The Queensland Academy of Arts and Sciences

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The Inaugural John O'Hagan Lecture

The Science of Australia

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Peter Doherty graduated from the University of Queensland in Veterinary Science and became a veterinary officer. Moving to Scotland, he received his PhD from the University of Edinburgh Medical School. He is the first person with a veterinary qualification to win a Nobel Prize.

Peter is also the author of several books, including "A Light History of Hot Air", "The Beginners Guide to Winning the Nobel Prize", "Sentinel Chickens: What birds tell us about our health and the world", and "The Knowledge Wars".

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The Science of Australia

Though many of our political leaders and citizens seem to be profoundly uninterested in the fact, the whole history of Australia since the time of European settlement has been in the modern scientific era dating (as discussed in *The Knowledge Wars*) from the 17th century and the insights of Francis Bacon. From 1788, this Nation has developed through all the phases of industrial revolution (and devolution) that led to the extraordinary possibilities we enjoy today.

Embarked on the *Endeavour*, "natural philosophers" Joseph Banks and Daniel Solander began the world's long fascination with our unique flora and fauna, while James Cook, then Mathew Flinders, surveyed our reefs and shorelines. Part of the reason for the *Endeavour* expedition, which was co-sponsored by the British Government (via the Royal Navy) and the British National Academy of Science (The Royal Society of London), was to map the transit of Venus from Tahiti, then sail on to chart the undiscovered East coast of *Terra Australis*. The *Endeavour* astronomer, Charles Green, died on the voyage home, so Cook wrote up his results. Along with Banks and Solander, Cook was elected to the Fellowship of the Royal Society (FRS), which remains the highest accolade accorded to leading scientists in the UK and the British Commonwealth.

I doubt that any Australian who has thought about it at all would fail to endorse the view that the science of this country, its plants, animals, insects, soils, geology, oceans, and climate is our responsibility. In addition, could we doubt that the fact we have long been a major player in the science of the southern oceans, the atmosphere

as it relates to the southern hemisphere and Antarctica is of major importance to us. Yet these are the very areas that the most regressive government in our history recently decided to compromise.

That particular threat is currently diminished a little, but we should be in no doubt that the toxic, economic-rationalist, "Billy Tea Party" (Christian AID activist Tim Costello's description) movement that has poisoned the US Republican Party has a tight hold on the far right of our politics. Unless we are extremely careful, we could lose much of our science capacity, our international stature, and even our basic rights and freedoms.

There is nothing new about countries being taken over by extremist ideologues who gain power initially via democratic elections. If the one party has control of both the House and the Senate in Canberra, the protections in our political system are close to zero. These are very dangerous times for Australia. Our science is not all that is at risk. Think back to the recent attacks on our major public institutions: The ABC, our health and education systems. Without appropriate taxation and regulation Australia will not remain a decent, fair, and open society. Forget "relaxed and comfortable": The price of liberty is eternal vigilance!

A Major Concern

The draconian cuts to CSIRO climate monitoring and modeling announced in February of this year highlight a major problem for the practice of science in Australia that stands to have substantial negative consequences for both present and future generations. The decision of the present CSIRO Board that the organization would benefit from a leader who focuses on translating science to business activity is understandable, and it is not

surprising that the Silicon Valley entrepreneur who took the job wants to focus on that value system.

The problem is, however, that apart from the "Industry" responsibility in its portfolio, the CSIRO has long been the home for what we might call "public good" science, though I think that a better term is "long-term economic-good science". If we fail to do that science properly, then act on the basis of the evidence that is generated, it is inevitable that we will make very bad and very expensive policy decisions concerning, for example, northern development in a time of rapid climate change. My guess is that those costs to both the taxpayer and to our social fabric would greatly outweigh any economic benefit that might devolve from CSIRO being more oriented towards short-term business activity. There are pluses about taking that direction, but we need to find a different "home" for the long-term investigative and monitoring activities.

Apart from climate science, other obvious examples of long-term economic-good science are earth and soil science, water science, and marine science, though the last does find another (non-university) home in Townsville's Australian Institute of Marine Science (AIMS). Funding for AIMS was, of course, cut by the Abbott Government, along with other institutions like the Bureau of Meteorology (BOM) that operate in the general area of environmental science. Though some of those dollars have since been restored, the Colonel Blimp "we don't wish to know that" approach to "inconvenient" science still prevails for too many in both our federal and state parliaments and in the big business community.

But complacency about what's happening in the natural world explored by science is simply not an option if you

have a functioning brain and care at all about the future of this country and, indeed, the long-term prospects for complex life forms (including us) on this small planet. There's also a problem that much of the activity in what we might think of as "on the ground" environmental science, regulation and monitoring has long been the province of State Governments that are operating under increasing financial constraints.

Some of the cuts we've seen have no doubt been ideological: Choosing ignorance when it comes to environmental consequences can no doubt speed up the process of destructive development! But the problem is that threatened species and future generations of citizens will pay the cost after the current league of real estate entrepreneurs is long dead and buried. The Great Barrier Reef may already be lost: If we want to secure future income from high value eco-tourism, we should think very seriously about any actions that might compromise the integrity of our remaining wilderness areas and spectacular beauty spots.

Our Place in the World

Though there seems little consciousness of the fact in the increasingly narrow arts/law/politics/economics educated governing class, part of what keeps Australia in the league of first world nations is our role in international science. One of the reasons for writing *The Knowledge Wars*, which is very "user-friendly" to non-scientists, was to try to engage such people. Those who govern need to understand what science does for us. Commodity producing countries cannot take first-world status for granted and it is not inconceivable that, as we disinvest and the emerging economies of the Pacific rim continue to advance their investment in (and contributions to) both discovery science and the science of global monitoring,

Australia will slip slowly and inexorably down a slippery pole that will be impossible to climb.

Aside from anything else, if we deliberately compromise what has been a centre of scientific excellence in the South Pacific and, indeed, the Southern Hemisphere, we will lose the respect of both the global scientific community and the Asian countries to our north. Diminish our research capacity related to Antarctica, for example, and how can we expect to be heard at the table when it comes to future decisions about what will happen on that (as yet) frozen continent? The same is true if we abandon the marine science of the southern oceans. Yes, we can always freeload on what the taxpayers of other nations fund, but don't expect that there will be no price to pay in either international stature or control.

Part of our opportunity to build and sustain useful bridges is via meaningful international scientific collaborations. That will not happen if governments continue to insist that the only worthwhile science is that leading to "products", by which they seem to mean manufactured goods of one sort or another. Science-based commodities that are worth anything generally have decades of discovery and intellectual development in their making. Fail to fund that and you end up with nothing.

And, while it seems we are still prepared to put money into "big blue sky" science like the Square Kilometer Array, what we have been seeing at both the State and Federal level is a continuing contraction of environmental science and biological research in all except the more "translational" aspects of medicine. Translation (to products) is fine. We all want to see that happen, and have had some big successes like the bionic ear and the early phase development of the human papillomavirus vaccine (*Gardasil*). But the

starting point is always to have something worthwhile to translate. Otherwise, as Nobel Laureate Jim Watson said many years back, "you end up funding cannon builders to put a man on the moon." I've been around medical science for a long time, and have seen hundreds of millions of dollars blown away on bad, even dangerous biomedical translation.

Science translation operates optimally in the context of a dynamic business culture. There we have to ask: "Is there some key element missing in Australia? Is it lack of investment, of appropriate tax breaks, of entrepreneurs? Are we limited by the mediocrity of old-school-tie nepotism? Have we somehow got the relationship between business innovation and the discovery/development based in universities and organizations like the CSIRO wrong?

Problems and Solutions

It's pretty obvious that, as a society and particularly in the business world, we've been too complacent in relying on the commodity sector, especially mining, on mindless (and massively destructive) "development", and on big mark-ups for imported retail goods. Whatever happens next, the world needs metals, rare earths, and uranium. But fossil fuel extraction can't work for us in the long term, especially as the countries to our north bite the bullet and continue to back off in their demand. China, Korea, and India are all building nuclear reactors and investing heavily in renewables. One of the justifications given for buying submarines that won't be available to us for 30 years is to protect the ocean-based oil and gas wellheads. That has to be insane: If there's still a big demand for oil and methane 30 years from now, humanity is in big trouble globally. Might the job of a few extraordinarily expensive submarines be done equally well by a mass of relatively inexpensive, unmanned aerial (or submersible) drones?

How do we improve the science/business equation? There's a tendency for the right of Australian politics to relate to what they believe to be the US model though, having lived there for decades off and on, it's very obvious that (taking their lead from dubious propaganda outfits like The Heartland Institute) many seem to lack even the most basic understanding of how the place actually works. Where we might better look to gain insight into how a nation like ours can develop a stronger science-based business culture is to Germany, Switzerland, and the Scandinavian countries. They all provide comprehensive social services, including essentially free university education, and have a long tradition of academia working closely with business.

We also see that latter nexus operating in US universities like MIT, Stanford, and Harvard which, incidentally, as they have massive endowments to fund scholarships, also provide free university education to bright students of limited means. Australia has more people than Switzerland or any one of the Nordic Nations, and we have the critical mass (in the intellectual sense and trained work-force sense) to expand the business/science interaction in most of our capital cities. Why is it, then, that many of us are asking: What jobs are there for science graduates and engineers? That is a disaster for both our country and for our young people.

That silo, "my power base" mentality, is one of the many reasons we can't expect the broader public interest to prevail by combining the so-called research budgets of Australian federal departments under an expanded Australia Research Council (ARC) that, via its review processes, removes any opportunity for pork-barreling. An honorable exception is Health, that operates a properly constituted research funding body in the National Health

and Medical Research Council (NHMRC) and, with its diversity of focus to areas like nursing and public health, should remain separate from an ARC-type structure.

But we could get a lot more "bang for the scientific buck" if we handed out more dollars to our best scientists, especially to our young scientists and entrepreneurs. Many such people are currently massively under-funded or unfunded, and close to despair. Unless we change this, those bright youngsters we send overseas to train will either not return, or leave science in disgust if they come back to dismal prospects.

A bright spot for graduate students is the new Wade Institute for Entrepreneurship at Melbourne's Ormond College. Kicked off by a $AU10 million gift from tourism entrepreneur Peter Wade and driven by the young and imaginative Ormond College head Rufus Black, this is a model that, operating in different guises, could make an enormous difference for the future of this country. Having real business people involved via directed philanthropy has infinitely more likelihood of success than efforts to drive business via the insights of professional politicians who, increasingly, have all the breadth and substance we associate with pipe-stem diarrhea. Academics may have ideas and intellectual property but, beyond the initial start-up phase, most are notoriously bad at business.

The level of political interest in science can change with a powerful Prime Minister who thinks that quality research is important, as was the case for Bob Menzies and John Howard. Malcolm Turnbull is promoting innovation as a national strategy. Bill Shorten has committed to the strong support of science, and Kim Carr has long made science and technology-based development his primary focus. Adam Bandt and Richard di

Natale have well thought through positions on major science-based issues. We were sorry to see the departure of Queensland's Brett Mason, who left the parliament at the time of the disastrous Tony Abbott/Maurice Newman ascendancy.

At that time, many Australian scientists were thinking that their best recourse was to look for a job in the northern hemisphere. Though M. Newman and Abbott are hopefully consigned to the trashcan of political history, any trust that academia might have had in the intellectual integrity of the Australian political right has, I think, been severely damaged. A senior Australian researcher who is established in the USA or Europe would take a massive risk in returning here. Perhaps the situation regarding science and the universities may improve for a time under PM Malcolm Turnbull, but can the centre of the LNP hold? I remain unconvinced.

The Political Future is Scary

The long-term dynamic of the Liberal Party is, with two IPA "Billy Tea Party" types recently parachuted into Victorian parliamentary sinecures, clearly going in a direction that will be disastrous for any form of intellectual life (or long-term perspective) in Australia. Indeed, when you look at the mechanisms for pre-selecting candidates for the Australian Senate and the preferential voting system together, the only thing that distinguishes that aspect of Australian politics (for both major parties) from the corrupt "pocket boroughs" and "rotten boroughs" of 19th century UK governments is that British citizens of that era were familiar with the identities of the landed aristocrats who chose their parliamentary representative for them!

I look forward to voting for individuals "below the line"

in the next Federal Senate election, and thank both Malcolm Turnbull and Richard di Natale for having the guts to bring that change about. The question is whether voters can access the information, and take the trouble, to use this opportunity to advantage. How many Victorian Liberal Party members really wanted to see a 28-year-old IPA ideologue take top place on the Victorian Senate paper? At least for the people of that political persuasion in my acquaintance, the answer would have to be, none! I can't imagine what the late Malcolm Fraser would have said, but I would have enjoyed hearing his observations.

A New National Institute for Earth Systems Science?

It has been obvious for some time, even before the current CSIRO head was appointed, that the future of "long-term economic-good" science is threatened in this country. For example, the outstanding CSIRO effort in forest products and wood science was cut several years back because it did not receive sufficient support from the relevant industry. The basic message: If you have a dumb industry, abandon the relatively small investment in work that just might make it smarter! Is that a good idea?

True, we may have some excellent ARC funded science in these areas in our universities, but Abbott also cut the ARC to pay for "medical translation", and the maximum funding period for the outstanding ARC Centres of Excellence is 7 years. The need is for a mechanism that allows continuity, but with continuing performance review for the lead players. A familiar model that works well is a 5 or 7 year "rolling tenure" system with review every 3 or 5 years and a guaranteed further 5 or 7 years. And the review process can be skewed to serve the stated interest of the operation, ranging from benchmarks like contributions to global economic monitoring and the understanding of (say) weather and tide patterns, long-

term economic planning, local understanding and/or innovative business development, patents where applicable, and quality research publications.

Though politicians do like construction as it provides jobs for the workers and dollars for the "little mates", a "virtual" Institute of Earth Systems Science (earth/soil, water, atmospheric science) would not require a large building and might consist of separate "nodes" located at (or close to) substantial university campuses. Australia has a good history, through its NHMRC Program Grants and ARC Centres of Excellence, in running successful collaborative enterprises that work well across the nation. Being near to a university but not administered by it (or by the public service bureaucracy of the CSIRO) facilitates flexibility, access to graduate students, and interaction with academics and business. If there is a dedicated building, or buildings, it could also be appropriate to co-locate basic scientists and State and Federal employees who might be at the more practical end of things. We've done that in our new Infection and Immunity institute in Melbourne, and the interaction is working well.

Science, the Community, and Where We Get Our Information

Looking at science both broadly and in depth (for a few areas) as I wrote *Sentinel Chickens: What birds tell us about our health and the world* (2012), *Pandemics: what everyone needs to know* (2013), and *The Knowledge Wars* (2015), one of my most encouraging discoveries was the internet-enabled world of Citizen Science. As I discuss in *The Knowledge Wars* this works at different levels and in different contexts (amateur astronomers can operate at a very advanced level) but the basic opportunity open to any one of us is to become engaged as observers in properly designed (by professional scientists) studies

operating through established organizations like *Birdlife Australia* and *Earth Watch*. Even without the intervention of Abbott-like reactionaries, there is very little money available for this sort of science and volunteers can make an immense contribution. You don't even need to be mobile to participate in *Birdlife's* "Birds in Backyards" project! Then, if you're fit and interested in conservation projects, the website for the Moreton Bay Regional Council lists a lot of opportunities.

What if, for instance, you own a small boat, have time on your hands, and are passionate about one or other aspect of the environmental health of Moreton Bay, or Oxley Creek, or Cabbage Tree Creek, or the Brisbane River? An online search should show if there's a group with this focus, or if an academic researcher in one or other of the universities has a program where they could use help. Otherwise, with some online skills (perhaps from a grandchild) it might be possible to get something quite new under way. Apart from anything else, we all have mobile phones with cameras that also provide co-ordinates. The possibilities are obvious.

The fact that the Queensland Academy of Arts and Sciences exists is a tribute to John O'Hagan and to those who worked with him. Many of us who are older have taken Australia's institutional commitment to public media like the ABC and the SBS, the State Orchestras, the Australian Opera, the CSIRO, the ARC, the NHMRC, and our public universities for granted. I've harped on about Abbott and his actions, but what he showed is that our public institutions (he came to power with promises to protect them) are not safe from lying political demagogues.

If this Academy is to be useful it must stand up for the arts, the sciences, and what's left of Queensland's natural splendors, and that includes putting political

candidates on the spot at election time. They may lie, but it's then possible to ensure that they can never forget that they did. Apart from that, if the Academy is to have any impact, it must do everything it can to involve young people. If someone has a few philanthropic dollars to disperse, perhaps the best thing you could do is to support the employment (even if it's only one day a week) of an internet-savvy young activist who, working via the website, will develop new evidence and excellence-oriented strategies and linkages across community groups, schools, Australia, and the planet.

We live in a time of extreme danger to the values of open, evidence-based enquiry and action. Our public institutions are under sustained threat. In particular, the climate-change issue has forced major business players and people with extreme wealth to attack science and the culture of discovery and accurate reporting that it represents. Public media operations like the ABC that are not in thrall to extremist ideologues and to those whose only motivation is self-serving greed are extremely vulnerable. We all saw the damage to the ABC done by Abbott & Co. A substantial component of the Australian print media has become fundamentally untrustworthy and can, at best, only be read for entertainment and the death notices.

There are some good sources of information: If you're not signed up, go to *TheConversation.edu.au* and put in your e-mail address to see the table of contents delivered free to your inbox each day. The same is true for *Guardian Australia* and the *Huffington Post*. Morry Schwartz's *Saturday Paper* and *The Monthly* are certainly worth looking at, though you have to pay a subscription. Queensland's *Griffith Review* is an excellent publication. If your thinking is more on the right of the political spectrum,

The Economist is terrific, but it is an expensive read and it doesn't have much of an Australian focus. Having lived a long time in the USA, I subscribe to *The New York Times* online. The *International New York Times* replaced the old *International Herald Tribune* that was a great read when traveling in Europe and Asia but, as yet, there is no Australian edition.

What Must Be Defended

There's a perception in some quarters in Australia that our involvement in basic, discovery science (which we do well) is an unaffordable luxury. What such people don't understand when they compare us with what they see as the ideal world of business-oriented science in the USA is that the US now, and for many years, puts a vastly greater proportion of its tax revenues into publicly supported science than we do, or ever have done.

Apart from obvious venues like the US National Institutes of Health (NIH) and the National Science Foundation (NSF) that have the same remit as our NHMRC and ARC, there are organizations like the National Aeronautics and Space Administration (NASA) and the National Oceanographic and Atmospheric Administration (NOAA). And beyond that, enormous amounts of money badged as "defence" (including the mysterious DARPA) or "energy" research pour into the major universities and into regions like Silicon Valley. Silicon Valley is, in fact, built largely on US tax dollars.

Where we are different from the USA, and more like the UK, is that we fund public broadcasting (the ABC and the SBS) and we have less philanthropic support for the arts. Those who have had some downtime in a US hotel room and tried to watch TV will be in no doubt that what we have in the broadcast area is vastly superior

and merits our continued support. Similarly, is anyone in doubt that our public health system is better, fairer, and delivers good quality of care much more cheaply, even if we think only in terms of tax dollars?

My personal view is that the Australian political system needs to work a lot better. Though I have little hope that I will see this happen, we should be looking hard at our Constitution, the issue of state versus federal responsibilities, and the nature of our governance. Those who are members of the major political parties need to protect the moderate centre from the small, and sometimes extreme, cliques that seek to control them, and we all need to question political candidates and make the best use of our precious vote. Why, for instance, is it not mandatory that every elected official and political candidate put a full list of potential conflicts of interest (family business activities, political donations, memberships, religious affiliations) online that is constantly updated? We surely have the right and obligation to demand openness and integrity from those who seek to govern us.

The Queensland Academy of Arts and Sciences

Many outstanding recent advances have come from interactions between individuals from various disciplines, creating new departments of knowledge. This has resulted in new insights about the world in which we live, new disease cures have been found, and new profitable industries have developed.

Some examples of such connections can be diverse fields including found in molecular biology, biotechnology, computer science and information technology, geosciences, motion picture and television arts and sciences, and process and control engineering. Most fields of knowledge have impact on others. So an Academy bringing members of diverse fields together has many benefits for the individual and for the community.

Benefits to the individual:

- *Providing a direct means of professional and social networking with other knowledgeable persons from other disciplines, departments, and institutions;*
- *Creating opportunities to extend greatly one's breadth of interests and to present one's ideas to a wider audience;*
- *Enabling membership of, and the potential to be elected a Fellow of, a distinguished body, with advance in professional status;*
- *Having outstanding contributions to the community's welfare acknowledged through the awarding of prizes.*
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Benefits to the community:

- *Organising of interdisciplinary conferences and publishing their proceedings and other reports for distribution locally, nationally, and internationally;*
- *Providing a contact point for visiting learned persons and for the media;*
- *Awarding Fellowships, Scholarships, and Prizes to promote learning and development in Queensland;*
- *Sponsoring public lectures on topics of general interest and encouraging interest in learning among young people;*
- *Providing valuable advice to Governments and to other bodies on matters affecting Queensland's future;*
- *Developing strong links between the arts, the sciences, industry and commerce for the further intellectual development, commercial benefit, and prestige of the State and its citizens.*