Australian Government

AUSTRALIA'S CHIEF SCIENTIST

PROFESSOR IAN CHUBB

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LA TROBE UNIVERSITY

UNIVERSITY DRIVE, ALBURY-WODONGA

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

Good evening

It is an honour to be invited to deliver the 2012 Mann Lecture.

This annual address was first established by Dr David Mann to honour Jonathan Mann, his grandfather and a pioneer of this region.

But it now also honours Dr Mann, who passed away in June this year.

Dr Mann was a community leader and a long standing member of the Regional Advisory Board of this campus.

He was thus instrumental in the development of this campus and the “David Mann” Library recognises that contribution.

University campuses are unique places - places where people are constantly engaged in the endeavour of learning, of enquiring, of finding things out and passing them on: to the community at large and, of course, to the coming generations.

It is in these places that discoveries are made, by people with one, true, eternal belief – that it is important we know something today, that we did not know yesterday.

And the science being taught in our universities has an especially important role to play. Without it, we cannot hope to tackle issues like food security, climate change and disease.

Nor can we expect to keep our nation competitive and innovative, guaranteeing jobs and economic security for a secure and prosperous future for all.

With this in mind, the *Health of Australian Science* report done by my office sought to produce a snapshot that allows us to identify what's strong about science in this country, but also where there are threats to our capacity.

By doing so, we can turn our attention to what is required to address those gaps.

We started with schools. The HAS report reveals that science teaching in secondary schools depends by-and-large on the transmission model of teaching.

It cited several studies which report that science in lower secondary school lacks meaning and relevance for many students.

Traditional `chalk-and-talk' teaching, copying notes and `cookbook' practical lessons have offered little challenge

or excitement and there is reluctance to move to a more inquiry-based approach to science teaching.

Is it any wonder then that the number of Year 12 students taking biology, chemistry, physics and mathematics has been declining in recent years.[1]

A $54 million package in this year's budget will help.

New measures 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 advice for school laboratory technicians and science teachers on safe practices.' [2]

I also welcome measures under the new Australian curriculum for secondary schools, particularly the inclusion

[1] HAS – Pg 43

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

of the strands - `science as a human endeavour' and

`science inquiry skills'.[3] this has at least two benefits:

students who study science will know how it works; and students who don't study science (ultimately the majority of our community) will know how it works!

But basically , If we can have students experiencing the joy of scientific discovery through field work and laboratory experiments, if theory can come alive for them in this way, I expect many more of them will be inspired to keep studying science.

Students like the Australians who recently attended the biggest STEM competition in the world - the Formula One in Schools Challenge in Abu Dhabi.

[3] ACARA – The Australian Curriculum – Version 3.0

It’s a team challenge that pits nine million students from 17,000 schools in 31 countries against each other in a competition to design, test and make miniature F1 cars.

The Australians took out categories including the Fastest Car and Best Engineered Car, as well as the Best International Collaboration award.

If you were writing the marketing campaign for science education to resemble the practice of science more than it currently does, you might say ``Engaged Kids Do very well!’’

It’s important we address the potential supply issue from secondary school; otherwise it starts to become a problem for our universities.

Consider the survey we commissioned - *STEM and NON-STEM First-Year Students* - from Universities Australia.

It found the common underlying factors in why students choose the university course they do in order were: - 1) career aspirations, 2) enthusiasm and encouragement of secondary school teachers and 3) interest in the subject.[4]

You can see how the choices students make about subjects at the ages of 14, 15 and 16, as they venture into senior secondary levels, has implications for funding in a range of areas.

Naturally it follows that the money for all manner of resources in higher education is driven by the pattern of enrolments by undergraduate students and their study choices.

The *Health of Australian Science* report looked at our universities and showed the extent to which the enabling sciences of mathematics, chemistry and physics all suffered decreases in enrolments among undergraduate

[4] HAS – Pg 122

science students in the 1990s, especially at the continuing level.[5]

These losses have not been recovered and this looms as a potential problem if it is not addressed, especially for the future supply of science teachers.

We showed that other enrolments differed greatly by field of study. For example, health science had robust enrolment, whereas agricultural science had decreasing enrolments and our capacity in this field is vulnerable.

We need to address these differences in the various scientific fields not in a knee jerk way but strategically because it is in the national interest.

If you count the beans; fewer students means less Commonwealth funding which eventually means fewer staff which means less research and, ultimately, less innovation.

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[5] HAS – Pg 59

It snowballs; less research means fewer jobs in research; that means fewer postgraduate candidates; fewer completing post-graduates means fewer staff and the cycle of fewer students, less research and less innovation continues.

As a nation, we cannot afford to have our basic research capacity diminished in any way because we are locked in a contest with competitors who have historically been serious about protecting theirs.

Twenty years ago, Derek Bok, a former President of Harvard University wrote: - *By cutting back our basic scientific research effort and relying more on discoveries abroad, we would shift the contest of innovation to the arena where we are likely to fare least well against our foreign rivals*[6]

In 2008 the U.S. Committee on Science, Engineering and Public Policy in its report *Rising Above the Gathering*

[6] Universities and The Future of America, Derek Bok, Pg 27

Storm wrote: - ``In a world where advanced knowledge is widespread and low-cost labor is readily available, U.S. advantages in the marketplace and in science and technology have begun to erode. A comprehensive and coordinated federal effort is urgently needed to bolster U.S. competitiveness and pre-eminence in these areas''

Earlier this year, *Science* magazine reported that the budgets of most U.S, basic research agencies remained protected in an environment of fiscal tightening; indicating the degree to which science is still valued in America.[7]

This surely suggests that to ensure ourselves a prosperous future, we need more Australians with a science education, not less.

And we need a great acceptance of science, especially recognition of the value of STEM skills. Those that posses them understand their value, so shouldn't all Australians?

[7] *Science,* VOL 335, 6 JANUARY 2012 ,Pg 25

Take the report *A Background in Science: What science means for Australian Society* by Dr Kerri Lee Harris, which was commissioned by the Australian Council of Deans of Science.

Dr Harris asked 805 science graduates in what ways their science degree was useful.

One in four respondents were working in scientific or medical research, and 12 per cent worked in scientific or engineering industries. [8]

But the rest had found jobs across sectors including law, government, health, education, food, agriculture, mining and construction.

97% of all respondents, regardless of where they were working, said their science knowledge or skills were useful in their work.

[8] http://www.cshe.unimelb.edu.au/research/disciplines/docs/BackgroundInScience%20_web.pdf Pg VIII

My office followed up by mapping employer attitudes to STEM graduates for the fourth of its Occasional Paper series - *STEM Education and the Workplace.*

It cited a study done for the UK's Department of Business,

Innovation and Skills (BIS) which showed a diverse range of employers seeking to attract STEM graduates, citing numeracy, analysis, and problem solving as key skills of value.

And I would expect we are going to see more of this because as technology transforms developed economies, from manufacturing and retail to law and banking, STEM graduates will continue to be in demand in a range of sectors.

It is for this exactly this reason that I am engaged in an ongoing conversation with our employer and industry groups - to find out what they think they need from our

public support of science and scientific research in Australia.

I might say that in turn, I've been trying to encourage them to employ more scientists and technologists in their companies because I think they will benefit enormously.

I would dearly love to see a positive change to the statistic that I think best illustrates how Australia's science and industry sectors tend to reside in silos - just 4% of our doctorate holders work in manufacturing[9]

We should all take some responsibility for this situation and work out how to get the best and brightest into the right job at the right time.

Universities need to ensure their degree programs are more responsive to the broad range of occupations that

[9] Access Economics - Australia's future research workforce: supply, demand and influence factors 30 April 2010

STEM graduates might enter, not just academic research positions.

That means adjusting their curriculum settings, for one.

The former Australian Learning and Teaching Council recommended that universities map their science curricula against a set of ‘threshold learning outcomes’ which include many of the skills valued by employers.

And the Australian Government’s Research Workforce Strategy argued for the development of both ‘soft’ or generic skills and innovation capabilities in university research training programs, which could then support students’ productivity in a wide range of jobs.

Similarly, in the US, an advisory committee to the National Institutes of Health has recommended a shift away from degree programs “aimed almost exclusively at preparing

people for academic research positions”, to include diverse training in entrepreneurship, project management, and research translation.

Business-relevant STEM degree programs, such as the Professional Science Masters taught at some US institutions, provide examples of such a transition.

It is important that Australian students interested in pursuing STEM degrees are not deterred by a false perception that their only option is a research career.

There are avenues at all stages of the student cycle to signal the possibilities that STEM capabilities unlock.

As part of recruitment efforts for prospective students, and careers services for current students, universities can highlight the applicability of STEM skills to a wide range of professions and sectors.

The UK House of Lords committee recommends that universities and employers collaborate to expose more students to the workplace through internships and other means.

In Australia, for example, the Cooperative Research Centres (CRC) program can provide an environment to foster industry-relevant skills.

So universities and employers need to engage with each other and reach consensus about what those skills should be and how to best deliver them.

There is clearly much work to do in building better linkages between science and industry which is why I am currently engaged in the recruitment of a new National Science & Mathematics Education & Industry Adviser.

He or she will work in my office, and will help develop and provide policy advice to government, reporting through me.

It is a new position, designed specifically to address the issue of emerging STEM skill shortages.

The successful candidate will champion the role of mathematics and statistics, science and engineering across education and industry, but perhaps more importantly, actually work with these sectors to deliver on the vision.

I hope to have some news on this appointment early in 2013.

Besides industry, we also need to engage the community more broadly.

One of the interesting asides to the ACDS report was that STEM graduates said many social and personal issues are more easily navigated with the aid of scientific knowledge and skills.

Simple things like being able to understand your doctor more easily or establishing what is important or not in one-and-a-half minute media reports.

88% of respondents reported drawing on their science knowledge or skills in understanding contemporary issues in society; 83% in providing advice to friends and family; and 87% in their personal interests and pursuits.

So the overwhelming majority of those that gained STEM skills and knowledge could see how the benefits flowed well beyond work.

In a developed, democratic country like Australia, this is a positive message we need to ensure is heard throughout the community.

I’d like to see a recognition and respect for STEM skills

beyond those that hold them and a greater scientific literacy across the board.

And we need to hear a loud, non-partisan message of support, similar to that from the National Science Foundation in the U.S. which says: -

Appreciating the scientific process can be even more important than knowing scientific facts. People often encounter claims that something is scientifically known. If they understand how science generates and assesses evidence bearing on these claims, they possess analytical methods and critical thinking skills that are relevant to a wide variety of facts and concepts and can be used in a wide variety of contexts.[10]

If we have this in Australia, we can change the way our community thinks about science, mathematics and engineering. And give them the information they need to make informed decisions about what to do, and what is important.

[10] National Science Foundation, Science and Technology Indicators, 2008

In Australia, and the world, we start from a position where the worth, the real value of science is treated across a spectrum from ignorance through to neglect through to utter contempt, by too many.

It's evident in the media, in public discourse and sometimes, in parliament. This is a process that has developed life-saving medicines, engines that run our planes and cars, the electricity to power our homes and the technologies that preserve our food and improve our diets.

In this climate, the value of science needs to be protected – from being manipulated by politics, misinterpreted in the media and from being dulled down in our schools.

Ladies and gentlemen, anything who thinks we can risk a diminished scientific capacity and literacy and still tackle the many challenges facing this country is mistaken.

Some of the initiatives I've mentioned tonight will help but keeping Australian science in a strong position will take vigilance, and not just from those of us predisposed to advocate for science.

I'd like to conclude with a quote from Wilfred Cantwell Smith, who was Director of Harvard's Center for the Study of World Religions.

He said: - *We manufacture knowledge as we manufacture cars, and with similar objectives: to increase our power, pleasure or profit - or if we are altruistic, to offer it to others so that they may increase theirs*[11]

It is my sincere hope that our great nation, Australia, can continue to manufacture enough knowledge to secure a stable, prosperous, healthy and equitable future for its people and others.

[11] Wilfred Cantwell Smith, review article, *Dalhousie Review* 57 (1977) 540, 546

I think that is an aspiration that truly honours the pioneers who went before us.

Thank you.