Australian Government

Chief Scientist

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RICHARD SELBY SMITH ORATION

Strong science: sharing the opportunity

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STANLEY BURBURY THEATRE, UTAS

It is good to be back in Hobart.

I have been here several times in recent years and each time I've come, I'm reminded that Tasmania represents an important part of our national scientific effort, and as we know, it is especially well-placed to contribute much to our Antarctic and marine science fields.

While I am aware that many of you in this room are not scientists, I know, or hope, that you appreciate the role science plays. I also hope you understand the benefits to young people who study science.

Tasmania is a place full of natural wonder, ideal for young inquiring minds to explore whatever makes them curious. It is an ideal setting for a young person to commence their journey in science.

It is important that they do. When I am asked about why science is important to us, I can immediately turn to the impact of science on me, and on you, close to every hour during every waking moment – and for some of us – during every hour asleep, too.

I know, for example, that I have used an aeroplane today to get here in a couple of hours. I have used a plastic banknote or two; and some asthma medication. Plus a couple other medications that are between, my doc and the pharmacist. I know that I have eaten cereal with milk for a breakfast that is nutritious and safe. I have eaten food that was heated in a microwave having been cooked on an induction cooktop. I drove in a computer facilitated car with an economy that would have made my Volkswagen of ancient times blanche.

When I think not just of me – and many of you – I come to some big things, like the climate. How will we manage, or

mitigate or even adapt to the effects of a greenhouse gas which we **through our activities** release into the atmosphere at a rate many, many times faster than the fastest measured in ice-core samples dating back 850,000 years? And given that our activities have already released some 2 trillion tonnes of CO2 in the past 150 or so years, the question needs an answer – not some trivialising of an important and complex matter by impugning the integrity of the scientists, or by dismissing the science as a new religion, or as a delusion.

It will be careful, deliberate and properly conducted science that will contribute to the answers.

How will we manage, confine and eventually cure viral outbreaks such as Ebola, or HIV, or plain influenza in its many and evolving forms? Probably immunisation will play a role in there somewhere or new and improved pharmaceuticals – as they have for so many afflictions of humankind – or animal-kind for that matter.

It will be careful, deliberate and properly conducted science that will contribute to the answers.

How will we develop new antimicrobials as we move to an age where an increasing number of bacteria show antibiotic resistance? Whether we extract them from soils or plants, from marine organisms or whether we synthesise them from the basic component parts, it will be careful, deliberate and properly conducted science that will contribute to the solution.

How will we feed the inhabitants of the planet: sustainably, nutritiously and adequately? We can already estimate that some 1 billion of our present 7 billion suffer from inadequate nutrition – and we know that the population will increase to about 9 billion over the next few decades. During that time we

know that water supplies could be at risk, rainfall patterns will be changing, that pesticide resistance is increasing in some parts of the world, soil salinity is increasing in key areas and urban sprawl will intrude into agricultural land.

It will be careful, deliberate and properly conducted science that will contribute to the answers.

Closer to home, we have raging bushfires, torrential rain, floods and droughts. Adaptation will be our key to survival. We can argue forever about whether having more than 100 bushfires in NSW late last spring was just nature at its harshest – or whether it was early, or whether there were more than we had ever seen before. Of course we can let our viscera rule our cerebrum. But we do know that each of the last three decades has been hotter globally than any before and each of **them** was hotter than the previous one. So maybe the conditions for bushfires which have always been with us are just more extreme - as we get warmer and drier.

I was reminded as I wrote this that this particular topic was covered by UTAS' Professor David Bowman, a landscape ecologist and bushfire scientist, who contributed to a free eBook produced by my office last year called *The Curious Country.*

In that book, David writes*; I was lucky, as over the last 40 years numerous scientific discoveries have changed the way Australians think and feel about the bush. And of great importance has been the recognition that, along with drought and floods, bushfires have shaped our 'wide brown land'. We must coexist with these powerful natural forces, and science provides the key to this urgent adaptive process.*

I could go on, and on; the list is long. But the summary is short: it is science, science and more science **and** its application that will be a core part of the solution to many of the problems we face: as individuals, as humankind, or as one of the life forms on the planet.

So the question becomes: are we **preparing** ourselves with the science, the understanding of science and the capacity to apply the knowledge that comes from science to real life problems in real time? Will we have the capacity and the capability we need to do what we have to do to provide those who come after us with a living that is one that we would be pleased to enjoy were we still around?

As Carl Sagan once put it in the 1990s, we seem to have: *arranged things so that almost no one understands science and technology. This is a prescription for disaster. We might get away with it for a while, but sooner or later this combustible mixture of ignorance and power is going to blow up in our faces.*

From that ignorance coupled with power often comes rejection – reject the message because you don't want to hear it – because if you heard it you might have to do something about it.

But it is here that my talk intersects with Richard Selby Smith who – as you have heard – devoted much of his life to education: as a teacher, as a Professor and as a Dean. Our lives also intersected at Monash (although he would not have known that) because he established the Education Faculty which gained great renown as a place where top-notch pre-service science teaching was offered. I was a minute cog in the machine at that time; but I do remember the opening of that Faculty.

My talk from here intersects with Richard Selby Smith because it is about **education**.

As I said at the very beginning of this talk: Tasmania is a place full of natural wonder, ideal for young inquiring minds to explore whatever makes them curious. It is an ideal setting for a child to commence their journey in science.

And some good things happen in Tasmania.

For example, I launched a publication earlier this year which featured Michael Van Der Ploeg of the Table Cape Primary School in the north-west of this state.[1]

Michael's story is interesting. By his own admission, he got average marks for science at school, was not interested in it and had no passion for it.

But he says all that changed in his first year as a primary school teacher when he saw inspirational hands-on science teachers in action and saw how engaged the children were.

Michael says: *Primary school is when kids are most interested in science, seeking answers about the world around them with questions such as: Why is the sky blue? How does rain form? What makes a drink fizzy?*

The hands on approaches Michael says he developed *over 24 years of trial and error* were recognised with the 2012 Prime Minister's Prize for Excellence in Science Teaching in Primary Schools.

And I remind you of how Carl Sagan put it: *Every kid starts out as a natural-born scientist, and then we beat it out of them. A few trickle through the system with their wonder*

[1] http://www.chiefscientist.gov.au/2014/03/launch-australias-future-stem/

and enthusiasm for science intact. It is much about nurturing that interest – encouraging that creativity and inquisitiveness – that is what we have to do.

But when you look at Australian performance in mathematics in PISA - the Programme for International Student Assessment of 15 years old students, it is clear that Australia could do better. Our **average** score of 504 is better than the OECD average of 494, but it significantly trails that of jurisdictions like Shanghai-China with 613.[2]

But an **average** score hides the detail – often detail that we need to know. So when you drill further down into the PISA data, you see differences in performance amongst the Australian states and territories that should be troubling.

The ACT is well ahead of the Australian average and a point away from Finland. It is closely followed by WA, with New South Wales, Victoria and Queensland close to the Australian average.

But South Australia, Tasmania and the Northern Territory all perform at a level significantly lower than the OECD average.

As the report states: *the difference in mean mathematical literacy between the highest* (ie: the ACT) *and lowest* (ie: the NT) *performing jurisdictions is 66 score points, the equivalent of almost* ***<u>two years</u>*** *of* schooling.

In scientific literacy, the picture is slightly better.

Tasmania's performance (and the Northern Territory's) was not significantly different from the OECD average, but was significantly lower than the other Australian jurisdictions.

[2] PISA in Brief, Highlights from the full Australian report: PISA 2012: How Australia measures up

The PISA report states that: *The difference in mean scientific literacy between the highest and lowest performing jurisdictions is 52 score points, the equivalent of* ***one-and-a-half years*** *of schooling.*

Now. I know that there are people who wish the data didn't exist. But it does. And it tells us that we should do better.

A few years ago, the Harvard Graduate School of Education released a report *Pathways To Prosperity*.

Its opening paragraph says: *One of the most fundamental obligations of any society is to prepare its adolescents and young adults to lead productive and prosperous lives as adults. This means preparing all young people with a solid enough foundation of literacy, numeracy, and thinking skills for responsible citizenship, career development, and lifelong learning.*

I would add to that list the notion of scientific literacy for all – at least to the point where people understand the methods, practises and the history of scientific achievement and how they have helped make the world we live in. You will note that I said 'add' scientific literacy. Science does not exist in a vacuum. As Tony Blair once said (and I paraphrase), *Science allows us to do more but it doesn't tell us whether doing more is right or wrong.*

Other skills and thinking in different disciplines will help place science in context – the context where it will benefit humankind.

Before I turn to how we might get there, let me touch briefly on what I don't think that we would want to do. What we can't do.

I suggest that we cannot allow a knowledge divide to take root in Australia.

I saw the reason well expressed in an article in New Statesman by Ian Leslie:

Before the internet and the before the printing press, knowledge was the preserve of the 1 per cent. Books were the super yachts of 17th century kings.

Today, in a world where vast inequalities in access to information are finally being levelled, a new cognitive divide is emerging: between the curious and the incurious.

Twenty-first century economies are rewarding those who have an unquenchable desire to discover, learn and accumulate knowledge.

It's …(about)… *how much you* ***want*** *to know.*

The question is, how do we ensure our young people want to know? Just as importantly, how do we ensure that opportunity is shared by all?

The first piece of advice I gave government on becoming Chief Scientist was the report *Mathematics, Engineering and Science in the National Interest.*

The report talked about inspirational teaching as the key – both to the quality of our science education system and to raising student interest to more acceptable levels.

As I've said on numerous occasions since, it is time to re-think how we prepare our teachers and how we support them: support to strengthen their content knowledge, to maintain it at contemporary levels and to instil the confidence to deliver the curriculum in interesting and novel ways through relevant pedagogical development.

Taking natural curiosity and engaging with it in a way that encourages the learning of scientific principles requires not just dedication, but a good understanding of education theory and its application.

The then federal government put $57m to support most of the recommendations in the advice.

But the only way programs like this will be successful is for education and science faculties to continue to work together, not just because there's funding available, but because they understand the innate value of this collaboration.

And let's not pretend it is easy. It takes effort, by individuals and institutions, to bring what really seems like a simple experience to fruition.

What we need to do now, is get more individuals and more institutions to do the same. We need scale and we need coordination.

Our ambition should be to prepare every trainee teacher with the expertise and tools to go into the classroom and teach science and mathematics as they are practised and to continue supporting those teachers right throughout their career.

If we can do that, we take an important step towards meeting our obligation to the next generation – an equality of opportunity that makes Australia stronger and better.

Thank you.