



Australian Government

AUSTRALIA'S CHIEF SCIENTIST

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

Thank you for the invitation to deliver the 2013 Australian Centre on China in the World (CIW) lecture.

My topic tonight is *Partners in influence: How Australia and China relate through science*. I hope to do the topic justice – and I don't want to make it appear simple. It is not. It involves human beings with all their foibles working across cultures, languages and over distances. But it will be worth it in the end; good science will have, must have, a serious influence on our future; and it is likely to have **more** when it involves science based largely on international collaboration.

As I go along, I do hope to persuade you that the relationship will benefit from some strategic forethought both to build on and to get the best out of what is a truly strong foundation.

But first, let me say that it is a pleasure to be here – and even more of a pleasure to see how the Centre has developed. I well remember the days of negotiating the arrangements with Officials and the Prime Minister's Office. It was probably not the most difficult negotiation of my life - since both the Prime Minister and I wanted it to happen – but not everybody sang from the same sheet.

It **was** an important issue for us – by that I mean Australia, not just the ANU.

I also remember Prime Minister Rudd's concept – it was to be a place that studied China and its place in the world. It wasn't about China *per se* – but about China in context. This gave the Centre a focus and highlighted the depth – to understand China and its role in the world, you had to understand China – and understand it well. So we were expected to build capacity to learn as much about China as we could - and to contextualise it to contemporary times.

Accordingly it was expected to be a Centre that drew together experts from other places in Australia and internationally, not just ANU. I am pleased to see that is happening, too. It seems that some of my former senior academic colleagues may have put the dummy back where it belongs having spat it out – driven as we say by the well-known syndrome called self-interest.

Before I get lost in reminiscences, let me get on with the main game and turn to the China-Australia relationship

In the past few decades, China and Australia have become increasingly important to each other – the bonds have got tighter. Not a surprise, really. There is now a substantial Chinese presence in Australia. Mandarin, for example, is now the second most widely spoken language in Australia after English, and the people who speak it are not all products of the Australian education system.

In the four decades since formal diplomatic relations began, China has not only become Australia's largest trading partner, but also our most significant single education partner, and a growing research partner. The last point in particular represents a scientific engagement that began even before diplomatic relations were established (I'll talk a little about this point later).

Australia and China now share a strong and highly productive relationship in science¹ that has been built over more than 50 years.

I didn't visit China before diplomatic relations were established. I first went there in 1987. It was clear even then the importance that China put on science and research – on international connections widely, and with Australia, too – as its pathway to a better future.

The universities in China in those days were not in good shape – but the determination to improve was palpable. I remember going into a dingy, dusty and dirty building in 1987 with a long dimly-lit corridor packed floor to ceiling with boxes of PCs. They said that they had been commissioned to develop word-processing in Chinese. As it happened I was back a few months later. That task was well in hand. The building was in better shape but still old and shabby. We were shown a room

¹ I will use science in this speech as shorthand for STEM: science, technology, engineering and mathematics.

with a small(ish) but powerful main-frame computer behind glass walls – it was a gift from a Japanese company. They were going to use it to network the campus. A year or so after that they had a bigger computer (a bigger gift). They had a bigger plan - to network the province. They'd done more than that not long afterwards.

I visited a few years ago I went back to the same place. I was with an Australian colleague and we were shown a number of machines making, as I recall, computer components. They were in separate and very clean rooms in a modern building with hatted, masked and overalled staff and students working them. I asked about equipment like that in Australia – and was told that we had one in the country – they had half a dozen or so in one corridor in one university. Now, after more than 25 visits, I have seen a change that is staggering: people, resources, facilities and infrastructure that is at least first class and in fact infrastructure that is probably setting the world standard; only the determination to improve is still as palpable as it was all those years ago.

Such change, and such determination, is admirable – but can be disconcerting. In the US, for example, much has been made of the proportion of the Chinese graduating class in a year that comprises scientists, technologists, engineers and mathematicians. As a percentage, it is around three-times that

of the US (and roughly the same multiple of ours). This disparity was doubtless one of the reasons to cause President Obama to say in 2011: *the countries which out-educate us today will out-compete us tomorrow*. He had already said in 2010: *...leadership tomorrow depends on how we educate our students today*. The US response has been to plan for 1,000,000 more science graduates within the decade (a 33per cent increase) and an increase in funding to develop more (and better) science teachers in schools; all within a 5-year strategic plan for science education. Of course, the US is concerned about retaining a pre-eminent position. We can't sensibly do that in all fields: but we can do that in those that we choose to prosecute – and I'll come back to this need for alignment, focus and scale a little later.

Our relationship with China is important – to us, and I think I can presume to the Chinese, given the recent growth.

Let me be clear: they have more people than us (hardly breaking news) more universities than us (not news either) and they are developing capacity at a pace that will take them way beyond us soon (seeing is believing) and maybe even beyond the current big players; but while we can't do everything because we are relatively small, we have some comparative advantages and strengths that are compatible with their needs

and aspirations. And we have been there in partnership with them for a long time – so we know how to work with them.

For us, persistent linkages with a potential scientific super-power are important. To be in a longstanding, trusting and culturally aware partnership is a key. Under those circumstances we can together mould and share the basis for our relationship, and that is a better and more secure place for us both than a fly-by opportunistic purely mercantile arrangement.

Our scientific relationship with China is not like that. It has prospered because each of us brings, and has brought, scientific capacity of quality, and a need, to the relationship, based on quite different intellectual traditions that come together in exciting ways to create new knowledge. We have been doing it for a long time now, and it is growing not stagnating. Science and scientists have helped us relate, country to country, in an enduring way.

The relationship has also been scientifically productive. It has given rise to many exciting discoveries, innovative new products and strategic new relationships.

These include the development of the first electricity generating plants to capture carbon dioxide for storage so contributing to world-leading research on reducing carbon pollution from coal-fired power stations; clinical trials of potential treatments for

diabetes and pre-diabetes conditions; the discovery of biological control agents that have the potential to improve China's national wheat harvest by up to 10 per cent.

And it is not just academic researcher to academic researcher. It includes academics working with industry. The Baosteel-Australia Joint Research and Development Centre is a world-first joint venture between the Chinese steel company and four Australian universities – the University of Queensland, the University of NSW, Monash University and the University of Wollongong.

The collaboration is designed to ensure a more holistic approach to research in order to drive innovation and develop new products.

When we think about another plank in our relationship, education, the connection is also strong.

In 2012, Chinese students accounted for around 30 per cent of all international student enrolments in Australia and 40 per cent of all international enrolments in higher education.

Australia places great value on the contribution our Chinese students make to our institutions and to our communities, a value well beyond simple economics.

The presence of so many smart young Chinese in Australia helps us to learn about China, and them to learn about

Australia. An Australian of my age, who was in our education system when I was, saw the students here under the Colombo Plan close up and personal. We saw the importance of the 'learning' that comes from sharing a class-room, a tutorial group or a bench in the practical class with students from other cultures. And we made some enduring friendships along the way. It didn't hurt either for us to branch out from the staples of lamb chops and mashed potato, or Chiko Rolls, to food with real and variable taste - and spice. All are long-term legacies I continue to enjoy.

Today's generation of young people will see a different world from the world I saw at their age. But it won't be the insular even insulated world of my parent's generation that changed slowly with mine and which is now changing at a breathtaking pace. If the world is to be a better one, then barriers to comprehensive social, economic and cultural understanding need to be minimised. As far as I am concerned, that will come about, in part at least, if young people are educated together so that they learn about each other while they study physics, or chemistry or even economics.

It is fair to say, I think, that we have seen what can be achieved through international relationships. And China and Australia are now solid partners aspiring for a better future: both are deeply committed to the generation of knowledge and its use, and

education, that will combine to deliver improved economic, social and environmental outcomes for all.

From early individual contacts in the 1960s, and I will talk about some of these later, China and Australia have become prolific partners in scientific publications, with a wide range of institutions involved and the full spectrum of the sciences².

It is clear that science is a universal 'language' and it isn't even political, although we have seen how it can be politicised. But it is the **issues** that draw us together; it is the **issues** that encourage Australia and China to collaborate. The shared 'language' makes it possible.

But why does that collaboration matter?

Why does international science collaboration matter?

I think it is important to note that scientific collaboration is part of a much broader international effort.

It is also important to note that many of the problems that confront us in Australia are global in character: issues related to climate are not uniquely Australian problems; nor are pandemics; antibiotic resistant microbes; influenza; food; security both for citizens and nations, to name just a few.

² DIIS RTE – Science and Research Collaboration between Australia and China

No one country can find the way to solve, or manage, or mitigate any of these huge problems on their own. We cannot, for example, face down bird-flu without working seriously with neighbours to our north. We can't do on our own all there is to do about antibiotic resistance given our propensity to travel and to be travelled to. How could we, to paraphrase Jane Lubchenco from NOAA: *manage the unavoidable and avoid the unmanageable* without a concerted and coordinated international effort?

It is I think a self-evident that science (indeed STEM) will be at the core of many of the solutions to the big problems facing humanity. It will be science that finds the new antibiotic, or a new way to treat microbial infections. It will be science that is at the heart of approaches to feed the people of the planet; and science will help us understand the climate, and the environment. It will be science that has a big part to play in finding the ways of *managing the unavoidable and avoiding the unmanageable*.

I don't argue that science (or STEM) will be there on its own; but it will be a constant. And I can't possibly argue that it will be Australia on its own; but I will and do argue that Australia as part of a globally connected STEM will help define the pathways we need to take; and we will be there because we

earned a place. Because we are there, we will make our contribution to worldwide prosperity and global security.

Science (STEM) plays an important role in building partnerships between countries that can be sustained. As I said, it is not political, it is universal and the problems are large and many are global – or at least cross international borders.

It seems to me that it would be a pity if we do not use to the maximum extent possible the linkages around the world that have been built by scientists: sharing a curiosity, sharing knowledge, sharing infrastructure along with a focus on matters where the benefits will be shared. Using the linkages to influence outcomes.

To understand the links better, and to work out how to use them better, the Prime Minister's Science, Engineering and Innovation Council has sought (and funded) a project from the Australian Council of Learned Academies (ACOLA) called Asia Literacy-beyond language. It will include consideration of science in diplomacy - or science of as a part of diplomacy. The report will be released next year.

The point really is simple: Australian science has been internationally networked from the time we got truly serious about it –from 1946 onwards. And it was networked because it had to be. We did not produce our first PhD graduate until 1948, so when ANU was established a fair bit of its early

budget was spent either recruiting from overseas or sending people overseas to get the qualification to bring research expertise into the country. Many of those links were sustained over the years – primarily though not exclusively with the UK and the US. While the output from these links has grown in recent times, there has also been substantial growth with researchers in many countries in our region.

I think Australia learnt a lesson back then – one that I hope is not forgotten.

Until we did research on a reasonable scale in Australia, until our universities were expected to engage in the search for knowledge, until we became a contributor to the world's bank of knowledge, we were outside the tent relying on others to tell us what we needed to know. Whether or not they did that is one thing; but as part of post-war reconstruction, it was a clear resolve of the leadership at the time that we should not find ourselves in that situation again. Contribute, therefore get to sit at the table where important knowledge is exchanged and important decisions are made. Offer knowledge to draw benefit from the work of others might have been a suitable mantra for the time. It still is.

We have seen change. Some 35 per cent of articles published in international journals in 2008 are now internationally co-

authored. Twelve years ago, that figure was 25 per cent³. The proportion of internationally co-authored publications from Australian science has risen from 25per cent in 1996 to 45per cent in 2009.⁴

International collaboration has grown faster than domestic-only research in countries like Australia, the UK and Switzerland.

For China, the proportion has remained at around 25per cent, although this a constant proportion of a much larger volume - from fewer than 3,500 papers to over 30,000 during the period 1996-2009.⁵ Australian papers co-authored with Chinese colleagues has risen from 4 per cent to 14 per cent during that time.

The message is clear: STEM activities in any country with aspirations for the future will be internationalised at their core; and global presence is essential, not an optional add-on.

The relationship with China began on an individual, sporadic basis.

For example, Professor Wilbur “Chris” Christiansen, a radio astronomer at the University of Sydney, visited China in 1963 as a guest of the Chinese Academy of Sciences (CAS).

³ Knowledge, Networks and Nations: Global Scientific Collaboration in the 21st Century – Pg 6

⁴ HAS

⁵ DIISRTE – Science and Research Collaboration between Australia and China – page 33

After the success of that visit, a number of delegations were organised: the Australian Academy of Science sent a delegation to China, a reciprocal delegation was received in Australia, and a group of Australian scientists attended the 1964 Peking Symposium.

This period also saw the beginning of temporary researcher exchanges. Two Chinese astronomers visited Australia for six months, and Professor Christiansen spent a sabbatical year in China in 1966, assisting with the construction of a radio telescope based on his previous work.⁶

Like many worthwhile relationships, what began as *ad hoc* meetings and arrangements have moved towards a more formal, mutually beneficial union.

The relationship continues today. For example Chinese and Australian engineers and scientists are collaborating on the technology for both Australia's part of the SKA radio telescope in Western Australia and China's new FAST telescope to be built in southwest China.

What's happening in radio astronomy is also happening in other fields. And the pace of change is unnerving for some – and an opportunity for us.

⁶ Interview at <http://www.science.org.au/scientists/interviews/c/cc.html>

China is moving up the global ladder in terms of the number of research publications.⁷ It has overtaken the United Kingdom as the second-ranked country in scientific publication output and on current trends will probably overtake the United States by the end of the decade - if those trends continue⁸.

China is also collaborating more with other nations, and even more so with Australia.

Between 1995 and 2010, Australia-China collaboration grew faster than China's overall collaboration with the world, and faster than China's collaboration with the USA⁹.

There are now 885 formal university-to-university partnership agreements in place to support exchange and cooperation between Australia and China – 72 per cent more agreements than a decade ago – a situation that for the first time outnumbers US-Australian agreements. Some 2000 or so Australian students travelled to China to study in 2011 – and 3 universities (VU, UTS and Monash) have established joint campuses in China.

In several fields of research—such as mathematics, engineering and chemistry—China is now Australia's leading partner in collaboration¹⁰.

⁷ Knowledge, Networks and Nations: Global Scientific Collaboration in the 21st Century – Pg 6

⁸ Knowledge, Networks and Nations: Global Scientific Collaboration in the 21st Century – Pg 6

⁹ HAS

And it is the second-top source in agricultural and veterinary science and immunology.¹¹

But there's more!

Joint publications with China in more than half the subject areas examined have an average citation impact higher than that for all Australian publications in the subject area.¹²

The China / Australia science relationship has been based on mutual benefit – surely the right way to go. How do we identify areas where we want to work together, put the processes in place, share know-how, and both get benefit?

As it happens, Australia and China appear to have complementary research foci. And we do share some research priorities. We both have concerns related to: (but by no means confined to) issues like adapting to changing climatic conditions, meeting the healthcare needs of ageing populations, the environment, energy and food security and future economic directions to build and sustain prosperity.

Elaborating on what I said earlier. We need two approaches to our international collaboration: one approach is to align with shared challenges so that we can ensure focus and scale; the second is to ensure that individual researchers can participate

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¹² DIISRTE, *Science and Research Collaboration Between Australia and China 2012*

in projects with colleagues that might arise because of shared curiosity and the like.

An example of the first approach is the Joint Research Centres program (or JRC as I will call them). These are virtual centres that link Australian and Chinese research institutions conducting a portfolio of research-related activities in a specified field of research.

The JRC for Energy will develop advanced energy technologies for improved energy security and reduced CO₂ emissions from both countries.

The JRC for Light Metals will develop revolutionary light-weight alloys and advanced manufacturing processes that will ultimately lead to greener, cheaper transport systems.

The JRC for Wheat Improvement aims to achieve major technical advancements in grain quality for wheat improvement.

The JRC for Minerals, Metallurgy and Materials (the 3-M Centre) aims to facilitate Australia-China collaboration for excellence in minerals, metallurgy and materials.

The JRC for River Basin Management aims to increase water productivity, food security and economic returns while protecting water ecosystems

The ANSTO-SINAP Joint Materials Research Centre Development will develop materials that will lead to zero-carbon

emission technology for power generation and hydrogen fuel production.

These Joint Research Centres were announced during the visit to Australia last year by then State Councillor and now Vice-Premier Madam Liu Yandong.

Examples of the second approach, really a hybrid of the two approaches I mentioned, are the visits planned and supported by the Australia-China Science and Research Fund.

By next year it will have supported over 80 Australian research groups to travel to China; two groups of mid-career researchers to China (and two groups to Australia); one knowledge exchange symposium; and two Australia-China Science Academies Symposia (one in Australia, one in China).

All of this is good. All of this is worthwhile. But all of this will not be enough for either country.

What we need to do – both nations - is ensure we have sufficient alignment, focus and scale in order to increase the level and impact of China-Australia collaboration. To get more influence from the partnership.

China has already acted in order to prepare for a future more dependent on Science and Technology (S&T).

This important partner of Australia is continuing to develop its capacity in S&T to provide a strong knowledge base to secure a prosperous future for its citizens.

China took action in 2006, by adopting a new Science and Technology development goal to 2020 covering agriculture, industry, high-tech and the generation of new ideas.

It adjusted its Science and Technology (S&T) strategies to align them better with the overall national strategy and the goals for economic and social development.

Those strategies sum up the contribution of science and technology thus:

**the advancement of S&T is the radical motive of social and economic development;*

**scientific innovation will accelerate the transformation of economic development, which is the first priority of the national strategy;*

**S&T are not only about knowledge and skills, but are also closely related to the national culture and spirit. The scientific spirit and qualities of a nation determine the future and vitality of the nation¹³.*

¹³ OCS position paper - Science, Technology, Engineering and Mathematics in the National Interest: A Strategic Approach
July 2013

What these statements indicate to me is that there is an understanding in China about what the consequences are of not taking strategic action now.

The development of China and the role of science, technology and innovation is not being left to chance.

It says to me that one of our most strategically important collaborative partners is taking urgent and planned steps to improve their skill and knowledge base in any or all of STEM.

Australia could also choose to be strategic.

Like China we could plan to equip our education system to prepare the increasingly STEM-dependent workforce of tomorrow.

We could plan to ensure a steady flow of new ideas.

We could plan to align research and innovation with areas of comparative advantage and national need.

We could plan to strengthen international alliances.

I recently laid out the case for such a strategy in a position paper which is available on the Chief Scientist website.

It proposes many key actions, one of which is the establishment of an Asian-Area Research Zone.

This makes sense. As I have said, many of the challenges that confront Australia are shared with neighbours like China. It is

obvious that the solutions to those challenges must also be shared. Sometimes on a bilateral basis and sometimes multilaterally.

Of course an Asian-Area Research Zone is one of many key actions contained in the position paper.

It is important that none of them are read in isolation.

That's the point of having a strategy to guide Australia's STEM enterprise -education, research, innovation, and influence – and it must be done in its entirety.

Australia can build capacity if we commit to a strategy. This becomes even more important when we hear that the resources boom is coming off the boil. Our relationship with China will enter a new and different phase. We will need to start now to work out how to build from the base that has been constructed by all these people over all these years

And if we have a strategy, as China does, we can be partners in influence: changing the way we do what we do and how we think about the important issues that we need to be concerned about. We can find a way to manage the unavoidable and avoid the unmanageable. We can help find the solutions we need. And together we can influence how the world thinks on important scientific matters

It seems to me that it would be a pity if we do not use to the maximum extent possible the linkages around the world that have been formed by scientists: sharing a curiosity, sharing knowledge, sharing infrastructure along with a focus on matters where the benefits will be shared.

And that with China is surely what we want – a real and effective partnership between friends and colleagues – a partnership of influence.

Thank you.