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

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Thank you for inviting me to speak to you tonight.

At the outset, I want to say that I was surprised to be invited to be your Association's patron earlier this year.

I used to think of a patron as all being like the ones depicted in the Maigret novels: fat men with grubby aprons, a limp unfiltered Gauloise hanging from the corner of the mouth, a scowl, a gallic shrug while waving a dirty cloth at a zinc bar and all the while dispensing poor wine and avoiding eye contact.

Now I know there is another sort of patron, I am honoured to be one.

I will leave you to judge whether any of the characteristics of the Maigret-style patron fit me – but I can tell you that I don't smoke, and I don't drink poor wine.

The Science Industry is where research takes on its commercial form. Where we take the results of research, and the knowledge, and turn it into new ways of doing

things – new and better goods and services, and processes – that improve the lot of human-kind.

It is no secret that the channels of communication between science and industry are not all that we'd like them to be.

In their recently released report, *Smarter Manufacturing for a Smarter Australia,* the non-government members of the Prime Minister's Manufacturing Taskforce calls for some fundamental changes in behaviour on the part of researchers, research organisations and businesses.

As the report indicates, there is much work to be done; and it includes many recommendations aimed at building better bridges, or building more of them. They take aim at building a culture that has employers looking to engage more with highly educated and creative people and universities educating people in a manner that prepares graduates for multiple career options – not just a few, or even one!

And as we work to build those bridges, it remains important that we continue to understand the importance of the complete research spectrum. These are times when there can be an inclination to argue that we don't need as much basic research and that we could divert some of its funding to application and innovation.

It is important, I think, that we do not presume that there is a simple and uncomplicated pathway to a rosy research-led future. We do need innovation; we do need application and we do need discovery-based research. And we need them to interact seamlessly.

Let me use the example set by the United States to illustrate the point.

In 1996, a group of 21 CEOs from some of the largest corporations in the U.S. wrote to President Bill Clinton, urging him to protect funding for basic research.[1]

Their letter says: *History has shown that it is federally sponsored research that provides the truly `patient' capital needed to carry out basic research and create an environment of inspired risk-taking that is essential to technological discovery*.

Cast forward to the current U.S. administration and *Science* magazine reports that the budgets of most U.S, basic research agencies remain protected in an environment of fiscal tightening; suggesting the sentiment of those inspiring words written in 1996 continues to resonate around Washington D.C. to this day. [2]

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[1] Congressional Record Volume 142, Number 139 (Tuesday, October 1, 1996)] [Extensions of Remarks] [Page E1888] From the Congressional Record Online through the Government Printing Office [www.gpo.gov]

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

In our system, the proportion of expenditure on R&D directed to basic and strategic research has been declining: in 1992, it made up 64% of universities total R & D spend. By 2009 it was 45%.

ABS figures show the proportion spent on basic research has also dropped in Commonwealth public research organisations, private non-profits and Australia as a whole.[3]

These figures illustrate that there has been a change in how we conduct research in Australia – and what the outcomes will be.

However, it is hard to imagine innovation without knowledge. Innovation in the sense that it *adds value in its application* depends on us knowing something today

[3] Australian Bureau of Statistics, All Sector Summary Australia (2008-09)

that we didn't know yesterday**.** And that, I think, is a fair definition of 'discovery'.

We do need people who are curious – people who ask: why is it like that? And set out to discover the answer.

And we do need people who will define a value by a practical outcome or a process that creates new value for customers.

Our real problem in Australia (and we are not alone) is that we don't get right, or get right on the right scale, the means by which the people who create knowledge engage easily with the people who will use it.

That makes it ever more important that we work to minimise barriers between the creation of knowledge and its application; and that we work to ensure that we have the scientific and technical capabilities that we need in our workforce, to create knowledge and to use it; that they are in the right places in our workforce, and that they are able to apply their skills wherever they are in the workforce. [I

can add parenthetically that Access Economics[4] reported that as of 2009 just 3.7% of Australia's doctorate holders were employed in manufacturing, while more than 70% were in higher education].

The Health of Australian Science report produced from my office examines Australian science from different perspectives: school enrolments, university degrees, research spending, output and collaborations, and industry engagement.

The underlying message is that things look pretty good. We produce well-trained, well-educated and knowledgeable graduates in a broad range of disciplines. And our research performance is OK.

But we have no room for complacency.

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[4] Access Economics (2010) Australia's Future Research Workforce: Supply, Demand and Influence Factors

For whatever reason, we as a community seem to have lost or be losing our connection with science.

Despite making extensive and productive use of science and its applications every day, the ‘Apple and Android generation’ appears to lack understanding or comprehension of the science and mathematics and engineering behind the things they focus on or use every day.

In fact, attitudinal studies of students last year show what can be best described as a perverse indifference to science.

It could be because humans are no longer worried about the future because we believe we will always have technology and innovation to get out of trouble - as is suggested in the 2010 book *The Rational Optimist*,

So yes. We may think that science, mathematics and engineering WILL provide the solutions to many of our

existing and future challenges, **but** we think that whatever we need will be there when we need it.

But we really can't take for granted that it will be there when we need it.

Without more people studying the science, technology, engineering and mathematics disciplines, our capabilities will slip.

After school retention rates stabilised in 1992, the proportion of Year 12 students taking physics, chemistry and biology fell by 31 %, 23 % and 32 % respectively. And there has been a shift from advanced mathematics to elementary mathematics.

Enrolments for university mathematics, engineering and a number of the science disciplines have flat-lined for about a decade and IT enrolments, for a number of reasons, have plummeted.

And it should concern us that 61 % of undergraduate students studying physics at university are in first year – that is, only 39 % of those that start continue; in the other core science disciplines, chemistry, 64 % are in first year and in mathematics it is 46 %.

I’m sure that as science industry people this malaise of the developed world must alarm you.

They did me.

No doubt there are many reasons.

The broad range of subject choice nowadays, is one; seen as too hard another; too boring is a third; mixed messages from the universities about what is important could be a fourth and the list goes on.

And the message is not out there widely enough that a science education can lead to interesting careers.

I recently launched a report that was commissioned for the Australian Council of Deans of Science.

The report *A Background in Science: What science means for Australian Society* by Dr Kerri Lee Harris, asked the big question of 800 science graduates, namely: What's the point in doing a science degree if you aren't going to be a scientist?

It examines the way the graduates have used their science degrees and how their degree influences their lives in a broad sense.

In terms of careers, the report found only 40 % of science graduates ended up as working scientists.

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

More broadly, the report found that people with science degrees were more likely to be life long learners and to

take a continuing interest in science, regardless of their profession.

The core finding is that graduates value the different methods of processing and understanding information they gain more than the body of facts and fundamentals they also pick up.

Dr Harris says in her report the science degree *plays a fundamental role in shaping the way people think about problems.*

But we must remember that this generation of students has many, many more options open to it than were around when many of us were choosing our study paths, and that they exercise their right of choice. And they need to be helped to make the right one.

It is up to us to explain science in ways that make the wonder of science clear for all to see. So clearly that more and more will be drawn to study science because it

is so interesting, so engaging, so amazing and with such a kick when you understand how the part of the world you are studying got to be what it is.

Let me then draw this talk to a close by describing for you what **might** be in our world – and a lot of what follows may not need a wand to achieve it – just the will.

Our world could be one in which:

1.. We would have an education system that led to students being so fascinated by science that nearly all year 12 students would take at least one science subject.

2..All secondary students would get a thorough grounding in the history and philosophy of science and in the scientific method.

3..Many of those students would go on to study STEM at university – where lecturers would offer science in an interesting and practical way with the intention not of replicating themselves, but ensuring that their students

were prepared for all sorts of career options – and learnt how they could use their knowledge and apply their skills;

4..Those who did not go on to study STEM would have a level of scientific literacy that would help them judge when an expert is an expert and not just a loud, ranting ‘entertainer’ masquerading as knowledgeable. With more of the community understanding how science works, how scientists work and what it means for a scientist to publish their evidence, they will be empowered to make reasoned decisions about what to do and what is important – and whom to trust.

5..Employers would see the benefits of the skill sets developed as part of an education in the scientific method - and would not shy away from employing people because of those skills – whether or not they needed the particular discipline knowledge of the student.

6..Universities and employers would offer various pathways to research degrees – and employers would draw more from the group that includes some of our most creative people, our PhD graduates;

7..There would be few if any barriers between the researchers and their discoveries and the (sometimes different) researchers applying that knowledge or using it to add value to a product or a process – to goods and services. We would understand and encourage both invention (mostly new-to-the-world discovery) and innovation (mostly new or significantly improved products, processes etc).

7..Australians would be proud of the intellectual capital of our country and understand how it makes a contribution to the betterment of humankind through the improved processes and products that we can develop – students, researchers and the scientific industries.

I could go on, but I won't.

All-in-all, there is a lot we can do as a community. And the opportunities are there for us to choose. I hope that we choose wisely.

Now, if anybody has any good wine….I **am** a patron, but I will make eye contact.