japan 64%, South Korea 41%, Europe 27% and the US 17%. Since then there have been strenuous efforts to change those percentages – in the US with additional funds and a target of an additional one million (STEM) graduates over the coming decade on top of their present three million, and in Europe where it was declared: *because Europe's future is at stake decision-makers must demand action on improving science education* (at all levels)[2] And they did.

I have argued that we, too, need to change. The Australian Government has now provided resources to support science and mathematics education.

I suppose that was why I was described as *contented* by one journalist when the government announced the $54m in the May budget.

The fact is that we need to prepare our teachers better and to support them better.

[2] Rocard M et al. Science Education now: a renewed education for the future of Europe. Directorate-General for Research, European Commission, 2007

Time and again during our work we were told about the importance of inspirational teaching and its influence on student choices. It follows that teachers need to be well qualified, well supported and confident in both their content knowledge and their pedagogical skills.

The teaching of science should resemble the practice of science more than it does; and the relevance of science as it is taught should be as obvious as the standards are high.

That brings us to the training and support for teachers. With respect to initial teacher training, there were approximately 73,000 students enrolled in 2010. Of those, 550 were enrolled in Diplomas of Education after a science degree. I have made the argument before that we need more science graduates in teaching, that we should have tailored programs in which the scientists teach the science and the education staff the pedagogy – and the government has now funded a program to encourage universities to develop the programs that would suit – bringing the disciplines together. And we need a change in scale, not an extra few here and there.

To be effective, the programs will need incentives. We should aim to get more high achieving science students into teaching using the new programs as the magnet. Some 39% of science offers nationally in 2011 went to students with an ATAR over 90. For education offers, it was 5.8%. I know that ATAR isn't everything – but it is not nothing either.

The Minister indicated on budget night that consideration would be given to introducing incentives for students taking initial teacher training. I look forward to being part of those discussions.

I also took the view that our teachers already in the workforce need better and more coherent support. The Minister announced funding for new approaches that will include: *'funding for a national advisory and linking service, online videos to illustrate new teaching standards, practical activities for school science laboratories and to provide for school laboratory technicians and science teachers on safe practices.'* [3] All good; but it is one step to get student interest, enrolments and graduations all increased. Another step is to engage with industry.

Part of our problem in Australia is a cultural one, I believe (and I am not only talking about gender imbalances in some sciences, mathematics and engineering). If you study Physics, or Chemistry or Mathematics then many employers appear to think that that is about all you can do – and if they don't need Physics, or Chemistry or Mathematics then they don't need you. I take a different view.

[3] Media Release. Senator The Hon Chris Evans and The Hon Peter Garrett: Investing in science and mathematics for the future 8 May 2012

I suggest that a science degree is basically a generalist degree different from, say, medical or accounting courses which prepare graduates for a particular career path.

The science degree and its process of education inculcates students with skills that are invaluable for work far beyond the straightforward use of scientific content. Scientific thinking promotes innovative inquiry, it encourages a robust debate of ideas, it values skepticism and it demands critical thinking and evaluation. It is inherently creative and imaginative.

These are workforce skills that a prosperous and innovative Australia cannot do without.

The cost to us of the culture may be high. Australia has one of the lowest, if not **the** lowest, number of researchers employed in **business** enterprises. We have 2.1 per 1000 workers, whereas Finland has 9.6, Sweden has 6.2 and Canada has 5.1. We have around 8 doctorate level people per 1000 in the overall workforce; Switzerland has 28, Germany has 20. Just 4% of our doctorate holders work in manufacturing. Why do we exclude some of our best educated and most creative minds from where they could do a lot of good? What do others know that we don't?

A survey of employers reveals a mix of reasons why this might be the case – some fair and some ill-informed. But surely we all, including employers and the universities, share a

responsibility to get it right: the right qualifications, the right skills in the right place at the right time.

There is much to be done.

Conclusion

Let me re-emphasise that we have many strengths in our system. The HAS report has reviewed them in some depth and I have not had the time to cover them all.

For example, I could have spent all the time available on our international linkages. Between 2002 and 2010, the number of internationally co-authored publications in Australia more than tripled. Now just under half of all Australian scientific publications are co-authored with overseas collaborators.

Collaboration is important to us: we are few in number but big in performance. We learn from collaboration, and we educate through collaboration.

We must continue to be a player; we must never be content to be follower – outside the tent, hand out palm up and hoping that the fruits of the investments of other nations will drop in exactly what we need exactly when we need it.

The Health of Australian Science Report is not a story about rebuilding after a train wreck. We do not have a train wreck. But the Report is a signal: it encourages us to be alert; to be prudent while willing to take bold action when we need to.

To be blunt, we have to.

We cannot afford to be left behind and become supplicant importers of knowledge and skills in an environment where costs are high and competition is fierce, and with nothing to contribute in exchange.

Whether we like it or not, we are already competitors in what President Obama has described as the Race to the Top.

The Report I have released today is aimed at boosting our chances in the race – to get us somewhere near the top.

It is a high-level account of where our strengths and vulnerabilities lie.

We need to leap forward, but it is appropriate that we look carefully before we do. I hope that this report stimulates the discussions about the science, the engineering and the mathematics that our nation needs.

My Office will contribute to the discussion: we plan a series of Occasional Papers arising from the Report. We will start with one on deeper analysis of our International collaboration and another on the gender imbalance. We will write about why science and investment is important; and the pervasive impact of science on our every day lives (even every hour).

Good things won't just happen because we are Australian. They will happen because of robust debate, our foresight and

hard work – and our deliberate efforts to build the Australia we want – for us all. And we can't do that without first class science, technology, engineering and mathematics.

Thank you