Science and its role in public policy

Hawkes Oration

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Good evening. It's a pleasure to be with you tonight.

It caps off a pleasurable day in fact, because one of my other duties has been attending today's graduation ceremony at Charles Darwin University.

During my many years in academia, as a teacher and researcher, and then as a Vice-Chancellor of two universities, I have attended and presided over more than 150 similar events.

And they are always wonderful occasions because, despite the fact that they represent the conclusion of a stage in the lives of the participants, each is filled with anticipation and conjecture about what the future holds.

Tonight I want to build on this a little more and link it with a number of themes that I think are relevant not just to you as policy advisors and decision makers in the Northern Territory but for policy advisors and decision makers wherever they are.

I want to talk about evidence based policy development and how science can and should be contributing to it. So

at this early stage, I want to nail my colours firmly to the mast, as a scientist and as an advocate for science, by saying that science and scientific endeavour is absolutely central to our world.

As I recently told the National Tertiary Education Union, a scientist engaged in meticulous scientific work can alter our world view. This occurs when their work is compelling and when it stands the scrutiny of their peers – not just those who agree to publish their work – but all their peers in their specialisation.

So, it's appropriate that since we are in Darwin I talk about the difficulties Charles Darwin had in gaining acceptance for what challenged the conventional wisdom of his time. Initially his work, supported by meticulously gathered evidence, was challenged by scientists (and theologians) of his time. However, ultimately his *Origin of Species* was accepted in the scientific community simply because his evidence had been so carefully documented and over time was supported by other independent research.

Darwin's life and experiences simply underscore what science and the practice of science is about. Scientists are dedicated specialists who spend many years developing

their knowledge and skills, sometimes singly but more often than not nowadays in collaboration with others.

It's important to spell out some parameters here, although these are evident in what I have just said about Charles Darwin. I want to affirm that science, in the **true** sense, is first and foremost a discipline; it is practised ethically and regulated where regulation is right; and licensed when that is appropriate.

I can also tell you what it is **not** and that is some free ranging, hypothesized activity that deals casually with facts and evidence and therefore lacks responsibility or authority.

Unfortunately, it is the latter that sometimes holds sway in public debate and therefore impacts on public policy decision making. Indeed this can be to the detriment of what I could term 'real science,' because scientists often become bogged down fighting a rear guard action against the 'bad science' asserted by those who seek to question the ideals, values, principles and practices of science.

To a point, scientists may have been complacent and allowed this to happen, because it seemed that the battles

over the value of science, of the contribution that universities and other public research make to the common good and the importance of intellectual freedom were won.

Instead, we have lost sight of what forms the very basis of science and the values that make up an informed, progressive and enlightened society are under siege.

So, what do I mean by **real** science? Scientists unpick, examine and reconstruct. They seek to replicate, re-analyse and re-interpret – and when they do, certain directions and conclusions that withstand this scrutiny and become much more central to our thinking. They are not, ever, immune from challenge – but when an observation has been made and confirmed many times, it can be considered secure if not absolutely certain. However, when different evidence comes to light, and it withstands the scrutiny, it will shift the way we think.

This hasn't changed.

It's under attack, often because the conclusions science leads us to are inconvenient, or tell us something that some don't want to know.

So we have shifted from a society which trusted and respected scientists for the outcomes they were delivering to people. Putting a man on the moon was a great achievement and, to borrow an economic term, it had enormous multiplier effects for science and everyday life. Similarly CSIRO research associated with astronomy yielded wi-fi communications. Even simple science has enabled us to survive what 50 years ago were often fatal, for example, vaccinations for polio and small pox and treatments for HIV infection.

So many of the applications that have flowed from science are around us all the time that many of us, instead of marvelling at the achievements, take science and what it offers for granted. And we forget to defend science.

As a society, we should be challenging those who, regardless of reason or factual basis, mock science and scientists for their own spurious ends, whether it is a headline or avoiding an inconvenient truth.

Let me be clear, the challenges we face will continue to become more complex and with this complexity the importance of science will become even greater.

In my recent NTEU address I urged academics to contribute to public debate even when they come against great challenges from critics.

These challenges that researchers face should be known by everyone, especially policy-makers and advisors who work with science. They should understand how science works, its value, and where critics stand and the relative weight of the criticism.

Against this background we should be considering how we, the scientists, and you, the policy makers and advisors, can work together more effectively to develop public policy.

In June 2011 the board of the American Association for the Advancement of Science, an organisations serving 262 affiliated societies and academies of science with a world-wide constituency of 10 million individuals, concluded a statement on the impacts of attacks on science and scientists with the following comment: *“While we fully understand that policymakers must integrate the best available scientific data with other factors when developing policies, we think it would be unfortunate if*

policymakers became the arbiters of scientific information and circumvented the peer-review process,"[1]

It goes further by saying that this might become counter productive: *"Moreover, we are concerned that establishing a practice of aggressive inquiry into the professional histories of scientists whose findings may bear on policy in ways that some find unpalatable could well have a chilling effect on the willingness of scientists to conduct research that intersects with policy-relevant scientific questions."*[2]

Consider the implications of that for a moment, what would public policy developed in an evidence vacuum, or an evidence-weak environment achieve?

The Australian Government has recognised that grounding policy in science is of great importance. The Department of Prime Minister and Cabinet's *Blueprint for Reform*[3] acknowledged that building connections between academia and policy makers was a major driver for innovation. In its submission to the *Blueprint*, your own

[1] American Association for the Advancement of Science, 2011 "AAAS Board: Attacks on Climate Researchers Inhibit Free Exchange of Scientific Ideas" 29 June 2011, viewed 4 October 2011, www.aaas.org//news/releases/2011

[2] American Association for the Advancement of Science, 2011 "AAAS Board: Attacks on Climate Researchers Inhibit Free Exchange of Scientific Ideas" 29 June 2011, viewed 4 October 2011, www.aaas.org//news/releases/2011

[3] http://www.dpmc.gov.au/publications/aga_reform/aga_reform_blueprint/part4.3.cfm

institution – the Institute of Public Administration Australia – said:

"The future is always uncertain. It is an important task of policy advice and formulation, supported by quality research, investigation and data analysis, to appreciate the variety of possibilities and to place government in situations where they can be handled advantageously."[4]

If we don't utilise what science has to offer, then it would a missed opportunity at best, at the worst, in some cases, it may even be catastrophic.

Maybe we need to take a new approach. Maybe it is time for science to be sold more vigorously and defended more rigorously.

Certainly, Paul Nurse, the President of the Royal Society, believes this. He wrote in New Scientist: "*We need to emphasise why the scientific process is such a reliable generator of knowledge - with its respect for evidence, for scepticism, for consistency of approach, for the constant testing of ideas. Everyone should know and understand*

[4] http://www.dpmc.gov.au/publications/aga_reform/aga_reform_blueprint/part4.3.cfm

why the processes that lead to astronomy are more reliable than those that lead to astrology."[5]

Defending science can be challenging, it can't be done in a 10 or 15 second sound bite.

In the past fortnight there have been some supreme examples of just how the scientific method of accumulating evidence from a multitude of sources using a variety of approaches has again been verified.

The Nobel Prize in Physics this year was shared by three individuals in two groups who, working independently of each other, came to a common conclusion, a conclusion that has withstood intense peer scrutiny.

Closer to home we are also rewarding the scientists who are placing Australia at the head of meeting major global challenges like food security.

At present Australia produces enough food to contribute to the diet of some 60 million people – we are a net food exporting nation, one of the few in the world. Along with the rest of the world we will face challenges such as

[5] Nurse, P 2011 "Stamp out anti-science in US politics", New Scientist, 14 September 2011, viewed 4 October 2011 www.newscientist.com

access to arable land and usable water which will affect global food security. By 2050 Australia's salt-degraded land will have increased from a present 5.7 million hectares to 17 million hectares. Our already urbanised country (with 90 per cent living in urban settings) will grow to ~37 million. No doubt housing them will continue our encroachment on arable land. On a global scale, by 2050 we will be striving to feed 9 billion people when we can't presently feed 7 billion[6].

Realistically, Australia will never be the food bowl for the world, but we are nonetheless able to play our part to prevent a catastrophic food crisis.

So I'd like to share with you one of many glimmers of hope. Just last week, Associate Professor Min Chen won the Science Minister's Prize for Life Scientist of the Year. Her work with *chlorophyll f* has the potential to lead to more sustainable agriculture, because *chlorophyll f* harvests red light, which is lower on the energy spectrum than visible light. Utilising chlorophyll f could lead to more efficient energy collection in solar cells and crop plants[7].

[6] Professor Ian Chubb's Address to the AIFST, 20 July 2011 www.chiefscientist.gov.au

[7] http://www.innovation.gov.au/Science/InspiringAustralia/PrimeMinistersPrizesforScience/Recipients/2011PrizeRecipents/Pages/2011ScienceMinistersPrizeforLifeScientistoftheYear.aspx

Dr Chen's work has the potential to lead us in to a more efficient and sustainable future in food and energy production. Her work, and the work of other researchers, gives us the evidence-based foundation to inform measures we can take to overcome our greatest challenges. But governments and policy makers need to support and work with researchers like Dr Chen every step of the way.

Maybe this is a daunting task. Public servants tend to have a very different set of skills than those of researchers. Coming together to collaborate and build strong, evidence-based policy may not come naturally.

Recent research done internally within the Federal Department of Innovation, Industry, Science and Research[8] found that collaboration between researchers and public servants can create real tension. Not only do they speak different languages, but they have very different priorities when working together. They also don't always have the skills they need to manage the relationships over time, communicate effectively, and give each other the feedback and support they need throughout the policy-making process.

[8] Graduate project report findings. The report has been finalised but has not been approved for distribution.

There's a lot we can do to help both researchers and public servants to do this better. We can train them, we can encourage more networking and relationship-building opportunities, and we can help policy makers, and the Australian public at large, gain a better understanding of how science and scientists work.

I think this is vital.

The Australian Government has certainly opted for a new approach for renewal of Australian attitudes to science. Its $21 million dollar initiative *Inspiring Australia* aims to integrate science and society, and support clearer communication of science.

Not only will this three year initiative benefit the science sector, but it will help Australians understand how science is woven into the fabric of their daily lives and, through this, help our industries and businesses to flourish. As the *Inspiring Australia* report says: *"Australia aspires to an innovative society with a technologically skilled workforce,*

a scientifically literate community and well informed decision makers".[9]

I want to come back to Paul Nurse and the New Scientist article I cited earlier when I was talking about the challenges of defending science. He argued for a pure approach to policy development: *"It is essential, in public issues, to separate science from politics and ideology. Get the science right first, then discuss the political implications."*[10]

So when it comes to science, the question that springs to mind is – who should you trust?

Too often, ordinary Australians, along with some policy makers, are easily tempted by the opinions of the one scientist who tells them what they want to hear. But, that's very unsafe.

I'd like to use a quick analogy. Suppose you are attending a medical conference and you have a suspected heart attack. There are plenty of doctors in the room, including 10 cardiologists. Who would you consult? Of the 10

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[9] http://www.innovation.gov.au/Science/InspiringAustralia/Pages/InspiringAustraliaAnationalstrategy.aspx

[10] Nurse, P 2011 "Stamp out anti-science in US politics", New Scientist, 14 September 2011, viewed 4 October 2011 www.newscientist.com

cardiologists, nine say that you need heart surgery. The 10th says the other cardiologists are frauds and that your condition can be treated with rose petals. Who would you listen to?

The scientific community works on evidence and facts. But although not all scientists have the same evidence, you'll see that, with uncontroversial topics, the large majority of scientists around the world tend to agree on the same point. Just because one or two scientists think differently about something doesn't make the others frauds. We need to encourage academic freedom and allow critics to say what they have to say. But, ultimately, decisions need to be made on the weight of evidence – sometimes called a scientific consensus. Our nine cardiologists.

I'd like to share with you a real-life story that shows us that we *don't* do this in reality.

In 1998, Andrew Wakefield made the claim, against scientific consensus, that the triple measles, mumps and rubella vaccine – the MRR vaccine – might be linked to autism.

He suggested that, rather than giving a triple vaccine, the vaccinations should be given separately.

The British Medical Journal revealed that not only was Andrew Wakefield in the minority, but he had a major conflict of interest. His motivations lay elsewhere: he had a patent for a single measles vaccine, and he was being paid by lawyers who were assembling a case against MRR manufacturers[11].

But people listened to him. Parents listened to him. They chose not to vaccinate their children based on what he said. And a drop in MRR vaccination meant the inevitable outbreak of preventable diseases.

The real story of Andrew Wakefield and the MRR vaccination highlights something very important about the human psyche. That is that the ordinary person can easily be swayed by the extreme minority when it comes to science. Scare tactics work. And they can lead to terrible consequences for themselves and for society.

[11] http://theconversation.edu.au/mondays-medical-myth-the-mmr-vaccine-causes-autism-3739

As policy makers, politicians, and those who make and influence important decisions, it is your responsibility to understand science and do the right thing by it.

I think that much of what I've said so far will have sounded like common sense. But you'll also be aware that time pressures can get in the way of common sense. Governments work on tighter timelines than research and this presents considerable challenges and needs careful management.

I've spoken so far about the importance of science, of creating evidence-based policy, and how we should use and interpret the science we have.

But there's one more thing that shouldn't be overlooked.

Sometimes, science is not perfect, and sometimes it's not even available.

In fact, it's never perfect – and I prefer that to be a great strength, not a weakness. Science works on evidence, so whenever we get new evidence, science adapts. Once upon a time, people and scientists thought that the Earth was flat. That was because they had not yet made the

observations and gathered the data necessary to update this theory. Once the data conflicting with the old theory was in, the model was updated to reflect it. Conventional wisdom these days is that the Earth is round, but we can't really be 100 per cent certain. Perhaps one day, when we gain a deeper understanding of the fabric of space and time, we'll discover that the world is not round at all – it just looks that way from our perspective.

As a more recent example, just to show that this sort of thing happens on an ongoing basis, you may have heard that European physicists recently found evidence that tiny sub-atomic particles can travel faster than the speed of light[12]. If these experiments are confirmed, then scientists will have to re-evaluate Einstein's special theory of relativity. This will mean rethinking our models of space, time, and our universe. It will be fascinating to see the implications, but we must first wait for the peer community to check and cross-check the outcomes.

Our theories, even from the most prominent scientists, are working models of the world. We can never say with absolute certainty that these working models are correct,

[12] http://www.abc.net.au/news/2011-09-23/particles-travel-faster-than-light-scientists-say/2912450

for that would require complete knowledge that science never claims to have.

To better describe this, I'd like to use an analogy by another Nobel Prize winning physicist, Richard Feynman[13].

He said that the scientific process is similar to trying to describe the rules of chess without prior knowledge of the game. When you first watch a game, you observe things like 'bishops stay the same colour over time.' And further observation leads to the theory that bishops move diagonally, and so on with the other pieces. Thus you develop theories on the 'laws of chess.'

But then something that you hadn't predicted happens and a pawn reaches the other side of the board and becomes a queen.

The message here is that although our world is not the same as a game of chess, our observations don't always lead to a complete understanding of it, and science adapts in response to the information available.

[13] http://www.youtube.com/watch?v=o1dgrvlWML4

We can never claim absolute certainty over anything unless we specify bounding conditions and timeframes.

The dynamic nature of science and its reliance on the evidence that we *do* have is what makes it relevant to us as the world changes, as new discoveries are made, as new technologies are applied, and as governments and public policies forge ahead to make the foundation for a more prosperous future.

However, because of the fundamental need for evidence driving science that I have been talking about and the fact that evidence can come from many different sources, there is not always a consensus on every issue.

Most individuals can form opinions on just about any topic without knowing everything there is to know about it. But science can't form 'opinions'.

So what do we do when we don't have evidence? And, importantly to us here tonight, what do decision makers and policy makers do when science can't give them conclusive answers?

Sometimes, we need to make decisions in the absence of evidence, or in the absence of a robust scientific consensus.

Whenever there is imperfect knowledge, a clash of opinions, or an outright lack of evidence, policymakers shouldn't ignore the scientists. And researchers should not be tempted to think that they have nothing to say when they can't give 100 per cent certainty.

If decisions on scientific matters are made without scientific consultations, then nobody is doing their job effectively.

When you are tasked with making decisions when the evidence is far from conclusive, then I encourage you to be resilient. Be as scientific as you can and don't be misled.

You have a responsibility to understand the way that science works to inform your decision making.

But on the other hand researchers also share some of the burden. The UK's Overseas Development Institute argued

this in a 2004 briefing paper *Bridging Research and Policy in International Development:*

[Researchers] *"need to develop a detailed understanding of i) the policymaking process – what are the key influencing factors, and how do they relate to each other? ii) the nature of the evidence they have, or hope to get – is it credible, practical and operationally useful? and iii) all the other stakeholders involved in the policy area – who else can help to get the message across?*

It said: *"…they need to develop an overall strategy for their work – identify political supporters and opponents, keep an eye out for, and be able to react to policy windows, ensure the evidence is credible and practically useful, and build coalitions with like-minded groups.*

Finally: *" … they need to be entrepreneurial – get to know, and work with the policymakers, build long term programmes of credible research, communicate effectively, use participatory approaches, identify key networkers and salesmen and use shadow networks."*

Conclusion

After all this, I am encouraging you to use science, but I'm encouraging you to use the **right** science. It would be

very dangerous to have an idea in mind then go and find a scientist to support it, then use that as evidence for your decisions.

When there is a majority view in science, then that's what you need to listen to. That's what we need to build on when we develop public policy, or when we choose what research to fund, or when we choose how we should plan for a more prosperous country.

As with the legal system, science will only ever at best come down to the civil proof, of 'a balance of probabilities.' The art is getting the balance right.